Crux200MF User Manual



Thank you for choosing the CRUX200MF, a lightweight, portable equatorial mount that adopts the harmonic gear system, a very advanced reduction system, and can 100% meet your needs for astrophotography. HOBYM Observatory is creating a new standard by successfully mass-producing the world's first compact harmonic gear equatorial mount. CRUX200MF boasts a high payload weight of more than a medium-sized equatorial mount despite its light weight of only 10 kg. In addition, 100% CNC processing provides high processing precision and fast response, making it an excellent portable device for full-scale astronomical observation and photography. The development process also went through a long period of photography testing, and improvements were carefully reflected, and continuous upgrades and research and development will be carried out in the future. Designed and manufactured from the consumer's perspective, the CRUX200MF is a portable device that guarantees high efficiency and ease of use. CRUX200MF will serve as a semi-permanent companion in your astronomical activities.



Competitive advantage factors of Crux200MF

The RA axis contains two harmonic gears. The R.A. axis contains a No. 20 80:1 main harmonic gear and a No. 11 50:1 harmonic gear. This results in virtually zero overall backlash. This is very powerful if the conditions are perfect for performing the PEC function.

The DEC axis is also equipped with a harmonic model number 20. This setting is for when using Meridian Free Mode.

All parts are CNC machined. This is the reason for improving mechanical perfection.

Robust and reliable XY stage. Smooth movement is possible by using a high-load precision slide guide and thrust bearing in the altitude adjustment part.

Various usability with one Crux. Crux200MF is equipped with German equatorial mode, Alt-Az mode, Meridian free mode, ground mode, and 2-axis time lapse mode, so it can be used for various purposes with one Crux.

The groundbreaking Meridian Free Mode. The mode can be used through simple switching depending on the deep-sky object. Optimal weight distribution enables consistent quality guiding. This has the same advantage as a fork equatorial mount.

The PEC algorithm exclusively for Crux. Titan TCS's powerful PEC function shines thanks to the backlash-free RA axis design.

High mechanical reduction ratio. Crux200MF uses a step motor. Additionally, there is no vibration when observing at high magnification through a mechanical reduction ratio of at least 2000:1

Low power design. By allowing the user to adjust the input voltage, we have laid the foundation for low-power operation in mobile observation.

Various safety functions. There are various safety support functions, including altitude limit and low altitude limit to prevent tripod collisions, and time-off function.

Electrical safety. Resistors to protect the circuit from sudden voltage changes, such as static electricity or lightning, are installed in multiple paths to increase electrical stability.

Stability at minus 30 degrees Celsius. As the TCS and machine were developed in Korea, where the annual temperature difference is large, it can be used without problems from -30 degrees Celsius to +35 degrees Celsius. There is a big difference in stability compared to low-cost harmonic equatorial drivers.

Crux mount never gets old. The independent design of the machine and controller ensures simple after-sales service even as time passes, and new technologies can be applied at any time. There is a big difference in lifespan compared to the built-in driver type.

Continuous firmware upgrades. You can enjoy the feature upgrades of Titan TCS at any time, even on older versions. There is a big difference from other companies' products that do not provide support after a certain warranty period.

Compatible with wireless environment. When upgrading the firmware of Titan TCS, you can select Wifi or Bluetooth to suit your environment.

Supports various software with its own driver. Titan TCS, which has its own advanced ASCOM driver, supports astronomy simulation programs such as NINA, APT, Asiair, The Sky, and Sky Safari pro.

Various parking assist functions. The functions are supported to respond to remote observation.

For astrophotography; light weight 6-inch refractor, 10-inch RC, and 10-inch photo reflecting telescope.

TiTaN TCS is equipped with a list of nearly 14,000 items in its memory that can be of all interest to astrophotographers.

IAU-approved Star Name / 240 New General Catalogue / 7840 Messier Catalogue / 110 IC (Index Catalogue) Objects / 5386 Caldwell Catalogue / 109 Sharpless Catalog / 341 RCW Catalogue / 182 Gum Catalogue / 94 Barnard Catalogue /174

The harmonic gears used are only precise through self-inspection.

HOBYM only uses +- values within 17 arc-second. This is fundamental to the reliability of mounts produced by HOBYM Observatory.



English https://www.youtube.com/watch?v=X1by1cWDAkw

Korean https://www.youtube.com/watch?v=H7vLF9wf6YU&t=14s

Japanese https://www.youtube.com/watch?v=JwQRor91-18&t=29s

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Product Details

Mount Mechanism

- Type: German-style equatorial type and alt-azimuth type using harmonic gear reducers at RA and DEC.
- RA drive: Harmonic gear reducer (20-80 & 11-50) driven by a stepper motor with a microstep driver.
- DEC drive: Harmonic gear reducer (20-120) driven by a stepper motor with a microstep driver.
- Azimuth adjustment: Fine adjustment of about 10° available
- Altitude adjustment: can be adjusted from 0° to 90°
- Payload: assuming the telescope's center of mass is 15cm away from the DEC mounting surface, the payload is 15kg without any weight. Can load up to 35 kg if the counterweight is attached.
- Equatorial mount total weight: 10.5kg (excluding the weight and Titan TCS)
- Polar Axis Alignment: available using QHY's Pole Master, sold separately.
- Operating temperature: -35 °C degrees to +40 °C degrees
- Parts Provided: TitaN TCS, Shaft, Motor Cable, RS232 cable, USB Cable, DC power connection cable.
- Warranty: 5 years of mechanism
 (Cost is at the user's expense if defects were caused by the user's fault.)

Motor drive system

• Drive system: RA motor - about 1185 pps

DEC Motor - about 640 pps

- Operating area: Almost anywhere in the world, where the altitude is adjustable.
- Recommended fast slewing speed: about max 600 times faster than sidereal rate
- Input voltage: 12V 3.0A or more
- GoTo: GoTo available both from the hand controller and PC.
- Warranty: 3 years of electronic parts

(Cost is at the user's expense if defects were caused by the user's fault.)

What's Included in the Box and Optional Parts

In-the-Box Items

- Crux200MF
- Titan TCS
- PoleMaster Adapter
- L-wrench set
- M8X12, two each
- Card USB Memory Programs and Manuals
- Motor cable, RS232 cable, Battery to power cable, USB cable
- HOBYM Observatory Stickers variety pack
- Weight shaft (diameter-20mm)
- Extension weight shaft

Crux200MF Harmonic Gear Mount Layout



- 1. Scope Mount Adaptor : M8x2_PCD35
- 2. DEC Housing : contains DEC motor and harmonic gear.
- 3. RA Housing : contains RA motor
- 4. Weight shaft / Ball head Adapter Mounting Bolts: a 3/8-inch screw and can be equipped with a weight shaft or ball head adapter
- 5. RA, DEC Motor cable connection jack.
- 6. Altitude adjustment knob: turn clockwise to lower altitude and counterclockwise to increase altitude.
- 7. Azimuth adjustment knob: push and pull to adjust azimuth
- 8. Azimuth adjustment lock handle: locking bolts to tighten after azimuth adjustment, one in front and one in back.
- 9. Altitude adjustment lock handle: a handle that unlocks before adjusting the altitude and locks after adjusting
- 10.PoleMaster Adapter: An adapter that can attach a PoleMaster.
- 11. Altitude adjustment slide guide : Increased reliability by adopting a slide system for high loads.
- 12. Azimuth adjustment support block
- 13.TiTaN TCS : It is the most advanced system among existing step motor drivers for Telescope Control system.

Dimensions of the Mount



Precautions for Use

- 1. If you forcibly mount a large telescope, it may damage the equatorial mount. The payload may vary depending on the size of the telescope, even in the case that the telescopes have the same weight.
- 2. Adjust the altitude azimuth after loosening the fixing handle. Forcibly adjusting with a wrench in a tightly joined state will cause damage to the mount.
- 3. Do not supply more than the specified voltage. (Max DC 13V)
- 4. Please refrain from using the equatorial mount in case of excessive moisture and rain.
- 5. Since the driving torque is strong, make sure to fully understand the safety zone function of Titan TCS and carefully set it up at the initial set up.
- 6. Avoid applying excessive shock to the mount or dropping it. In these cases, the axis may bend, or the tooth surface of the harmonic gear may be damaged, causing a decrease in its accuracy.
- 7. Tripods and piers should be sturdy. Especially, tripods for general photography have a narrow angle compared to astronomical use. We recommend using an astronomical tripod.
- 8. Do not loosen the altitude adjustment lock handle too much when adjusting the altitude. If you loosen it too much, the polar axis may deviate after locking.
- 9. In case of using Go-To function frequently, lower the slewing speed to prevent the motor from overheating. When operated at the highest speed for a too long time, it may lower the performance of the motor due to the overheating.
- 10. When using Meridian-Free Mode, be sure to carefully review whether it will collide with a pier or tripod before using it. It can mainly be used for targets south of the celestial equator.

How to set up in Equatorial Mode

1. Set up a tripod on a firm, level surface and place one of the tripod legs toward the north or south pole



2. The Crux140 Traveler has a M16 female screw tap on the bottom. M16X40 bolts are provided. This bolt can be used to attach to any pier or tripod. Of course, there are times when it is necessary to create a separate hole. Please discuss this with your sales agent to decide. A separate M8 tap hole is also available for use. Please refer to the drawing below.



3. Assemble the removable pier head and Crux200MF.



4. After mounting on a tripod, hold the body and tighten the bolts.

5. After connecting the motor cable to the TitaN TCS, connect the motor cable to the Crux200MF.





6. After installing the Pole master (Purchased separately).



7. Move the entire tripod to roughly align with the position of the North Star.



8. Introduce the Polestar on the Polemaster by adjusting it with the azimuth adjustment handle released. Precise polar alignment should be done after all equipment has been mounted.



9. After Polestar Align is complete, use the knobs to fix the altitude and direction.



10. Connect the power line to the TiTaN TCS



11.Determine the telescope's approximate center of mass. This is to minimize the load on the mount during operation.



12. Secure the telescope to the dovetail holder and turn on the TiTaN TCS.



13. Plug in the Titan TCS to power, and you are ready to go. The telescope in the photo below is headed for due east. In the Titan TCS Object menu, select Manual > East > Sync. Use GoTo function targeting the celestial object you know using the Titan TCS Object menu. The telescope will move near the selected target. Then center your target using TCS's keypad and sync..



How to Set Up in Alt-Azimuth Mode

1. After the installation in the same manner as the equatorial mode, loosen the altitude holding handle to some extent and set the right ascension to 90 degrees.



2. Check the level on the top of the mount and adjust the height of the tripod so that it is level. Horizontal installation in Alt-Az mode is an important task to increase the accuracy of Go-To.





3. Determine the telescope's approximate center of mass. This is to minimize the load on the mount during operation.



4. After the declination head points north, the telescope points west. Then we put the weight on the end as shown below.



5. When using the Alt-Az mode, installation is very important to level. Installation should be done using the provided bubble level.



- 6. The installation position and simple instructions for Titan TCS in alt-azimuth mode are as follows. Please refer to the manual for Titan TCS for more detailed information.
- Menu > System > Mount Type > Alt-Az mode> Enter
- Menu > Save > Save & Exit > Enter
- Restart the Titan TCS.
- The telescope should be to the south and the pier to the north.
- Point the telescope to the due east.
- In the Titan TCS Object menu, select Manual
 East > Sync
- Use Go-To function targeting the celestial object you know using the Titan TCS Object menu. The telescope will move near the selected target. Then center your target using TCS's keypad and sync.

Now you can observe any object using Go-To.

How to Set Up in Alt-Azimuth Mode

1. Meridian Free Mode is a function that allows you to freely go to the subject in advance from the meridian and continuously shoot without changing the position from east to west. It cannot be used in all areas of the sky and can mainly be used to photograph southern celestial targets.

2. Meridian Free mode should only be used when the object to be photographed is so south of the celestial sphere that there is no chance of the telescope colliding with a pier or tripod.

3. Proceed with the same setting sequence as in equatorial mode. Once all settings are complete and you are ready to use it, use the Titan TCS to point the telescope towards due west.



4. When the position is like the picture above

- Menu>system>Meridian Free>Enter
- Menu>Save>Save & Exit>Enter

5. If you Go-To the east in this situation, the situation will be like the picture.



6. Meridian Free mode is very useful for taking astrophotos that require a long exposure until a celestial object rises in the east and sets in the west.

7. The reference pages for Meridian Free Mode in this manual are pages 70-71.

8. Please refer to the link below for a more accurate method of use and a video to help you understand.

Features of Titan TCS

Titan Telescope Control System (TCS) is compact but one of the most powerful equatorial mount control system. Titan TCS comes with a list of nearly 14000 objects that can be used by all astrophotographers in its memory.

- List of Objects -

IAU-approved Star Name 240 items New General Catalogue 7840 items Messier Catalogue 110 items IC (Index Catalogue) Objects 5386 items Caldwell catalogue 109 items Sharpless catalog 341 items RCW 182 items Gun 94 items Barnard 174 items



1. Key Features of the TiTaN Telescope Control System

- 1. TitanTCS operates with a specialized control processor (120MHz / 32bit) for mathematical operations and control, alongside a dedicated processor for user interface and communications. This configuration ensures readiness to accommodate a wide range of demanded functionalities.
- 2. With its built-in database including the Messier, NGC, IC, Caldwell, and SH-2 catalogs, users can navigate to their desired objects using only the TCS, without the need for a PC.
- 3. It supports the Bluetooth Serial Protocol (SPP), enabling connectivity with various devices. This feature allows wireless connection between the TCS and a user's PC or mobile device via Bluetooth.
- 4. Supports automated microstep adjustment The integrated stepper motor driver supports microsteps from 1/2 to 1/128, automatically optimizing the resolution for the device. In tracking mode, it shifts to a 1/128 microstep for optimal observation performance, while in high-speed slewing mode, it automatically adjusts to the best performing microstep. This enables smooth and precise tracking, along with high-speed slewing, with minimal power consumption. Additionally, the TCS dynamically controls voltage and current based on the motor's speed conditions.
- 5. The integrated motor driver's power supply efficiently generates an optimized voltage for motor operation from the input power. The power voltage for the

motor is independently step-down or step-up from the input power, according to the motor's operating conditions, ensuring it is appropriately supplied to the motor.

- Supports the widely used Meade LX200 compatible protocol; can be connected with various astronomical software. Can be connected with the PC using the ASCOM driver for LX200.
- It supports the major commands of the Meade LX200 protocol, which are widely used in various astronomical software. This allows for connectivity between the TitanTCS and user devices in environments where the ASCOM driver for TitanTCS is not available or in non-Windows OS settings.
- 8. If the user correctly completes the Parking procedure before turning off the TCS, when the power is turned back on, the TCS automatically restores the telescope's last position, enabling more convenient and accurate observations.
- 9. The TitanTCS, with its compact and sturdy metal casing, offers enhanced portability and a wide range of functionalities.
- 10. It is equipped with a high-resolution color graphic OLED display, allowing users to monitor various information such as the current status of the telescope and the motor's power consumption. Unlike LCDs, which can have slower response times in cold temperatures, the OLED display remains instantly responsive even in extremely cold conditions, down to -20°C. (1.69" Diagonal Size, 160 x 128 Pixels, 16Bit Color)
- 11. The current supplied to the motor can be set separately for tracking and highspeed slewing modes. This allows for the minimization of power consumption, even in outdoor observation settings where power supply is limited.
- 12. In tracking mode, the current consumption may vary depending on the settings, but it can be reduced to a minimum of 0.35A. This feature proves to be a significant advantage for outdoor observations with limited power resources and can be quite useful.
- 13. Two RS-232 connection ports: Two of PC or other devices can be connected by two ports at the same time. This allows simultaneous connection to multiple astronomical software.
- 14. USB Virtual COM Port Supported: can connect TCS to your PC via USB. Two Virtual COM Ports are supported, reducing the number of cables needed.
- 15. 4 LED equipped in the guide port input The guide status for each axis can be checked in real time during auto-guiding.
- Built-In Beeper The controller can inform the user about its status and various error situations through melodies or beep sounds.
- 17. Guide Port Isolated with Optocoupler

The guide port is isolated from the internal circuit using an optocoupler, effectively blocking external electrical noise and shocks.

Notice

TitanTCS hardware comes in two versions, V1 and V2, and is further explained with illustrations on the next page.

- 1. V1 is connected to the motor using a circular connector.
- 2. V2 is connected to the motor via a D-Sub connector and includes an added camera shutter control function.



• Titan TCS V1

• Titan TCS V2



2. Using the Navigation Button & Wheel

The navigation button and wheel operate in two distinct modes:

1. Telescope Mode

The up/down/left/right navigation buttons directly control the telescope, moving it in the respective directions.

The center enter key is used to stop the telescope while it's in motion. Holding down the center enter key for more than 2 seconds switches to Menu Mode.

2. Menu Mode

The up/down/left/right navigation buttons navigate through the menu. The navigation wheel enables fast vertical scrolling through the menu. The center enter key enters a submenu of the currently active menu or executes the currently selected option.



3. Parking & Speed Volume Knob

Speed Selection:

Adjust the slewing speed by rotating the volume knob. The current speed is displayed on the OLED screen, allowing for adjustment of the telescope's driving speed from 0 to 100% to suit your needs.

Parking:

Rotate the volume knob fully counterclockwise until you hear a clicking sound to park the telescope. The park/unpark function automatically saves and restores the previous telescope position, making operations easier for the next observation.



Parking

Switch off : Parking Mode on : Tracking Mode

Slewing Speed

CCW : Decrease slewing speed

CW : Increase slewing speed

4. System Configuration Diagram

- When connected to a PC via Bluetooth, two connections may appear on the control panel, but only one connection can be used for Bluetooth.
- If you use an older operating system, such as Windows 7, you need to manually install the USB driver.

The driver program is provided separately.

When connected to a PC via USB, two virtual serial ports are created. Both virtual serial ports can be used simultaneously to communicate with various astronomical software.

Caution, Titan TCS V1 Only

Although the Titan TCS V1 has both Micro USB Type B and USB Type A connectors, both are internally connected to the same USB port. NEVER CONNECT TO BOTH CONNECTORS AT THE SAME TIME!

It is advisable to use the larger USB Type A connector when using a USB connection. The Micro USB Type B connector is very small and may result in frequent contact failures depending on the cables used. The Micro USB Type B should only be used for emergency or spare purposes.



• Motor Cable Connection (Circular Connector Type, V1)



• Motor Cable Connection (15 pin D-Sub type, V2)





5. Operation Sequence of Titan TCS

First Time Using or If you have not used Parking function.

- A. Mount the telescope on the equatorial mount: Ensure that the weight is balanced as much as possible to prevent excessive leaning to one side.
- B. Connect the motor cable to the Titan TCS.
- C. Connect the power cable to the Titan TCS.
- D. Turn on the power switch.
- E. Choose a bright star: It does not matter if it is in the east or west. However, select a star near the celestial equator and at least 15 degrees away from the meridian. First, use the arrow keys of the TCS to bring the star into the field of vision of the telescope. Then, position it at the center of the eyepiece.
- F. Enter the controller's menu and navigate to [Object] [Star Name] (Selected Star Name) [Sync] to synchronize.
- G. Slew to the desired celestial object and observe.

If the Parking function was used during the previous observation.

- A. Mount the telescope in the same way as the previous observation: It will be easier to remember if you park the telescope pointing to the east horizon or to the west horizon.
- B. Connect the motor cable to the Titan TCS.
- C. Connect the power cable to the Titan TCS.
- D. Turn the power switch on.
- E. Make sure that "SYNC" message appears at the top of the TCS screen.

If there is no "SYNC" message, you should follow instruction under "First Time Using or If you have not used Parking function" section.

- F. Select adequate bright star from [Object] menu and slew the telescope to it.
- G. Make fine adjustments at low speed to center the star exactly.
- H. In the controller menu, select [Object] [Star Name] (Pointed Star Name) [Sync] to synchronize.
- I. Slew to desired object and observe.

6. Menu List

6.1. User Menu

Top Menu	Sub Menu	U/I Mode	Option	Functions	
Telescope	TCS Main Operation Screen (Telescope Mode)In Equatorial Mode: Displays RA (Right Ascension), DEC (Declination), time, and TCS status.In Alt-Az Mode: Displays Azimuth (Az), Altitude (Alt), time, and TCS status.				
Object	Star Name	В	Alphabet	240 items	
	Manual	В	Home / East / West / South / Current	Home: Telescope location (Northern Hemisphere) - Top & North Pole Telescope location (Southern Hemisphere) - Top & South Pole Current: The location currently displayed in TCS.	
	Solar System	В	Sun / Mercury / Venus / Mars / Jupiter / Saturn / Uranus / Neptune / Moon	After synchronizing with or performing a GoTo operation to the moon or sun, the tracking rate will change to the lunar or solar tracking rate.	
	Messier	В	Number	110 items	
	NGC	В	Number	7840 items	
	IC	В	Number	5386 items	
	Caldwell	В	Alphabet	109 items	
	SH-2	В	Number	341 items	
	LBN	В	Number	1124 items	
	LDN	В	Number	1800 items	
	RCW	В	Number	182 items	
	GUN	В	Number	94 items	

	Barnard	В	Number	174 items
	Lower Object	В	Show / Hide	Shows or hides objects below the horizon.
RA / DEC	Max Speed	В	Input numerical values	Maximum slewing speed
	Acc. Rate	В	Input numerical values	Acceleration Rate
	Direction	E	Normal / Reverse	Specifies the rotation direction of the telescope's drive axis. The direction of rotation for the telescope's drive axis varies depending on the internal wiring, cabling, and mechanical design. (This varies by product model.)
	Slow Current	E	Current setting for slow speed (Tracking condition)	135mA ~ 955mA
	Fast Current	E	Current setting for high speed (Slewing condition)	135mA ~ 1,150mA
	Gear Aging	E	Start, Exit -> Reverse, Stop, Exit	Gear Aging: Idle rotation to smooth the tooth surface of the driving gear. Start: Starts Gear Aging. Reverse: Reverses the rotation direction of the motor.
Time Lapse	Alt, Az Speed	В	Speed setting for	Speed: 0 ~ 99.0x
			moving speed	Direction: +, -
				Minutes: HH:MM
				00:01 min ~ 99:00 min
				1 minute ~ 99 hours
				Start
				Cancel
	Interval Tmr *This menu is	В	Interval Timer for camera shutter control	Delay (Seconds) : 3 sec ~ 120 min Exposure (Seconds) : 3 sec ~ 120 min

	only supported on V2 models.			Interval (Seconds) : 3 sec \sim 120 min Repeat (Seconds) : 3 sec \sim 120 min Stop Mount when exposure: Yes or No Cut Count: 1 \sim 999 Exposure Set Count: 1 \sim 999 Sets for Cuts group Wake up: Wakeup signal for Camera (double focus
				commands) Stop Time-lapse: Cancel [Az, Alt speed] action. F/S Swap: Swap Focus and Shutter signal for different cable connection. Start: Start Interval timer. Cancel: Cancel this menu.
Observatory	Date/Time	В	Set Date & Time	YYYY-MM-DD HH:MM:SS
	Site	E	Select a site from the site list.	4 sites are supported.
	Site Name	E	Enter the name of the selected site	Up to 12 characters
	Location	В	Enter the location of the selected site	Latitude, Longitude
	Time Zone	В	Enter the time zone of the selected site	-12 ~ + 12 hours
Parking	Select Bank	E	Select bank for parking configuration. Selected bank can set name & position. User 0 is for ASCOM. It cannot be renamed. It is parking information used by ASCOM.	Latest Position ASCOM (=User0) User 1 User 2 User 3 User 4

	Edit Name	E	Edit name of current selected bank	
	Save Position	E	Save the current position as the parking position of the selected bank.	
			* This menu cannot be selected when not in sync.	
	Parking Knob	E	Select the location to park with the parking knob.	Select bank
Safety	Meridian Stop	В	Enable / Disable	Enable: In tracking mode, RA tracking automatically stops when the RA axis passes near the meridian. The auto stop position can be specified in the "RA Limit" menu. In case RA auto stopped, "RA Stop! Meridian" message is displayed at the bottom of the OLED.
	Meridian Limit	E	Input numerical values (Degree)	Adjust the "Meridian Stop " position in degrees. If it is negative, it will stop before passing the meridian. In case it is positive, it will stop after passing.
	Landscape	E	Sky view / Landscape	When Landscape mode is selected, RA tracking stops and " Stop! Landscape" message is displayed at the bottom of the OLED.
	Alt Limit	E	Stop tracking / Cancel Goto / Warning Only / Ignore	Specifies the operation of the TCS when the altitude limit is exceeded.
	Go below Horz (=GoTo below the horizon)	E	Enable / Disable	GoTo below the horizon. Enable: When the TCS executes a command that slews to the

			target, the telescope can be directed down the horizon.
			But, if the "Meridian Flip" is
			slew the telescope down the
			horizon is ignored.
			Disable:
			commands that slew the
			telescope below the
			horizon.
Alt Lower Limit	Е	Altitude of the horizon limit (Degree).	When [Go below horizon] option is enabled, you can
		This limit is affect only	adjust the altitude of the
		slewing final target	horizon.
		position.	
Alt Upper Limit	Е	*Altitude limit for	0 + ~ +30
		This limit is affect only	Value 30 is altitude 60)
		slewing final target position.	
Idle Timer	E	Stop mount for long	A value of 0 disables idle
		action.	timer.
			1 ~ 999 minutes:
<u>.</u>			Enable idle timer
Sleep Limer	E	When the timer expires, the mount is stopped.	A value of 0 disables sleep timer
			sleep timer
Timeout Action	E	Stop Tracking / Park	Specifies the action when a
		Inere / Park ASCOW	timeout occurs.
			In case of "Park ASCOM",
			ASCOM control window.
Safe Power Off	E	Enable / Disable	If TCS is synced, make sure
only supported			even if you turn off the
on V2 models.			power switch before
			parking.

Meridian (Meridian	Flip	В	Enable / Disable	When GOTO is executed, if the telescope crosses the
Flip)				meridian, Meridian Flip is executed.
	Skip Once	E	Skip Once / Meridian Flip	Skip Once: Bypass Meridian Flip 1 time when GOTO. Afterwards, when GOTO, Meridian Flip is performed normally. Meridian Flip: Perform Meridian Flip normally when GOTO.
PEC	PEC	В	Enable / Disable	
	PEC Training	В	Start / Stop	
System	Mount Type	Е	Mount Type	German Equatorial / Alt-Az
				*If you change the mount
				reboot.
	Meridian Free	E	Disable / German EQ / Meridian Free	
	Def Track Rate	Ш	Sidereal Rate / King Rate	Default Tracking Rate
	Night Vision	В	Yes / No	Display screen color in red only.
	Max Bright	В	Input numerical values (%)	Maximum OLED Brightness (20~100 %)
	Min Bright	В	Input numerical values (%)	Minimum OLED Brightness (20~50%)
	Dimming Sec	E	Input numerical values (seconds)	OLED Auto dimming delay time (5 ~ 300 seconds)
				When the "Dimming Sec" elapses, the brightness of the OLED dims to the minimum brightness.
	Guide Speed	В	Input numerical values	0.1x ~ 0.9x
	Batt Low V	E	Input numerical values (voltage)	Set voltage for battery low voltage warning

Batt Over V	E	Input numerical values (voltage)	Set voltage for battery over voltage warning
DC/A Limit (DC Current Limit)	В	Input numerical values (current)	If the total current consumption exceeds the set value, the TCS temporarily reduce the motor acceleration rate. Note: The actual current consumption is not limited. It only reduces the
CPU Overheat	E	Input numerical values (Celsius degree)	Set Celsius degree for CPU Overheat warning.
Tracking Rate	В	Select current tracking rate	Sidereal / Solar / Lunar
Beep Level		Select message beep level	Detail ~ Silent
Serial A	В	Communication Speed (BPS)	Default (115,200) 9600 ~ 115,200
Serial B	В	Communication Speed (BPS)	Default (115,200) 9600 ~ 115,200
U/I Mode	В	Select U/I menu level Beginner / Expert	This setting is not reflected until reboot.
Power Monitor	E	Power monitor	Volt & Current for DC-in. Volt & Current for internal motor power source.
			The current sensor may have an offset error of about 0.2A.
			Users can optimize power consumtion for low power system.
Guide Port	E	Ignore ST-4 guide port.	Guide port(RJ-12) can be ignored using this menus.

				TCS has pulse guide
				function using ASCOM or
				LX200 protocol.
				·
Bluetooth	TCS Name	В	Enter name of TCS for	Up to 12 characters
			Bluetooth connection.	
		_		
WIFI		В	None / Station / AP	CCID of TCC itaalf an arating
	AP 551D	В	Enter SSID of AP	in AP mode
	AP Password	В	Enter SSID of AP	Password of TCS itself
	STA SSID	В	Enter SSID for external	SSID of WiFi service to
			WiFi service	which TCS will connect
	STA Password	В	Enter Password for	Password of WiFi service to
			external WiFi service	which TCS will connect
	Detail	В		It shows the current WiFi
				settings and connection
	WiEi Doboot	D	Xee / Ne	Status. Robect the WiFi module
Save	Save Exit	B	Save last settings	Yes / Cancel
Cave			ouve last settings	
	Backup	E	Save last settings to	
			backup memory	
	Destaur		Destant setting for m	
	Restore	E	Restore settings from	
			backup memory	
	Reboot	В	Reboot TCS	
Heln	Hardware	B	Illustrations of various co	prector locations on TCS
	Thataware	D		
	Serial BPS	В	Display the speed of	RS-232 / BPS
			serial port A/B	
			(Display only)	
	Version	В	Display firmware	Model, version, date
			information & Serial	Serial Number
			number of TCS	
	Firmware		Enter firmware update	I o terminate this function,
	Update		mode	turn the power off and on.
				However never turn off the
				power after the firmware
				has been started

U/I Mode

- B : Beginner Mode
- E : Expert Mode

"Observatory" / "Date / Time" does not need to be saved after changing the setting. Immediately after entering the Date & Time is reflected in the internal clock.

"Safety" / "Landscape" does not need to be saved after changing the setting. It is an execute command, and this value is not stored in memory. When you reboot, it will always be initialized to "Sky View" mode.

[System] / "Tracking rate" does not need to be saved after changing the setting. It is an execute command, and this value is not stored in memory. When you reboot, it will always be initialized to "Sidereal Tracking Rate" mode.

[System] / "U/I Mode" must be saved after changing the setting. This setting is reflected in the menu after rebooting.

"PEC" / "PEC Training" does not need to be saved after changing the setting. If training is started and training is successful by the "PEC" / "PEC Training" / "Stop" menu, it is auto saved in separate memory for PEC.

"Bluetooth" / "TCS Name" does not need to be saved after changing the setting. Immediately after entering the TCS Name is reflected in the internal special memory.

You do not need to save the "Telescope", "Object" and "Help" menu groups. These menu groups are execution commands.

Menus not specifically mentioned above must be saved after setting values have been changed so that the changed values can be read after rebooting.

[RA] and [DEC] menus must be saved after setting value is changed to reflect the changed result. The TCS performs the calculations and initialization related to the motor again when setting values are saved.

Under normal operating conditions, if the temperature of the TCS exceeds 45°C, it may be overloaded.

To improve the overload condition, adjust the Slow / Fast Current properly in the [RA], [DEC] menu.

Operation for long time beyond 55 °C may result in damage to internal components.

Power devices generate heat, so the temperature is higher than the CPU.

It is recommended that you save, reboot, and check the function again after you change important settings.

7. Explanation of Menu

7-1. How to enter menu mode

To enter the menu operation mode, press the enter key in the center of the navigation button for more than 2 seconds.

Press for more than 2 seconds at "Telescope" Mode.



When you enter menu mode, the top menu is displayed on the screen. To return to telescope mode, select the telescope menu and press the enter key. Use the rotation wheel for quick menu navigation.

7-2. Telescope Mode

The first state after power up is Telescope mode. Displays basic information, including current date and time, RA and DEC, current status.



- B/T : When Bluetooth is connected to the TCS, "B/T" is displayed at the top.
- SYNC : When TCS is synchronized, "SYNC" is displayed at the top.
- PEC :

If the PEC data is valid but the PEC has not been started, dimmed gray color "PEC" will be displayed at the top.

If the PEC has been started, red color "**PEC**" will be displayed at the top.



PEC Status Examples



PEC data is valid.

During PEC operation

PEC Menu



- Tracking Rate :

If the RA tracking rate is not Sidereal tracking rate, a yellow color "Solar" or "Lunar" is displayed at the top.

1. Sidereal tracking rate



There is no status indication for Sidereal tracking rate.

2. Solar tracking rate



Status : "Solar"

3. Lunar tracking rate



Status : "Lunar"

The tracking rate can also be changed using the "Object/Solar System/Goto" or "Object/Solar System/Sync" menus.

- Speed Volume knob:

The speed of the motor operated by the navigation button is displayed as a dimmed red bar at the bottom.

The Speed Volume affects only when slewing with the TCS navigation button.





Speed about 0%

Speed about 40%

Speed about 100%

Parking

Use the parking knob to enter the parking mode.

TCS stores the last harmonic and mount position in nonvolatile memory.



The parking procedure is complete. You can turn off the power.

Later, when you turn on the power, you can see that the previously saved information has been restored.

The final position of the telescope, whether it is synced or not, and the PEC training results are restored to the same as before parking.



The TCS carefully moves the stepping position of the stepper motor to the origin and completes parking. However, if the power is turned off and on many times, the step position may change unintentionally.

For precise PEC, It is recommended to refresh the PEC training after many power cycles.

• Top menu screen



8- Object

It is possible to slew or synchronize to the desired object by directly choosing it from TCS menu

• Select celestial list type



First, select the type of celestial list.

• Search Screen: Provides three methods based on the selected celestial list type.



HOBYM Observatory

After selecting a list type, a search screen appears, allowing you to select objects from the list.

There are two methods to search by keyword: by string and by number. Alternatively, objects within the solar system can be selected from the name list.

The maximum length for a keyword is 4 characters. Typically, typing two characters is sufficient to find exactly what you are looking for.

Keywords are not case-sensitive and are searched at the beginning of the string, making them appear at the top of the list.



• Search screens.

• Star Name : 240 stars

- Solar System : Solar system objects including the Sun and Moon.
- Messier : 110 objects
- NGC : 7840 objects
- IC : 5386 objects
- Caldwell : 109 objects
- SH-2 : 341 list of Sharpless
- LBN : Lynds' Catalogue of Bright Nebulae
- LDN : Lynds' Catalog of Dark Nebulae
- GCW : Rodgers, Campbell & Whiteoak
- GUM : An astronomical catalog of 84 emission nebulae in the southern sky. It was made by the Australian astronomer Colin Stanley Gum.
- Barnard
- Manual

Use the arrow keys to input the keyword and press the Enter key. Up to 100 results are displayed.



The list is white if the altitude of the celestial body is above the horizon and gray if it is below the horizon.

ex) "Nekkar" is above the horizon, "Alcyone, Arneb" are below the horizon.

In the displayed list, select the target using the up / down arrow keys and press the Enter key to display the Goto / Sync screen



When a low-altitude object is selected, the following Warning screen is displayed so that it cannot be goto / sync.

• Goto / Sync / Adjust position function screens.



Goto / Sync / Adj Screen

Goto Monitor

When the 'Goto' function is selected, a window similar to 'Telescope' mode appears, displaying the movement to the target.

Up / Down / Left / Right buttons do not work in this screen.

If you press the Enter key at this time, the movement is immediately canceled, and the screen returns to the previous screen.



Selecting the "Sync" function will synchronize the position of the selected object with the telescope.



By selecting 'Adj', you can adjust the position of the telescope using the directional keys.

Press the Enter key to finish the "Adjust position" operation.

Manual Mode

When aligning in the East / West / South / Home direction, the telescope and the pier should be in the designated position.



- 1. Home: Set the telescope's DEC axis to face the polar point and position the RA axis at the top.
- 2. South: Telescopes should be to the west, and piers to the east.
- 3. East: The telescope should be to the south and the pier to the north.
- 4. West: The telescope should be to the north and the pier to the south.
- 5. Current: These are the current coordinates displayed on the TCS Screen.

9- RA

Sets RA speed and other variables.

• RA sub-menu



• Max Speed: Sets the maximum RA slewing speed.



Acc. Rate: Adjusts the RA speed's acceleration and deceleration. The lower the value, the slower the acceleration and deceleration. Slowing down the acceleration reduces the load on the mount and motor. An excessively high Acc. Rate requires a large current instantaneously at the moment of acceleration and relatively high torque from the drive system, which may cause the stepper motor to stall.



• Direction: Specifies the rotation direction of the stepper motor. Use this menu option when the telescope's actual direction does not match the command.



 Slow Current (Tracking Speed Current): Specifies the current required for lowspeed operation, primarily used for tracking. In this setting, the stepper motor operates at 1/128 microsteps.



Fast Current (Slewing Speed Current): Specifies the current required for high-speed operation. The torque needed for acceleration and the voltage boost for high-speed operation consume a significant amount of current in a short time. In this setting, the motor automatically operates in the 'Fast Microstep' mode calculated by the system



• Gear Aging:

Occasionally, some users age the gears in the mount to improve tracking performance. Therefore, a function has been added to idle the drive system. Once the Gear Aging function starts, the drive axis begins rotating at maximum speed. If it exceeds +180 degrees or -180 degrees, the rotation stops and reverses. This function does not stop until [Stop] is selected. In normal cases, the company performs gear aging before shipping, so the user does not have to do it themselves.

Caution: During the operation of the Gear Aging feature, rotations exceeding 360 degrees will be repeated, so it is essential not to have the telescope mounted. If the telescope is mounted, a collision with the pier is unavoidable. Additionally, ensure good ventilation for the TitanTCS to prevent overheating, and operate it for no more than 30 minutes.

During the operation of this function, always ensure that the device is functioning properly and check for any warnings or errors.





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10- DEC : Sets DEC speed and other variables. Same as RA settings.



11- Time Lapse

- 11-1. Az, Alt Speed
 - Az : Moving speed of azimuth axis (=RA axis)
 - Alt : Moving speed of altitude axis (=DEC axis)
 - Minute : Duration of time lapse operation, At the end of the time, the mount stops.
 - Stop / Start : Time lapse operation command



11-2. Interval Timer

*This menu is only supported on V2 models.

- Delay Time delay until 1st exposure. (unit : seconds)
- Exposure Exposure time
- Interval The time interval between each exposure.
- Repeat The time interval between each set.
- Stop Mount Stop the motor during exposure. Motor stopping is about 4 seconds before exposure, and restarting is after exposure.
- Cut Count Number of exposure in single set
- Set Count Count of set, Total exposure count is [Cut Count] x [Set Count]
- Wake up Camera wake-up function. Turn off the camera power saving function by sending a focus signal 5 seconds before exposure.
 - Stop T-Lap. (Stop Time-lapse) The entire exposure is completed, turn off the Time-lapse function. TCS returns to tracking mode.
 - F/S Swap (Focus / Shutter Swap)
 Depending on the release cable, the Focus / Shutter wiring may have

changed. Focus and Shutter signals are interchanged and output.

- Start Start interval timer
- Cancel
- Time chart about action (example case : single set, two cuts, wake up, stop mount)



12- Observatory

Current Date/Time and location setting



• Date/Time : Set current date and time. Current date and time will always retained by internal Real Time Clock(RTC.)

If the current date and time are cleared each time the power is turned off, try moving the battery tray back and forth several times.

Moisture or other causes may cause poor contact.

HOBYM Observatory

If this does not improve, replace the CR2032 button cell.



• Site :

Select a site from the site list. The number of sites in the list is four.

"Location", "Time zone", and "Site Name" are information corresponding to the selected site.



• Site Name :

Enter the name of the site selected in the "Site" menu.

Up to 12 characters can be entered, and blank characters cannot be entered consecutively.



• Location : Enter the location of the site selected in the "Site" menu. Set the Latitude and Longitude of current site.

B/T SYNC PEC
Location
37'33"59 N
126'59"59 <u>E</u>
106159059 8-
120 55 55 6-

• Time zone : Enter the time zone of the site selected in the "Site" menu. Set the standard time zone in current site.



13-Safety



HOBYM Observatory

• Meridian Stop :

Enable :

In tracking mode, RA tracking automatically stops when the RA axis(=Telescope Direction) passes near the meridian. The auto stop position can be specified in the "RA Limit" menu.

In case RA auto stopped, "RA Auto Stop!" message is displayed at the bottom of the OLED.



Meridian Limit : Adjust the "Meridian Stop" position in degrees.
 If it is negative, it will stop before passing the meridian. In case it is positive, it will stop after passing.



 Landscape (RA tracking stop)
 When "Landscape" mode is selected, RA tracking stops immediately and " Stop! Landscape " message is displayed at the bottom of the OLED.



"Sky view mode" is normal tracking mode.



 Alt Limit (Altitude Limit Action) Stop tracking :

Stops tracking when the specified altitude is exceeded.

Cancel Goto :

Ignores the Goto command if the specified altitude is exceeded. Warning Only :

Only displays a warning when the specified altitude is exceeded. Ignore :

Ignores if the specified altitude is exceeded.

• Go below Horz. (GoTo below the Horizon)



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Enable :

When the TCS executes a command that slews to the target, the telescope can be directed down the horizon.

The lowest altitude of the telescope is aimed at is -15 [deg].

But, if the "Meridian Flip" is disabled, the command to slew the telescope down the horizon is ignored.

Disable :

The TCS ignores the command that directs the telescope below the horizon.

• Alt Lower Limit :

Altitude of the horizon limit (Degree). This limit is affect only slewing final target position.





Alt Upper Limit

Altitude limit for slewing target position. This limit is affect only slewing final target position.

WiFi
Safety
Go below Horz
Alt Lower Limit
>Alt Upper Limit
Idle Timer
Sleep Timer
Idle Timer 5:59:24



 Idle Timer Stop mount for long operation without any action.





HOBYM Observatory

• Sleep Timer

When the timer expires, the mount is stopped.





A value of 0 disables idle timer.



1 ~ 999 minutes : Enable idle timer

Timeout Action

Specifies the action when a timeout occurs.

In case of "Park ASCOM", park as specified in the ASCOM control window.



Safe Power Off

When the TCS is synchronized, it prevents the user from turning off the power using the power switch before parking. To avoid loss of synchronized information, the user should turn off the power after parking.

However, this feature does not operate if the external power supply is disconnected or if it is not synchronized.





14- Meridian

Set the operation related to the meridian.



• Meridian Flip:

Disable or enable automatic meridian flipping by choosing this option. By limiting the movement of the RA, the collision between the telescope and the tripod or pier can be prevented.



• Skip once :|

Skip Once: You can select [Skip one] to ignore the Meridian Flip triggered by a GoTo command just once. This feature automatically clears after one GoTo command is executed, regardless of whether the Meridian Flip occurs. While this feature is active, the message 'Meridian Flip is disabled.' is displayed on the TCS screen.

Meridian Flip: You can deactivate this feature by selecting [Meridian Flip]

from the menu.



15- PEC

It corrects periodic error of harmonic reducer and enables high precision guiding for astrophotography and high magnification observation.



 PEC : Select whether to enable Periodic Error Correction through Disable / Enable option. The PEC function can only be activated when stored PEC data is valid.



 PEC Training : It performs measurement of periodic error and calculation of correction data by using internal microprocessor.
 PEC Training function is only available during operation of auto guide system using a guide CCD, a guide telescope, and PC.

When you select [start] and start training, it usually collects data of 2 cycles. If the training was successful, the PEC function is automatically activated. If the period of two cycles is too long or it is impossible to learn by variables such as clouds, the user can stop training by selecting "PEC Training" / "Stop". In this case, the PEC function is available only if training has been completed for more than one cycle.

PEC training will always be kept up-to-date. If new training is performed, the old training data will be deleted automatically and new training data will be used for PEC function.

During PEC training is running, yellow color "PEC/T" is displayed at the top. TCS shows the progress of PEC training in percentage at the bottom of the screen



Ex) PEC Training progress examples

16- System

Guide Speed, power-related and communication speed settings.



 Mount Type If you change the mount type, you must save and reboot.

The mount type must match the mechanical type of the mount. For Equatorial Mount, the coordinates are based on RA and DEC. For Alt-Az Type, the coordinates are based on Az and Alt.



German Equatorial Mode

Alt-Az Mode

Meridian Free

WARNING: The Meridian Free function is a special function created for uninterrupted photography without using Meridian Flip.

When GOTO or tracking, there is a possibility that the eyepiece or telescope collides with the pier, so you must sufficiently check the movement of the telescope before use. If you are not familiar with Meridian Free features, we recommend not using it.

When synchronizing for the first time after installing the telescope, you should position the telescope above the weight and synchronize while looking at the western star.

When Meridian Free is enabled and the telescope is pointed east, the telescope will be positioned below the weight.

Therefore, there is a possibility that the eyepiece may be placed close to the pier or collide with it.



Disable :

Does not use the Meridian Free feature.



German EQ :

This is a traditional German Equatorial mode that does not use the Meridian Free feature.

"GEq" appears on the screen.



 Meridian Free : Use the Meridian Free feature.
 "M/F" appears on the screen.



 Max Bright Maximum OLED Brightness(20~100 %)



 Min Bright Minimum OLED Brightness (20~50%)



Guide Speed : The guide speed can be set from 0.1 to 0.9 and it is the setting to maintain the optimum guide condition.
 For example, when the guide speed is set to 0.5, the right ascension (RA) motor is driven at a speed of 0.5~1.5 times, and the deceleration (DEC) motor is driven at a speed of -0.5 ~ +0.5 times.

For reference, increase Guide Speed for short focal length guides and decrease guide speed for long focal length guides.



- Batt Low V : Set Battery low voltage warning You can set the minimum battery voltage value for warning.
- When a under voltage situation occurs, a under voltage message will be displayed on the screen with the beep sound.



Ex) Under voltage condition

• Batt Over V : Set Battery over voltage warning You can set the maximum battery voltage value for warning.

When an overvoltage situation occurs, a over voltage message will be displayed on the screen with the beep sound.



Ex) Over voltage condition

 DC/A Limit : Set DC Current Limit The total current consumption is monitored.
 If the TCS consumes more current than the set value, motor speed acceleration is automatically lowered to reduce current consumption. Nevertheless, the actual consumption current may exceed the specified set value even if the consumption current decreases by lowering the acceleration amount.



Ex) Over current condition

 Tracking Rate : Select RA tracking rate Sidereal / Solar / Lunar



• Beep Level : Select message beep level



 Serial A : RS-232 A You can set the communication speed with the astronomical simulation software and Serial port A. The factory default setting is 115,200 bps, no parity, 8 data bits, and 1 stop bit. User can select from $9,600 \approx 115,200$ bps.



• Serial B : RS-232 B

You can set the communication speed with the astronomical simulation software and Serial port B.

The factory default setting is 115,200 bps, no parity, 8 data bits, and 1 stop bit. User can select from $9,600 \approx 115,200$ bps.



• U/I Mode : Select U/I menu level Beginner / Expert

This setting is not reflected until reboot.



Ex) Expert Mode Menu



Ex) Beginner Mode Menu

 Power Monitor In Telescope Mode, switch the display to a screen for monitoring voltage and current.



Deceleration
 Deceleration rate is proportional to [Acc. Rate]



If greater than 1, deceleration is faster than acceleration. If this value is 1, acceleration and deceleration are the same.

Generally, a lot of current or torque is required for acceleration.

Since the deceleration load is usually small, the deceleration ratio may be higher than the acceleration ratio.

17- Bluetooth or WiFi

Users can choose to install one of the firmwares for either Bluetooth or WiFi. Since the firmwares are separate, the two functions cannot be used simultaneously.

1. Bluetooth

There are no mandatory settings that users must input for Bluetooth. However, users can specify their own TCS name to use as the Bluetooth device name. If not specifically designated, the device name will be displayed as TitanTCS-*, where "*" is filled with the TCS's serial number.

Any device name entered by the user will also be used as the SSID in WiFi's AP mode."



2. WiFi

TitanTCS offers WiFi functionality in two distinct modes: AP Mode and Station Mode.

TitanTCS supports Wi-Fi 802.11 b/g/n protocols and operates in the 2.4GHz band.



A. AP Mode :

In this mode, TitanTCS functions as a WiFi Access Point. Users' PCs or mobile devices connect to the TitanTCS as clients, forming a local wireless network without internet access.

Users can specify an SSID and password for AP Mode on the TitanTCS. If not specifically set by the user, the default SSID for AP Mode is 'TitanTCS,' and the password is an empty string.

The IP address of the TitanTCS is always fixed at 192.168.4.1, and the port used for connections is 4030.




B. Station Mode :

Unlike AP Mode, in Station Mode, the TitanTCS operates as a client that can connect to an external WiFi router. External devices could be a mobile device supporting WiFi tethering, a PC with a HotSpot feature, or a WiFi router. TitanTCS's WiFi can communicate wirelessly with users' PCs or mobile devices through the external WiFi router.

In this mode, users must accurately enter the SSID and password of the external WiFi router into the TitanTCS's WiFi Station Mode settings. The entered strings are case-sensitive.





TitanTCS receives an IP address assigned by the external WiFi router. This information can be viewed in the WiFi menu under the 'Detail' section of the TitanTCS."

WiFi	WiFi
WiFi	SSID :
AP Password	PWD :
CTA CCTA	IP/Port :
STA BBID	
>Detail	RX Bytes : U
Villi Debeet	IX Bytes : U Comp. 0 Sto. 0
WIFI REDOOL	um: o sta: o
Idle Timer 5:58:20	Idle Timer 5:59:09

18-Save

The manipulated setting values can be stored in the nonvolatile memory of the TCS.

Once saved, the settings will not be erased even after the power is turned off and can be used when the power is turned on again.

• Save Menu



• Save, Exit

The TCS stores the last settings to internal memory and goes out to "Telescope" mode.



Backup

Save last settings to backup memory



Restore

Restore settings from backup memory



Reboot

TCS will reboot itself. If you use parking, please park first.



19- Help

The connector assignment of Titan TCS and current communication speed can be checked.



 Serial BPS : Display the speed of serial port A/B (Display only)

B/T SY	NC	F	PEC
Serial	A	:	115200
Serial	В	:	115200

Version
 Display firmware information.



• Firmware Update : Enter firmware update mode To terminate this function, turn the power off and on. <u>But, Never turn off the power while updating the firmware.</u>



8. Bluetooth

8.1. How to connect Titan TCS to your PC via Bluetooth (Standard: Win10)

1. Select "Devices" in Windows Settings.



2. Select "Bluetooth & other devices" of the left menu bar.



3. Make sure Bluetooth is on and select "Add BT".



When the "add device" screen appears, select bluetooth.



4. If the Titan TCS is powered on, it will take a moment and display "Titan TCS".

If you entered a different name in the [Bluetooth] menu in TCS, the name will be displayed.

It may take several tens of seconds to display the device.

Click the [TitanTCS] button or ["custom name"] button.



5. "Compare Password" window will appear. If you click the [Yes] button, Bluetooth will be automatically connected.

The password is randomly generated and changes every time.

Add a device	×	Add a device	×
Add a device		Your device is ready to go!	
Make sure your device is turned on and discoverable. S connect.	elect a device below to		
Connecting		Paired	
Press Connect if the PIN on TitianTCS matches thi	s one.		
606263 • Connect	Cancel		
II			
	Cancel		Done

6. When the connection is successfully completed, the message "Paired" will be displayed.

÷	Settings	↔ _		×
ŝ	Bluetooth & other device	es		
+	Add Bluetooth or other device			
Blue	tooth			
	On			
Now	discoverable as "F K"			
Oth	er devices			
Ľ	TitianTCS Paired			
	Download over metered connections			
To he	eln prevent extra charges, keep this off so de	vice softw	are	

7. There will be two "Standard Serial over Bluetooth link" generated, but only the top one can be used.

In the example of the figure, only COM4 can communicate. After connection, use as the same way as normal serial communication.



8.2. How to remove Titan TCS from Bluetooth connection (standard: Window 10)

Normally, the Bluetooth device needs to be installed only once.

However, if you connect the TCS to another PC, you may need to reinstall it on the previous PC. In this case, you can resolve the problem by removing and reconnecting the TCS Bluetooth from device.

Remove it with the [Remove Device] button in the "Bluetooth Device Management" window.

Wait for a moment after removing the device. The "Titan TCS" device will be displayed again.

Click [Connect] button to install again.



8.3. How to connect Titan TCS to your MAC (OSX)

1. Select "Open Bluetooth Preferences..." in status menu.

\odot	💦 🛜 🖵 🛋 37 % 🗊 Sun 11:	20
	Bluetooth: On Turn Bluetooth Off	
	Devices UE ROLL 2 Windows Phone C	
	Send File to Device Browse Files on Device	
	Open Bluetooth Preferences	
	4	

 If the Titan TCS is powered on, it will take a moment and display "Titan TCS". If you entered a different name in the [Bluetooth] menu in TCS, the name will be displayed. It may take several tens of seconds to display the device.

Click the [Pair] button.

	Bluetooth	Q, Search
	Devices	
∦	UE ROLL 2 Not Connected Windows Phone C Not Connected	
Bluetooth: On Turn Bluetooth Off Now discoverable as "MacBook Pro"	3 Titan TCS	Pair
	✓ Show Bluetooth in menu bar	Advanced ?

After a while, you will succeed Bluetooth pairing. Unlike windows, mac shows only one connection and can use it.

9. Technical Specifications

Power supply	12V, 4A	
	Built-in reverse voltage protection circuit, built-in	
	2.6A Polyswitch for overcurrent protection.	
Current consumption	About 250mA to 700mA when tracking	
	$0.7 \sim 2.5$ A when high-speed slewing, depending on	
	operational status	
Microprocessor	Main Control : 32bit 120MHz	
	U/I : 32 Bit 240MHz dual-core	
Internal power	3.3V, 5V, Motor power(~30V)	
	Over Voltage shut off function	
USB Power supply	5V 0.6A	
	Over Voltage shut off function	
Motor/microstep	Two-phase bipolar stepper motor	
	1/128 on tracking, 1/4~1/32 on high-speed slewing	
	depending on the setting.	
Motor PWM frequency	About 45 KHz	
Display	OLED 2.69", 160 x 128 x 16 Bit	
Serial port	RS-232 2 Port	
	1.GND, 2.NC, 3.Tx, 4.Rx	
Guide port	RJ-12, 4 status LED (Red)	
	1.NC, 2.GND, 3.RA-, 4.DEC-, 5.DEC+, 6.RA+	
DC jack	Barrel outer diameter: 6.3mm	
	Pin diameter: 2mm	
Bluetooth	Supports Serial Port Protocol (SPP 1.2)	
	Windows 10, OSX, Android are tested.	
	iOS are not currently support.	

Wi-Fi	Hardware ready for 802.11 b/g/n/e/i, Planned to be
	supported.
USB	TitanTCS V1:
	Micro Type A & USB Type A connector
	(CAUTION : cannot be used simultaneously)
	TitanTCS V2:
	USB Type A connector
Built-in Real Time Clock (RTC)	Built-in low-power RTC
	(current draw about 350 ~ 700 nA)
Replaceable battery	Lithium button cell battery (CR2032)
Motor connector	TitanTCS V1: Two Circular Connector
	RA :A+, A-, B+, B-, NC, NC (6 pin)
	DEC : A+, A-, B+, B- (4 pin)
	TitanTCS V2: High Density D-Sub 15 Pin
	RA :A+, A-, B+, B- (4 pin)
	DEC : A+, A-, B+, B- (4 pin)
	DC-In GND (2 Pin)
	DC-In +12V (2 Pin)
Camera Shutter Control	3.5mm Streo Jack for camera focus & shutter signal
	* TitanTCS V2 only

CAUTION: If AC power is supplied to the Titan TCS, it will be damaged. Make sure to use only at a limited voltage of DC 12V. User is responsible for the damage of the controller due to user's incautiousness.

10. LX200 Commands supported

Command	Explanation
:CM#	Synchronizes the telescope's position
:MS#	Slew to target object
:SdsDD*MM:SS#	Set object target
:SrHH:MM.T#	
:SrHH:MM:SS#	
:GD#, :GR#	Get telescope position
:SdsDD*MM:SS#	Set target object
:SrHH:MM.T#	
:SrHH:MM:SS#	
:GS#	Get the Sidereal Time
:GC#, :GL#	Get local Date, Time
:SCMM/DD/YY#	Set local Date, Time
:SLHH:MM:SS#	
:GG#	Get UTC offset time (Time Zone)
:SGsHH.H#	Set UTC offset time (Time Zone)
:Gg#, :Gt#	Get current site Longitude, Latitude
:SgDDD*MM#	Set current site Longitude, Latitude
:StsDD*MM#	

:RC#, :RG#, :RM#, :RS#	Set slew rate	
:Me#, :Mn#,:Ms#,:Mw#	Move Telescope at current slew rate	
:Q#	Halt Slews	
:Qe#, :Qn#, :Qs#, :Qw#		
:U#	Toggle precision positions	

11. Replacing the battery

For some information and internal clock, the TCS has a built-in CR2032 battery.

The battery tray is on the left.

The battery tray can be removed using a small slot head screwdriver.



If the battery tray does not draw easily, you can slightly loosen the bolt on the back of the case within 3 turns to make drawing easier.

If the bolt is turned more than four turns, the bolt may be taken out and the internal parts may be detached.

12. Pin Map

Bottom View



13. Frequently Asked Questions

For Mount

- It does not guide well: There may be several reasons for low guide quality:
 - 1. The cable of guide CCD is not properly fixed
 - 2. The guide CCD is not securely fixed
 - 3. The payload for CRUX is exceeded or counterweight is not properly used
 - 4. Smoking nearby the mount
 - 5. There is a source of heat or an entrance where the guide camera is facing.
 - 6. Seeing is poor
 - 7. The focus of the guide CCD is not clear
 - 8. The guide star is too bright
 - 9. The guide is too dark
 - 10. The guide star is located at the edge of the guide CCD.
 - 11. There was too little movement during the guide calibration
 - 12. There was too much movement during the guide calibration
 - 13. The guide exposure was too long
 - 14. The guide exposure was too short
 - 15. Guiding speed is too fast for the focal length
 - 16. Guiding speed is too slow for the focal length
 - 17. The lens or the primary mirror of the guide telescope is not securely fixed
 - 18. The focal length of the guide telescope is too long
 - 19. The focal length of the guide telescope is too short
- What is the safe payload?
 - When the CRUX mount is appropriately loaded, the mount should not be slipped when the telescope is mounted, the declination is completely parallel to the ground, and the power is turned off. In case of the telescope is being slipped, the counterweight may be needed. The safe payload for the mount is the load that does not make it be slipping, even when the power is off.
 - When the power is supplied, the torque generated by the electromagnetic of the motor may allow additional load, but this load should not be considered safe payload. When testing, put your hands under the telescope to prevent any unexpected collision.
- What is the amount of periodic error?
 - The periodic error of the CRUX mount is about ±20 seconds, the same as that of a harmonic gear. In the case of high magnification observations, the object seen by the eyepiece may be wobbling about the diameter of the Saturn or the Jupiter. This is much larger than the periodic error of EM200, which is about ±7 seconds. The biggest advantage of the harmonic gear mount is that it has no backlash and a large payload compared to the weight of the mount. In general, photography using the harmonic gear mount presupposes a guided shooting. When taking a guided shot, its advantages are maximized, unlike the usual worm wheel mount. The Titan TCS has a built-in PEC function. The user can take the most advantage of harmonic gear mount using PEC function in that it eliminates the backlash.

- ASCOM Driver for CRUX series
 - The ASCOM Driver designed for Titan TCS is available. It can be downloaded from the *Download* page of the HOBYM Observatory homepage. Please upgrade the old firmware to the latest version before using it.
- On a very cold day, there is a stall or vibrational noise while slewing and dose not properly move.
 - If the weather is below -10 °C, it is recommended to attach counterweight or to reduce the maximum motor speed to about 50% level to minimize the mechanical burden to the mount Please contact HOBYM Observatory if you continue to experience the same problem after trying the above-mentioned suggestion.
- What telescopes can be mounted without counterweights?
 - The Crux140Traveler has a large payload, but it is recommended to use a counterweight or to mount less than the recommended payload when taking photographs. Maintaining a safe payload will ensure the quality of photography. Please refer to *"What is the safe payload?"* section of the FAQ for more details.
 - The example below is the case of observing with an eyepiece.
 Takahashi: Refractors under FSQ106, Cassegrain telescopes under Mewlon-200, Epsilon-160
 - GSO: 8-inch RC telescope or less, 8-inch reflector or less
 - Celestron, Meade: 8-inch Schmidt Cassegrain Telescope or less
 - Vixen: Visac 8-inch, R200ss, 4-inch Refractor or less
 - For astrophotography, use smaller telescope because extra equipment is required.
- The guide graph is poor.
 - There can be two major causes.
 - The first is when the polar alignment is not precisely done. If the tripods are lightweight, the polar alignment can be distorted after you mount the telescope to the tripod. It is recommended to install on a hard floor, set the telescopic cameras, etc. and then proceed to polar alignment.
 - The second case is when the seeing is not good.
 Since the CRUX mount has no backlash, the scene has a major influence on the guide quality.
 Often, when seeing is poor, the guide graph has a high correction level and large peak-to-peak.
- The motor stalls while slewing.
 - There can be two causes.
 - The first is power issues. The problem may occur due to the low voltage because of the insufficient DC adapter capacity or a low battery. In this case, use a DC adapter with a higher capacity or charge the battery.
 - The second is when the payload weight is exceeded. In this case, reduce the load to the mount. Even if the telescope is within the recommended payload, when it has a large aperture, the payload will be lower as it gets farther away from the DEC mounting surface.
- About the holding torque of the motor
 - There may be a possibility that the mount slips when a heavy telescope is mounted, and the mount turns off. Therefore, it is recommended to uninstall the telescope before you turn off the mount. Do not forcibly rotate the axis of the mount, as it generates electrical power and may cause severe damage to the Titan TCS.

- The mount/tripod falls over due to the unbalance.
 - The problem may be because the center of mass of the total system changes as the mount rotates and cause unbalance in weight distribution. If the center of mass is near the outer edge of the total system, the system may fall over with a very small additional force. Use the tripod that can extend the legs as wide as possible or use a heavier one.
- Can it be used in the southern hemisphere sky?
 - Manu> Observatory> Enter longitude and latitude> Change time> Save, and restart.
- GOTO is not precisely done.
 - > The synced star has to be exactly at the center of the eyepiece.
 - > Check the polar alignment.
 - > Check whether there is error message displayed on TCS.
 - If previous two are not the case, contact the manufacturer or the seller. Such problem may occur due to the incorrect factory default setting such as gear ratio.
- Telescope moves toward wrong direction after GOTO.
 - > Check the current date/time setting.
 - > Check the observatory location data.
 - > Sync should not be done when telescope is located lower than the counterweight.

TCS is programmed to sync when telescope is at higher position than the weight.

If it is synced when the telescope is at lower position than the weight, it recognizes the telescope to be at the opposite direction.

- > Sync again at proper position before using.
- > Check whether there is an error message displayed on TCS during GOTO operation.
- > Make sure that the direction of rotation of the RA or DEC axis is correct.
- > Make sure that the RA and DEC cables are correctly connected.
- > When malfunctioning continues, contact the manufacturer or the seller.

Such problem may occur when the direction of rotation of the RA and the DEC axis is reversed.

- GOTO takes too much time.
 - > For accurate pointing, it slows down near the target point.

Check the current coordinate values from OLED.

> Check whether the speed volume is at or near parking.

- > Check the maximum speed setting.
- When accelerating at maximum or high speed, the motor is noisy and does not move.
 - Motor is stalled, caused by the mechanical overload due to lower temperature or low current under too much load.
 - > Disconnection due to the aging of the RA / DEC cable.
 - Low DC input current / voltage.
 - > Excessively imbalanced counterweight and the telescope.
 - > Check the [Acc. Rate] setting. The load increases if the set value is high.
 - In this case, decrease the set value of maximum speed and acceleration speed and balance the weight of the telescope before operating.
- Bad connection with the simulation programs.
 - When connecting with serial port. Make sure to use an RS-232 cable dedicated to Titan TCS.

The RS-232 cable used by TCS is not a standard cable, and the pin connections are different for each manufacturer. Be extremely careful.

Even if the connectors are the same shape, never use unidentified serial cables.

There is a potential for permanent damage to the TCS or PC.

- Check the serial communication speed for TCS. The default baud rate is 115,200 bps. You can change the baud rate to suit your needs in the [System] menu. You can check the communication speed at [Help]-[Serial BPS]
- Check USB, Bluetooth and the COM port number: number of serial port of TCS in Device Manager.
- When connecting via Bluetooth, a blue color "B/T" indication should appear at the top of TCS.
- Confirm that communication protocol is selected as LX200 in the astronomical programs. Please note that the setting method for each program is slightly different. Follow the manual provided by software distributer.
- The time and location of the simulation program does not match with the ones of TCS.
 - Check the settings of the simulation software: Some simulation software supports a function to download the data such as time and location of PC to TCS.
 - If it is difficult to set the date / time and observatory location by software, use the functions of TCS itself and set it same as software.

- TCS does not allow to enter the time before 2017. Therefore, date / time information only after 2017 is available.
- Poor guide performance
 - Try to adjust the guide speed from the System menu. Lower the guide speed for long focal length guiding, and increase the guide speed for short focal length guiding.
 - Check the status of the LED at the bottom of the TCS. LEDs directly connected to the guide signal are arranged as RA +, DEC +, DEC-, RA-. Confirm whether all LEDs respond to the signal or not.
 - Make sure that the mount, telescope and guide scope are securely fastened. You can also check by gently shaking the tip of the telescope by hand.
 - Try to turn off the PEC function.
 In rare cases, the guide signal and PEC processing may interfere.
- Date and time is not maintained between power downs.
 - Open the battery cover of the side of device to replace the battery. Replace with new CR 2032 lithium button cell.
 - Normally, the battery should be maintained for more than 2 years after purchase. If the problem suddenly occurs before expected battery life ends, contact the manufacturer or the seller.
 - If the current date and time are cleared each time the power is turned off, try moving the battery tray back and forth several times. Moisture or other causes may cause poor contact.

If this does not improve, replace the CR2032 button cell.

- When replacing the battery, please refer to the above explanation
- When automatic meridian flip function is undesired for photographing.
 - Select Disable from [Meridian]-[Meridian Flip] Menu
 - When disabling the meridian reversal function, always be careful of moving the telescope. In this case, it is programmed to reject the GOTO command which goes below the horizontal line.
- When it automatically stops with a melody sound while tracking.
 - The RA Auto Stop function operated. Check the time and location settings to accurately calculate the meridian information.
 - > Check the RA Auto Stop function.
 - > Please check the message at the bottom of the screen

- When TCS receives a command from Object / GOTO, the error message is displayed without moving.
 - Check time and location setting.
 - > The first star has to be synced and Object / GOTO.
 - > Do not GOTO near the horizon.
- PEC is turned off but dimmed gray color "PEC" appears in display.
 - It is normal. Indicates that the PEC function is disabled, but has valid PEC training information.
 If there is no "PEC" indication, you cannot use the PEC function until you refresh the PEC training.
- Turning PEC on worsens the guide performance.
 - > In a case the load on telescope caused a slip after PEC training.
 - > In a case that the position was lost due to the stall of motor.
 - > In a case that the power was turned off without Parking.
 - In previous three cases, arrange properly according to the presence / absence of the home sensor.

If there is no home sensor (CRUX 170, etc.): Refresh the PEC Training. The PEC function uses newly trained PEC data.

If there is home sensor (Early CRUX 200, etc.):

Turn the power off and reboot. Move RA axis from east to west, then west to east across the home sensor. Each time moving from east to west or west to east, the melody will sound twice: once when the mount passes the home sensor (touch message will appear with melody), and once when it moves away from the sensor (touch out message with melody). Repeat this movement more than twice. Make sure you hear both touch in and touch out melody each time you move RA axis across the home sensor.

When the home sensor is recognized properly, the melody will sound and "H/S" will be displayed at the top of the screen.

If PEC data is valid, the PEC function will be automatically activated. If PEC function is not activated automatically, redo PEC Training and use newly trained data to operate PEC function.

- When using a low rated power supply
 - > DC power supply is recommended to be rated 12V 4A or higher.

When using a low rated power supply, the current must be limited through the [DC/A Limit]

function in the [System] menu to prevent damage to the power supply.

It is also recommended to lower the acceleration / deceleration values through the [Acc. Rate] function in the [RA] and [DEC] menus.

- When the telescope is moving, the TCS reboots or suddenly stops and the melody sounds.
 - This is caused by a voltage drop, when using a low rated power supply. Change the setting to the lowest possible acceleration setting and the lowest possible maximum speed. Replace with a fully rated power supply.
 - It may be caused by poor contact of the power input DC Jack. Make sure the power input is loose. The specifications of DC Jack Pin Diameter: 2mm, Barrel Outer Diameter: 6.3mm

CRUX 200MF	ITEM	Specification
	Туре	German Equatorial Mount
	Azimuth Adjustments	± 15°
	Elevation Adjustments	0 to 90°
MAIN SPEC	Weight (without counterweight)	10kg
	Maximal Loading Capacity with 5kg Counterweghts	30kg (The position of 150mm from DEC head)
	Operating Voltage	12V DC
	Tube moutings	4 x M8 screws Takahashi Standard
	R.A. Reduction Gear	20 Type 80:1 Harmonic gear or Equivalent
		11 Type 50:1 Harmonic gear or Equivalent
	DEC. Reduction Gear	20-100 Harmonic gear or Equivalent
	Final Reduction Gear Backlash	Almost Zero
MECANICAL SPEC	P-motion	± 7" w/ PEC function
	High Speed Mode	500x the sidereal rate (12V DC)
	riigii opeea moae	Computerized-GoTo
	Ontion Parts	Under Development
	option runts	Stainless 5kg Counterweight
	Dimension	395mmX340mmX180mm (In case of Altitude 35°)
	RA Stepping Motor	200step 1.8degree
	Dec Stepping Motor	19:1 geared 200step 1.8degree
	RA total output PPS	711pps
	Dec total output PPS	474pps
	Frexible micro step control	Tracking : 1/128 Microstep Slewing : 1/4
	Maxumum Slewing Speed	500x the sidereal rate (12V DC)
Telescope	Input Voltage Translation	12V DC -> 30V
Control System		ARM Cortex-M4F
TiTaN TCS	Main CBU stress	120MHz Operation ; 150DMIPS
	Main Cro spec	1024KB Flash memory System SRAM
		6KB of EEPROM
	Communication Protocol	Meade LX200 Compatible
	Object Database	NGC, IC, M, Plenet, etc. over 12,000
	OLED Color Display	1.69" Diagonal Size, 160X128 Pixels
	Tracking current sinking	12V / 0.3~0.5A
	Max speed Slewing current sinking	12V / 1.5~2A
	Wireless Control	Bluetooth Connection
	Various Port	RS232, USB, Guider port,

Have a great astronomical life with the Crux200MF. HOBYM Observatory will do our best to support the product until its lifetime.

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Horse Head Nebula / FDK250/ASI2600MMHSO/Crux200MF / Hwang, Injoon / Apr. 2024



LDN1622_20221126_FDK170_Crux200MF_Dr. SHCHANG_2560

Equipment setting reference



Crux200MF + FDK250 F4.5



Crux200MF + **SCA260 V2**

참조 웹 페이지

- → HOBYM Observatory main homepage : <u>www.hobym.net</u>
- → HOBYM Observatory Facebook Page

: https://www.facebook.com/HOBYM-Observatory-1414619488756747/

- → Crux200MF webpage : <u>https://www.hobym.net/crux200mf</u>
- → TiTaN TCS webpage : <u>https://www.hobym.net/titan-tcs</u>
- → Download Manuals: https://www.hobym.net/manual-1
- → Blog : <u>https://www.hobym.net/blog</u>
- → International Distributor : https://www.hobym.net/partner
- → Contact Info. : <u>https://www.hobym.net/contect</u>
- → Facebook User Group : <u>https://www.facebook.com/groups/193879510629347/</u>
- → Facebook Japanese User Group : <u>https://www.facebook.com/groups/165687264123804/</u>

Limited Warranty

- CRUX equatorial mounts are warranted by HOBYM Observatory(HOBYM) to be free of defects in materials and workmanship for period of 5 Years(Mechanical parts) and 3 Years (Electronical parts) from the date of original purchase. Your official HOBYM dealer or Hobym will repair or replace(period of 90 days from the date of purchase) a product or part thereof, which upon inspection by HOBYM or offical HOBYM dealer, is found defective in materials or workmanship. Provided the defective part is return to HOBYM observatory, freight-prepaid, with proof of purchase.
- This warranty is not valid in cases where the product has been damaged, dropped, abused, mishandled, subjected to temperature or weather extremes, where unauthorized repairs have been attempted or performed, connect to improper voltage supply, or where depreciation of the product is due to normal wear-andtear. HOBYM observatory specifically disclaims special, indirect, or consequential damages or lost profit which may result from a breach of this warranty.
- This warranty gives you specific legal rights, and you may have other rights which vary from country to country (US, state to state)

