# Astro-Physics Command Center (APCC) Help File

## **APCC Standard Version**

1.9.7.x

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12/2/2024

## Astro-Physics Command Center (APCC) Help File

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Very special thanks to our beta testers who found bugs, offered valuable suggestions and provided useful pointing data. We thank you for graciously offering your valuable time to assist with development.

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## 1 Welcome to APCC

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Welcome to the instruction manual and help file for the Astro-Physics Command Center (APCC). This is a working document that will be updated frequently based on user feedback. Please check the website often to obtain the most recent version. <u>Find the most recent documentation and updates here</u>

The topics in this "Welcome" section provide information about the features of APCC Standard and Proversions, version history and the license agreement. We hope you find this information useful and easy to understand.



The Astro-Physics Command Center (APCC) Main Window

### 1.1 Features

Astro-Physics Command Center (APCC) is available in two versions, APCC Standard and APCC Pro. Please review the feature list below regarding each version.

#### **APCC Standard Features**

• NEW in v1.9 - RA tracking rate correction for refraction(King Rate) has been added for APCC Standard and Pro.

- NEW in v1.9 Updated drivers for Eltima virtual COM ports include bug fixes and better support for Windows 10.
- NEW in v1.9 bug fixes for parking/unparking with counterweight up and negative altitudes.
- NEW in v1.8 Full support for GTOCP5 and Mach 2.
- NEW in v1.8 Safety Park has been improved. In addition to being able to park in place, it can park to home or any of the AP park positions.
- Full support for the GTOCP4 control box including Ethernet and WiFi connectivity.
- Support for increased precision in the GTOCP4.
- NEW in v1.7 -- Support for Encoder-equipped mounts, including configuration of encoder-based Home, and RA/Dec encoder limits.
- NEW in V1.7 -- Support for ASCOM ObservingConditions.
- NEW in V1.7 -- Improved support for operation with Sequence Generator Pro.
- NEW in V1.7 -- Meridian limits now has a merdian flip offset feature.
- All features of the latest GTOCP3 control box firmware are supported allowing feedback of the actual status of the mount at all times.
- Tight integration with the AP V2 ASCOM driver.
- Advanced support features for Mach2GTO, 3600GTO/3600GTOPE, 1600GTO and 1100GTO series mounts, including Home recovery. Editable 3D telescope view shows the current orientation of your telescope.
- 3D Viewer warns you if your celestial coordinates differ more than 5 degrees from the mechanical axis coordinates which could indicate trouble.
- Editable horizon tracking limits to stop tracking or park the mount once a horizon limit is reached.
- Editable meridian tracking limits to protect your telescope from pier collisions, and yet allow safe tracking past the meridian.
- Slew to counterweight-up positions with dynamic meridian delay feature (tied to meridian tracking limits).
- Safety slews for going into and out of counterweight-up positions. All declination movement occurs while counterweight is safely pointing down.
- Multiple virtual ports to allow easy connection of applications that do not require ASCOM support (like PulseGuide or TheSky6/X).
- Site management allows easily changeable setup for multiple sites.
- Display and change time zone settings
- Support for reading latitude/longitude/elevation from third-party GPS devices
- GoTo/ReCal on RA/Dec and Alt/Az coordinates
- Coordinate conversions for JNow <-> J2000 and Alt/Az <-> RA/Dec
- Access to backlash, reticle, focus (GTOCP3) and PEM settings (All mounts).
- Set custom RA/Dec tracking rates

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- Can save/recall multiple RA/Dec and Alt/Az slew coordinates.
- Park to editable alt/az position.

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- Available safety timer will cause the mount to park after a settable interval if a controlling computer crashes or loses COMs.
- Enables auto-park on power-down.
- Easy to read status window summarizes mount status of critical parameters.
- Logging of all commands for debugging if a problem occurs.
- Convenient log zipper function to bundle relevant log files should problems occur and you need support from AP's world-class support team!
- Can be configured to utilize a secondary serial port to prevent communication loss if a serial port to USB converter or network connection fails
- Terminal Interface tool to send commands directly to the mount.
- Includes the Horizons program for satellite, comet and asteroid tracking.
- Errant ReCal protection. Prevent outside client software from recalibrating on the wrong object
- Home and Limits for NON-Encoder mounts. Now your 400GTO, 600EGTO, Mach1GTO, 900GTO, 1200GTO or non-encoder 1100GTO, 1600GTO or 3600GTO can have Home and Limits

#### **APCC Pro Features**

- NEW in v1.9 Platesolve, Autocenter feature for APCC Pro licenses dated 1/1/2022 and later.
- NEW in v1.9 Ability to disable the prompt to confirm park.
- NEW in v1.9 APPM supports ASTAP plate solving for APCC Pro licenses dated 5/1/2020 and later.
- NEW in v1.9 APCC Pro includes Declination Arc tracking for APCC Pro licenses dated 5/1/2020 and later.
- Includes all features of the Standard version.
- Dual-model pointing and tracking rate correction even with the telescope in the counterweight-up position
- Includes a separate application to acquire Pointing/Tracking model data (APPM).
- NEW in v1.8 -- Many improvements and bug fixes to APPM.
- NEW in v1.8 -- Improvements and bug fixes that improve pointing and tracking rate accuracy.

### 1.2 Version History

Beginning with version 1.9, Astro-Physics implemented a one-year renewal subscription plan to provide an upgrade path for all licenses issued more than one year prior to the release date of new versions. Upgrading is optional. All licenses, regardless of age,

are eligible for bug fixes and minor updates as designated in the release notes below. Please refer to our website for additional information:

#### https://www.astro-physics.com/apcc

Version 1.9.7.29 - 12/02/2024 (Pro version) Version 1.9.7.28 - 12/02/2024 (Standard version)

Important: ASCOM V2 driver 5.60.17 or later is required. Uninstall prior versions of the V2 driver and APCC before upgrading from 1.9.6.x or earlier. Your license key and settings will be saved automatically.

APCC Pro and Standard - Bug Fix - Safety Park to Alt/Az position was not always working.

APCC Pro - Bug Fix - APPM would not detect ASTAP plate solve failures that had a Warning message instead of an Error message.

Version 1.9.7.27 - 11/17/24 (Pro version) Version 1.9.7.26 - 11/17/24 (Standard version)

Important: ASCOM V2 driver 5.60.17 or later is required. Uninstall prior versions of the V2 driver and APCC before upgrading from 1.9.6.x or earlier. Your license key and settings will be saved automatically.

APCC Pro and Standard - APCC now robustly checks the mount's firmware version before allowing APCC to connect.

APCC Pro and Standard - Bug Fix - Restored logic to check and match computer's Time Zone to the mount's Time Zone (provided **Keep mount time synched to PC Time** is enabled in APCC's **Advanced Settings**).

APCC Pro - Bug Fix - **Don't display images** check box on APPM's **Camera Settings** tab was not working.

Version 1.9.7.25 - 10/08/24 (Pro version) Version 1.9.7.24 - 10/08/24 (Standard version)

Important: ASCOM V2 driver 5.60.17 or later is required. Uninstall prior versions of the V2 driver and APCC before upgrading from 1.9.6.x or earlier. Your license key and settings will be saved automatically.

APCC Pro and Standard - BUG FIX - Now, when site latitude updates, the new site latitude will update in these windows if they are open: Meridian Limits, Horizon Limits, and 3D Scope.

#### Version 1.9.7.23 - 09/08/24 (Pro version)

Important: ASCOM V2 driver 5.60.17 or later is required. Uninstall prior versions of the V2 driver and APCC before upgrading from 1.9.6.x or earlier. Your license key and settings will be saved automatically.

APCC - Site names containing commas are now passed correctly to the ASCOM Driver. ASCOM driver v5.60.17 or later is required to properly decode site names with these characters.

APCC - Check for and warm the user if the AP V2 ASCOM driver is running before shutting down APCC.

APCC - Check for and turn off King rate if active.

APCC - Removed "+" from commands to shorten the length of commands sending degrees, minutes, and seconds. This was causing the set longitude command to fail as the length the command exceeded the maximum length accepted by encoder mounts using the GTOCP3 and AE box.

APCC Pro - APPM now has an extra digit of precision for Dec and RA spacing, allowing mapping points to be spaced closer together than 1 degree.

APCC Pro - APPM will no longer continue trying to use the ASCOM camera after switching to another camera type.

APCC Pro - Instead of using telescope focal length from the ASCOM driver when using the ASCOM camera type, APPM will now insert a calculated focal length into the FITS header calculated from the set image scale in APPM and camera pixel size (from the ASCOM Camera driver). This was done to make it easier to get plate-solving working.

APCC Pro - APPM will now reject plate solves that return results with RA=0 and Dec=0.

APCC Pro - APPM includes a indicator when the REST API was not created. This can happen if two instances are run at the same time. The first instance will be able to register the REST API to port 60011, but the second cannot because the port is already allocated. See the screen shot below, which shows that a tool tip with more details will show when hovering the mouse over the indicator.

🧕 Astro-Physics Point Mapper - Points: 13519 — 🗆 🔿	×
File Settings Tools Help	
Run General Information Camera Settings Plate Solve Settings Measurement Points	
Connect     Site Latitude     Environment     Latitude     Longitude     Elevation (m)       Scope:     Connect     Driver Settings     37.26     Image: State Latitude     Image: State Latitude	?
Camera: Connect ASCOM Camera V Select Temp (C) Pressure (mb) Humidity (%)	
Dome: Connect Select Dome Plate Solve Recal	
Recal near Zenith at start Skip Plate Solves (for Testing) All Sky Solve Autocenter	
✓ Precess J2000 to JNow Pause after each Slew	
Verify Pointing Model	
REST API is inactive After Complete: Measurement # Good / Bad Solves Current State	_
Start St REST API failed to register on TCP port 60011	
Start at specific Earled to listen on prefix 'http://* $60011$ /' because it conflicts with an existing registration on the machine	
Num         Time           Applications such as APCC and NINA cannot use REST to control this instance of APPM.         ure         Solve Error         F	11
	-
	_
	-
Scope: Not Connected Camera: Not Connected Dome: Not Connected Slew Rate: 900x	

Version 1.9.7.21 - 08/05/24 (Pro version)

Important: ASCOM V2 driver 5.60.14 or later is required. Uninstall prior versions of the V2 driver and APCC before upgrading from 1.9.6.x or earlier. Your license key and settings will be saved automatically.

APCC Pro - APPM - Improve Pause/Restart reliability.

APCC Pro - APPM - Slow down checks for Image Ready to once every 250 msecs. Previously they were happening as fast as possible.

APCC - Restore pointing and tracking correction states after Homing completes.

APCC - Increased QAC buffers to 256 from 128 to give APCC more time to recover from CPU resource scarcity.

APCC - Removed checking of Pointing Model terms that sometimes cause a model to be disabled.

#### Version 1.9.7.19 - 07/01/24 (Pro version)

Important: ASCOM V2 driver 5.60.14 or later is required. Uninstall prior versions of the V2 driver and APCC before upgrading from 1.9.6.x or earlier. Your license key and settings will be saved automatically.

APCC Pro - Fix Encoder status for 3600 mounts.

APCC Pro - Miscellaneous bug fixes.

#### Version 1.9.7.17 - 03/19/24 (Pro version)

Important: ASCOM V2 driver 5.60.06 or later is required. Uninstall prior versions of the V2 driver and APCC before upgrading from 1.9.6.x or earlier. Your license key and settings will be saved automatically.

APCC Pro - APPM: made improvements to settings file management and ASCOM FITS headers to prevent issues reported by users.

Version 1.9.7.15 - 03/10/24 (Pro version) Version 1.9.7.14 - 03/10/24 (Standard version)

Important: ASCOM V2 driver 5.60.06 or later is required. Uninstall prior versions of the V2 driver and APCC before upgrading from 1.9.6.x or earlier. Your license key and settings will be saved automatically.

APCC Pro - Bug Fix - APPM Pause/Restart was not working.

APCC - Bug Fix - Internal Julian Date calculation was in error for some months in some years.

APCC - Bug Fix - fixed handling of G\_S and G\_E commands from the ASCOM Driver to the GTOCP3 controller.

APCC - Behavior change: When initializing the mount, using "Don't Unpark" in the "Unpark from" setting will no longer reset to "Last Park Position" after initialization.

#### Version 1.9.7.13 - 01/20/24 (Pro version)

Important: ASCOM V2 driver 5.60.06 or later is required. Uninstall prior versions of the V2 driver and APCC before upgrading from 1.9.6.x or earlier. Your license key and settings will be saved automatically.

APCC Pro - Bug Fix - Pointing and Tracking Rate correction may be incorrectly loaded from APPM after a point mapping run.

#### Version 1.9.7.11 - 01/20/24 (Pro version)

Important: ASCOM V2 driver 5.60.06 or later is required. Uninstall prior versions of the V2 driver and APCC before upgrading from 1.9.6.x or earlier. Your license key and settings will be saved automatically.

APCC Pro - Bug Fix - Pointing and Tracking Rate correction may be incorrectly disabled at start up of APCC.

Version 1.9.7.9 - 01/08/24 (Pro version) Version 1.9.7.8 - 01/08/24 (Standard version)

Important: ASCOM V2 driver 5.60.06 or later is required. Uninstall prior versions of the V2 driver and APCC before upgrading from 1.9.6.x or earlier. Your license key and settings will be saved automatically.

APCC Pro and Standard - Bug Fix - Fixed handling of ASCOM FindHome method.

APCC Pro - Don't allow pointing or tracking rate models if RMS error exceeds 500 arc-seconds. This can be adjusted in the settings file only via this setting in Settings.apcc:

#### <PointingModel>

<MaximumAllowedRMS>500</MaximumAllowedRMS>

</PointingModel>

APCC Pro - APPM - If "Get Real-time RA/Dec" fails, get RightAscension and Declination via the slower, conventional ASCOM properties.

APCC Pro - APPM - To make it easier to notice errors APPM will show the last error or warning message.

	-			After	Complete	e:			
	Paus	e S	itop	Park		$\sim$	Progress Map		
	Star	t at specific	point		2	•			
	Num		Time	Side	CW	Hour Angl	e RA		
	1	5:14:	25 AM	East	Down	-0.20	0 12.490687		
	2	5:14:	36 AM	East	Down	-2.66	7 14.960430		
	3	5:14:	59 AM	East	Down	-4.00	0 16.300113		
	4	5:15:	14 AM	East	Down	-2.66	7 14.970949		
	5	5:15:	38 AM	East	Down	-1.33	3 13.644279		
		5:16:	27 AM	East	Down	0.00	0 12.324549		
		5:16:	42 AM	East	Down	-4.00	0 16.328795		
	~								
	Last error: Point 6 - Warning, remaining image dimensions too low!								
Sco	ope: C	onnected	Ca	mera:	NASA	SkyView (In	ternet) Do		

#### Version 1.9.7.7 - 12/12/23 (Pro version) Version 1.9.7.6 - 12/12/23 (Standard version)

# Important: ASCOM V2 driver 5.60.06 or later is required. Uninstall prior versions of the V2 driver and APCC before upgrading from 1.9.6.x or earlier. Your license key and settings will be saved automatically.

APCC Pro - APPM enhancements:

- \* Added an image-scale calculator. It is available in the Common Settings group box on the Plate Solve Settings tab.
- \* If ASCOM camera image data fits in a 16-bit range, APPM will now save ASCOM FITS files in 16-bit integer format, otherwise it saves in the original format (32-bit integer values).
- \* When using ASCOM Camera option the following keywords are now included in the FITS header file:

**RA** and **OBJCTRA** - Set to the decimal Right Ascension value last retrieved from the AP V2 ASCOM Driver.

**DEC** and **OBJCTDEC** - Set to the decimal Declination value last retrieved from the AP V2 ASCOM Driver.

**FOCALLEN** - Set to the telescope focal length in mm last retrieved from the AP V2 ASCOM driver. This value can be set using the AP V2 Driver ASCOM Setup window.

**APPMVER** - Set to the APPM Version.

**ASCOMCAM** - When an ASCOM camera is used this is set to the name of the ASCOM Camera driver name.

\* The **SWCREATE** keyword now is set to "Astro-Physics APPM" instead of "ASCOM Camera Test".

APCC Pro and Standard - Updated to check for P02-16 firmware and display to the user. <u>See this</u> section for more details.

APCC Pro and Standard - Fixed firmware check in trial dialog window.

#### Version 1.9.7.5 - 11/18/23 (Pro version) Version 1.9.7.4 - 11/18/23 (Standard version)

Important: ASCOM V2 driver 5.60.06 or later is required. Uninstall prior versions of the V2 driver and APCC before upgrading from 1.9.6.x or earlier. Your license key and settings will be saved automatically.

APCC Pro and Standard - Fixed north/south radio button when getting site coordinates from mount in Manage Sites.

APCC Pro - Updated ASCOM camera's file save orientation in APPM. Although this did not affect platesolved position APPM was saving the image's long-edge vertically instead of horizontally

APCC Pro - Updated APPM to correctly read and append fits headers as needed, avoid unreadable fits files sent to plate solver

APCC Pro - Updated APPM to cut the size of ASCOM FITS files by saving image data as 16-bit instead of 32-bit data. The FITS files are now 1/2 the size, which improves the speed of ASCOM camera writes to disk and plate-solver reads of these images.

APCC Standard - Safety Monitor changes - added option to only log changes and errors to cut down on log writes. Also, three communications errors in a row are required before UnSafe is set to prevent shutdowns from transient conditions. NOTE: This feature is already available in APCC Pro since v1.9.7.3.

#### Version 1.9.7.3 - 10/05/23 (Pro version)

# Important: ASCOM V2 driver 5.60.06 or later is required. Uninstall prior versions of the V2 driver and APCC before upgrading from 1.9.6.x or earlier. Your license key and settings will be saved automatically.

APCC Pro - Removed comments written to FITS headers as a temporary solution to FITS file corruption. .

APCC - Safety Monitor changes - added option to only log changes and errors to cut down on log writes. Also, three communications errors in a row are required before UnSafe is set to prevent shutdowns from transient conditions.

APCC Pro - added new command to enable/disable Dec Arc Tracking (requires license dated to enable Dec Arc tracking).

Version 1.9.7.1 - 09/24/23 (Pro version)

Version 1.9.7.0 - 09/24/23 (Standard version)

Important: ASCOM V2 driver 5.60.06 or later is required. Uninstall prior versions of the V2 driver and APCC before upgrading to the new versions. Your license key and settings will be saved automatically.

APCC - If a temperature below -100C is passed from an ASCOM Observing Conditions driver, APCC will fall back to the user setable temperature control on the Pointing Model tab.

APCC - Added support for driver getting site settings from APCC (AP V2 ASCOM driver 5.60.06 or later is required).

APCC - Allow processing of additional GPS message types. Supported messages: \$GPGGA, \$GNGGA, \$GLGGA, and \$GAGGA

APCC Pro - APPM has a new option to not display ASCOM images, which will speed mapping runs.

## The following new features are only available with APCC licenses or renewals dated 09-01-2022 (Sept. 1, 2022) or later:

APCC - ASCOM Safety Monitor support. An action (Park, Home, stop tracking, or Warn) can be configured when an ASCOM Safety Monitor indicates outdoor conditions are unsafe (e.g. rain, wind, etc.)..

APCC Pro - Points near the zenith can be excluded in APPM with the new Max Altitude settings.

APCC Pro - Atlas sky database in DC Dreams PinPoint 7.

#### Version 1.9.6.7 - 02/03/23 (Pro version)

Version 1.9.6.6 - 02/03/23 (Standard version)

Important: ASCOM V2 driver 5.60.04 or later is required. Uninstall prior versions of the V2 driver and APCC before upgrading to the new versions. Your license key and settings will be saved automatically.

APCC - Query mount status immediately after a park operation completes to update park status and satisfy NINA and ASCOM desired behaviors.

Version 1.9.6.5 - 01/23/23 (Pro version) Version 1.9.6.4 - (Standard version)

Important: ASCOM V2 driver 5.60.03 or later is required. Uninstall prior versions of the V2 driver and APCC before upgrading to the new versions. Your license key and settings will be saved automatically.

APCC - Keep slewiing status active during entire park operations to satisfy NINA and ASCOM desired behaviors.

APCC - Keep polling once a second for mount latitude/longitude until the mount responds.

APCC - Save and restore the View South checkbox between APCC runs.

APCC Pro - Restrict range of Dec Arc Tracking to within min and max declination.

Version 1.9.6.3 - 01/05/23 (Pro version) Version 1.9.6.2 - (Standard version) Important: ASCOM V2 driver 5.60.02 or later is required. Uninstall prior versions of the V2 driver and APCC before upgrading to the new versions. Your license key and settings will be saved automatically.

APCC - Improved handling of ASCOM SetPark command.

Version 1.9.6.1 - 01/02/23 (Pro version) Version 1.9.6.0 - (Standard version)

Important: ASCOM V2 driver 5.60.01 or later is required. Uninstall prior versions of the V2 driver and APCC before upgrading to the new versions. Your license key and settings will be saved automatically.

APCC - Minor user interface changes.

APCC - APCC now controls park and unpark positions.

APCC Pro - renamed *recenter* to *autocenter* in APPM.

Horizons - Fixed tracking rates in the "Test Tracking" mode.

#### Version 1.9.5.45 - 12/09/2022 (Beta - Pro version)

APCC - Fixed auto-shutdown when the ASCOM driver uses the REST API.

#### Version 1.9.5.43 - 12/07/2022 (Beta - Pro version)

APCC - Changed button and menu naming for the button that plate solves and recenters.

#### Version 1.9.5.41 - 11/21/2022 (Beta - Pro version)

APCC - Changed units for sidereal rate value from sec/hr to sidereal.

APCC - Fixed auto-shutdown when the driver is using REST to communicate with APCC. It activates the shutdown countdown when the driver disappears from Windows process list.

#### Version 1.9.5.39 - 11/18/2022 (Beta - Pro version)

APCC - Changed how APCC gets the driver mode (REST or Virtual Ports).

#### Version 1.9.5.37 - 11/16/2022 (Beta - Pro version)

APCC Pro - Changed button name to "Plate Solve, Recal, and Center".

APCC - Fixed mount Auto-connect checkbox.

APCC - Fixed Dec encoder message not popping up.

APCC - Show "Dec Arc" instead of "Rate Corr" in the tracking correction status label when the Dec Arc Tracking algorithm is being used.

#### Version 1.9.5.35 - 11/12/2022 (Beta - Pro version)

APCC - Limited Virtual COM port maximum to COM99.

APCC - Fixed the refresh of controls when APCC is resized.

APCC Pro - fixed a typo in APPM message.

APCC Pro - added button to Move group box to launch APPM, plate solve, and recenter.

#### Version 1.9.5.33 - 11/06/2022 (Beta - Pro version)

APCC - Updated default values for controls.

APCC Pro - Changed wording of PNT files to "Active Point Map".

APCC Pro - Changed wording when prompting user to load a map at the end of a mapping run.

#### Version 1.9.5.31 - 10/31/2022 (Beta - Pro version)

APCC - Restricted guide rates to 1.00x.

APCC - Removed Exhaustive Port Search in Advanced settings.

APCC - Removed the search for network mounts and refresh com port list buttons. Added new "Find Mount" button that can search for the mount. Also, "Connect" mount will auto-find the mount if "None" is selected.

#### Version 1.9.5.29 - 10/15/2022 (Beta - Pro version)

APCC Pro - AE Homing can be canceled by clicking the homing status window:

📕 Astro-Physic	s Comma	nd Center P	ro					
File Settings	Tools	Help						
	AE Action	s]	?				AE Status & Inf	• <b>•</b>
CANCE	EL HOM	1E		Home Status:		Ho HA -10	me Coordinates <b>)Oh 00m 00.0s</b>	C
Configure Home	Enc	oder Correction	]	Encoder Status:	DISABLED	Dec -	100° 00' 00"	D Tir
Configure RA Limits		RA Limits OFF	]	RA Limits:	DISABLED	н	ome Position	
Configure Dec Limits Setup Site	Park Ho	Dec Limits OFF ming/Limits		Ho Ho	ome RA Dista ome Dec Dista	nce: +80 ance: +95	)° 14' 31.2" 5° 44' 37.6"	Di
Conne Serial/USB	Connection: Serial/USB Click this window to CANCEL HOMING							h

#### Version 1.9.5.27 - 10/09/2022 (Beta - Pro version)

APCC Pro - Fixed reversed buttons when canceling the Home operation.

APCC Pro - the APPM Test Solve folder window now allows copy/paste of its entire table.

APCC Pro - Fixed the issue when NINA connect failed, which allowed a user to continue a mapping run with NINA not connected.

APCC - Keep the "Park" button enabled even when the mount is parked. This will allow the user to park to another position without having to unpark first.

APCC - Added a new feature to disable the prompt to confirm park, **available only with licenses after the date specified at the time this feature is released.** 



#### Version 1.9.5.25 - 09/30/2022 (Beta - Pro version)

APCC Pro - Fixed missing help link for AE tab.

APCC - Updated commands sent to reconfigure the AP V2 ASCOM driver.

#### Version 1.9.5.23 - 09/18/2022 (Beta - Pro version)

APCC Pro - Changed Tools menu option to say "Recal" instead of "Sync". It now says "APPM Plate Solve, Recal, and Recenter...".

APCC Pro - APPM shows a checkbox for RECAL (instead of the two buttons) even if the user does not have a subscription which includes the Recenter checkbox.

APCC - Warns the user if there is a version earlier than ASCOM Platform 6.6SP1 installed.

#### Version 1.9.5.21 - 09/11/2022 (Beta - Pro version)

APCC Pro - Changed Tools menu option to say "Recal" instead of "Sync". It now says "APPM Plate Solve, Recal, and Recenter...".

APCC Pro - New Feature - Removed buttons for "Plate Solve and Recal". Added checkboxes for "Recal" and "Recenter", available only with licenses after the date specified at the time this feature is released.

APCC Pro - Ignore command line settings file if the file is already loaded.

APCC - Fixed Status window's combo box for button rates to match APCC's those in main main.

#### Version 1.9.5.19 - 09/05/2022 (Beta - Pro version)

APCC - Added the DefaultSettings.apcc file, tested and fixed a few issues.

APCC - Removed GuideRate from status bar.

APCC - Added units to RA and Dec tracking rates in the status bar of the main window.

Mount		AP V2 Driver	255x 🔽			Ð	ALT	+37° 1	5' 41.4"
Auto-Conne	ect		Auto-fix N/S/EW Movements	Clour Pate 650v	SLEW S		AZ	+00° 00	)' 01.3"
Discourse			Swap E/W	Siew Rate 050X	3D View	N		PointCorr	Rate Corr
Disconn	ect	Config <u>D</u> river	Swap N/S	<u>r</u> ier riip		PEM	_ [	Horizon	Meridian
COM4	None	REST API	~	Comm Ev	Status Window	To Tra	acking	<u>E</u> MERG	ENCY STOP
Unparked (A	P) Tr	acking = Sidereal	PEM = Enabled	RA = 0 (arc-sec/hr)	DEC = 0 (arc-sec	/hr)			.;

APCC - Fixed RA and Dec tracking rates displayed in the Status window.

APCC - Fixed - APCC did not connect to the mount with Mount Auto-connect disabled when APCC was started by the ASCOM driver.

APCC - Added new check box to clear all previous errors when APCC starts, or is connected to the mount.



#### Version 1.9.5.17 - 08/28/2022 (Beta - Pro version)

APCC - The **Metric** check box in the **Manage Sites** window, which is used to select Meters and Celsius scales (or Feet and Fahrenheit) is now linked with the **Meters** check box on the **Site** tab. Changing one will change the other. Note that now you cannot display Meters and Fahrenheit values simultaneously. That is you can select Meters and Celsius -or- Feet and Fahrenheit scales.

APCC - RA and Dec Encoder warnings are shown only once after three consecutive warnings, and will not show again unless disconnected and reconnected to the mount.Warnings are still written to the log file.

APCC - The Rate Units selected on APCC's Rate Settings tab will now be used in APCC's status bar.



APCC Pro - The displayed RA rate units is now Arc-sec/hour in the **Tracking Correction Status** group box on the **Pointing Model** tab. Hovering the mouse over the box will show the old value (Sec/hour).

Operat Enable Pointing Enable Trackin	on ( g Correction g Correction	Pointing Correction RA 01m 36.31s Dec -11' 58.2"	Status ?
	Temp (C)	Tracking Correction	Status
<u>M</u> odel	10.0 🚖	RA 54.36	Arc-sec/ hour
<u>A</u> PPM	Pressure (mbar) 1010 🚔	Dec -11.5	Arc-sec/ hour
Correct for Ref	raction	🗹 Enable Dec Arc Tr	acking

APCC - In the **ASCOM Driver** tab of **Advanced Settings**, there is a new control to specify the minimum virtual port number that APCC will use. The default is 30, which means the lowest COM port APCC will use for a virtual port is COM30.



APCC Pro - APCC will now Plate Solve, Sync (Recal), and Recenter the scope using this menu item in the **Tools** menu:

Astro-Physics Command Center Pro							
File Settings	File Settings Tools Help						
Progra	Terminal Interface						
	Log Window						
🔲 Ask if OK To e	Error Log Window						
🔲 Keep APCC o	Onen European Instance In Lean Directory						
Show Emerge	open explorer instance in Logs Directory						
	Log Zipper						
	Launch APPM						
Log File							
Adv							
Se APPM Plate Solve, Sync, and Recenter							

#### Version 1.9.5.15 - 08/26/2022 (Beta - Pro version)

APCC - Slew rate list is remembered when restarted, even when the mount is not connected.

APCC - The "Refresh Ports" button now tests each COM port for a mount and will select the COM port if found.

#### Version 1.9.5.13 - 08/19/2022 (Beta - Pro version)

APCC - Fixed slew rates shown for the 3600GTO when GTOCP4 P02-15 or later firmware is in use.

#### Version 1.9.5.11 - 08/14/2022 (Beta - Pro version)

APCC - Removed button to connect to the ASCOM driver and checkbox option to Auto-Connect the driver, which is no longer supported. The "Now" button is now larger and is renamed to **Config Driver**.

Mount Auto-Connect	AP V2 Driver
<u>D</u> isconnect	Config <u>D</u> river

APCC - Installer defaults to use REST API for new users. This will not install Eltima Virtual Ports unless the user selects the option to do so.

APCC - Detects when the Eltima Virtual Ports are not installed or not working, and switches the driver to use REST API if not already selected. Also, the **Eltima Virtual Ports** option will be disabled in the **ASCOM** tab in the **Advanced Settings** window:

APCC Advanced Settings	_		×
Advanced Settings			
Driver to APCC Connection			0
Eltima Virtual Ports (Eltima is not installed)			
© REST API			
REST TCP Port Number			
NOTE: Changes in this groupbox will require an APCC rest	tart to take	effect.	
<u>O</u> K <u>C</u> ancel			

Version 1.9.5.9 - 08/08/2022 (Version Skipped)

#### Version 1.9.5.7 - 08/08/2022 (Beta - Pro version)

APCC - The installer now gives the option to not install the Eltima Virtual Ports.

APCC - Modified to work when the Eltima Virtual ports are not installed.

APCC - When the driver and APCC are mis-configured, the "Now" button in the **AP V2 Driver** group box will be red. It will turn back to blue after clicking the button and the driver is reconfigured. This should not be done when the user does not want to use APCC (i.e. driver to the mount).

APPM - Add additional information to FITS header, including when an image has been dark-subtracted.

APPM - Bug fix - values that "wrap" when dark subtracted are now handled properly.

Horizons - Change NASA Horizons link to use https instead of http.

#### Version 1.9.5.5 - 06/27/2022 (Beta - Pro version)

APCC Pro - On the **Pointing Model** tab, moved **Correct for Refraction** check box to the **Operation** group box.

APCC Pro - On the **Pointing Model** tab, removed check boxes and pointing terms and replaced with scatter plots of East and West pointing models.

APCC - In **Advanced Settings**, the **Reset All Defaults** button now resets the settings using the values in file c:\ProgramData\Astro-Physics\APCC\DefaultSettings.apcc. Settings not in DefaultSettings.apcc are not changes in the user's settings files.

APCC - Fixed - The Auto-Connect check box in the Mount group box was not functioning.

APCC Pro - APPM - Increased NASA Sky View image size from 1600x1200 to 2400x1600 to include more stars for plate solving.

APCC Pro - APPM - When performing a **Plate Solve Now** or **Plate Solve and Recal Now**, added a check box allowing the user to set the camera image scale from the plate solve results.

#### Version 1.9.5.3 - 06/12/2022 (Beta - Pro version)

APCC - Removed "Third Party Applications" tab in Advanced Settings.

- APCC Added "Purge Logs" option in Advanced Settings.
- APCC Added "Reset All Defaults" button in Advanced Settings.
- APCC Removed "Windows Priority" combo box in Advanced Settings.
- APCC Changed default to unchecked for "Clear Meridian Delay" check boxes in the GoTo/Recal tab.
- APCC Added "Set Constant Limit" to Meridian Limits Explorer window.
- APCC Removed "Stop Tracking after unparking" check box from the Park tab.
- APCC Counterweight-up parks are now allowed.

#### Version 1.9.5.1 - 05/02/2022 (Beta - Pro version)

APCC - Removed "Create Virtual Ports First" check box in the Mount connection group box.

APCC - Removed AP V2 Driver group box's "Auto-Config" check box.

APCC - Change Advanced setting tab's name from "API" to "ASCOM Driver".

APCC - In Advanced settings "ASCOM Driver" tab, change to use radio buttons select "Eltima Virtual Ports" or "REST API". When 'REST API' is selected, the Virtual Port tab and four status boxes at the bottom of APCC are removed and "REST API" shows in the status bar.

APCC - Added "Fixed Limit" check box and horizon Altitude settings in APCC's Horizons tab.

#### Version 1.9.4.3 - 02/27/2022 (Release - Pro version)

Version 1.9.4.2 - 02/27/2022 (Release - Standard version)

APCC Pro and Standard - Fixed connect to AP V2 driver from APCC.

APCC Pro and Standard - Allow upper or lower case "M" for units (meters) from MGBoxV2 ASCOM drivers.

#### NOTE: AP V2 ASCOM Driver version 5.50.02 or later is required for proper operation.

#### Version 1.9.4.1 - 02/15/2022 (BETA - Pro version)

APCC Pro - for APCC's GPS tab, added internal check for new MGBoxV2 ASCOM server. Of found it will be used instead of the older driver.

APCC Pro - added REST API command that allows external applications, such as the ASCOM driver, to send native mount commands and receive responses. This is an alternative to using APCC's Virtual Ports for communication.

AP V2 Driver ASCOM Setup ×						
	A A	<mark>stro-P</mark> h scoм v2 <sup>-</sup>	<b>iy</b> : Tel	sics ( escope	GTO Driver	<b>Mount</b> - v5.50.00
	juratio	n	1	ſ <sup>Site Setu</sup>	р	
Mount Type:	1100 (	GTO 🔻		New	Save	Cancel Delete
Controller:	GTO (	:P4 🔻		<u>R</u> efresh Sites	Current New Si	Site: ite
IP Address D	etails -	CC REST API	2	Latitude:		37 00 00.0
IP Address:	127.0.	0.1:60001		Longitude:	w –	121 00 00.0
Timeout:	1000	•		(meters):	100	
Retry Count:	0	-		Get Latit	tude/Lon	gitude from Mount
	Check Port					
Default Park/U	– Default Park/Unpark Positions —- 🔝					
Unpark From: Last Parked 👻				Aperture (mm): 105		
Park To:	nt Position 📃 💌		Focal Le	ength (mn	n): 670	
<u>?</u>	(	<u>C</u> ancel	ł	Reset to De	faults	Advanced >>>>>>

To setup the ASCOM Driver (version 5.50.00 or later is required):

#### Version 1.9.3.3 - 01/20/2022 (Release - Pro version)

APCC Pro - Fixed bug in APPM Trial mode that prevented use of ASTAP.

APCC Pro - Fixed bad pointing and tracking rate correction when the model's PNT file was missing.

#### Version 1.9.3.1 - 12/26/2021 (Release - Pro version)

#### Version 1.9.3.0 - 12/26/2021 (Release - Standard version)

APCC - Eltima V10 is incompatible with Windows 7, so the installer will install Eltima V9 for Windows 7. APCC Pro - fixed a bug in the ASCOM camera view window.

#### Version 1.9.2.5 - 11/28/2021 (Beta - Pro version)

#### Version 1.9.2.4 - 11/28/2021 (Beta - Standard version)

APCC - Fixed - Horizons now accepts JPL NASA ephemeris files with refraction model set to "standard atmospheric model".

APCC Pro - Updated MappingRun/Status REST API to use numeric instead of text values for certain properties.

#### Version 1.9.2.3 - 11/18/2021 (Beta - Pro version)

APCC Pro - APPM - Added new REST API commands to close APPM from an external application.

#### Version 1.9.2.1 - 11/13/2021 (Beta - Pro version)

APCC Pro - Upgraded Eltima Virtual Serial Ports ActiveX to version 10.

APCC Pro - APPM - Added new REST API commands to start, stop, and get status of APPM mapping runs.

#### Version 1.9.2.0 - 11/13/2021 (Beta - Standard version)

APCC Standard - Upgraded Eltima Virtual Serial Ports ActiveX to version 10.

#### Version 1.9.1.5 - 11/9/2021 (Beta - Pro version)

APCC Pro - Fixed - APPM - The -M option was not parsing some values to double precision floating point.

APCC Pro - APPM - Added new REST API commands to get/set **Measurement Points** tab values.

APCC Pro - fix potential issue with Error Log window not showing when APCC is minimized.

#### Version 1.9.1.3 - 10/23/2021 (Beta - Pro version)

APCC Pro - Fixed - APPM - Binned full-frame images passed the wrong width and height to the ASCOM Camera driver.

APCC Pro - Fixed - When opened, the 3D Viewer no longer prompts Mach2 scopes with warning dialog boxes.

#### Version 1.9.1.1 - 10/18/2021 (Beta - Pro version)

#### Version 1.9.1.0 - 10/18/2021 (Beta - Standard version)

APCC Standard / Pro - The NASA Horizons website has been revamped so copying/pasting the website data no longer works. Horizons now accepts an ephemeris file downloaded from the new NASA Horizons web site.

APCC Standard / Pro - Report encoder error only if three or more read errors occur in a row.

APCC Standard / Pro - Provide additional time offset for meridian flip point for Sequence Generator Pro users.

APCC Pro - Any calculated pointing term that exceeds a predetermined maximum value is set to 0 to prevent huge over-corrections when using the all-sky pointing models.

APCC Pro - The 3D View now follows the Mach 2 position even when declutched.

APCC Pro - APPM - Add new command line switch (-M) to accept configuration on the Measurement Points tab.

The following change requires a license dated August 1, 2020 or later:

APCC Pro - APPM - Add check box to ASTAP plate solve configuration to use FITS header for RA, Dec, and image scale.

#### Version 1.9.0.13 - 09/26/2021 (Beta - Pro version)

APCC - Log user double-clicks to status bar.

The following changes require a license dated August 1, 2020 or later:

APCC Pro - Further improve performance of Real-time RA/Dec.

#### Version 1.9.0.11 - 09/23/2021 (Release - Pro version)

The following change require a license dated August 1, 2020 or later:

APCC Pro - Fixed - remove extra character in Real-time RADec response before converting RA to a decimal value.

#### Version 1.9.0.9 - 09/19/2021 (Release - Pro version)

APCC Pro - Fixed - Updated ServiceStack license to latest.

The following changes require a license dated August 1, 2020 or later:

APCC Pro - Improved Real-time RA/Dec response time.

APCC Pro - APPM now uses the Real-time RA/Dec feature, improving slew settling times.

#### Version 1.9.0.7 - 09/14/2021 (Release - Pro version)

APCC Pro - Fixed - Menu item **Tools->APPM Plate Solve and Sync** did not work. Also, if an error occurred, error messages were not being sent back to APCC from APPM.

APCC Pro - Fixed - External RA and Dec Tracking rates from ASCOM driver were sometimes added to the tracking rate with the wrong sign.

#### Version 1.9.0.5 - 09/05/2021 (Release - Pro version)

#### Version 1.9.0.4 - 09/05/2021 (Release - Standard version)

APCC - Fixed - APCC did not send meridian limit value to Sequence Generator Pro.

APCC - Fixed - backup COM port value did not save when set to "None".

APCC - Fixed - trial license did not enable latest subscription features.

APCC Pro - Fixed - MoveAxis commands were disabled when Dec >= 80 or Dec <= -80 degrees.

APCC Pro - Fixed - Dec-Arc check box did not save.

APCC Pro - Fixed - APPM did not allow non-standard spaces in OBJCTRA and OBJCTDEC FITS header keyword values.

APCC Pro - Fixed - ASTAP results in APPM did not work with FITS files with extensions other than ".FIT".

#### Version 1.9.0.3 - 08/19/2021 (Beta - Pro version)

APCC Pro - Add log file output to track command queue entries.

#### Version 1.9.0.1 - 08/01/2021 (Release - Pro version)

#### Version 1.9.0.0 - 08/01/2021 (Release - Standard version)

#### New Features - requires license dated August 1, 2020 or later

APCC Pro - Declination-Arc tracking algorithm. This new algorithm is an alternative to the normal all sky tracking model that APCC Pro uses.

APCC Pro - APPM can use ASTAP for plate-solving.

APCC Pro - APPM can use NINA for camera control.

APCC Pro - For third-party satellite trackers, real-time RA/Dec can be returned using the :GRGD# command.

#### Updates and Bug Fixes for all Licenses

APCC Pro - Added command line option to APPM to use a startup settings file.

APCC - Updated to Eltima V9.0 Drivers. Changes/fixes to the Eltima drivers include:

- Added: Windows Server 2016 support.
- Added: full Windows 10 support.

- Improved: displaying a more detailed information about the virtual serial ports in Windows Device Manager.
- Improved: drivers are digitally signed with WHQL.
- Fixed: displaying of the newly created virtual ports in the device manager.
- Fixed: timeouts processing during the read operation.

APCC - Added King rate as a new tracking rate (requires GTOCP4/CP5).

APCC - Meridian limits tab includes a title of the last meridian limits file saved or loaded.

APCC - BUG FIX - ComponentOne License dialog was coming up on a Horizons tracking graph window.

APCC - BUG FIX - When parking to a location "under" the celestial pole, APCC was setting an incorrect meridian delay, causing the mount to slew the wrong way.

APCC - BUG FIX - APCC was removing "X/Y/Z" characters from the response to :GOS# command.

#### Version 1.8.8.17 - 01/22/2021 (Release - Pro version only)

APCC Pro - Handle race condition between Horizon/Meridian Limits stop tracking and updating the modeled tracking rate.

#### Version 1.8.8.15 - 01/15/2021 (Release - Pro version)

#### Version 1.8.8.14 - 01/16/2021 (Release - Standard version)

APCC - Use an alternative method to perform "check for updates".

APCC - WiFi Mac address now displays correctly in Find GTOCP4/5.

#### Version 1.8.8.15 - 01/15/2021 (Release - Pro version only)

APCC Pro - Try alternative method to perform "check for updates".

APCC Pro - WiFi Mac address now displays correctly in Find GTOCP4/5.

#### Version 1.8.8.13 - 01/03/2021 (Release - Pro version only)

APCC Pro - Change default settings for check box options.

APCC Pro - Latitude and Longitude now display with N/S and E/W symbols, respectively, instead of positive/negative values.

#### Version 1.8.8.11 - 12/26/2020 (Release - Pro version only)

APCC Pro - Bug Fix - Fix the slow start up issue.

#### Version 1.8.8.9 - 12/19/2020 (Release - Pro version only)

APCC Pro - Bug Fix - Fix licensing issue with chart component.

#### Version 1.8.8.5 - 12/12/2020 (Release - Pro version only)

APCC Pro - Bug Fix - RA and Dec values in APPM log files sometimes had incorrect HH:MM:SS, and DD:MM:SS values, respectively.

#### Version 1.8.8.3 - 11/10/2020 (Release - Pro version only)

APCC Pro - Bug Fix - APPM was opening a new window for every ASCOM camera operation.

#### Version 1.8.8.1 - 11/08/2020 (Release - Pro version)

#### Version 1.8.8.0 - 11/08/2020 (Release - Standard version)

APCC - Bug Fix - APCC was not parking the Mach2 correctly to Home position.

APCC - Bug Fix - When comparing mount time to computer time, Date/Time was not always initialized properly, thus incorrectly reporting mount time was more than 2 seconds from computer time.

APCC - Bug Fix - Under certain conditions it was possible to set the meridian inclination value out of the valid range of 0-180 degrees. This resulted in an application exception.

APCC - Bug Fix - The command ":m#" was being sent to firmware versions that don't recognize this command. This command now is sent only to mounts with firmware P02-05 and later.

APCC - Internal mount limits are now disabled for mounts with P02-05 and later firmware.

APCC - Add new commands to set Virtual Port output RA and Dec precision from external applications.

APCC - now displays "Connected" in the pop-up window, which then will close more quickly than previous versions.

APCC Pro - APPM - Add up to 15 second delay above settle time if mount is not at the target coordinates when collecting data points for a model.

#### Version 1.8.7.0/1 - 10/04/2020 (Release - Standard/Pro versions)

APCC - Bug Fix - APCC was erroneously sending a command that is unrecognized by firmware versions before P02-05.

#### Version 1.8.6.0/1 - 08/24/2020 (Release - Standard/Pro versions)

APCC - Re-initialize encoder ranges when RA or Dec Encoder limits are enabled.

#### Version 1.8.5.1 - 08/23/2020 (Release - Pro version only)

APCC Pro - For Mach 2 and other encoder equipped mounts, turn off mount's internal RA and Dec limits.

APCC Pro - Initialize Encoder Limits every time APCC connects to the mount.

#### Version 1.8.4.1 - 07/26/2020 (Release - Pro version only)

APCC - BUG Fix - On the **Goto/Recal** tab declination values greater than 90 degrees could be entered under the right circumstances.

APCC Pro - BUG Fix - Point counts on the top of the Pointing Model tab were not getting set.

APPM - Improvement - Manually add DATE-OBS keyword to ASCOM FITS images.

#### Version 1.8.3.0/.1 - 05/31/2020 (Release - Standard/Pro versions)

APCC - BUG Fix - Because of a rare race condition a Meridian flip might not occur when it should have.

APCC - BUG Fix - Turning off Slews within West Meridian limits did not reset the meridian delay.

APCC Pro - BUG Fix - APPM Camera errors were sometimes ignored.

#### Version 1.8.2.0/.1 - 05/25/2020 (Release - Standard/Pro versions)

APCC - BUG Fix - Tracking rates were not working correctly for the GTOCP3 in 1.8.1.1.

APCC - BUG FIX - Prevent Mach 2 from setting HOME to be anything other than Park 3.

APCC - BUG FIX - The ASCOM driver can send values in exponential notation when the value is near zero. APCC was rejecting this exponential notation.

APCC - BUG Fix - Commands starting with "G\_" were rejected.

APCC - BUG Fix - Clear flashing scope view when user clears all errors.

APCC - BUG FIX - Settings were not always being correctly saved.

APCC - BUG Fix - Prevent possible overflow in Meridian Limits Add Point dialog.

APCC - BUG FIX - Horizons - some of the menus did nothing.

APCC - BUG FIX - Horizons - Fixed a number of display bugs and made the displayed data more useful.

APCC - BUG Fix - fixed an integer overflow error that would happen occasionally.

APCC Pro - BUG FIX - APPM - Slew would sometimes fail to appear to complete thus stalling data mapping runs.

APCC Pro - BUG Fix - tracking rate correction was not always saved correctly.

APCC - Improvement - Moved virtual port handlers to their own threads to reduce latency when user interface elements are updated.

APCC - Improvement - In the Meridian Tracking Limits Explorer dialog window, add a button to update Meridian Inclination.

#### Version 1.8.1.0/.1 - 04/07/2020 (Release - Standard/Pro versions)

APCC - Warn user if CP4 firmware is older than VCP4-P01-13.

APCC - BUG FIX - Horizon Limit could sometimes use excessive CPU cycles.
APCC - BUG FIX - 1600 mounts with GTOCP3 and encoders would not display the AE tab.
APCC Pro - BUG FIX - ASCOM RA tracking rates were inverted.
APCC Pro - BUG FIX - Fixed math sign for all user interface RA and Dec rate values.
APCC Pro - Improved precision of tracking rates.

#### Version 1.8.0.8/.9 - 03/07/2020 (Release - Standard/Pro versions)

APCC - BUG FIX - Fix meridian limit flip offset value.

APCC - BUG FIX - Not all centering rates were available for earlier versions of firmware.

APCC - BUG FIX - Pressing Control-Key on start did not override saved window positions.

APCC - BUG FIX - The "Use numerical IP address" checkbox in the Find GTOCP4/GTOCP5 window was not saved/restored.

#### Version 1.8.0.7- 03/07/2020 (Beta - Pro version)

APCC Pro - Allow APPM to use camera binnings other than 1x with SGPro.

#### Version 1.8.0.4/.5 - 03/07/2020 (Release - Standard/Pro versions)

- APCC BUG FIX AE tab values are not populated or updated.
- APCC BUG FIX Custom slew rate option was missing in Rates tab and Initialization windows.
- APCC Restored Encoder Trim controls to ELS tab.
- APCC Disable Encoder enable/disable switch for Mach 2/GTOCP5.

#### Version 1.8.0.2/.3 - 02/29/2020 (Release - Standard/Pro versions)

- APCC BUG FIX clicking AE tab can cause it to switch to ELS tab.
- APCC Limit Safety Park position option if the control box does not have the appropriate firmware.
- APCC Updated documentation for APPM and Virtual Port and Park tabs.

#### Version 1.8.0.0/.1 - 02/27/2020 (Release - Standard/Pro versions)

- APCC Added support for GTOCP5 and Mach 2.
- APCC Added Safety park to park positions.
- APCC Allow custom Alt/Az parks to negative altitudes and to counterweight up positions.
- APCC Fix various slew and park issues.
- APCC Pro Fix issues with plate solving NASA SkyView camera type.

APCC Pro - In APPM improve information presented when manual plate solving andplate solve+RECAL.

APCC Pro - Made improvements to APPM user interface.

#### Version 1.7.1.4/.5 - 11/29/2019 (Release - Standard/Pro versions)

APCC - BUG FIX - Mount flip does not complete when meridian limit is reached and flip mount is the selected action.

#### Version 1.7.1.3 - 09/29/2019 (Release - Pro version)

APCC Pro - BUG FIX - Upgrade from Standard license was not working.

APCC Pro - BUG FIX - Refraction checkbox option was not saved.

APCC Pro - BUG Fix - Final correction slew might not appear to complete if a response from the mount is not received.

APCC Pro - miscellaneous bug fixes and improvements.

#### Version 1.7.1.2 - 09/29/2019 (Release - Standard version)

APCC Standard - miscellaneous bug fixes and improvements.

#### Version 1.7.1.1 - 03/14/2019 (Release - Pro version)

#### Version 1.7.1.0 - 03/14/2019 (Release - Standard version)

Relabeled 1.7.0.28/29 to released status!

#### Version 1.7.0.29 - 03/07/2019 (Beta Release - Pro version)

#### Version 1.7.0.28 - 03/07/2019 (Beta Release - Standard version)

APCC Pro and Standard - Added Camera rotation parameter to 3D Telescope Editor.

APCC Pro - A couple buttons in the Pointing model window were shifting position after the window opened.

APCC Pro - Tracking rate correction commands were being overridden by a command from the ASCOM driver.

#### Version 1.7.0.27 - 02/22/2019 (Beta Release - Pro version)

#### Version 1.7.0.26 - 02/22/2019 (Beta Release - Standard version)

APCC Pro and Standard - Unsafe Slew moves were not always being honored.

APCC Pro - fixed flip flop slew to counterweight up position when using APPM with counterweight-up slews.

APCC Pro - APPM removed extra slew when settling.

APCC Pro - APPM toggling between Decimal and HH:MM:SS/DD:MM:SS formats works much better.

APCC Pro - APPM 5x Verify now only does a RECAL on the first iteration.

APCC Pro - APPM fixed several cross-threading exceptions.

APCC Pro - Improved tool tips when hovering over graphs in Pointing Model window.

#### Version 1.7.0.25 - 02/14/2019 (Beta Release - Pro version)

#### Version 1.7.0.24 - 02/14/2019 (Beta Release - Standard version)

APCC Pro and Standard - Fixes to handle edge and start up Meridian Limits conditions.

APCC Pro and Standard - State of Limit to Meridian check box on Meridian Limits tab was not being restored when APCC restarted.

Version 1.7.0.25 - 02/14/2019 (Beta Release - Pro version)

#### Version 1.7.0.24 - 02/14/2019 (Beta Release - Standard version)

APCC Pro and Standard - Fixes to handle edge and start up Meridian Limits conditions.

APCC Pro and Standard - State of **Limit to Meridian** check box on Meridian Limits tab was not being restored when APCC restarted.

#### Version 1.7.0.23 - 02/13/2019 (Beta Release - Pro version)

#### Version 1.7.0.22 - 02/13/2019 (Beta Release - Standard version)

APCC Pro only - Improvements to tool tips in pointing model graphs.

APCC Pro and Standard - GPS tab now supports reading GPS information from the **MGBoxV2** from Astromi.ch.

APCC Pro and Standard - Improved formatting of Latitude and Longitude

#### Version 1.7.0.21 - 02/07/2019 (Beta Release - Pro version only)

APCC Pro - BUG FIX - UDP IP Address now works without needing to provide a port number.

APCC Pro - Tracking correction now sends an updated tracking rate when the rate actually changes instead of always sending once per second.

#### Version 1.7.0.19 - 02/06/2019 (Beta Release - Pro version only)

APCC Pro - BUG FIX - Tracking rates were inverted after removing relative moves in 1.7.0.17.

#### Version 1.7.0.17 - 02/05/2019 (Beta Release - Pro version only)

APPM - Replaced HA/Dec slews with RA/Dec slews. The HA/Dec slews were adding a slight amount of positional error.

#### Version 1.7.0.15 - 02/04/2019 (Beta Release - Pro version)

#### Version 1.7.0.14 - 02/04/2019 (Beta Release - Standard version)

APCC Pro and Standard - BUG FIX - Meridian delay was getting reset under certain circumstances which sometimes prevented counterweight up slews (same as Standard).

APCC Pro and Standard - BUG FIX - Fixed cross-threading issue that might prevent the Mechanical Home position from being correctly displayed

#### Version 1.7.0.13 - 01/28/2019 (Beta Release - Pro version only)

APCC - BUG FIX - On the AE tab clicking Cancel in **Configure Home** would pop up an error and still start up APPM.

APCC - BUG Fix - The Enable Refraction option was not being saved.

APPM - BUG Fix - West pier side counterweight-up slews were slewing to the opposite side then back.

APPM - BUG Fix - Reset RA/Dec plate solve offsets when restarting a new run.

APPM - BUG Fix - Getting a NASA SkyView image would always fail the first time.

APCC - BUG Fix - Pier flip would not happen under certain circumstances because of the difference between the pointing model's Right Ascension value and the mount's actual Right Ascension.

APCC - Bug Fix - Fixed several bugs that sometimes would result in inaccurate pointing corrections.

#### Version 1.7.0.11 - 01/11/2019 (Beta Release - Pro version only)

APPM - BUG Fix - West pier side counterweight-up slews were slewing to the opposite side then back.

APPM - Reset RA/Dec plate solve offsets when restarting.

#### Version 1.7.0.10 - 01/11/2019 (Beta Release - Pro + Standard version)

APCC - Implemented new meridian limits operations to copy "East to West" and "West to East" data points.

APCC - Various bug fixes.

#### Version 1.7.0.9 - 01/09/2019 (Beta Release - Pro version only)

APCC - BUG Fix - Fixed calculation of RA/Dec error when refraction is enabled/disabled.

#### Version 1.7.0.7 - 01/08/2019 (Beta Release - Pro version only)

APCC - BUG Fix - Fixed sign of Southern Hemisphere RA movements.

APCC - BUG FIX - "Emergency Stop" was not stopping motions caused by RR and RD commands.

#### Version 1.7.0.5 - 01/07/2019 (Beta Release - Pro version only)

APCC - Totally reworked the pointing model functionality for improved pointing and tracking rate correction.

APCC - Improved accuracy of Sidereal Time calculation, which is important to the accuracy of the pointing model.

APCC - Fixed a refraction calculation bug in the model.

APCC - In the Pointing Model window, added buttons to select all mapping points.

APCC - Fixed several bugs in the pointing model window.

APPM - Fixed a bug related to the hour angle/dec slews.'

APPM - Added "automap" command line switch to start an automated APPM run.

APPM - BUG FIX - when selecting certain Point Ordering Strategy values, the appropriate controls were not always enabled.

APPM - added command line switches to load a previously saved settings file and a custom point list.

#### Version 1.7.0.3 - 12/2/2018 (Beta Release - Pro version only)

APPM - Changed slew to use Hour Angle/Dec commands.

APCC - Added refraction coefficient back in.

APCC - Added new Pointing model graphs to map the relationships between pointing errors and position in the sky. The graphs have features like zooming in and out to get a better view of the data in the graphs.

APCC - Added filters to remove potentially bad data points from the pointing model.

APCC - In the pointing model window hovering over a point in the graphs will automatically show and select its entry in the table. Also a popup window will show some details about the point that is being hovered over.

APCC - Selecting a row in the pointing model table will highlight the corresponding point in the pointing error graph.

#### Version 1.7.0.1 - 10/27/2018 (Beta Release - Pro version only)

APPM - Added Environment group box for ASCOM ObservingConditions Driver

APPM - Keep appropriate camera and plate solve settings enabled during plate solving so they can be adjusted while running.

APPM - Add new option to use last plate solve error offset to the next plate solve's hint. This usually speeds up plate solves.

APPM - Add robustness to PinPoint Remote Server setup.

APPM - Various other bug fixes.
APPM - Add "Declination (Graduated RA Density)" point ordering strategy.

APPM - Add quick "Map Type" selection.

APPM - GTOCP4 counterweight-up slews no longer slew to meridian and back to destination ("safe slews").

APCC - AE (encoder) tab added. Features include define and find Home, define fixed and variable RA limits, define fixed Dec Limits, enable/disable encoders.

## Version 1.7.0.0 - 10/27/2018 (Beta Release - Pro + Standard version)

APCC - Add new **Environmental Settings** settings to select ASCOM ObservingConditions driver or THUM device.

APCC - Meridian Limits - Added **Flip Offset** and **Limit to Meridian** controls. The **Flip Offset** value allows the mount to flip during a period of time before the meridian limit is reached.

APCC - Meridian Limits - Allow a negative meridian flip point to be passed to Sequence Generator Pro.

APCC - Meridian Limit Editor - Automatically disable Meridian Limits when in the editor. This can cause unintentional meridian flips.

APCC - Site Information tab now includes the site's Time Offset from UTC, including any offset from Daylight Savings Time when

APCC - AE (encoder) tab added. Features include define and find Home, define fixed and variable RA limits, define fixed Dec Limits, enable/disable encoders.

## Version 1.6.0.4 - 08/03/2017 (Public Release - Standard version only)

#### Note: This version must be used with the AP V2 ASCOM driver v5.10.00 or later.

APCC Standard - enable RA/Dec limits checking for Standard version.

#### Version 1.6.0.3 - 07/27/2017 (Public Release)

# Note: This version must be used with the AP V2 ASCOM driver $\underline{v5.10.00}$ or later.

APCC Pro - Fix formatting of extended precision response to GR commands with the pointing correction enabled.

APCC - Aborting Pier Flip would not restore original meridian delay.

APCC - Removed all "blocking" message box windows. All pop up windows will automatically close with a default action. All actions are recorded in the log file.

APCC - Status of a canceled slew was not always propagated up to the driver, so the driver would think the slew was still active.

APCC - Only send commands to Sequence Generator if it is running.

APCC - Fix UDP backup to COM port not working.

#### Version 1.6.0.2 - 07/17/2017 (Public Release)

#### Note: This version must be used with the AP V2 ASCOM driver v5.10.00 or later.

APCC - some commands were mistakenly sent to the GTOCP3 with extended precision.

#### Version 1.6.0.1 - 07/14/2017 (Public Release)

#### Note: This version must be used with the AP V2 ASCOM driver <u>v5.10.00</u> or later.

APCC - Fix problem with main window scaling for high DPI monitors and laptops.

#### Version 1.6.0.0 - 07/12/2017 (Public Release)

#### Note: This version must be used with the AP V2 ASCOM driver v5.10.00 or later.

APCC - Do not use extended precision format for GTOCP3 controllers. (GTOCP4 firmware "P01-04" and later will use extended precision).

APCC - Allow RA/Dec move rates up to 999.999x for GTOCP3 firmware "V1" and all GTOCP4 controllers.

APCC - Improve performance over remote connections by decoupling many controls in the user interface from virtual port commands.

APCC - Added missing J2000/JNow conversions for Sync. Fixed a few other bugs related to J2000/JNow conversion.

APPM - Many improvements and bug fixes.

# Version 1.5.1.1 - 06/06/2017 (Private Release)

#### Note: This version should be used with the AP V2 ASCOM driver v5.09.10 or later.

APCC - Fixed qualification of high precision formated RA/Dec/Alt/Az commands coming in through the virtual ports.

APCC - Made changes to reduce slow UI updates (e.g. over Remote desktop) from delaying responses to commands received on virtual ports.

#### Version 1.5.1.0 - 06/04/2017 (Private Release)

#### Note: This version should be used with the AP V2 ASCOM driver v5.09.10 or later.

APCC - All versions of CP3 "V" chip and CP4 "P01-04" and later now will send higher precision values to the mount for these commands:

:Sr, :Sh, :Sd, :Sz, :Sa, :St, and :SM

APCC - Increased display resolution of RA/Dec/Alt/Az/HA in various places.

APCC - Changed behavior of RA/Dec and Alt/Az Save/Restore functionality on the Goto/Recal tab.

APCC Pro - Pass point model's corrected alt/az position to the driver and other applications on the virtual ports.

APCC - Removed incorrectly displayed SGPro warning on the meridian limits tab.

APCC - Fixed popup message with incorrectly labeled buttons.

APCC - Various other bug fixes and enhancements.

APPM - Strip potential port number from network address in PinPoint platesolve settings to allow pinging to work.

APPM - Fixed ASCOM file save function.

APPM - Added Status bar on bottom to show device connection status.

APPM - Fixed ASCOM connect - ASCOM device was not saved.

APPM - When starting an APPM run a new settings summary window shows the parameters.

APPM - Fixed - incorrect interpretation of the SetSlewRate response from APCC, which was mistakenly throwing an exception.

APPM - Fixed - User defined slew rate was not being used.

#### Version 1.5.0.20 - 02/25/2017 (Public Release)

## Note: This version should be used with the AP V2 ASCOM driver v5.09.04 or later.

APCC - Expanded allowable timezone range to -23:59:59 to +23:59:59.

# Version 1.5.0.19 - 01/29/2017 (Public Beta)

#### Note: This version should be used with the AP V2 ASCOM driver v5.09.04 or later.

APCC - Updated documentation.

APCC - FIXED - Protect against certain out of range values in Home and Limits Configuration dialog.

APCC - IMPROVEMENT - A popup window will open to restore unpark from last parked position after unparking from one of the named park positions. If the user is not at the screen or does not select an option, the window will auto-close and change the default to unpark from last parked position.

APCC - FIXED - Status window's Connect/disconnect button wouldn't change when APCC is connected/disconnected from the mount.

APCC - FIXED - a set tracking rate command was being sent out of order during initialization.

APCC - IMPROVEMENT - On both the Horizon and Meridian Tabs, removed the Reset Limit Trigger button and the Auto-reset checkbox. Auto-reset is now always the default.

APCC - IMPROVEMENT - removed the check box option to close the Stop Window when a slew completes. The Emergency Stop window now always closed automatically when a slew completes .

APCC - BUG FIX - The Log Zipper was not working so it has been moved into its own separate application. The new log zipper application is included in the installer going forward.

APCC - NEW FEATURE - Automatically send mount flip point to Sequence Generator Pro. "Meridian Limits" and "Counterweight up slews within West limits" must both be enabled.

APCC Pro (APPM) - BUG FIX - After a point mapping run APPM offers to immediately use the data. Clicking "OK" would often result in a message saying the model was not installed correctly (but it was). model. This false error message should no longer occur.

APCC Pro (APPM) - IMPROVEMENT - when attempting to connect to Sequence Generator Pro, APPM first checks that SGPro is running. If SGPro is not running, a pop up message indicating that is displayed.

APCC Pro (APPM) - BUG FIX - Numerous improvements and bug fixes to the plate solving architecture.

APCC Pro (APPM) - BUG FIX - DSLR ISO values are now properly passed to SGPro.

APCC Pro (APPM) - BUG FIX - The command to set Slew Rate was getting ignored when starting a APPM run.

APCC Pro (APPM) - BUG FIX - Camera Binning setting was not being used to adjust the unbinned image scale.

APCC Pro (APPM) - Optional settings review dialog allows you to review the settings before starting a mapping run.

## Version 1.5.0.18 - 12/09/2016 (Public Beta)

APCC - Updated documentation.

APCC - Fixed Status View Connect button text (never changed from "Disconnect").

APCC - Advanced Settings window was missing the "Help" button.

APCC - Fixed a problem that could cause the Virtual ports to not be auto-allocated.

APCC - When the mount needs to be initialized APCC will now bring up the Initialize mount window, even if auto-initialize is disabled. The user can decide to initialize or not.

APCC - Fixed issue with APCC showing the wrong button text when a connect to the driver fails.

APCC - Removed some unnecessary debug log statements.

APCC Pro (APPM) - APPM's slew rate was not getting set down in the mount.

APCC Pro (APPM) - Fixed several problems with plate solve directory function.

APCC Pro (APPM) - Fixed several bugs in the plate solving state machine.

APCC Pro (APPM) - To improve startup speed, if dark frame subtraction is selected APPM will start the dark frame in parallel with the mount settling after a move.

#### Version 1.5.0.17 - 11/14/2016 (Private Beta)

APCC - Updated documentation.

#### Version 1.5.0.16 - 11/02/2016 (Private Beta)

APCC Pro - Increased range of allowable barometric pressure from 800-1100 to 500-1300.

APCC Pro (APPM) - Minor fixes for PinPoint compatibility (Note: PinPoint 6.1d or later is required if using PinPoint's All-Sky plate solves)

## Version 1.5.0.15 - 10/31/2016 (Private Beta)

APCC - Added new option in Advanced Settings to keep mount time synced to the computer. This option overrides the same feature in the ASCOM driver. If enabled, APCC will sync time even if the option in the driver is disabled (Driver v5.09.02 or later required). When disabled in APCC however, the driver can temporarily (until APCC is restarted) enable time sync in APCC. When connected to APCC the driver will delegate Time syncing to APCC and the driver will not itself perform time syncing.

APCC - **EXPERIMENTAL** - **Requires driver v5.09.02 or later** - APCC will now define two Virtual Ports for the ASCOM driver. Because of the way COM interop works, a separate instance of the driver will be created each for ASCOM clients running from the user account, and for ASCOM clients running "as administrator." In a hope to allow applications that need to be run "as administrator" work with applications that don't.

- The first virtual port will be used by the instance of the driver started in user mode.
- The second virtual port will be used by the driver if it started "as administrator"

APCC - Fixed range errors in some controls.

APCC Pro (APPM) - Added support for SGPro Cameras to APPM.

APCC Pro (APPM) - Removed checkbox for PinPoint All-Sky and added separate buttons to do All Sky Solve and All Sky Solve and Sync

APCC Pro (APPM) - Added new plate-solving choices to APPM: SkyX Image Linking, and Sequence Generator Pro (tested with PlateSolveX)

APCC Pro (APPM) - Added option to set explicitly set the Slew Rate for mapping runs.

APCC Pro (APPM) - Added option to open Images in the by double clicking the entry in the mapping table.

APCC Pro (APPM) - Added feature to Plate Solve files in a directory.

# Version 1.5.0.14 - 09/19/2016 (Public Beta)

APCC - FIXED - do not invoke COM port fallback when disconnected.

APCC - FIXED - responses to the ASCOM driver could sometimes be delayed significantly, thus making the driver think it had lost a connection to the mount.

APCC - Adjusted position of new indicators in the "Telescope Position" group box to look better for APCC Standard.

APCC - Widened the "TRACK" indicator to allow "TRACKING" and "PARKED" to fit.

APCC - FIXED - PEM indicator was not working correctly.

APCC - Added "Auto-Reset" option to Horizon Limits and Meridian Limits. When checked these limits will automatically be reset when the mount goes back within limits.

APCC - FIXED - APCC was returning a cached value of the mount's time to the driver, which was causing the driver to sometimes think the time had gone outside the two-minute range.

APCC - Stopped using cached values on the virtual ports for the following commands: GC, GL, GG, GP, GA, and GZ. These commands now pass through to the mount.

APPM - Added "Sequence Generator Pro" as a new camera option.

APPM - Fixed the "Image Link Test" setting for TheSkyX plate solving.

APPM - BUG FIX - Even when TheSkyX plate solving was selected, PinPoint Plate solves were being used. (more work needed here).

## Version 1.5.0.13 - 09/07/2016 (Private Beta)

APCC - Added COM port fallback to ethernet/wi-fi connection

APCC - Added "Pier Flip" button to "Move Scope" and "Meridian Delay" Group boxes

APCC - Added "Slew Speed" to "Move Scope" group box so that it is easy to tell the set slew speed.

APCC - Rearranged controls in "Move Scope" group box to make better use of space

APCC - Added Tracking State and PEM State labels (with Tool Tips) to "Telescope Position" group box

APCC - Meridian/Horizon labels in "Telescope Position" group box can be single-clicked to open their respective tabs. Double clicking will toggle their enabled state.

APCC Pro - Changed labels for Pointing and Tracking rate correction to "Point Corr" and "Rate Corr", respectively.

These labels can be single-clicked to open the Pointing Model tab. Double clicking will toggle their enabled state.

APCC - Added warning messages when enabling "Stop Tracking after Unparking"

APCC - Don't allow user to set or clear Meridian Delay while Meridian Limits and Slew within East/West is enabled.

APCC - Added "Exhaustive COM Port Search" option (default) to Advanced Settings

APCC - Added "Just Warn" option to Meridian and Horizon Limits

APCC - Fixed behavior of Horizon and Meridian Limits status fields

APCC Pro - Changed RA and Dec pointing error from Decimal mins/arc-mins to Mins/Secs and Degs/Secs, repectively.

APCC Pro - Changed RA and Dec tracking rate units from "secs/sec" and "arc-secs/sec" to a more understandable "secs/hour" and "arc-secs/hour", respectively.

APCC - Close "Find GTOCP4" window when "Select" is clicked.

#### Version 1.5.0.12 - 08/25/2016 (Public Beta)

APCC - Added check box to stop tracking after unparking.

APCC - Changed confusing custom park Alt/Az boxes to labels.

APCC - Changed look of a number of labels to be more consistent.

APCC - Added status labels for Meridian Limits, Horizon Limits, Pointing and Tracking rate correction (Tooltip info is presented when mouse hovers over them).

#### Version 1.5.0.11 - 08/25/2016 (Private Beta)

APCC - Fixed incorrect time zone when unparking

APCC - Fixed meridian delay getting cleared when slewing with meridian limits disabled.

## Version 1.5.0.10 - 08/21/2016 (Public Beta)

APCC - Even more changes to Time Zone logic to fix issues with an European version of Windows.

- APCC Fix double moves in counterweight up positions when using the GTOCP4.
- APCC Fixed some logic errors with the Counterweight-up slews within East/West Limits.

## Version 1.5.0.9 - 08/17/2016 (Private Beta)

APCC - Further changes to Time Zone logic to fix issues with an European version of Windows.

## Version 1.5.0.8 - 08/14/2016 (Private Beta)

APCC - Captured Time Zone initialization errors and allow APCC to complete startup.

APCC - "Create Virtual Ports first" option will now automatically select a virtual COM port if none is defined for the first virtual port.

APCC Pro - Fixed labels for RA pointing and tracking rate corrections

APCC - when loading a settings file, put up a window indicating the operation is active.

#### Version 1.5.0.7 - 08/07/2016 (Private Beta)

APCC Pro (only) - Pointing model corrections were not being applied when a pier flip occurred when using a GTOCP4.

#### Version 1.5.0.6 - 07/17/2016 (Public Beta)

APCC - Fixed double initialization that can happen sometimes.

APCC - Added tool tips to some of the options in the connection group box.

APCC - Added a "Now" button to do a one-time configuration of the ASCOM driver (as an alternative to the "auto-config" option that re-configures every time APCC starts the ASCOM driver).

#### Version 1.5.0.5 - 07/13/2016 (Private Beta)

APCC - Removed unintentional residual use of Eltima 7.x.

#### Version 1.5.0.4 - 06/27/2016 (Private Beta)

APCC - Direct broadcasts for GTOCP4's out all network devices that support IP V4.

APCC - Allow control characters to be sent in Terminal Interface (by pressing CTRL+character)

APCC - Upgraded to the latest Eltima Virtual Port driver (v8.0.435).

## IMPORTANT NOTE: This requires any previous version of APCC to be uninstalled.

#### Version 1.5.0.3 - 06/05/2016 (Private Beta)

APCC - Added a command line switch so APCC knows it is being started by the driver and can do certain start up actions to better ensure the driver can connect.

APCC - Before unparking force meridian delay to 0.

APCC - Auto-create the first virtual port if not defined when starting.

APCC - Improved robustness of matching the ASCOM driver's port to APCC's first virtual port (requires ASCOM driver v5.09.00 or later)

#### Version 1.5.0.2 - 06/03/2016 (Private Beta)

APCC - Prevent the Log Zipper window from being used while connected to the mount or driver.

APCC - Disable Log Pausing for now to capture any potential errors that might be missed when logging is paused.

APCC - Added additional log output to help debug certain scenarios.

## Version 1.5.0.1 - 05/31/2016 (Private Beta)

APCC - Fixed accidental dual Virtual port threads when there should have been only one thread.

## Version 1.5.0.0 - 05/31/2016 (Private Beta)

APCC - Poll site longitude/latitude from the mount when connecting to the mount.

APCC - Add more logging detail for debugging in case a network error occurs.

#### Version 1.0.25.0 - 05/29/2016 (Private Beta)

APCC - Moved polling to a background thread so that resizing windows and other user interface actions do not slow down polling (noticed by Chris Erickson)

APCC - Removed UDP checkbox, and the Serial/USB and the Net/WiFi radio buttons and replaced with a drop down list of connection methods. While connected the user can still switch between UDP and TCP in real-time.

APCC - Instead of "Net" the first connection status box will show "TCP" or "UDP", reflecting the protocol being used.

APCC - Added a new discovery button to locate any CP4 on the local LAN and allow it to be selected.

APCC - When connecting to the AP driver, if "Auto-config" is not selected APCC will automatically setup the driver's COM port and APCC setting if not correctly set.

APCC - When starting APCC it will create a full backup of settings in C:\ProgramData\Astro-Physics\APCC\Backups. APCC - APCC will try up to 3 times to write a setting to a file before throwing an error. It will wait at least 50 milliseconds before retrying a save.

## Version 1.0.24.0 - 05/25/2016 (Private Beta)

APCC - Add UDP as alternative to TCP/HTTP requests.

## Version 1.0.23.0 - 05/22/2016 (Private Beta)

APCC - BUG FIX - disconnecting the driver did not update the button user interface state correctly.

## Version 1.0.22.0 - 05/21/2016 (Private Beta)

APCC - Major internal changes to combine multiple commands for more efficient polling of the GTOCP4 when using LAN/wi-fi.

#### Version 1.0.21.0 - 05/14/2016 (Private Beta)

APCC - Refinements to improve Ethernet/Wifi command/response reliability.

#### Version 1.0.20.0 - 05/13/2016 (Private Beta)

APCC - Made mount timeout value available while connected (was formerly disabled while connected) to allow changing timeout dynamically.

APCC - Create separate timeout values for Ethernet/Wifi and for Serial/USB ports.

APCC - Lowered Ethernet minimum timeout to 10 msecs.

APCC - In "Comm Events" window add a "Clear Queues" button to allow a user to clear all command queues to hopefully allow a lost wifi connection to be res-established.

APCC - Removed "Reset Limit Triggers" button in Home/Limits tab.

#### Version 1.0.19.0 - 05/12/2016 (Private Beta)

APCC - BUG FIX - Fixed Primary and backup COM port boxes. They were too narrow to fit two-digit COM ports.

APCC - BUG FIX - COM ports were sometimes randomly ordered in the drop down list box. They are now sorted numerically.

APCC - BUG FIX - Emergency Stop window wasn't stopping moves for the GTOCP4.

#### Version 1.0.18.0 - 05/11/2016 (Private Beta)

APCC - Changed text and position of some Connection group box controls around for more clarity.

APCC - Disable Ethernet/WiFi option if GTOCP3 is being used.

APCC - Fixed bug in the Connect operation to the AP V2 Driver.

#### Version 1.0.17.0 - 05/10/2016 (Private Beta)

APCC - Slightly increased height and width of APCC's main window to fix additional Connection group box controls for ethernet/wi-fi connections.

APCC - Moved "COM Events" (COM Port events) button to status bar and renamed to "Comm Events" (Communications Events). It will turn light red (pink?) if there are any communications errors.

APCC - Reworked Connection group box to include radio control options for Ethernet/Wi-fi and Serial/USB

APCC - Moved Connect Driver button from Virtual Ports tab to Connection group box

APCC - When APCC is connected to the mount or driver, the corresponding button turns light green as an indication.

APCC - Moved "Close Emergency Stop window when done slewing" option from "Advanced Settings" to "Program Operation" group box

APCC - Moved "Create Virtual Ports first" option from "Advanced Settings" to "Connection" group box.

APCC - Added "Auto-Connect Driver" and "Auto-Configure" driver options to "Connection" group box.

APCC - Added "Edit Initialize Mount Settings..." to the Settings menu. This allows a user to edit initialization settings without initializing the mount.

APCC - "Initialize Mount..." option in Settings menu no longer will proceed unless mount is connected and RA=0 and Dec=90.

APCC - BUG FIX - Fixed issue with Emergency Stop window not closing after parking.

APCC - BUG FIX - the Error Log Window no longer also opens the 3D Viewer.

APCC - BUG FIX - Home and limits feature never requires reprogramming the GTCP4 personality

APCC - APCC automatically starts a new log file if the log file size exceeds about 100 MB.

#### Version 1.0.16.0 - 05/01/2016 (Private Beta)

APCC - BUG-FIX - fixed endless re-initialization loop when mount was first initialized

#### Version 1.0.15.0 - 05/01/2016 (Private Beta)

APCC - BUG FIX - Fixed exceptions when connection the driver to APCC.

## Version 1.0.14.0 - 05/01/2016 (Private Beta)

APCC - Added ability to connect to the GTOCP4 via an ethernet/wi-fi connection.

#### Version 1.0.13.0 - 03/26/2016 (Private Beta)

APCC - Added "Update personality" button and associated functionality to enable end users to reconfigure their mount to use the Home and Limits feature. The button will only display if the personality has not already been updated.

APCC - Made Goto RA/Dec controls like Goto Alt/Az controls.

## Version 1.0.12.0 - 03/16/2016 (Private Beta)

APCC - Fixed a bug in the Status window that would cause an exception if the user had configured the Status Window to be shown when APCC starts.

## Version 1.0.11.0 - 03/16/2016 (Private Beta)

APCC - disable safe slews if it detects the CP4.

APPM - Add ASCOM Camera and SkyX Camera Add-on as new cameras.

APPM - Add SkyX Plate Solving as alternative to PinPoint.

APCC - Add popup window to report details of unhandled exceptions back to me (The user must ok the sending of this data).

#### Version 1.0.9.0 - 12/29/2015 (Private Beta)

APCC - made an user interface change for the Declination limit.

#### Version 1.0.8.0 - 12/23/2015 (Private Beta)

- APCC changes to match the status window and main window's move rates.
- APCC added a warning for the east/west limits
- APCC Hide the home/limits tab if AE box is detected.

#### Version 1.0.7.0 - 11/23/2015 (Private Beta)

APCC - Added settings save via SQLITE database.

- APCC Added new status box to the user interface for backup COM port.
- APCC Added new way of determining which COM ports are real and which are virtual ports.

# Version 1.0.6.0 - 11/16/2015 (Private Beta)

- **APCC** improved intelligence in selecting a free virtual com port for the driver to use.
- APCC Fixed issue with backup COM port not working as designed.
- APCC Fixed syntax error in a command sent to the mount (double ":")

Horizons - Added extra debug statements.

# Version 1.0.5.0 - 11/04/2015 (Private Beta)

APCC - Some semi-major reorganization of the user interface.

- 1) Changed look of the setup tab.
- 2) Placed the AutoConnect option into the Connect groupbox.

3) Moved the Virtual Ports tab to the second tab position so users can find it more easily.

4) Each of the four new application buttons (ApTimer, ApJog, ApRAPAS, PEMPro) will only be visible if the corresponding application is installed.

5) Added one extra option in the Advanced settings to close the Emergency Slew window automatically after a slew completes.

## Version 1.0.4.16 - 10/25/2015 (Private Beta)

APCC - Added more debug statements to track down issues when users have COM port errors.

## Version 1.0.4.15 - 10/8/2015 (Private Beta)

APCC - (now defunct) balance mount procedure.

#### Version 1.0.4.14 - 10/1/2015 (Private Beta)

APCC - fixed problem reported by David on Ap-gto forum concerning goto incorrectly loading the mount's RA/Dec with Pointing Correction enabled.

## Version 1.0.4.13 - 9/17/2015 (Private Beta)

APCC - fixed problem reported by Joe Z. (never-ending park when the park position is under the Horizon limit).

## Version 1.0.4.12 - 9/12/2015 (Private Beta)

APCC - fixed the lockup problems and the RA/Dec limits.

#### Version 1.0.4.11 - 9/7/2015 (Private Beta)

APCC - fixed limit bug with Park 4.

## Version 1.0.4.10 - 9/5/2015 (Private Beta)

APCC - Fixed problem with the "Set" personality commands.

# Version 1.0.4.9 - 9/5/2015 (Private Beta)

- APCC Fixed problem with the "Get" personality commands
- APCC Implemented the faster bounce logic.

# Version 1.0.4.8 - 9/3/2015 (Private Beta)

APCC - Fixed a bug that sometimes caused an incorrect park position.

APCC - Pol mount for personality and disable Home/Limits tab if personality has not been updated.

## Version 1.0.4.7 - 8/29//2015 (Private Beta)

APCC - Added read personality command.

APCC - Changed bounce back to happen only in the axis that hits a limit (and not both axes).

APCC - Added short pause before a bounce.

## Version 1.0.4.6 - 8/28/2015 (Private Beta)

APCC - added an automatic clear of the limits if the mount goes back within limits.

APCC - added the bounce back option but I didn't have time to try it this morning so I'm not sure it will work as you expect. When bouncing back I start homing operations on both axes simultaneously and stop after 2 seconds.

APCC = fixed typo in the Dec Limits checking. It wasn't checking Dec limits at all like it was supposed to but was checking RA limits.

## Version 1.0.4.5 - 8/27/2015 (Private Beta)

APCC - Fix an issue with the limits not being saved.

APCC - Added a check for a minimum ASCOM platform version, which was causing an issue with APCC's pointing calculations because the old ASCOM utility functions had a few bugs.

#### Version 1.0.4.4 - 8/13/2015 (Private Beta)

APCC - Properly handle Home configuration aborts

APCC - Limits should now work for both Southern and northern hemisphere

APCC - Added three new limit actions:

a) "Just Warn" -- does nothing but pop up an asynchronous window warning the user that a limit was breached (all actions do this also). This might be good for your testing so you won't be triggering parks and homing actions.

b) "Stop Slew" -- Stops the slew but does not stop tracking.

c) "Stop Slew, Stop Tracking" - Stops slew and tracking, but does not Park

## Version 1.0.4.3 - 8/12/2015 (Private Beta)

APCC - Use the move RA/Dec fields to detect slewing done when homing (the GOS slew field is not indicating correctly).

## Version 1.0.4.2 - 8/11/2015 (Private Beta)

APCC - Added missing RA home command.

APCC - Other minor fixes to homing/limits logic.

## Version 1.0.4.1 - 8/10/2015 (Private Beta)

APCC - Fixes and changes to Home and Limits tab.

APCC - Added error log window

## Version 1.0.4.0 - 7/9/2015 (Private Beta)

- APCC Added 3D Warning Windows.
- APCC Add Calibrate Home Warning Windows.
- APCC Started work on Environmental Graph Window.
- APCC Added Home and Limits window.

# Version 1.0.3.4 - 5/27/2015 (Release)

APCC - BUG FIX - releasing any of the Status View move buttons would trigger the Emergency Stop window because the StopMove function used by the Emergency stop button was also used by the mouse up events for all of the Status View's move buttons.

#### Version 1.0.3.3 - 5/27/2015 (Release Candidate)

APCC - Redesigned 3D Scope syncing logic to fix potential boundary conditions where the 3D scope view might incorrectly show the mount's orientation.

APPM - Internal changes preparing for additional plate solving

#### Version 1.0.3.0 - 4/20/2015 (Beta)

#### APCC

- \* To prevent confusion on the use of the refraction checkboxes, they have been removed.
- \* Fixed display issues with the 3D Scope View
- \* Added "Create Virtual Ports First" option to Advanced settings, which when enabled will always create the

virtual ports, even if the mount is off or not connected. This will allow the ASCOM driver to attach to a virtual port

and potentially wait for the mount to be powered on.

\* Fixed extra flip when scope is in a counterweight up position and the meridian limit set such that scope should slew directly to the target position.

- \* Fixed similar to the above when meridian limits are set up.
- \* Fixed rounding error in longitude/latitude
- \* Park 2 and Park 3 used a hour angle of exactly -6, which caused some anomalies.
- \* Added additional commands for external programs to use:
- APCCVERSION returns Pro or Standard
- LIMITREACHED returns if a limit has been reached (Meridian or Horizon)
- SETTEMP/GETTEMP
- SETPRESSURE/GETPRESSURE
- SETHUMIDITY/GETHUMIDITY

## <u>APPM</u>

Added missing DLL for AstroArt Added new camera option to select SkyXPro Camera

## Horizons

Allow "steps" to be used in calculations for fast moving satellites, like ISS When clicking Stop tracking button tracking was completely stopped instead of returning to sidereal Added option to display Native tracking rates.

## Version 1.0.2.0 - 1/16/2015 (Release)

APCC - BUG FIX - Fixed link in Horizons to APCC's help file.

APCC - BUG FIX - Set Meridian Delay to 0 before unparking.

APCC - BUG FIX - Fix excessive CPU utilization when "Automatic Shutdown" is selected.

APCC - BUG FIX - Improve some of ELS homing functionality.

# Version 1.0.1.0 - 1/1/2015 (Beta)

APCC - Allow APCC to be connected to a COM Port waiting for mount to be turned on.

APCC - BUG FIX - Fixed "arithmetic overflow" that sometimes happened when calculating CRCs

# Version 1.0.0.9 - 12/20/2014 (Release)

APCC - BUG FIX - Fixed start up issue with Windows XP.

APCC - BUG FIX - Fixed homing issue with 3600 mounts Homing feature.

# Version 1.0.0.8 - 11/30/2014 (Beta 8-11)

APCC - BUG FIX - Fixed extra slew that was happening sometimes when slewing from Park 1.

APCC - BUG FIX - Main window's position should now be restored if the Save windows positions option is set. Also, other window positions should be saved when closing the main window to exit APCC. Previously the windows had to be closed first to be remembered.

APCC - BUG FIX - Not all COMM timeouts were being reported in the COM Timeouts window.

APCC - Improved detection of mount disconnects and reconnects. LST/RA/Dec/Alt/Az fields will now flash when mount connection is lost.

APCC - Made improvements to logging.

## Version 1.0.0.8 - 11/22/2014 (Beta 1-7)

APCC - Meridian Limits - Changed entry value precision to 2 decimal places.

APCC - Improved robustness of "Connect to Port" logic.

APCC - Improved the look and feel of the COM Port warning/error dialog. Removed pop-up warning messages (replaced by aforementioned dialog).

APCC - Changed "Administrator" to "Elevated" to more accurately describe APCC's privilege level. Implemented a different way to check for elevation.

APCC - BUG FIX - Main window's position should now be restored if the Save windows positions option is set.

APCC - BUG FIX -Port status colors were sometimes incorrect.

APCC - Tweaked Park 1, 3, and 4's positions

APCC - Added "Always on top" option to Scope 3D View window.

APCC - BUG FIX - If the THUM service is running queries to the THUM would fail after 10 seconds but would hold up APCC during that time so querying the THUM has been moved to a separate thread. WARNING: users should NOT install and/or enable the THUM service/application software because then APCC will not be able to communicate with the THUM.

APCC - BUG FIX - Added separate checks for updates for the Standard and Pro editions.

APCC - Added various information to the log files.

APPM - New Feature (Pro Only) - For dome users added new passive method for checking for dome move completion. Instead of actively moving the dome via the ASCOM dome slewing commands, APPM will assume that another program (e.g. DC3 dreams' ACP software) will issue the slew. APPM just passively waits for the slew to complete. This option is setable via a new dome settings window in APPM's settings menu.

Installer - Give permissions to "everyone" for Read/write access for logs and settings directories.

#### Version 1.0.0.7 (Official Release) - 10/12/2014

APCC - FEATURE - Added an option to the Log window to only show telescope move commands, which can be useful for debugging autoguider issues.

## Version 1.0.0.6 - 10/06/2014

APCC - Fixed issue with reading settings file.

## Version 1.0.0.5 - 8/25/2014

APCC - Declination degrees was being set to 0 after a save if the field was a negative value.

APCC - Restored "West Limits" check box and finished implementing corresponding functionality (see help section on Meridian Limits).

# Version 1.0.0.4 - 8/15/2014

APCC - Now requires firmware version 'V" or later to run.

APCC - Changed out of date references to "U" firmware to save "V" firmware.

APCC/APPM - Further updates to the documentation .

## Version 1.0.0.3 - 8/10/2014

APCC - BUG FIX - ASCOM driver would lock up if "Check for Valid Firmware" was clicked and the driver was already setup to talk to APCC.

## Version 1.0.0.2 - 8/8/2014

APPM - BUG FIX - Changing how Image FIT files were saved in an APPM run did not change immediately (required a restart).

APCC - BUG FIX - When "start with Status View Window" was selected and the Main window brought up from the Status View, the Status View Window would minimize if the main window was minimized. Now the Main Window will (only) Minimize and optionally hide itself if the appropriate settings are enabled.

APCC - BUG FIX - Clicking a button to show a window from the Status View would not show the window if the window was previously opened but minimized.

APCC - BUG FIX - Horizon Limits check box was (purposely) cleared whenever parking or initializing the mount. Now it is not cleared but not "armed" until the scope if first slewed into an area that is within the horizon limits. Also, when clearing the Horizon limits trigger (which starts tracking) it won't actually be armed again until the mount is again within the Horizon limits.

APCC - Made visible the "Correct for refraction" check box.

#### Version 1.0.0.1 - 7/16/2014

APPM - fixed bug reading Horizon limits from APCC's settings file.

# Version 1.0.0.0 - 7/14/2014

APCC - added a triangulator class for future use.

APCC - automatically force the ASCOM driver to enable "chkAllowConnectIfMountNotPresent".

APCC - Updated the Help file with Howard's changes.

APPM - Improved performance of APPM when adjusting Point map and connected to APCC/Driver.

#### Version 0.99.99.73 (Release Candidate) - 6/25/2014

Minor changes to try to fix an issue found in RC72.

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# 2 New Features

Important: Some new features may not be available to all APCC users. Some features may require a newer license date than you have (which may require a software renewal). Where noted, certain features require an APCC Pro license, which is a paid upgrade from APCC Standard (most notable is the sky modeling and tracking enhancements). If you have any questions please contact Astro-Physics for additional assistance. Keep in mind the license you purchase for APCC is good forever for the version. Access to new features may require license renewal.

If you find a license update required to access newer features you can purchase a renewal by clicking APCC's menu Help->View/Update License subscription that will take you to the appropriate web page. The link is shown in this screen shot:

Astro-Physics Comman	id Center Pro	
File Settings Tools	Help	
Program Opera	Help	
	Clear License	
Ask if OK To exit	Check for updates	sion
Keep APCC on top	View/Update License Subscription	
M Show Emergency Sid	About	—(

The new features include:

<u>NINA Support</u> <u>Dec-Arc Tracking (APCC Pro only)</u> <u>ASTAP Plate Solving (APCC Pro only)</u> <u>Real-time RA/Dec</u> <u>Platesolve, Autocenter (APCC Pro only)</u>

# 2.1 NINA Support

Important: The following new feature requires a license dated August 1, 2020 or later. If your license is older you can get access to these features by purchasing a license renewal. The renewal license never expires so you will always be able to use this new feature.

Dale Ghent (author of the Astro-Physics Tools plug-in) has graciously provided a quick how-to guide for using AP mounts with NINA. This guide applies to both APCC Standard and Pro:

https://daleghent.com/nina-and-astro-physics-mounts

NINA can be downloaded from this link: https://nighttime-imaging.eu/download/

**APCC Pro only:** NINA now offers an Astro-Physics Tools plugin for automating APCC point map creation (both all sky and Dec arc maps) and enabling Dec arc tracking using NINA automation.

The Astro-Physics Tools plugin is available through NINA's standard plug-in downloads area within the NINA application



**APCC Pro only:** Additionally, APPM can connect to NINA 1.11 and later, allowing APPM to use a camera connection via NINA. This means any camera supported by NINA can be used as an APPM camera.

🔘 Astro	o-Physics Po	int Ma	pper - l	Points: 121								_		×
File	Settings T	ools	Help											
Run	General Inform	nation	Camera	a Settings Pla	ate Solve	e Settin	gs Me	asurement F	oints					
Conn	pe: Conn	ect	Driv	er Settings	Site La	titude 0			Environmer	nt Latitude	Longitude	Elevation (n	1)	?
Came	era: Conr	ect	NINA	۱.		$\sim$	Cor	nfig		Temp (C)	Pressure (mb)	Humidity (%	)	
Dor	me: Conr	iect					Select	Dome	Plate \$	Solve	Plate Solve ar	nd Recal		
Re Re	cal near Zenit	h at sta	rt	Skip Pl	ate Solv	es (for	Testing)		All Sky	Solve	All Sky Solve a	ind Recal		
Pre Pre	ecess J2000 to	JNow		Pause	after ead	h Slew	/							
U Ver	rify Pointing M	odel		Require	e high ao	curacy	/ slews							
			After	Complete:				Measurem	ent# Good /	Bad Solves		c	Current State	
Sta	art St	op	Park		$\sim$	Progres	s Map							
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Num	Time	Side	CW	Hour Angle	RA	Dec	Status	RA Delta	Dec Delta	RA Solved	Dec Solved	Temperature	Solve Error	FI1
<														>
Scope:	Not Connect	ed	Cam	era: Not Co	nnected		Dome:	Not Conn	ected S	Slew Rate:	Mount Contro	lled		

# 2.2 Dec-Arc Tracking

Important: The following new feature requires a license dated August 1, 2020 or later. If your license is older you can get access to these features by purchasing a license renewal. The renewal license never expires so you will always be able to use this new feature.

APCC Pro has had pointing and tracking rate correction since it was launched. The correction values are based on an pier-side model, best fitting all of the acquired data points in each pier side. This does a really good job of improving pointing and tracking rate accuracy, but sometimes localized behavior deviates from the model slightly.

The model for Dec-Arc tracking is created by optimizing and best-fitting the pointing errors along declination arcs (paths) that APPM usually follows. This improves the tracking rate accuracy in areas where there are enough data points to create a good dec-arc mode (5-7 points per declination arc is a good baseline).

Enabling Dec-Arc tracking is as simple as setting a check box in APCC Pro. It can be enabled/disabled at any time which allows you to easily compare its tracking rate quality with that of the all-sky model.

📕 Astro-Physics Command Cente	r Pro				
File Settings Tools Help					
Operation Enable Pointing Correction Enable Tracking Correction	Pointing Correction Status ? RA 01m 31.84s Dec -11' 51.9" N				
Model       Temp (C)         8.1         Pressure (mbar)         APPM	Tracking Correction Status ? N RA 3.78 Sec/ hour Dec -21.9 Arc-sec/ hour FI Enable Dec Arc Tracking				
Setup Virtual Ports Site Park Homing/Limits GoTo/ReCal Rate S					

# 2.3 ASTAP Plate-solving

Important: The following new feature requires a license dated August 1, 2020 or later. If your license is older you can get access to these features by purchasing a license renewal. The renewal license never expires so you will always be able to use this new feature.

APPM now supports the plate solver built into ASTAP.

ASTAP and associated stellar databases can be downloaded from this link: https://www.hnsky.org/astap.htm

e Settings Tools He	p		
General Information Can	era Settings Plate Solve Settings Measurement Points		
Plate Solve Application: AST	AP ~		?
Common Settings			
Max Solve Time (sec)	60 If initial Plate Solve fails then:		
Karc-sec/pixel (unbinned)	Iny All-Sky Plate Solving if available Time (sec)		
r arc-sec/pixel (unbinned)	1.66		
mage Scale Tolerance (%)	10		
Refine image scale from ne	t solved image Use last plate solve's offset as hint for next plate solve		
ASTAP Plate Solve Settings —			
Image Link Test			
Image Link Test	a numeric value, set it to 0.		
Image Link Test NOTE: To use the default for Max Number of Stars	a numeric value, set it to 0. 2000 🖨 Tolerance 0.010 🚖		
Image Link Test NOTE: To use the default for Max Number of Stars Radius Search Field (deg)	a numeric value, set it to 0. 2000  Tolerance 0.010 5.0  Speed Mode Default		
Image Link Test NOTE: To use the default for Max Number of Stars Radius Search Field (deg) Min Star Size (arc-sec)	a numeric value, set it to 0. 2000  Tolerance 0.010 5.0  Speed Mode Default		
Image Link Test NOTE: To use the default for Max Number of Stars Radius Search Field (deg) Min Star Size (arc-sec) Down Sample Factor	a numeric value, set it to 0. 2000  Tolerance 0.010 5.0  Speed Mode Default Uefault V Restore Defaults		
Image Link Test NOTE: To use the default for Max Number of Stars Radius Search Field (deg) Min Star Size (arc-sec) Down Sample Factor	a numeric value, set it to 0. 2000  Tolerance 0.010  5.0  5.0  Speed Mode Default Default V Restore Defaults		
Image Link Test NOTE: To use the default for Max Number of Stars Radius Search Field (deg) Min Star Size (arc-sec) Down Sample Factor	a numeric value, set it to 0. 2000  Tolerance 0.010 5.0  Speed Mode Default  Default V Restore Defaults		

# 2.4 Real-time RA/Dec

Important: The following new feature requires a license dated August 1, 2020 or later. If your license is older you can get access to these features by purchasing a license renewal. The renewal license never expires so you will always be able to use this new feature.

APCC V1.9 provides a new "virtual mount command" that returns the mount's RA/Dec coordinates with minimal latency.

The command's format is:

:GRGD#

This command will return both RA and Dec values. The result will have this format:

# HH:MM:SS.dd|sDD\*MM:SS.d#

Where:

HH = 2-digit hour,

**MM** = 2-digit minute,

SS = 2-digit second,

d = decimal digit,

| = ASCII pipe character, separator between RA and Dec.

**s** = sign (+/-),

**DD** = 2-digit degrees.

Here is an actual example of sending a full response:

## 01:47:49.33|+89\*55:04.1#

# **Background Information and Use Case**

The APCC polls and caches the mount's RA and Dec coordinates once per second. Also, the AP V2 ASCOM driver polls and caches RA and Dec from APCC once per second. The poll and caching scheme that APCC and the AP V2 driver use causes up to two seconds of latency when retrieving mount coordinates. Normally this will be fine, but there are some use cases, like satellite tracking, where a two-second latency is not acceptable.

The real-time RA/Dec command reduces the latency by directly pushing separate :GR# and :GD# commands into APCC's high-priority command queue and consolidating the responses into a single return response. The latency is most reduced when APCC is connected to the mount via ethernet (GTOCP4 and GTOCP5 only).

# How to use this command

Using the AP V2 ASCOM driver via COM interop

#### VB.Net console example:

```
Module Module1
    Sub Main()
        ' Create a COM interop instance of the AP V2 ASCOM driver
        Dim mount As Object = CreateObject("AstroPhysicsV2.Telescope")
        If mount IsNot Nothing Then
            ' Connect to AP V2 Driver
            mount.Connected = True
            ' NOTE: APCC 1.9 must be connected to the mount and the APCC license date
            ' must allow for the GRGD command to be available.
            Dim realTimeRaDec As String = mount.CommandString("GRGD")
            ' Check if there was a valid response
            If String.IsNullOrEmpty(realTimeRaDec) = False Then
                Dim radec As String() = realTimeRaDec.Split("")
                If radec.Length = 2 Then
                    Console.WriteLine($"Full response: '{realTimeRaDec}',
RA={radec(0)}, Dec={radec(1)}")
                Else
                    Console.WriteLine(realTimeRaDec)
                End If
            Else
                Console.WriteLine("No Response from APCC! APCC 1.9 must be connected
to the mount and the APCC license date must allow for the GRGD command to be
available!")
            End If
            ' Disconnect from the AP V2 ASCOM Driver
            mount.Connected = False
```



# 2.5 Plate Solve, Autocenter

Important: The following new feature requires a license dated January 1, 2022 or later. If your license is older you can get access to these features by purchasing a license renewal. The renewal license never expires so you will always be able to use this new feature.

**APCC Pro only:** Plate Solve/Autocenter is a new and convenient way to quickly and accurately center a target after a GoTo. After a GoTo, pushing this button will plate solve your current pointing position (via APPM), recal your mount, and send one GoTo to center the target. This feature requires the mount to be connected and tracking, and APPM must already be correctly configured according to your system and software preferences.



# 3 Getting Started

# Some Notes on Installing and Upgrading APCC

Here are some helpful hints to assist you in installing or upgrading APCC.

- Installation Order: ASCOM Platform → AP V2 Driver → APCC
- Install the latest ASCOM Platform BEFORE installing either the driver or APCC.
- Install the latest AP-V2 driver BEFORE installing APCC.

- For major version upgrades: (i.e. 1.8.x.x to 1.9.x.x), it is a good idea to uninstall the old version first. Use the Windows Control Panel to perform the uninstalls.
- For minor version upgrades: (i.e. 1.9.4.x to 1.9.5.x), simply install as usual.
- You are always safest installing software with all other programs closed.

# **General Information**

The information in the rest of this section will guide you through the APCC installation process and show you how to set it up with the Virtual Port for the Astro-Physics V2 ASCOM driver.

Two detailed work flow sections have been prepared:

- 1. The first <u>Getting Started Work Flow</u> outlines the work flow for getting the program set up for your system. The tasks in this section are performed when you first start using APCC, and are performed much less frequently afterward.
- 2. The second work flow section <u>Operational Work Flow Basics</u> gives you an outline of the general work flow you will use in your night to night astronomy endeavors.

To get the most from your observing session with APCC, be sure to review the <u>Tips to Get the Most from</u> <u>APCC</u>.

In addition to this manual, we encourage you to <u>visit the Astro-Physics YouTube channel</u> for tutorial videos and additional content

# 3.1 Getting Started Work Flow

There are basically two work flow descriptions that should be helpful to you as you work with APCC. First, you need to understand how to get the program set up to work with your mount, your observatory and other software. This section provides a step-by-step outline of this work flow - but it is an outline. Be sure to follow the more detailed steps in the next three sections to actually set up your system with APCC. Later in this "Getting Started" section, we will provide the second section on operational work flow. This will deal with suggested procedures and methods of operation in your normal night-to-night observing and imaging after your system is all set up.

# **Before You Start**

- 1. Get familiar with your mount. If you are new to Astro-Physics mounts, spend some time simply using the mount with the keypad. Learn how your mount behaves. Become familiar with the mechanics of the mount.
- Make sure that you are familiar with the other software programs that you plan to use with APCC. If you try to learn TheSkyX, Starry Night, MaxIm DL, NINA, Sequence Generator Pro, ACP, CCDAutoPilot and APCC all at the same time, you will probably be doomed to failure.
- Become familiar with the AP V2 ASCOM Driver before you begin using APCC. Since most of the software you will use with APCC connects through the AP V2 ASCOM Driver, it is best to first become proficient with operations with the driver. If you have been using a program like TheSkyX with its native driver, make the switch to using it with the AP V2 ASCOM Driver before combining it with APCC.

4. Confirm that you meet all of the Hardware/Software Requirements.

# A Quick Primer on Virtual ports and REST API.

The original versions of APCC employed virtual serial port (VSP) drivers licensed from Eltima. The virtual ports allowed APCC to serve multiple client programs which could all access the mount at the same time through APCC. Over time, our customers taught us that they don't usually need multiple connections within APCC and therefore multiple virtual serial ports. This is because the AP V2 ASCOM driver already acts as a hub for multiple clients.

We therefore decided to offer an alternate method of connection for the AP V2 driver. It has some advantages in terms of setup and config. We now offer a REST API (an application plug-in) to facilitate the connection between the driver and APCC.

*Our current recommendation is to use the REST API, and to not even install the Eltima drivers. If you are a new user, don't install the Eltima drivers unless we determine that they are necessary for your particular setup. Leave the Eltima Virtual Port option box unchecked during setup.* Unless you have a specific reason to use them, you are better off not installing the VSP drivers. Windows no longer likes serial ports, so installing unneeded VSP software can be a bit probelmatic. There will, of course, still be people who will find advantages in installing the VSP drivers. That's why they are still available. They can always be added later if needed.

Setup - Astro-Physics Command Center (APCC) - Pro Version	
Setup - Astro-Physics command center (AFCC) - Pro Version -	
Select Components Which components should be installed?	Ð
Select the components you want to install; clear the components you do not w install. Click Next when you are ready to continue.	ant to
Custom installation	~
Install/Re-install Virtual Ports (NOT recommended)	4.3 MB
Current selection requires at least 123.0 MB of disk space.	
< Back Next >	Cancel

Installation Screen Capture. We no longer recommend installing the Virtual Ports.

The screenshot above shows the point in the installation where the VSP drivers could be installed.

# Initial Setup - Recommended "Easy" Setup

- 1. Prepare all of your physical connections. Have the cables ready to go.
- 2. Close ALL other software, especially other astronomy software (possible ASCOM client software)
- 3. Install in order:
  - a. The Latest ASCOM Platform, if not already installed As of this writing we require version 6.6 SP1 or later
  - b. The Latest AP V2 ASCOM Driver if not already installed v. 5.59.03 or later. If upgrading from 5.08.x or earlier, you <u>MUST</u> uninstall older versions of the driver in Windows Control Panel first!
- 4. Follow the instructions in the section that follows to: Install APCC. During the install:
  - a. Be sure you leave the box to install / re-install the VSP drivers UNCHECKED!
  - b. Check the box to: Allow to run after install.
- 5. NEW USERS: When APCC starts, enter your license key information when prompted to do so. This can be either the trial or full license key.
- 6. NEW USERS: You will be prompted to enter your <u>site information</u> for your primary site. You can also enter information for any other sites you wish at this time. For getting started, you only need the first site you will use, so don't worry if you don't have the information for every site you will eventually enter. You can add sites later. You can edit sties later as well, so for now, a good guess will probably work.
- 7. Close the driver's Setup Telescope window if it is still open from the update to the AP V2 Driver.
- To configure the AP V2 driver for APCC, simply click the small, but mighty \*Config Driver\* button in the AP V2 Driver section of APCC's Connection Group box.



The Config Driver button will momentarily turn grey and then return to the standard blue color.

The AP V2 driver will now be configured correctly for connection through the REST API.

If for some reason you have the ASCOM driver already running, you will receive the following error. You will need to close all applications that use the ASCOM driver and ensure the ASCOM driver is not running, and then you can try the Config Driver option again



 From the APCC Settings Menu (on the menu bar at the top), select Edit Initialize Mount Settings... This will open the <u>Initialization Window</u>. Enter your desired settings and then click the "Save" button.

📕 Astr	ro-Physics Command Center Pro	
File	Settings Tools Help	
As Th Sh	Edit ASCOM Driver Settings Edit Initialize Mount Settings Initialize Mount Manage Sites Resize to original Window Size Save Window Positions Close Main Window when opening Status Window Advanced Settings	Version
	Log <u>D</u> irectory	

- In APCC's <u>Connections Group Box</u>, select your connection method for connecting APCC to your mount - COM port, or Network for GTOCP4/GTOCP5 owners. You MUST select the proper method from the topmost drop-down menu in the \*Connection Group Box\* in order to connect successfully.
- 11. Power up the mount.

- 12. If you aren't sure of the parameters and choices to make: Click the \*Find Mount\* button. APCC will figure it all out for you.
- 13. If you know the parameters and choices to make, you can manually enter them now or any time the mount is not connected.
- 14. Note: The backup port and its timeout setting are optional and not required for proper mount connection and operation.
- 15. Once parameters are entered: In APCC's \*Connection\* group box, click the \*Connect\* button. As APCC connects to the mount, it will poll the mount for relevant info, and then proceed down one of several pathways depending on the system and how you have configured it.
- 16. To test the driver, open up the AP Jog Utility and click the \*Connect\* button.
- 17. Start to Play!! The instructions above will get anyone started with APCC. As you become more familiar with the program, you may wish to set up additional parameters as described in the section below.
- 18. Final note: AFTER you have set everything up and tested through a start-up shut-down cycle or two, you will probably want to consider checking the auto-connect option in APCC's Connections group box.

# Additional Things to Consider at the Getting Started Phase

- Set your desired Park position in the <u>Park Tab</u>. Set the Unpark option in the dropdown list to Last Parked. This is the normal Unpark setting for ALL permanent setups. If you are portable, and must reestablish your position at each startup, set this to Park 4. If you just need to reestablish your position this one time in a permanent setup, select Park 4 and then switch back to Last Parked once pointing is established. To resume from Park 4, you will, of course, need to place the mount into the Park 4 position.
- 2. Create your <u>Horizon Tracking Limits</u> if you will be using them.
- 3. Create your <u>Meridian Tracking Limits</u> if you will be using them.
- 4. Configure your Home and Limits (NON-Encoder mounts ONLY!) after you are finished using the clutches.
- 5.

If you follow these steps in order, you will have everything set up in a way that most users will find ideal. There are, of course, many additional options and settings in APCC that you can work with, but start with the basics and try to get a good understanding of the program before attempting to use the more advanced features.

# 3.2 Hardware/Software Requirements

# Mount Hardware Requirements:

- Astro-Physics GTO mounts, OEM German Equatorial mounts with GTO Servo System (Parallax Instruments or Mathis Instruments).
- GTOCP4/GTOCP5 Control Box or GTOCP3 Control Box with revision "V" or later firmware. Revision V began shipping with all mounts starting at the end of July, 2014. Refer to this information from the Technical Support section of our website. (<u>http://www.astro-</u><u>physics.com/tech\_support/mounts/servo/cp3-chipupgrade.htm</u>)

# Minimum Recommended Computer Hardware Requirements:

The whole idea of "minimum computer requirements" for a single application is really no longer valid in today's computer world. Any computer that can run any of the modern software packages that you will be using with APCC will be adequate to run APCC. The issue in today's environment is whether your computer can run ALL of the required software SIMULTANEOUSLY to achieve your desired goals. APCC is unlikely to ever be run as a stand-alone piece of software. When you consider your computer hardware, aim for a system that can handle all of the observing and imaging software that you plan to use, and that can handle all of it running together. That being said, here are some general tips and recommendations and a few specific requirements:

- RAM is generally more critical to adequate performance than processing power. If budgeting for a computer system, spend the money on more RAM instead of the latest and fastest processors with the most cores. 8GB of RAM is probably adequate for an imaging system, but 16GB or more is even better.
- Solid State Drives (SSDs) have recently become much more affordable. They are certainly not a requirement, but are recommended for your boot drive for their robustness, lack of moving parts, and overall speed. At least 10GB of free drive space (for logs and settings) should be available.
- APCC makes some demands for graphics capabilities, but its demands are generally less than those for either of the two most popular planetarium programs. If you can run TheSkyX or Starry Night Pro Plus, you have probably already exceeded APCC's minimum requirements. However, for clarity, please note the following:
  - 3D accelerated graphics card or integrated controller recommended if using the 3D Telescope View
  - OpenGL 1.5 or later required (Both planetarium programs mentioned above require higher Open GL.)
  - Note that having multiple graphics-intense applications open on the desktop simultaneously can cause problems if your computer doesn't have some graphics muscle!
- Native serial port, or installed PCI serial card, or USB/serial port converter required. For USB to serial converters, we recommend the following:
  - <u>USB to Serial Adapter from FTDI (USB1PFTDI)</u> units (sold by Astro-Physics)
  - High quality units with FTDI chipsets (i.e. Industrial units from serialgear.com like their <u>2-port</u> or <u>4-port</u>)
  - Industrial USB to Serial converters from Moxa
  - Converters from <u>Digi/Edgeport</u>

- Keyspan converters have also been used with success. Beware: Keyspan was sold to Tripp Lite, which is now part of a bigger conglomerate. Make sure to get the real Keyspan unit and NOT the basic Tripp Lite converter.
- We CAN NOT advise using ANY converter with a Prolific chip set!

• Network connections - Ethernet and/or WiFi (optional) for GTOCP4/GTOCP5 Control Boxes

# Minimum Computer Software Requirements and Recommendations:

- Windows 7 / 8 / 8.1 / 10 / 11 32-bit or 64-bit Windows 10 Pro 64 bit is our current favorite among OS choices, but Win 11 is coming up strong. Note that since Microsoft has abandoned older versions of Windows, we can no longer recommend or support systems that are running XP or Vista.
  - Required Run Windows Update to apply all updates.
  - Required The .Net framework must meet the same requirements that are needed for the latest ASCOM Platform. See below

NOTE: .Net 3.5 is also required for some of the AP V2 ASCOM Driver's features. Windows 8 and 8.1 do not ship with .Net 3.5 installed and you cannot directly download and install it. Please see this link to enable .Net 3.5 on Windows 8 and later to have full driver functionality:

http://msdn.microsoft.com/en-us/library/hh506443.aspx

- Required The latest ASCOM Platform installed (<u>http://www.ascom-standards.org</u>) The platform installer will ensure that the various required Windows updates like those for the .Net framework have been installed.
- Required The latest AP V2 ASCOM Driver installed (<u>http://www.gralak.com/apdriver</u>)
- $_{\odot}$  We recommend that you update your browser to the latest version
- We recommend that you install Adobe Acrobat Reader or another PDF reader (may be needed to read APCC and ASCOM PDF documentation)
- Please remember that we are NOT Microsoft. Whatever your hardware and Windows OS version, you should have the PC prepared and know the operational basics.
  - Know how to: use Windows Explorer to: copy and/or paste files and/or folders
  - ...navigate to Windows Device Manager
  - ...navigate through your file system and make the directory C: \ProgramData\xxx visible in Explorer. (It's hidden by default.)

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# Additional Requirement for APCC Pro's APPM Point Mapping Program:

**One** of the following is required:

- The FULL (paid) version of DC3 Dreams PinPoint application v5 or later (v6 or later is recommended).
- Sequence Generator Pro
- TheSkyX Image Link
- ASTAP

# 3.3 Installation and Licensing

# Preparation

In order to install and run APCC, please ensure following:

- 1. Make sure that you meet ALL of the requirements in the <u>Hardware/Software Requirements</u> section as described earlier in the <u>Getting Started section</u>.
- You must register a specific e-mail address with Astro-Physics for APCC. This will be the official e-mail address that is associated with your license. This is required to obtain a trial license key or make a purchase. When your e-mail address has been entered into our database, you will receive an automatically generated email with the subject line: APCC Email Authorization Sent: (your e-mail address displayed).
- 3. Download the program from this <u>APCC Download Link</u>

# Installation

We strongly advise that you log onto your computer with FULL administrator privileges. This means that you are logged on as the primary owner / operator of the computer with full Windows permissions, as opposed to being a user on someone else's computer. Being logged on as administrator is NOT the same as running or installing a program file "as Administrator." **DO NOT** try to install or run this (or any other) astronomy-related software "as Administrator."

If you are updating from v1.8.8.17 or an earlier version, you must <u>uninstall</u> any previous version of APCC in the Windows Control Panel. This is due to the new version of the Eltima Virtual Ports Driver (V9) that will be installed.

Double-click on the installer file: APCC\_Standard\_Setup\_1.x.x.exe or the APCC\_Pro\_Setup\_1.x.x.exe file that you have downloaded to start the installation process. Follow the instructions on the installer. You may need to disable some anti-virus or firewall software before installing.

During the installation process, you will be prompted if you wish to install the virtual ports. **We strongly recommend you do not install or use virtual ports unless you have a specific reason to do so**. Instead, APCC now uses REST API as a robust and reliable connection mechanism instead of Virtual Ports.



IMPORTANT NOTE IF YOU INSTALL VIRTUAL PORTS: Near the end of the software installation process, a black DOS-style Command window might open. DO NOT interfere with this command window! Don't touch anything on your computer, including the mouse or keyboard while this window is up. Doing so may cause a failure of the virtual port system. Please be patient!



One final note on upgrades from earlier versions. This will apply to all upgrades.

# **IMPORTANT NOTE:**

With successive versions of APCC (or any software), the various associated windows can change in terms of their content and arrangements. If the options regarding Window Size and Window Positions are selected when you install the latest version, you may need to turn the window options off, and then on again after installation to reset properly to the new appropriate window dimensions.

# Obtaining a license key

When you run APCC for the first time and until you enter a license key you will be presented with the Trial Registration Information Dialog when APCC starts.

APCC Pro - License Request / Activation - v1.9.0.1					
License Request / Activation					
IMPORTANT: In order to use APCC, you MUST have a GTOCP4 or GTOCP5 control box, or a GTOCP3 with the "V" (or later) firmware installed. If you have a GTOCP3, click the "Check for Valid Firmware" button to determine if you have the appropriate chip installed. This step is not needed for the GTOCP4/CP5. You must have the AP V2 ASCOM driver installed and your computer must be connected to the GTOCP3/CP4 and the power must be on. APCC will read the information from your control box.	Check for Valid Firmware Order Firmware				
To enable your 30-day trial of APCC you must first obtain a license key. The key will only work on the current computer so please be sure this is the PC on which you want to evaluate APCC. Your email address will not be used for any other purpose except to email your registration key. If you have purchased					
APCC and have a LICENSE key you can COPY and PASTE it below.	Clear License Key				
Please use only English characters:	Get Trial Key				
Name (Required):	(Via Internet)				
Email (Required):	Get Trial Key				
Confirm Email (Required):	(Manually)				
Please COPY and PASTE your Trial or Purchased license key into the box below. It must contain 5 lines of text and no extra spaces.					
	PURCHASE				
	Close				

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#### Confirming you have the proper firmware

#### You do not need to do this step if you have a GTOCP4 or GTOCP5.

If you have a GTOCP3 and you are not sure that your mount has the proper firmware installed then you can check it by clicking **Check for Valid Firmware**. For this to work, you must have the AP V2 ASCOM Driver installed and configured for normal (pre-APCC) operation. The serial cable must be connected from the computer to the mount, and the mount must be powered on. If you can successfully use the Check Port button in the AP V2 ASCOM Driver's Telescope Setup window, then you are set up correctly for this test.

If you don't have the correct firmware installed for this mount, you can click the **Order Firmware** button for more information on how to obtain it.

# Obtaining a trial license key or permanent license key if your computer has internet access

You can try APCC for up to 30-days before purchasing. To do so you will need to make sure your e-mail is authorized to receive a trial license key. Authorization is required to ensure that you have the correct firmware and control box, which will help minimize support questions.

To get an authorized e-mail you should contact Astro-Physics via phone or e-mail (support at Astro-Physics dot com) requesting that your e-mail be authorized for the trial. In order to be authorized, you will have to purchase the upgraded firmware (revision "V" or later) if you do not already have this firmware installed in your GTOCP3. Mach1GTO, 1100GTO and 1600GTO mounts shipped beginning July 22, 2014 and later will have the upgraded firmware. Owners of these more recent mounts must still get an e-mail address authorized for the licensing process.

Once your e-mail address has been authorized and entered into our APCC database, you will receive an email with the subject line: APCC Email Authorization Sent: (your em-mail address displayed).

Enter your Name and E-mail address (twice) and click the **Get Trial Key (Via Internet)** button. Make sure that you run APCC on the computer you intend to run it from.

You should receive an e-mail within a few minutes with your trial license key. Just copy and paste all 5 lines of the license key into the text box at the bottom of the window. Do not copy any extra spaces or lines.

If successful, the window will now tell you that you have 30 days remaining in your trial. This window will come up every time you start APCC so you'll know how many days remaining you have.

To begin using APCC click Start APCC.

APCC Trial Registration			
Trial Registration Information	?		
IMPORTANT: In order to use APCC, you MUST have a GTOCP3 control box with the "V." (or later) firmware installed. Click the "Check for Valid Firmware" button to determine if you have the appropriate chip installed in your GTOCP3	Check for Valid Firmware		
You must have the AP V2 ASCOM driver installed and your computer must be connected to the GTOCP3 and the power must be on. APCC will read the information from your control box.	Order Firmware		
You have 30 days left in your trial.			
	Clear License Key		
Please use only English characters:	0.1711/		
Name (Required): Ray Gralak	(Via Internet)		
Email (Required): ray@zzz.com	Cattinka		
Confirm Email (Required): ray@zzz.com	(Manually)		
Click "Start APCC' to begin the trial:			
Name: Ray Gralak	PURCHASE		
Email: raylezzz.com Date: 2012-10-01 RegCode: RZE{JIj-h]{t-[fPF-12345			
	Start APCC		
	.:		

Clicking the PURCHASE LICENSE button will take you to the Astro-Physics e-commerce page for APCC. From there, you can click the appropriate Buy now ! button for the version you wish to purchase. Follow the instructions to complete the purchase. Upon completion of the purchase, you will be sent an e-mail with your full license key.

It is also possible to purchase APCC directly from Astro-Physics by contacting us. If you have made your purchase directly, you will receive a license key via email shortly after your purchase. These license keys are manually generated, so please allow a day or so.

Enter your license key in the same manner as the trial license described above. If you are really smart, a successful registration of a full license will give a message like the following:

APCC Pro - Trial Registration v1.0.0.7			
Trial Registration Information			
IMPORTANT: In order to use APCC, you MUST have a GTOCP3 control box with the "V" (or later) firmware installed. Click the "Check for Valid Firmware" button to determine if you have the appropriate chip installed in your GTOCP3	Check for Valid Firmware		
You must have the AP V2 ASCOM driver installed and your computer must be connected to the GTOCP3 and the power must be on. APCC will read the information from your control box.	Order Firmware		
Full Registration Successful			
NOTE: Your license may be installed only on your own			
personal computers and used with mounts that you personally own.	Clear License Key		
Please use only English characters:	Get Trial Key		
Name (Required): Albert Einstein	(Via Internet)		
Email (Required): Big_Al@E=mc^2.com	Get Trial Key		
Confirm Email (Required): Big_Al@E=mc^2.com	(Manually)		
Please COPY and PASTE your Trial or Purchased license key into the box below:			
Product: APCC Pro Name: Albert Einstein	PURCHASE		
Email: Big_A(@E=mc^2.com	LICENSE		
RegCode: m@}E-IX<-T0p=SeCrEt->[-1038			
	Start APCC		
	.:		

## Obtaining a trial license key if your computer does not have internet access

If the computer on which you intend to use APCC does not have internet access you can click the **Get Trial Key (Manually)** button. A window like below will appear:

🔏 APCC - Get Trial License	e Key Manually	
Email the number belo and last name in the e- After emailing the requ business day, but prob	w to support @astro-physics.com. Make sure t mail. est you should receive a Trial License Key via ably within a few hours if during business hour	o include your first email within 1 s.
	1793588304	
	Close	

Write down the number and from a computer with internet access e-mail it to Astro-Physics. The staff of Astro-Physics will manually generate the license key for you and send via a return e-mail. This could take 2-3 days since the license key won't be generated over the weekend or holidays. Remember that if you use this method, you must install the trial version of APCC on the same computer from which this number was generated.

After you have entered the license key information, select the Start APCC button.

#### Clearing the license key

If for some reason you need to reenter your license key you can click the Clear License Key button.

You will then be able to enter a new trial license key the next time you start APCC.

## Applying a subscription renewal license

If you purchase a subscription renewal to have access to new APCC features, you must do the following:

- 1. Run APCC.
- 2. Click the menu Help->Clear License Key, and click OK.
- 3. Close APCC.
- 4. Run APCC again, and enter your new 5-line license key.
- 5. Close APCC again, and restart it.

## 3.4 Setting up your primary Virtual Port

This section is only for those using the virtual serial ports (VSP) instead of the default REST API. If you use REST API you can skip this section. Also note Virtual Ports tab is hidden when using REST API.

What is a virtual port? Real serial ports are single, unique point to point communication contacts between two, and ONLY two devices. Serial ports, by their nature cannot be shared. Virtual serial ports are software-based rather than physical. Through the Virtual port software, you can effectively create multiple ports that can all be merged into a single entity that can then communicate as a single device to your GTOCP3, CP4 or CP5 servo control box. APCC can create up to four of these virtual ports. The primary port is normally used for the AP V2 ASCOM Driver.

To integrate the AP V2 ASCOM Driver into APCC for seamless operation, you will need to first set up your primary Virtual Port in APCC. This only takes a few moments.

**Note:** You can allow APCC to simply set up and create the virtual ports for you by checking the box in the Connection Group Box to "Create Virtual Ports First." However, this may create conflicts if you have other unrelated serial devices that might not be connected or active at the moment. We have found that it is often safest to set up the primary virtual port manually to avoid these potential conflicts. Hence, the instructions below:

1. Decide on Port Numbers. In the latest release, we have limited the available ports to those between 30 and 99. Your first task is to determine which ports are already in use on your computer, and to make a good guess at which additional ports may be added. You may have a port reserved for APCC, and you may have additional ports reserved for such things as a focuser, rotator, dew heater controller, weather station, MGBox, smart UPS or other serial devices. Remember that at setup, you may not have all of these devices connected, and that they therefore may not show up on your system. Use Windows Device Manager to see your current COM Ports. If you use Keyspan USB to Serial converters, the Keyspan Serial Assistant will show you all of the assigned ports in Windows' Device Manager.

As a general rule, most people will reserve port #s 1 through 29 for normal "real" ports, whether native or via a USB to serial converter like the FTDI or Keyspan units. COM 30 is often a good place to start with your primary virtual port. If you use a lot of serial devices, reserve ports 1 - 30 for real ports, and start your virtual ports with COM 31. You can go as high as COM 99.



2. Open APCC, if it is not still open from your installation. You do not need to be connected to the mount.

#### 78 Astro-Physics Command Center (APCC) Help File

- 3. Click on the Virtual Ports tab in APCC.
- 4. Click on the Port Selection Dropdown list for the first (top) virtual port. The default is "None", but all of the available choices will be listed.



- 5. Select the COM Port that you decided on in step #1 from the dropdown list
- 6. **YOU MUST click the "Create" button to create the port in your system!** This isn't simply an APCC option, but goes to the heart of the PC's operating system.

📕 Astr	🛃 Astro-Physics Command Center Pro			
File	Settings	Tools	Help	
		V	irtual Port	
	Create	CO	M21	-
	Create	No	ne	-
	Create	No	ne	-
Click Create				
	Create A		Delete All	

- 7. Repeat this for the second COM port (i.e. COM 22) and any additional ports you may need. Defining the second port is recommended so that ASCOM client programs that must be run as administrator can have their own instance of the driver.
- 8. Remember the primary COM port number you just created, and proceed to the next step in these instructions: <u>Setting up the AP V2 ASCOM Driver</u>
- More information on using the Virtual Ports can be found under the Main Window => <u>Virtual Ports</u> <u>Tab</u>.

## 3.5 Setting up the AP V2 ASCOM Driver with APCC

Make sure you have the most recent version of the AP V2 ASCOM driver installed. The latest software versions can always be found at <u>Astro-Physics Software Update page</u>

- 1. The ASCOM Driver and the driver's Setup Telescope window must be closed.
- 2. When you launch APCC, you will see the Config Driver button in the ASCOM V2 Driver Connection Group in a "Pink" status. This means the ASCOM driver is not properly configured to match APCC



A 'Pink" status means ASCOM Driver configuration does not match APCC and needs to be updated

3. From within APCC, Click the <u>Config Driver</u> button in the AP V2 Driver Connection Group box as discussed in the <u>Getting Started Work Flow</u> section.

Seriously! That's all that 95% of you will ever need to do!



## 3.6 Operational Work Flow Basics

#### Introduction

The earlier section on Getting Started Work Flow was designed to help you get the system up and running. This section will guide you through normal operations as you use APCC with other software to achieve your observing or imaging goals. The steps below are not hard and fast rules. They are guides that, if followed, will present the easiest and most trouble-free way of operating your system as a whole.

#### Use the AP V2 ASCOM Driver

First off, the question often arises: If I have a choice between using an external program's native driver (as in TheSkyX), or connecting the software through the AP V2 ASCOM Driver, which should I choose? **We strongly advise using the AP V2 ASCOM Driver.** Here are some reasons:

- 1. The AP V2 ASCOM Driver is a full fledged hub. It will accommodate a very large number of programs all connected at the same time, and will do so without any problems. As a single hub, the driver will minimize the serial traffic between the software and the mount by eliminating redundancy.
- The AP V2 ASCOM Driver takes advantage of the full set of Astro-Physics servo commands, many of which were developed specifically for either the driver or for APCC. Since these new commands are not being published, the native drivers found in other software will be limited to the older set of published commands.
- 3. The AP V2 ASCOM Driver can create log files for troubleshooting any issues that you may have.
- 4. We can provide a certain amount of support if you encounter issues with a program that uses the AP V2 ASCOM Driver. We, of course, cannot fix a problem that is in someone else's software, but we may be able to figure out what is happening to cause the problem. If you use a native driver, you will be limited to the support that the software provider can give you. We are unable to support someone else's driver.

#### **Order of Operations**

While there are several ways that you can start up and run your system, we recommend the following order of operations:

- 1. **Power up your imaging camera(s) and software and start the cooler(s).** This is simply a time saver. The cameras might as well be cooling while the rest of the system is being activated.
- Power up your mount. Since APCC automatically sets the <u>Safety Park</u> feature in the servo, the mount will not start default sidereal tracking, even if it was not properly shut down at the end of the previous session. The mount will quietly wait in place until it is initialized and unparked by APCC with NO loss of pointing accuracy.
- 3. **Start APCC**. If you checked the Auto-Connect When Started box in the Connection group box on the main page, APCC will connect automatically to the mount and initialize it. It will then create all of the virtual ports that you have defined. Finally, if the Auto-Connect Driver when APCC connects box

is checked on the Virtual Ports tab it will start up the AP V2 ASCOM Driver and connect to it through the first virtual port.

- Connect the imaging software to the mount if you normally do that. This was added as a separate instruction because we advised you to start your imaging software earlier to cool the camera and we don't want you to forget.
- 5. **Start and connect other software.** Start up each additional piece of software that you will be using and connect that software to the mount, and to any other relevant devices. Refer to the other software and hardware documentation for advice on the order in which you power other devices like focusers and start the various other programs.

#### 6. DO YOUR ASTRO-THING!

Note: Many of you with remote operations will have a scripting program like ACP or CCD Auto-Pilot that will do this for you. If this is the case, we still recommend this basic sequence except that the first thing activated will be the scripting software. Your scripts should include sufficient time (waits) for each element to be completed before proceeding to the next.

If you insist on starting everything from an ASCOM client program (<u>not</u> the preferred method), please note the following: The two checkboxes in the AP V2 Driver section of APCC's Connection group box (Auto-Connect and Auto-Config) must be UN-checked. Also, in APCC's Advanced Settings window: Check Auto-Initialize and set the value to zero. Check the Auto-Shutdown and set its value to 1 second.

#### Shutdown

The shutdown sequence is very much the reverse of the Order of Operations listed above with a couple exceptions. Here is the recommended sequence:

- 1. **Start the imager's cooler warm-up.** Again, this is listed first as a time saver. For cameras that require a warm-up, this might as well be going on while the rest of the shutdown is taking place.
- Park the mount. Most of you will choose to park the mount to a predefined park position, even though this is not strictly necessary with an Astro-Physics mount. For many, the park position is dictated by the observatory architecture, or by the positioning of a flat screen. See the <u>Park Tab</u> section for more details. If you are using TheSkyX to park the mount, be sure to see the <u>special</u> <u>note</u>!
- Disconnect the imaging software from the mount. Since the warm-up of the cooler can take a while, the imaging software is often the last piece of software to be closed down before shutting off the computer. You will want to disconnect the imaging software from the mount before closing APCC.
- 4. **Disconnect and shut down other software.** Disconnect each piece of software from the mount and any other devices that it controls, and then shut that piece of software down.
- 5. Verify that everything is disconnected. There are 2 steps to this:
  - a. If you have connected to the mount with one or more <u>NON</u>-ASCOM programs, go to the <u>Virtual</u> <u>Ports</u> tab and make sure that the only active virtual port is the top one (the AP V2 ASCOM Driver's port). You do not need to delete the other ports that you may have. Just make sure that no further data is being transmitted or received over the lower three virtual ports. If you only connect to the mount through ASCOM clients, you can skip this step.

b. The AP V2 ASCOM Driver has an indicator at the top of the Handbox Window that tells you how many clients are connected. (See the AP V2 ASCOM Driver's help file.)



The first value (in the above case a 1) tells you how many client programs are still connected to the mount. The second value tells you how many DC synchronous focusers are connected. (Note: Digital focusers and focusers requiring drivers cannot use the simple AP focus controls and are NOT included in this count. For most of you, the second value will always be a zero.) When the client count gets down to 1, all the programs have been disconnected. The remaining 1 is APCC. If you have chosen the Auto-Shutdown feature in the <u>Advanced Settings</u> window, the shutdown timer will start when the last client apart from APCC is disconnected.

- Close APCC. If you did not choose Auto-Shutdown as mentioned above, close APCC in one of the conventional ways. When APCC closes, it will also close the last instance of the AP V2 ASCOM Driver. APCC and the driver should be shut down before proceeding to the next step.
- 7. Power off the mount.
- 8. Finish closing down your imager and shut down the observatory.

## 3.7 Tips to Get the Most from APCC

#### **Using the Help Files and Manual**

We have tried to make this information as complete and well organized as possible. If you have suggestions for improving the documentation, please let us know!

This information is available in many formats to suit your situation. We encourage you to refer to these help files first before posting to the forum or calling for support. Please let us know how we can improve the information or presentation to make it easier for all to use.

- APCC Toolbar The APCC toolbar includes a Help selection that will open the entire manual for your review in html format. This version includes a search function and allows you to designate sections of the manual as favorites for quick reference at a later date.
- Adobe PDF If you plan to review the manual at times when APCC is not active, the cross-platform PDF format will be handy. Download it to your computer, print it for reference or upload it to your portable device. If you use it in conjunction with an App like iAnnotate, you can highlight information that you want to remember or make additional notes for future reference.
- Apple iBooks (ePub format) This handy version can sit on the bookshelf on your iPad or even your iPhone! Naturally, other e-readers in ePub format can be used, as well.

We will make an effort to keep the screen shots updated as minor changes occur in upcoming releases, however you may find some outdated screen shots that look slightly different. Please bear with minor differences. However, if you find screen shots that are confusing and require immediate updating, please let us know.

#### Instructional Videos on the Astro-Physics YouTube channel

We have a growing library of tutorials and instructional videos on <u>the official Astro-Physics YouTube</u> <u>channel</u>. Videos are continually updated and new content is created on a regular basis. We highly recommend subscribing to our YouTube channel and enabling notifications so you will be informed as new content is added.

#### Help? in Corner of Group Boxes

Help icons - The Help icons available throughout APCC are likely to be the most handy method for gaining access to information when you need it. Each icon links to the specific part of help content that explains the feature or function. This puts pertinent information at your fingertips for immediate reference. There are frequent links to other information for further clarification.

Help lcons are the upper right corner of almost every group box in APCC you'll find a round button with a "?". Clicking this button will open the help for the group box.



Example of Help (?) icon, located in many group box corners for context-sensitive help

#### Tabs

Tabs provide a quick means to access key areas of the program. You can rearrange the order of the tabs to suit your needs by clicking and dragging the tab order, however the order will not be saved for the next session at this time.

All tabs are visible for all mounts and all versions of APCC with the following exceptions:

- Pointing Model Tab: Only visible for the APCC Pro version.
- ELS Tab: Only visible for 3600GTO
- AE Tab: Only visible for mounts with Absolute Encoders (e.g., Mach 2, 1100GTO with absolute encoders, 1600GTO with absolute encoders, etc.)

#### **Group Boxes**

Closely related items are subdivided into Group Boxes enclosed within a yellow box and given a title to describe their relationship. Some of the group boxes, like the Move Scope group box shown below are always visible on the Main Window. Others are organized within the various tabs or windows.



#### **Resizing Windows**

For your convenience, the various windows can be resized to suit your needs. Simply grab the lower right corner of the window (or the sides) and move it to fit the desired space. Note that the text and graphics will adjust proportionally to the width or length that you specify. This will allow you to optimize the monitor placement of all of the programs you typically use to enhance your work flow.

When you resize APCC, the controls will scale as well. The scaling of controls and fonts is not always perfect but is usually good enough for most purposes. For instance, you can maximize APCC so that the controls are easily visible from a distance, or shrink APCC so that other Windows are also visible.

If you wish to save the location of the windows when you exit APCC, refer to <u>Settings Menu</u>. Please refer to <u>Known Issues</u> if you are using Windows XP or Vista.

#### Limit Primary Control of Your Mount to One Input Device

Your mount can be controlled by a variety of input devices, including the Keypad, iPad/iPhone or computer. Although the devices can work together very well to command the movement of your mount, we recommend that you use only one in your session and that you always initialize, unpark and park with the same primary control device. We expect that for most of you, the primary control device will be your PC with APCC. Remove the primary control functions from any other device that you use. For the keypad, this means setting the auto-connect to EXT. Other devices like iPads should have the time-updating functions to the mount disabled, and should not be used during your final park and shutdown routine.

Remember these rules:

- ONLY ReCal from the same device that sent the slew command.
- NEVER perform a full SYNC from a secondary device!!!

This document provides information regarding various options for controlling your mount: <u>Control Options</u> for <u>Astro-Physics Mounts</u>

## 4 Initialization /Edit Initialization Window

This window can take two formats: It can appear upon connection to an uninitialized mount immediately prior to initialization, or it can be opened as a savable window from the Settings menu for convenient editing.

Whenever APCC detects that the mount needs to be initialized (right ascension = 0 and declination = 90), the **Initialize Astro-Physics Mount** window will open. By default, if you do nothing, whatever parameters have been set up in this dialog window will execute in a user-defined number of seconds. (Default is 10 sec. See the <u>Advanced Settings</u> section under Main Window => Setup Tab) However, you can stop this auto-initialization by clicking the button **Stop Auto-Init.** This will allow you to check your settings and change them, if you wish. You will NOT normally stop the auto-init sequence.

**Useful Tip:** Most users will want to select Auto-Initialize from the <u>Advanced Settings</u> Window so that initialization by APCC is automatic. If that option is checked, the window on the left will appear every time you start APCC after power-cycling the mount. Permanent setups where the various options are not likely to change can select a very short wait time in the Advanced Settings window - 1 or 2 seconds is usually fine. Portable users will want to set longer time intervals to allow time to check settings and possibly temporarily stop the auto-init to make changes.

#### Initialization Window Edit Initialization Window Automatic when connecting to uninitialized mount. Accessed any time from Settings menu. APCC - Initialize Astro-Physics Mount × APCC - Initialize Astro-Physics Mount $\times$ ? ? Awesome Observatory Manage Sites Select Site: Awesome Observatory Manage Sites elect Site --Last Parked Last Parked + nark fro Innark from Site 100° 54' 32.1" W 35° 12' 34.5" N 100° 54' 32.1" W 35° 12' 34.5" N (UTC-06:00) Central Time (US Canada) (UTC-06:00) Central Time (US Canada) ? ? Sidereal Sidereal Set Tracking Rate Set Tracking Rate 1.00× 1.00× -🗹 Set Guide Rate 🗹 Set Guide Rate Set Slew Rate Set Slew Rate 900× 900× Enable PEM Enable PEM Set PEM (Non-Encoder Only) Set PEM (Non-Encoder Only) Stop Auto-Init... 7 Cancel Initialize Cancel Save Click HERE to save these Click HERE to settings for the NEXT Click HERE to stop the Autotime the mount it initialize NOW! init if needed initialized

IMPORTANT: The window on the left above will NOT appear if you have already initialized the mount (including initializing the mount with another source, such as the keypad). Also bear in mind that the mount remains initialized until it is power cycled. Remote observatories that leave power on to the mount (not recommended in case of damaging lightening storms) will maintain an initialized state in the mount and will therefore not see this window upon startup of APCC.

At any time, you can access the editable version of this window under the Settings Menu to adjust the settings. This should be the normal way to change initialization settings. Re-initializing an already initialized mount with new information can result in changes to the mount's knowledge of where it is pointed. Therefore, the editable version DOES NOT have an initialize button.

#### Initialization

The primary initialization functions tell the mount its current location and give it the current time and date. The initialization also initiates the "unpark" calculations that re-establish the mount's pointing. For mounts that have been manually moved or set up in the field, the primary initialization functions also can include syncing the mount to a predefined Park position.

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**Select Site:** Selects the site that will be used to initialize the mount. APCC will use the site's latitude, longitude, time zone, elevation, default temperature and pressure. To edit or create new sites, click the *Manage Sites* button.

Manage Sites: Click this button to bring up the Manage Sites Dialog.

**Unpark from:** This selects the park position from which APCC will unpark. **Usually you will want to select "Last Parked."** This is true even if you park to a defined park position. The only time you would normally unpark from a defined position is if you are setting up the mount or if you have moved the mount via the clutches. Refer to the <u>Park Positions</u> section if you are unsure of the various options.

NOTE: You can also set the <mark>Unpark from:</mark> position to **Don't Unpark** (or <mark>Set Tracking Rate</mark> to <mark>Zero)</mark> if you do not want the mount to start tracking after initialization. Both are shown as examples in this screenshot:

📕 APCC - Initialize Astro-Physics Mou	nt — 🗆 🗙		
Initiali	zation?		
Select Site: California	✓ Manage Sites		
Unpark from: Don't Unpark			
Site Lat. 37° 00' 00.0" N	Site Long. 120° 00' 00.0" W		
Time Zone: (UTC-08:00) Pa	acific Time (US Canada)		
Optional In	itialization ?		
Set Tracking Rate	Zero 🔽		
🐼 Set Guide Rate	1.00x		
🗹 Set Slew Rate	Custom 🔽 1200 🖨		
Set Dec Backlash (GTOCP3 Only)	0.0 🚔 Arc-Secs		
📝 Set RA Backlash (GTOCP3 Only)	0.0 🚔 Arc-Secs		
Set PEM (Non-Encoder Only)	Enable PEM 🔹		
	Save <u>C</u> ancel		

**Unpark Now:** Clicking this button will allow you to unpark the mount from one of the Park positions. You cannot use this button if you have *Last Parked* selected. You typically would use this button to unpark after you have physically moved the telescope to one of the Park positions. Refer to the <u>Park Positions</u> section if you are unsure of the various options.

#### **Optional Initialization**

A basic initialization will give the mount the necessary information to calculate its position (time and location data) and will unpark the mount to either its calculated pointing position, or to a user selected pre-defined Park position. You may, however, wish to set other operating parameters as part of your

general start-up / initialization process. These other parameters can be set automatically at initialization by checking the boxes and selecting the values in the options listed below.

Note that the keypad, or any other software can set its own parameters which can override the parameters you set here at initialization. The GTO Servo will always act on the last parameter that it received for any given option below.

- Set Tracking Rate: If this option is checked, the selected tracking rate is sent to the mount. If this option is not checked, the mount will begin tracking at the default sidereal rate.
- Set Guide Rate: Guide rate is no longer configurable. The guide rate of 1.0x is the recommended guide rate and the only option available.
- Set Slew Rate: If this option is checked, the selected slew rate will be used for slews from within APCC. If this option is not checked, the default slew rate of 1200x (600x for the 3600GTO) will be used. Note the auto-population of slew rate is only available when running P02-01 or later.
- Set PEM: If this option is checked, periodic error correction can be forcibly enabled or disabled during initialization. If this option is not checked, PEM will remain disabled. Note that encoder mounts do not use PEM and will never have PEM enabled.

#### **Command buttons**

**Stop Auto-Init:** Stops the auto-initialization process. This button is not present in the Initialization window accessed through Settings since it is not needed there.

**Initialize**: Clicking this button will initialize the mount with whatever parameters you have defined above. If you have stopped the Auto-Initialization to make changes to your settings, this will then complete the initialization process. The rates on the Rate Settings tab will update.

**Save:** This is the alternate button to the "Initialize" button that is found in the editable version of the Initialization Window that is accessed from the <u>Settings Menu</u>.

**Cancel:** Clicking this button will cancel the initialization and any changes you have made to the settings will not be saved. You may wish to do this if you will be initializing later after downloading new GPS site information.

## 5 Status View Window

The Status View Window provides a convenient way to view information regarding your mount's position, rates, time and other information all in one window. You can initiate button rate commands to center an object in your eyepiece or initiate a "stop" command in an emergency. It also provides a quick link back to to other windows. The Status View Window can be <u>resized</u> to fit your screen.

😼 Status View - Astro-Physics Command Center			
	Quick	Access Controls	Q
<u>D</u> isconnect Park	EMERGENCY STOP!	Y NE N E 128x ▼	NW Main Window 3D View W Log Window
Tracking Rate:	N 😭 🕥 🖍	Swap E/W Swa	SW Default Window Size ap N/S Meridian Delay Meridian Limits
M	ount Position	R	ates
RA	17h 27m 20.0s	Tracking	Sidereal
Dec	66° 01' 10"	Guide	1.00x
Alt	58° 04' 32"	Slew	1200x
Az	334° 54' 51"	Custom RA	0.00000
Pier	EAST	Custom DEC	0.00000
	Time (	·	ther 🕜
Time	14:53:35	Latitude	40° 12' 34"
Offset	-6:00:00	Longitude	90° 12' 34"
LST	19h 41m 15.0s	PEM	Playback
HA	02h 13m 54.9s	Faults	None
HOR	05h 56m 30s	Park Status	Unparked (AP)
MER	10h 07m 57s		

#### **Opening the Status View Window**

**Show Status View Window When Starting:** If you want the Status View Window to display instead of the Main Window each time you start APCC, check the appropriate box on the Setup Tab of the <u>Main Window</u>.

**Status Window Button:** Click on the button located on the Main Window under the Telescope Position group box.

#### **Quick Access Controls**



**Connect / Disconnect:** To connect APCC to your mount, press this button. Note that if an ASCOM application invokes the driver and the driver cannot connect to APCC on its virtual port then the driver will try to start a new instance of APCC and wait until the connection has been established. In the Connection Group box, you will want to have "*Auto-connect when started*" checked. Refer to <u>Connection Group Box</u> for more information.

Park: Parks the mount to the park position selected on the Park Tab.

EMERGENCY STOP !: Press this button to stop the mount. For more information check this section.

**Tracking Rate:** The symbols represent various tracking rates. The yellow line above the symbol indicates which rate is active. You can change the rate by selecting the appropriate symbol, with the exception of the variable rate. This rate must be set on the <u>Rate Settings Tab</u>.

NOTE: You can move the scope with the move buttons and the rate will still be maintained. Doing a GoTo slew usually means you want to look at a different target so tracking is reset to sidereal because almost every other target's tracking rate is sidereal!

NOTE: If you find that your mount is stopped (not tracking) and you are unable to change to any of the tracking rates, click on the Emergency Stop button and see if tracking was stopped there. If it was, click again to begin tracking.

**N/S/E/W/NE/NW/SE/SW:** When pressed, the mount will move in the direction that the button indicates. The rate of movement will be defined by the number in the center box, which shows the rate the mount moves in sidereal rate units when the button is pressed. This number can be changed with the arrows or simply type the value in the field.

Swap N/S: Swaps the direction of North and South button commands.

Swap E/W: Swaps the direction of the East and West button commands.

**Buttons for quick link to other windows:** Any of the remaining eight buttons at the far right can be clicked to open the corresponding tab or window.

#### **Mount Position**

Displays information obtained from the mount control box.

Mount Position ?			
RA	RA 14h 32m 30.2s		
Dec	47° 37' 28"		
Alt	00° 46' 47"		
Az	08° 58' 10"		
Pier	EAST	CwUp	

Note that when the mount is in a counterweight-up position, this will be indicated in the Pier field along with the pier side.

#### **Rates**

Displays information obtained from the mount control box.

Rates ??			
Tracking	Sidereal		
Guide	1.00x		
Slew	600x		
Custom RA	0.00000		
Custom DEC	0.0000		

#### Time

Displays information obtained from the mount control box.

Time?		
Time	6:14:52 PM	
Offset	-6:00:00	
LST	03h 27m 55.2s	
HA	-11h 04m 34.9s	
HOR		
MER		

#### Other

Displays information obtained from the mount control box.

Ot	her 🥂
Latitude	42° 22' 54"
Longitude	89° 01' 05"
PEM	Playback
Faults	None
Park Status	Unparked

Faults: This field can display the following:

- None = No faults
- Power = Low Power fault
- Stall = Motor Stall
- Servo = Servo fault

If there are multiple items they will have a "+" sign between them. For Instance: "Power+Stall".

## 6 Main Window

The Main Window was designed so that you can monitor the most important connection, telescope position and status information at all times, regardless of which tab is open. The controls for moving the scope via the buttons are also handy.

The tab format allows you to easily access all settings throughout your settings.

Astro-Physics Command Center Pro					– 🗆 X
Program Operation Program Operation Ask if OK To exit Keep APCC on top Show Emergency Stop window Clear all errors when starting and connecting to the mount Log File Opened Advanced Settings	Mount Type ? 1600GTO Vers Tools ? Ierminal Log Window Log Directory	Firmwa ion Periodic Error O Enable Disable Record	re Correction Current State Record Countdown	- <b>?</b> ] ] ]	AP Timer AP Jog AP <u>B</u> APAS PEMPro
Setup Site Park GoTo/ReCal Pointi Connection ? TCP LAN / WF/(6T0CP4/5 Only)	ng Model Rate Settings Horiz Move Scope	on Meridian GPS	Uiew South	Telescope Posi	tion
Hostname / IP Address (GTOCP4) Timeout (msec) 192.168.50.193 500 🜩 Backup Port Timeout (msec) CDM3 👽 500 🜩	W STOP E Decta SW S SE	<u>C</u> lear	w	E DEC	
Mount Auto-Connect <u>Find Mount</u> <u>Connect</u> Config <u>Driver</u>	1200x  Auto-fix N/S/EW  Swap E/W  Swap N/S	Plate Solve, Autocenter Rate Pier Flip	SLEW S 3D View Not Connected		PointCorr Rate Corr Horizon Meridian
TCP COM3 REST API		Comm Events	<u>S</u> tatus Window	Toggle Tracking	EMERGENCY STOP

## 6.1 Connection Group Box

In this group box you can set up the connection to the mount via a COM port, or if you have a GTOCP4/GTOCP5, also via Ethernet or WiFi.

Below are some images showing various states of configuration and connection:



#### Using GTOCP4/GTOCP5 with Ethernet

Those of you with the **GTOCP4/GTOCP5** Servo Control Box now have the option of connecting directly with Ethernet or WiFi. Ethernet connections can either be direct peer-to-peer connections (cable direct from the computer to the **GTOCP4/GTOCP5**) or they can be through a local area network (LAN). In a similar manner, the **GTOCP4/GTOCP5** can have its WiFi configured as an Access Point for direct connection from a WiFi enabled PC, or it can join your established WiFi network in Station Mode. See IP connections below.

#### **Connection Types:**

You have two primary choices when connecting your computer to your mount: Serial (USB), UDP, and TCP. Serial requires a USB connection to the mount, while UDP and TCP require an ethernet or WiFi connection

The following sections describe how to connect APCC to your mount based on your preferred connection choice

#### Serial/USB

When you put APCC in serial port mode, the Primary and Backup COM Port drop down list boxes will become available and the Hostname/IP Address field will become disabled.

The USB connection on the GTOCP4/GTOCP5 is treated as a normal serial port as far as APCC or the AP V2 driver is concerned. If you are connecting with USB, simply follow the instructions for COM ports below as if it were a serial port. Please note that you MUST first install the FTDI Driver onto your computer for USB to operate properly. Note also that the FTDI USB to serial devices are all uniquely serialized. Each one will be assigned its own COM port that will be remembered through power-cycles.

Please check the Astro-Physics Software Updates page for links to the latest FTDI drivers

**Primary COM Port:** The list of serial ports that were detected on the computer will be displayed in this drop down list box. Select the default COM port that APCC will use when the *Connect to Port* button is pressed.

**Find Mount:** If you aren't sure of the mount's COM port number, you can also click the Find Mount button which will scan your serial (COM) ports.



It will scan your serial ports and if it finds a mount it will prompt if you wish to use the found COM port:



You can choose No to continue searching other ports (for example, if you have multiple mounts connected to the same computer). If it exhausts all ports and does not find a mount, it will report the COM ports it tried.

🛃 АРСС	×
Ports tried: COM3	
No port was found.	
<u>D</u> K	
Auto-closing in 56 seconds. Default Actio	n: OK 🚙

At this point you will need to investigate the physical mount connection (USB cable) and/or confirm the proper FTDI drivers are installed.

<u>Note for GTOCP3 users</u>: Be sure that your serial cable is connected to the *top RS-232 port on the GTOCP3 control box*.

<u>GTOCP4/5 users:</u> You do not need to show any preference between the top, bottom and USB ports. All should perform equally well.

**Backup COM Port:** If you choose to, you can select a secondary COM port for APCC to try if the primary COM port has a problem for any reason. To use this feature you will need to use both ports on the control box and will need a second USB/serial port converter. This adds an extra layer of reliability in case the primary USB/serial port converter fails. The backup port will be the bottom COM port of the GTOCP3 control box. Ideally, this should be a physically separate serial port from the primary port. If you simply use another port on a single multi-port USB to serial converter, and the converter or USB connection fails, you will lose both ports and gain nothing. If you use a second USB to serial converter that is attached to a different USB port on the computer, you are much more likely to survive a COMs problem.

**Timeout:** Here you can set the timeout in milliseconds for responses from the mount. In Ethernet or WiFi mode, the ideal timeout can be quite variable depending on the rest of your system. We suggest starting out at 50 ms for cabled Ethernet connections, and try 100 - 200 ms for WiFi networks. For COM ports - whether serial or USB, usually 100 or 200 ms is good enough. However, sometimes it may be necessary to increase this value to 300, 400 or even 500 ms. (Note the difference between this recommended setting and the longer recommendation for the AP V2 ASCOM Driver when it is used through APCC's Virtual Ports.)

UDP or TCP (LAN or WiFi)

UDP or TCP?

UDP LAN / WiFi (GTOCP4/GTOCP5 Only): UDP is a lightweight connectionless protocol that usually will be the best choice when connected to the CP4 with a reliable hard-wired connection. It can also be used for WiFi connections but the UDP protocol does not guarantee delivery of packets. APCC tries to resend a command one time if it gets no response, then it will report an error. To check the error count click the "Comm Events" button in APCC' status bar. You can only click this button if there are errors.

Note that when this option is selected the two COM Port's drop-down boxes will become inactive, and the Hostname/IP Address box will become active. The Hostname/IP Address box is not a dropdown box, but requires the entry of either the appropriate Hostname or IP address. It is always preferable to use the true IP address, but it is generally easier to use the Hostname. Clicking the *Find Mount button* will broadcast a request out to your local network. Any GTOCP4/GTOCP5 that gets the broadcast should and respond.

TCP LAN / WiFi (GTOCP4/GTOCP5 Only): TCP is a more robust connection-oriented protocol. It has considerably more overhead than UDP both in system and network resources but it is generally more reliable than UDP. It can be used for both wired and WiFi connections. In general it is better to use the lighter weight UDP protocol unless you start to see a considerable number of errors.

Note that when one of these options are selected the Hostname/IP Address box will become active and the two COM Port's drop-down boxes will become inactive. The Hostname/IP Address box is not a dropdown box, but requires the entry of either the appropriate Hostname or IP address. It is always preferable to use the true IP address, but the Hostname can also be used as an alternative. Clicking the <u>*Find Mount button*</u> will broadcast a request out to your local network. Any GTOCP4/GTOCP5 that gets the broadcast should and respond and be listed.

Note that a GTO controller's wired Ethernet Hostname and a wireless WiFi Hostname will be different from each other. In general, unless you have changed them the names will all end in the numeric portion of the GTOCP4/GTOCP5 serial number (without the leading zeros if there are any). For example, the control box with serial number: CP4-0456 would have a cabled Ethernet Hostname of: GTOCP4\_456. The WiFi Hostname would be GTO\_WIFI\_456.

IP addresses can be obtained easily from your GTOCP4/5's main web page. Use the handy <u>Find</u> <u>Mounts utility app</u> (look under Utilities and download Find Mounts) to find the relevant information and open the GTOCP4/5's internal web page. Note that network-based IP addresses are subject to changes, whereas the peer-to-peer and access point IP addresses remain unchanged unless you change them.

**Find GTOCP4/5 button:** Clicking the Find Mount button will open a new window and send out a broadcast to find a GTOCP4/GTOCP5 on the LAN (or WiFi).

Setup Site Park GoTo/ReCal Pointing	APCC - Find GTOCP4/GTOCF	2		— c	x c
TCP LAN / WiFi (GTOCP4/5 Only)	Type Name IP	Firmware	Mac Address	Access Poi	int
Hostname /IP Address (GTOCP4) Timeout (msec) 192.168.50.193 500 € Backup Pot Timeout (m. None ▼ 500 € Mount AP V2 D Find Mount 1 Config Driver	AN C 14654 19	2.168.50.193 VCP4-P02-15	02:00:00:00:02:8e	GTOCP4-N	ET-654
TCP None REST API	<u>R</u> efresh <u>S</u> elect	Use numerical IP address v	alue (recommended)		<u>C</u> lose

Use the following steps as indicated in the picture above:

- 1) Click the Find Mount Button
- 2) The Find GTOCP4/GTOCP5 window will open and report and control boxes that are found.
- 3) Click the entry for the mount that you want to connect to. This will enable the Select button.

4) Click the *Select* button. This will close the Find Mount feature and will copy the mount connection information into the Hostname/IP address field

**Backup COM Port:** You can also optionally setup a backup COM port for APCC to try if your TCP or UDP has a problem for any reason. This adds an extra layer of reliability in case the primary ethernet connection fails. To use this feature you will need to have a USB cable connected to your mount You can specify the backup port in the same way you specify a Serial USB connection, as described above.



#### Mount Sub-Group Box

This group-box has options for finding mounts and controlling the connections.

"Find Mount" button is described in the context of <u>Serial (USB)</u> and <u>Connection Group Box</u> connection descriptions above



**Auto-Connect -** When this is checked, APCC will attempt to connect to the mount as a part of its startup sequence. If you have this box checked, you will want to have an overall start-up procedure that powers the mount ON before starting APCC. This is common practice and is recommended in permanent and remote systems. Once connected, APCC will proceed through the initialization procedure you have previously defined.

When Auto-Connect option is enabled, APCC also attempts to auto re-connect to the mount if the connection is lost. It's a valuable option to enable when doing fully automated and/or remote imaging.

**Connect/Disconnect Button** - Click to connect APCC to the mount. The button will turn green to indicate successful connection. Click to Disconnect to disconnect from the mount, and the button will return to a blue color.

#### AP V2 Driver Sub-Group Box

This group box has one option: Config Driver. Pressing this button will configure the ASCOM driver with the correct settings for connecting to the mount via APCC.



**Config Driver** - When this is pressed, APCC will try a one-time configuration of the relevant sections of the APV2 Driver's settings in order for the driver to connect properly.

If APCC determines the settings in the ASCOM V2 driver need to be updated, this button will display in a pink color. This indicates you should press this button and APCC will try to update the ASCOM settings. If it succeeds the button will turn back to blue, indicating it successfully updated the ASCOM driver connection settings



When the Config Driver button is Pink, this indicates the ASCOM driver and APCC settings are not consistent, and needs to be updated. Pressing this button resolves this issue.

#### ASCOM Connection to APCC via Client Applications

Once the ASCOM Driver connection details are finished, connection from ASCOM to APCC now is initiated by the client application (such as NINA, SGP, AP Jog Utility, etc.).

When the client application connects to the mount, it will launch the ASCOM driver, which then will connect to APCC. This process happens behind the scenes so it should just appear that the mount connects. "Pre Connecting" via ASCOM V2 driver is no longer the preferred approach and is no longer supported in this version.

## 6.2 Move Scope Group Box

Controls to move the mount are in this group box. You can select the move button rate and also swap North-South and East-West directions. When you press and hold a button, RA Delta will display the approximate movement of the mount. When you let go of the button, the calculations will continue to be updated as polls to the mount are completed.



**N/S/E/W/NE/NW/SE/SW:** When pressed, the mount will move in the direction that the button indicates. The rate of movement will be defined in the *Move Button Rate* drop-down combo box.

**STOP:** Stops any mount movement initiated by a button press. This might be necessary if the serial port command gets corrupted or doesn't make it to the control box. Usually tapping one of the direction buttons will also stop movement because a quit move command is always sent when a button is released.

**Button Rate**: Select the rate that will be applied when you press one of the directional move buttons. Note the available button rates will change based on the type of mount connected (auto-fill available button rates requires version P02-01 or later).

**Swap N/S:** Reverses the direction of North and South button commands. This is useful to adjust the action of the button pushes to make them more intuitive and instinctual. For instance, if the star moves down when you push the "N" button, click on the *Swap N/S* button. Now, the star will move up when you push the "N" button, which will make subsequent adjustments easier. You can make the same adjustment with the "E" and "W" buttons. When properly set up, the direction buttons will cause the object to move according to your orientation.

**Swap E/W:** Reverses the direction of the East and West button commands. Refer to the Swap N/S section above.

#### **IMPORTANT NOTE:**

The background color of **Swap N/S** and/or **Swap E/W** will turn yellow if APCC detects that the mount has the direction reversed. When reversed this can cause autoguider calibration failures so it should **NOT** be left this way if you are attempting to do imaging.

**Auto-fix N/S/E/W Movements:** When checked, APCC will monitor and correct the mount direction if reversed. If you plan to autoguide through the AP V2 ASCOM Driver it is recommended that you keep this checked. It is important to understand that the direction buttons can NOT be swapped if this box is checked. This includes attempts to swap directions from the AP V2 ASCOM Driver and the keypad. If you wish to do some manual movements with the direction swaps in effect, temporarily uncheck this box, and then recheck it when you are ready to start imaging. It is important for calibration and guiding to all be done with the direction moves in their normal state.

**RA Delta/Dec Delta:** Shows the approximate amount of movement since the start of the last button press.

Clear: Clears the RA and DEC Delta values.

**Plate Solve, Autocenter**: This button will be invisible in APCC Standard as only APCC Pro has this feature.

Slew Rate: Displays current Slew Rate setting

**Pier Flip Button:** This button will initiate a pier flip under the following conditions:

• If the scope has crossed the meridian, the button will flip it by simply issuing a GoTo slew command to the current coordinates.

- If the scope has not yet reached the meridian, but its coordinates are within the "safe zone" of the meridian limits, a meridian offset will be set to allow the flip, followed by the GoTo slew command to the current coordinates.
- If the scope has not yet reached the meridian, and it is NOT in a safe zone vis-a-vis the meridian limits, no flip slew will occur.

## 6.3 Telescope Position Group Box

This box shows all of the position information for the mount.



When APCC is connected to the mount, the scope's position is shown by a red square in the virtual Sky window view. The pier side is shown in the upper left and right with either an *E* or *W* within a yellow box.

**View South:** When enabled this option flips the orientation of the sphere so South is at the top and East is on the left. This is primarily a visual aid for customers in the Southern Hemisphere.

The 3-D telescope view can be opened by clicking the 3D View button.

When slewing, the word SLEW will flash in the bottom left of this window.

When the mount's counterweight is "up", the word *CWUP* will show in the bottom right of this window.

**LST:** This shows the current local sidereal time. Clicking the *LST* text will swap to show the hour angle *(HA)*, which is the time distance of the scope from the Meridian. You may have noticed that there is no way to enter your clock time. APCC uses your computer time when sending time information to the mount. You may wish to utilize time server software to keep your computer time as accurate as possible, if that is important to your operation.

**RA:** This shows the right ascension position of the mount.

**DEC:** This shows declination position of the mount.

- ALT: This shows the altitude position of the mount.
- **AZ:** This shows the azimuth position of the mount.



#### The following four indicators have special features:

#### Point Corr: (APCC Pro only)

- This shows if pointing correction is enabled. When enabled the indicator has a yellow background and red text.
- $\circ$  Hovering the mouse over the indicator will show more details.
- Clicking the indicator once will switch APCC to the **Pointing Model** tab.
- o Double clicking the indicator toggles Pointing correction between enabled and disabled.

Rate Corr: (APCC Pro only)

- This shows if tracking rate correction is enabled. When enabled the indicator has a yellow background and red text.
- $\circ$  Hovering the mouse over the indicator will show more details.
- Clicking the indicator once will switch APCC to the **Pointing Model** tab.
- o Double clicking the indicator toggles Tracking Rate correction between enabled and disabled.

#### Horizon:

- This shows if horizon limits is enabled. When enabled the indicator has a yellow background and red text.
- $\circ$  Hovering the mouse over the indicator will show more details.
- Clicking the indicator once will switch APCC to the Horizon Limits tab.
- Double clicking the indicator toggles Horizon Limits between enabled and disabled.

#### Meridian:

- This shows if meridian limits are enabled. When enabled the indicator has a yellow background and red text.
- $\circ$  Hovering the mouse over the indicator will show more details.
- o Clicking the indicator once will switch APCC to the Meridian Limits tab.
- o Double clicking the indicator toggles Meridian Limits between enabled and disabled.



#### **Tracking/PEM Indicators**

PARKED: Indicates the tracking state (e.g. Parked, Tracking, Stopped, etc.)

**PEM:** This shows if PEM is enabled. When enabled the indicator has a yellow background and red text.

NOTE: This box might also read "ENC" (encoder) if the mount has encoders and the RA encoder is enabled.

## 6.4 Status Bar and Button/Indicator Bar

The Status Bar, and the Button / Indicator Bar are always visible at the very bottom of the main window.



The lower portion of the Status Bar (shown in blue color above) provides the following information:

• **Park State:** Valid states include Unparked, Parked, Parking, and Unparked (AP). The last state indicates that the mount will <u>auto-park</u> if the mount loses connection with APCC for any reason (e.g. the computer crashes).

**Note:** double-clicking the park state field will toggle the parked state of the mount. So if the mount is parked, double clicking will unpark the mount. Double clicking again will park the mount at its current position (which might not be the configured parked position on the <u>Park</u> tab).

• RA Tracking State: Valid states include Stopped, Sidereal, Lunar, Solar, and Custom.

Note: double-clicking the RA tracking state field will toggle the tracking state of the mount.

- PEM State: Valid states include On, Off, Recording, Encoder
- **RA Tracking Rate State:** rate in arc seconds per second offset from sidereal rate. There will only be values here if you have set a custom rate, or are set to the Lunar or Solar rate. Otherwise, the rate will show as zeros if you are set to sidereal.
- **Dec Tracking Rate State:** The rate in arc seconds per second. There will only be values here if you have set a custom rate. Otherwise, the rate will show as zeros.

All of the above values are polled from the mount every few seconds.

The Button / Indicator Bar Shows summary connection information and provides 4 buttons with special functions.

• **Mount Connection Indicators:** There are two indicators to show the current connection status. The first indicator will show one of three values depending on how APCC is connected to your mount: the COM port number (if serial), the word TCP to indicate a TCP connection through Ethernet or WiFi, or the word UDP to indicate a UDP connection through Ethernet or WiFi. The second indicator shows the number of the Backup COM port if one has been defined (it will be blank if no backup port has been defined). A Yellow indicator means a good connection. Black indicates no connection. A

problem connection will be pink and may flash. Please refer to the <u>Connection Group Box</u> section for more information.

Virtual Port Indicators: If you are using Virtual Ports instead of the REST API, the ports numbers
and status are indicated here. Virtual Ports are described in detail in the <u>Virtual Ports Tab</u> section.



• COMM Events Button: This button is enabled when there have been communications errors like timeouts, or servo errors like low power or motor stall. Clicking the button will open a viewer to the list of errors. For the 1100, 1600, and 3600 mounts a \$V# command timeout might get registered as a COM event. This is normal and it can be ignored. That command is simply being sent to try to determine if the AE or ELS box is present. This button is disabled if there are no communications errors.

# NOTE: If timeouts regularly occur, try increasing the appropriate timeout value in the <u>Connection group box</u>.

APCC Communications Event	2	8	
COMM Errors: 1	Show Low Power:	Show 0	
Servo Errors: 0	Motor Stalls:	0	
Error Event List:			
Time/Date	Еггог Туре		
8/6/2014 9:14:02 PM	Sent: '\$V#', Error: The operation has timed out.		
Clear Queues	<u>Clear Errors</u>		
* -			

Click the **Clear Errors** button to clear the screen. When you close the window, the **COM Events** button will be grayed out again. The **Clear Queues** button may be needed if you have an Ethernet or Wifi problem that results in a large number of timeouts.

- Status Window button: Opens the APCC Status View Window
- Toggle Tracking button: Quickly toggle back and forth between sidereal tracking and stop tracking.

• Emergency Stop: Stops mount motion and opens the Emergency Stop Window

## 6.5 Menus

### 6.5.1 File Menu



**Load Settings:** This will open a dialog window from which you can select a previously saved settings file. This menu item is only available (i.e. active) when APCC is not connected to the mount.

**Save Settings as:** This will open a dialog window from which you can select a file name to which settings will be saved. All Initialize Mount settings will be saved. Refer to the <u>Initialization Window</u> for more information regarding these settings. In addition, the file names of the current set of Horizon and Meridian Limits will be saved for automatic loading into APCC. This makes it much more convenient to use APCC with several favorite locations and setups that may have different limit settings.

Exit: this will exit APCC.

#### 6.5.2 Settings Menu

Astro-Physics Command Center Pro						
File	Sett	tings Tools Help				
		Edit ASCOM Driver Settings				
	Edit Initialize Mount Settings					
As		Initialize Mount				
Sh		Manage Sites Environmental Settings				
CI						
co		Safety Monitor Settings				
		Advanced Settings				
		Resize to original Window Size	F10			
		Save Window Positions				
	Close Main Window when opening Status Window					

**Edit ASCOM Driver Settings:** This will open the ASCOM V2 Driver's Telescope Setup Window. It provides a convenient way to set the driver up to work optimally with the APCC. In particular, the COM

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port details. For instance, checking the APCC Virtual Port checkbox so that the ASCOM driver opens automatically when you connect to the port using APCC. Note that the location, mount type, park and initialization settings in the ASCOM V2 driver are independent of the settings in APCC. You will create and adjust these settings within APCC. Refer to the ASCOM manual for additional settings that are useful when using APCC.

**Edit Initialize Mount Settings:** This will allow you to edit the mount initialization settings. These are the setting that APCC will automatically apply to the mount when it detects RA=0 and Dec=90.

**Initialize Mount:** This will open the initialize mount dialog window, which will allow you to reinitialize the mount. **Note:** The mount can only be initialized after a power cycle when RA=0 and Dec=90.Refer to <u>Initialization/Edit Initialization Window</u> for additional information.

**Manage Sites:** This will open the <u>Manage Sites</u> dialog window, which will allow you to add new sites, or modify existing sites.

<u>Environmental Settings</u>: Allows you to select an ASCOM ObservingConditions driver, or a THUM device. Environmental values can be used for refraction calculations.

<u>Safety Monitor Settings</u>: Allows you to select an ASCOM Safety Monitor driver. Safety monitors can be used to report unsafe conditions, such as rain or clouds.

Advanced Settings: This will open the Advanced Settings Window. Choosing this is identical to pressing the Advanced Settings Button in the Program Operation Group Box. See <u>Setup Tab =></u> Advanced Settings for more information.

**Resize to original Window Size:** This will resize APCC main window to its default size. Please refer to <u>Known Issues</u> for additional information regarding Windows XP and Vista.

**Save Window Positions:** When this is selected, APCC's window positions will be saved when APCC exits. The next time APCC starts the Windows will open in the same position that they were last closed in. If you are using Windows XP (and possibly Vista, though this has not been tested to date) and have resized the window, the screen may not load correctly. Please refer to <u>Known Issues</u> for additional information.

#### **IMPORTANT NOTE:**

With successive versions of APCC (or any software), the various associated windows can change in terms of their content and arrangements. If the options regarding Window Size and Window Positions are selected when you install the latest version, you may need to turn the window options off, and then on again after installation to reset properly to the new appropriate window dimensions.

**Close Main Window when opening Status Window:** As the name implies, having this checked will cause the main window to close any time the Status Window is opened.

#### 6.5.2.1 Environmental Settings

Using Environmental Settings within APCC can improve your pointing and tracking accuracy when doing things like sky modeling and refraction calculations.
APCC's Environmental polling uses the ASCOM standard ObservingConditions hub, so it can work with THUM devices, OpenWeatherMap, or any device or service that provides an ASCOM ObservingConditions driver. This includes:

- Pegasus Astro Uranus Meteo
- Pegasus Astro PowerBox (with environmental sensor)
- MGBox V2

If you are interesting in experimenting with Environmental Settings but don't want to invest in a dedicated monitor, you can try OpenWeatherMap which is a no cost source of weather data. Details on how to do this are in the following knowledgebase article: https://astro-physics.bolddesk.com/kb/article/61/how-to-set-your-location-for-environmental-variables-in-openweathermap

APCC - Environmental Co	—		×			
	Enviro	nmental Set	tings			?
Enable Environmental	Polling	Select D	river			
ASCOM ObservingCondition	ons 🔽	ASCOM.Si	mulator.Observir	ngConditions		
Poll Interval(secs) 10	<u>I</u> est	Temp (C) 5.4	Pressure (mb) 1020.5	Humidity 50.0	Dew Point (C) -4.2	
	<u>0</u> K		<u>C</u> ancel			

Open the Environmental Settings to configure the

## Enable Environmental Polling - turns on/off environmental polling

**Source** - you can choose THUM Device or ASCOM ObservingConditions. The source will need to be properly installed and configured prior to connecting in APCC.

**Poll interval (secs)** - how often is the device polled for updated conditions. Generally the default value of 10 seconds is sufficient for most situations.

Select Driver - If you chose ASCOM ObservingConditions, you need to select the specific device/driver.

**Test** - once your device is properly configured, you can click Test button to test the connection. If it works properly, you will see values for one or more of the environmental variables (please note your device may not support all variables. For example, pressure is often omitted from some results). Also note with MGBox V2 if it returns -273c for temperature, that indicates the device is not yet initialized, or it is not working properly. Consult the product documentation for possible fixes.

#### 6.5.2.2 Safety Monitor Settings

NOTE: This feature requires a license dated 9/1/2022 or later:

Safety Monitor enables APCC to poll an external ASCOM-compliant safety monitor . If Safety Monitor the driver returns that it is "unsafe" one of four actions will happen:

Allows APCC to poll an external ASCOM-compliant safety monitor. If Safety Monitor the driver returns that it is "unsafe" one of four actions will happen:

Allows APCC to poll an external ASCOM-compliant safety monitor. If Safety Monitor the driver returns that it is "unsafe" one of four user-configurable actions will happen:

- 1. Park Mount to the park position defined in APCC's setup tab.
- 2. Send the mount to the Home position (or Park position if Home is not defined).
- 3. Stops mount tracking.
- 4. Just warn that the conditions are unsafe.

Choose Safety Monitor Settings... from the Settings Menu:

📕 APCC - Safety Monitor Settings	_	· 🛛	×
ASCOM Safety Monitor Settings			0
Select Driver ASCOM.Simulator.SafetyMonitor			
Poll Interval (secs)     Action when unsafe or lost communication       5     Just Warn	<u>T</u> est	Status	
<u> </u>			

Enable ASCOM safety monitor polling - enables/disables safety monitor polling.

**Select Driver** - Clicking this brings up a standard ASCOM choose for selecting your desired Safety Monitor. The safety monitor must be installed and properly configured prior to selecting the option here. If

your desired safety monitor is not available in the chooser pulldown menu, please consult the safety monitor documentation for installing its ASCOM driver.

**Poll interval (secs)** - how often is the device polled for updated conditions. Generally the default value of 5 seconds is sufficient for most situations.

**Action when unsafe or lost communication** - This setting determines what happens when the safety monitor is enabled and reports unsafe conditions or communications is lost with the safety monitor. Remember the safety monitor is considered a critical point of failure to protect against events that may damage equipment (such as rain).

- Park Mount will park the mount at the park position defined in APCC.
- Home Mount will send the mount to its defined Home position (or park the mount if the Home position is not defined).
- Stop Tracking will stop the mount tracking and leave it at its current position.
- Just Warn will display a warning on the user interface but will not impact mount tracking or parking.

Which option you choose depends on what you want to happen when unsafe conditions are detected. For example, if you have a rolloff roof observatory and need to park your mount in a specific position before closing the roof, Park Mount may be a good option. If you are conducting a sky mapping session from APPM, and want to wait for clouds to pass and then continue with your mapping run, stop tracking might be a good choice.

Please note if you enable safety monitor polling, it is automatically used by APPM. If you do not want safety monitor to be used by APPM, uncheck Enable in this window. WARNING: If "Just Warn" is the selected as the action then APPM will continue even if an unsafe condition exists.

## 6.5.3 Tools Menu



**Terminal interface...:** This opens the Terminal Interface window, which allows you to manually send commands directly to the mount. Please see <u>the Terminal Interface Window section</u> for more details. The Terminal Interface Window can also be accessed from a button on the <u>Setup Tab</u>.

**Log window:** This opens the Log window, which allows you to see the commands sent by APCC to the mount and the mount's responses. Note the following options within the window. When the mount is connected, a continual stream of commands and responses will display. Please see <u>the Log Window</u> <u>section</u> for additional information. The Log Window can also be accessed from a button on the <u>Setup</u> <u>Tab</u>.

🔏 APCC - Command Log	x
Options	
V Always show last line V Show GOS Queries V Show	Other
Show RA/Dec Queries V Show Side of Mount Queries	?
Show Only Move Commands	_
2016-05-07 00:31:49.440 > :GOS#	*
2016-05-07 00:31:49.440 < 1990002C2E000#	
$2016-05-07\ 00.31.49.442 > 300072016-05-07\ 00.31.49\ 442 < 00.00.00\ 000$	
2016-05-07 00:31:49.444 > :HRG#	
2016-05-07 00:31:49.444 < -43*38:25#	
$2016-05-07\ 00:31:49.446 > HOG#$ $2016-05-07\ 00:31:49\ 446 < +228*53:03#$	
2016-05-07 00:31:49.461 > :Rr#	
2016-05-07 00:31:49.461 < 54148#	
2016-05-07 00:31:49.462 > :Rd# 2016-05-07 00:31:49.463 < 0#	
	Ŧ
Clear	ן ר

**Error Log Window...:** This opens the following window: The most common error log entry will probably be from attempts at errant ReCals as shown by the log entry below. Clicking the Clear Errors button clears the window and also stops the warnings from flashing. See <u>Advanced Settings</u> for more.

APCC Error Log			
Only show uncleared errors	5	Clear Er	Tors Uncleared Errors: 1
Time	Sub-System	Severity	Error Message
2016-05-07 23:27:05	VPort 1	Епог	Recal failed because it is too far (17.453 > 5.000 degrees) from current RA/Dec.
•		111	• • • • • • • • • • • • • • • • • • •

**Open Explorer Instance In Logs Directory:** This opens a Windows Explorer instance with the folder set to the logs directory. This allows you to conveniently open log files should you need to. The Log Directory can also be reached from a button on the <u>Setup Tab</u>.

**Log Zipper:** This opens the Log Zipper window which allows you to package log files and configuration files in case you have a problem or software bug to report. Please see <u>the Log Zipper Window section</u> for more details.

**Launch APPM...:** If APCC Pro is installed this will open APPM, the Astro-Physics Point Mapper utility. If you have APCC Standard, an error message will appear indicating that the specified file cannot be found.

Launch Horizons...: this will open Horizons.

**Platesolve, Autocenter** If APCC Pro is installed this will attempt to plate solve and sync the scope/mount to its pointing position in the sky, and then issue an additional goto to center the target. Note that the option to perform a plate solve will be disabled unless the mount is unparked and tracking.

## 6.5.4 Help Menu



**Help:** This opens this Help file. You can look through the table of contents or search on a topic. Save topics that you are likely to need on a regular basis to the Favorites tab.

**Clear License:** Clears the license key. You might use this if you do not plan to use APCC on a particular computer again.

Note: All of APCC's settings can be found in this folder (on Vista, Windows 7, 8 and 10):

C:\ProgramData\Astro-Physics\APCC

If you want to completely remove all traces of APCC you can delete the above folder and its contents.

**Check for updates...** If you are connected to the internet, selecting this will search for a more recent version of APCC.

View/Enter Subscription License... This opens the APCC - Update License/Subscription window (see <u>here</u>).

About: This opens the About dialog which shows the version number of APCC.

## **APCC - Update License/Subscription**

The **APCC** - **Update License/Subscription** window shows features that you are entitled to with your license.

APCC's subscription policy is the following:

A) Within a major point release bug fixes and some minor improvements are free. A major point release is the starting digit. For example, 1.0 and 1.9 are part of the same major point release (1.x), but 2.0 would be a new major point release.

B) Some newly developed features will require a license date within the last year of the feature's availability. For example, if new feature X is released on August 1, 2021, then it is available to everyone with a license dated one year earlier, which would be August 1, 2020 in this example.

C) If a license date makes a feature unavailable, you can purchase a subscription renewal, which will update the license date to the current date of the purchase. This will also make available any additional features added within the next year.

#### In the screenshot below:

1) Shows 6/2/2016 as the current license date.

2) Shows the list of subscription features enabled in the currently installed version of APCC, which is determined by the license date. In this case, none of the features are available.

3) Shows the list of features available with a subscription renewal.

4) Brings up a browser to the page where you can purchase a subscription renewal.

5) If you have a new license, you can paste it into this box. Note that for the license to become effective, you will need to restart APCC.



# 6.6 Setup Tab

There are a number of group boxes on the Setup tab.: *Program Operation, Mount Type, Firmware, Tools,* and *Periodic Error Correction* or *Encoder*.

Astro-Physics Command Center Pro			- 🗆 X
File Settings Tools Help			
Program Operation Ask if OK To exit Keep APCC on top Show Emergency Stop window Clear all errors when starting and	Mount Type         ?           1800GTO            Tools         ?	Firmware ? Version VCP4-P02-15 GTOCP4 Periodic Error Correction ?	AP Timer ↔ AP <u>J</u> og
Connecting to the mount connecting to the mount Log File Opened Advanced Settings	<u>T</u> erminal Log Window Lo <u>g D</u> irectory	Enable Current State Disable Record Countdown Record	AP <u>B</u> APAS
Setup Site Park Homing/Limits Go	To/ReCal Pointing Model R	ate Settings Horizon Meridian GPS	

## **Program operation**

If you change any of these settings, they are effective immediately.

**Ask if OK to exit:** Check this option if you want APCC to pop up a confirmation dialog before exiting. If unchecked and you exit by pressing F4 or the close window button (X), APCC will exit immediately. Note: Do NOT have this checked if you also check the Auto Shutdown box in the <u>Advanced Setting</u> window. Also, DO NOT check this if a script is shutting down APCC.

**This form is always on top:** Check this option if you always want APCC to stay on top of other windows. Note that if another window also has this property set it can be placed on top of APCC.

**Show Emergency Stop Window:** Check this option if you want the Emergency Stop Window to pop up when your mount is slewing. Review the <u>Emergency Stop Window</u> information regarding this option.

**Clear all errors when starting and connecting to the mount:** Check this option removes all prior Comm Events errors when you startup APCC and connect to the mount. This is helpful if you want to clear out prior errors and not have the pink reminder button.

opens another window with some additional

Advanced Settings: This button: settings.



Select your mount type from the drop-down box. You cannot change this setting if the mount is connected.

Advanced Settings

If you are using a mount from Parallax Instruments or Mathis Instruments with the GTOCP3 Servo Drive System, set your mount to 1200GTO. In the future, we will include a more specific setting for your mount.

## Tools

The tools group box contains several buttons to quickly access a few features. You can also access these tools from the <u>Tools Menu</u>.

**Terminal:** This button opens the terminal interface window, which allows you to send commands directly to the mount. Please see <u>the Terminal Interface Window section</u> for more details.

**Log Window:** Click this button to open the Command Log window. The log window shows commands being sent to and from the mount. Please refer to the <u>Log Window information</u>.

**Log Directory:** Clicking this button will open an instance of Windows Explorer into the directory where log files are stored. If you need to report a bug, use the <u>Log Zipper Window</u>.

## Firmware

When the mount is connected, the firmware version of the mount will display.

Occasionally APCC will require a minimum level of firmware to operate correctly with a GTOCP4 or GTOCP5. In that case the firmware version will highlight as shown in the image below. For APCC to operate best you must obtain a firmware update, which can be downloaded over the internet.



Directions can be found at this link: <u>https://www.astro-physics.com/software-</u>

<u>updates/#Utilities</u>. As shown below, you can click the "out of date" field and a browser should open to the web page with instructions.



# **Periodic Error Correction**

Astrophotography and CCD Imaging demand the highest tracking accuracy to obtain pinpoint star images throughout your photographic exposure. You do not need PEM unless you are engaged in one of these activities.

If you are not familiar with PEM (Periodic Error Memory) in the Astro-Physics GTO system, please read the <u>PEM Recording Options</u> section.

By default, PEM is disabled when the mount is powered on. PEM can be setup to automatically initialize each session in the <u>Initialization Window</u>.

## Encoder

Astrophotography and CCD Imaging demand the highest tracking accuracy to obtain pinpoint star images throughout your photographic exposure. You do not need PEM unless you are engaged in one of these activities.

If you are not familiar with PEM (Periodic Error Memory) in the Astro-Physics GTO system, please read the <u>PEM Recording Options</u> section.

By default, PEM is disabled when the mount is powered on. PEM can be setup to automatically initialize each session in the <u>Initialization Window</u>.

# **Periodic Error Correction Group Box**

**Enable PEM:** Enables PEM (periodic error correction). Please note that, at present, this setting does not change the status shown in the ASCOM V2 driver window. Also, the setting made in the ASCOM V2 driver does not impact APCC.

**Disable PEM**: Disables PEM (periodic error correction). Please note that, at present, this setting does not change the status shown in the ASCOM V2 driver window. Also, the setting made in the ASCOM V2 driver does not impact APCC.

**PEM Record:** Starts the mount's PEM recording feature. Please refer to this section first: <u>Use APCC to</u> <u>Record PEM</u>

**Last Sent:** The last sent command on this tab. The current PEM state is always shown in the <u>Status</u> <u>Bar</u>.

**PEM Record Countdown:** Shows the countdown, in seconds, after *PEM Record* is pressed. The amount of time required for the PEM cycle varies depending on the mount model and will display accordingly. Refer to the <u>Use APCC to Record PEM</u> section for instructions.

## **Periodic Error Correction in Mounts with Absolute Encoders**

**Periodic Error Correction is disabled for mounts with absolute encoders.** Encoders do the job of eliminating any periodic error. Encoders are enabled by default and should never be disabled unless under the direction of Astro-Physics customer support. Encoders cannot be disabled with the Mach 2.

## **Buttons for Quick Access to Companion Programs**

Buttons for the AP Timer, AP Jog, AP RAPAS and PEMPro (if installed on your computer) programs are located on the right-hand side of the Setup window for your convenience.

## 6.6.1 Advanced\_Settings

APCC Advanced Settings			- 0 X
Advanced Settings ASCOM Driv	ver		
	Advanced Set	tings	?
🗹 Auto Initialize (secs)	0 🛊		
Auto Shutdown (secs)	30 🚔		
🕼 Enable Logging (to disk)	Davis of Lonsto Save		
Purge old logs on startup	30	Purge Logs Now	
Show Status Window when	starting	🕼 Enable Tracking R	ate Tweak Window
Prevent errant RECALs			
Keep mount time synced to	PC Time (enabling wi	l override driver's setting	)
		<u>R</u> eset	All APCC Defaults
	<u>0</u> K	<u>C</u> ancel	

**Auto Initialize (secs):** If you check this option and then set a value, APCC will initialize an uninitialized mount automatically. If you do not check this option, then APCC will wait for you to either tell it to commence with initialization, or else for the mount to indicate that it has already been initialized. We strongly recommend that you let APCC handle all primary control operations like initialization. In other words, we recommend that this box be checked. Some people with permanent setups will want a value of 0 or 1 second. Choose a low time value like this if you never need to change any of the initialization settings. Users who are portable or who operate hands-on may want to set the time delay higher. This gives you a chance to stop the auto-initialization to change locations or other parameters. The Initialization Window was discussed earlier in these instructions.

Remember that the mount remains initialized until it is power cycled. If you change this setting, power cycle to see your changes take effect.

**Auto Shutdown:** Checking this option will cause APCC to shut down after the last ASCOM driver client disconnects. It allows easier automation by removing the requirement that you manually close APCC at the end of your observing session. Hint: You may wish to consider a longer value for this feature, depending on your circumstances. For people who occasionally switch software, it is a good idea to give a time cushion so that APCC doesn't shut down before you are up and running with the next client program. Some automated remote observers, on the other hand, may want the auto-shutdown to occur immediately to facilitate full system shutdown. Be sure to coordinate this with this checkbox: <u>Ask if OK To exit</u>.

**Enable Logging (to disk):** Check this option if you want to enable logging to disk. The resulting log file will be saved to your hard drive. It is not possible to uncheck the box at this time. We want to assure

that log files are created so that we can better assist you if you encounter any issues. Refer to <u>Log</u> <u>Window</u> for further information.

**Purge old logs on startup/Days of Logs to Save:** When this option is enabled, Log files that are older than the "days of Logs to Save" will be deleted from disk. Under normal operating conditions, this is a good option to enable to avoid large numbers of log files that can take up disk space.

**Show Status Window when starting:** If this option is checked, when APCC starts, the <u>Status Window</u> instead of the APCC's main window will display.

**Prevent errant RECALs:** The same basic logic that allows non-encoder mounts to have home and limits also provides a means of avoiding another common user error. We have all mistakenly clicked on the wrong object in a planetarium program and then asked for a ReCal on that object. When this box is checked, APCC will compare the requested ReCal coordinates to the mount's mechanical position and abort the ReCal. Several things then happen:

- An entry will be made in the APCC Error Log. See the <u>Tools Menu</u> section for more information.
- The Virtual Sky window view in the Telescope Position group box of the Main Window will start to flash between normal blue background and bright red background.
- A "View Error" button will also appear on the Virtual Sky window that will open the APCC Error Log.
- The 3D Scope Window if open will also flash the alternating warning red background.
- To restore normal appearance and get rid of the warning flashes, click the Clear Errors button on the APCC ERror Log.

**Enable Tracking Rate Tweak Window:** (Pro version only) This feature allows the user to access a small window from the Pointing Model Tab that allows tweaking of the model's calculated tracking rates if minor adjustment is needed. This feature should only be used by the most advanced users.

**Keep mount time synced to PC Time (enabling will override driver's settings)** The default is checked. This option takes time maintenance functions away from the driver and gives them to APCC. It makes time keeping much more efficient since it is APCC that is in direct communication with the mount.

**Reset All APCC Defaults Button:** When this button is pressed, all APCC settings will revert to standard default application settings. This is helpful when you need to "start fresh" from a known settings, or you are troubleshooting settings and need to start over.

## ASCOM Driver Advanced Settings Tab

**NOTE:** Any changes made to the ASCOM driver tab will require restarting APCC for the new settings to take effect.

APCC Advanced Settings		_		×
Advanced Settings ASCOM Driver				
Driver to APCC Connection				2
Eltima Virtual Ports				
Minimum Virtual COM Port				
O REST API				
REST TCP Port Number 60001				
NOTE: Changes in this groupbox will require an APCC re	estart	to take ef	fect.	
<u>O</u> K <u>C</u> ance	ł			

**Eltima Virtual Ports:** When selected, Virtual Ports will be used when the ASCOM driver is connected to APCC. The default and recommended setting is to use REST API instead of Virtual Ports

**Minimum Virtual COM Port:** Specifies the starting COM port number Virtual Ports will be created. For example, a setting of 20 will result in Virtual Ports of COM 20, COM 21, etc. This only applies when Eltima Virtual Ports is active.

				Virtual Port Mana	agement
	Virtual Por	t	Bytes Received	Bytes Sent	SYNC->
Delete	COM20	-	0	0	Translat
Delete	COM21	-	0	0	Translate
Delete	COM22	-	0	0	Translate
Create	None	•	0	0	Translat
Create All	Delete A	JI	Delete Residu	ial Virtual Ports	
		Ţ,			
Setup Virtual Port	Site Parl	Hor	ning/Limits_GoTo/I	ReCal Pointing M	odel Rate

**REST API:** When selected, REST API will be used when the ASCOM driver is connected to APCC. This is the default and recommended setting for APCC

**REST API Port Number:** Specifies the port number for REST API. Default is 60001. If this is changed (for example, due to port assignment conflict), the ASCOM driver must be reconfigured using the Config Driver button on the Setup tab.

## 6.6.2 PEM-Recording Options

## What is PEM?

PEM is the term used by Astro-Physics for periodic error correction. When it was first introduced, we chose PEM (Permanent Error Memory) rather than PEC (Periodic Error Correction), which was in common use at the time by other manufacturers. At the time, mounts with PEC had to be retrained each observing session - a real drawback. We chose PEM to indicate that our mounts retained the error correction in memory so that the process of correcting it did not have to be repeated each session. Later mounts on the market unitized the acronym PPEC (Permanent Periodic Error Correction). We have chosen to continue using PEM for consistency, although it can be confusing at first. Generally speaking, PEM and the market use of "PEC" are interchangeable terms.

The servo drive electronics contain a very sophisticated permanent periodic error compensation circuit. Because a majority of the periodic error is due to the RA drive worm and is quite predictable, it is possible to significantly reduce it by simply having the controller "memorize" the corrections you make with your button inputs and automatically play them back for each cycle of the worm. This circuit has some unique features that makes it easy to operate and almost totally foolproof.

A most valuable feature of this circuit is that it automatically compensates for any drift inadvertently introduced by the operator in the process of recording the gear error. For instance, if the mount was not properly polar aligned in altitude, the right ascension drift rate would be in error. The circuitry automatically subtracts this slow drift from the memory, so that the overall long-term drive rate remains exactly at the sidereal rate. This way, the compensated driving rate will always be correct for any other position in the sky and for any other time that the mount is set up in the field.

There are several ways to correct the residual periodic error in Astro-Physics mounts, as described below.

## **PEM Already Programmed at Astro-Physics**

The heart of your Astro-Physics mount is a precision gearbox using custom high-quality fine-pitch gears, coupled to a highly accurate worm and worm wheel. These parts are manufactured and assembled at our facility and individually tested to meet or exceed our periodic error standards before adding any periodic error correction. The PE is smoothly variant with extremely low ripple or moment to moment error. As a final step to the mount testing process, we optimize performance even further using a special version of Ray Gralak's *PEMPro* developed specifically for our test equipment. We generate a unique PE curve for each mount that we program into the Control Box. Simply use the Keypad or your Astro-Physics software (ASCOM V2 driver or *APCC*) to turn the PE Correction "on" and you will see results significantly better than our published 5 or 7 arc second spec (depending on the mount).

NOTE: Your new Astro-Physics mount comes with a factoryinstalled PE curve. You should use the factory-supplied curve, do not immediately run PEMPro and replace it. Over time your mount gearing will wear in and later the PE can be updated via PEMPro. (Mounts that have encoders such as the Mach2 do not require PEM and therefore do not have PEM factory curve.)

# Use PEMPro by Sirius Imaging to Record PEM

*PEMPro (Periodic Error Management Professional)*, Version 3, by Sirius Imaging is a very powerful Windows software application that allows you to correct your mount's periodic error, polar alignment and backlash using your astro camera to dramatically improve tracking and guiding. As mentioned previously, our extensive testing procedures include several *PEMPro* runs so that your new mount will perform with optimum PE correction out of the box. Although you will not need to use *PEMPro* when you receive your mount, you may wish to do a *PEMPro* run at a later date after the worm gear has run in. Depending on usage, re-measuring error and re-loading periodic error correction from one to four times a year is a good practice, especially if you do some unguided images from time to time. The corrections have been stored in the GTOCP3 Control box and can be enabled via the Keypad, the *ASCOM* driver or *APCC* in subsequent sessions.

NOTE: Your best results will be obtained by using a PEMPro PE curve, whether it is the factory installed curve or a new one that you do yourself. The next two methods that follow can be used if there is a problem with your existing curve, but, they should NOT be used to replace a perfectly good PEMPro model. The reason is that the native recording capability in the servo only records a single worm cycle for its curve. PEMPro averages a larger number of worm cycles to create a much more statistically valid curve to represent the mount's true periodic error.

# **Use APCC to Record PEM**

**NOTE:** Like the Keypad method below, using APCC to record PEM will use the GTOCP3's servo recording capabilities, and will only record a single worm cycle. DO NOT replace a good PEMPro correction model with this single cycle model. Think of this as an emergency tool for getting a quick PE curve into the mount, NOT as an ideal way to program your PEM, or as a way to improve on a PEMPro model!.

Polar align your mount so that you have minimum R.A. and Dec drift. Be sure that the night is steady enough with minimum atmospheric motion, and pick a star near the zenith (refer to the LST value in the Telescope Position group box) to minimize atmospheric refraction errors. You must use a CCD camera or webcam, which will faithfully remember each error correction that it makes. These cameras can respond quickly to changes so they are extremely accurate and will place into memory a very smooth correction of the gear error. The corrections will be stored in the GTOCP3 Control box and can be enabled via the Keypad, the *ASCOM* driver or *APCC* in subsequent sessions

1. Select 1x response rate for N-S-E-W buttons on the Rate Settings tab.

2. Go to Setup tab of *APCC*. Refer to <u>Setup Tab</u> for a discussion regarding the other functions on this tab.

3. Choose *PEM Record* button and click OK in the confirmation window that will appear. The *PEM Record Countdown* display box will show the amount of time remaining for the recording. The length of time may vary depending on the mount model. You cannot cancel the recording session once it begins.

4. If you are not satisfied with your results, record again using the same procedure.

## Use the Keypad to Record PEM

If you plan to use a crosshair eyepiece, this is the best choice since you can use the keypad as you stand at the eyepiece. Follow instructions in the Tools Menu section of the Keypad Manual. The corrections will be stored in the GTOCP3 Control box and can be enabled via the Keypad, the *ASCOM* driver or *APCC* in subsequent sessions. Like the APCC Recording method above, this should not be used to replace a perfectly good PEMPro model.

# 6.7 Virtual Ports Tab

# This section is only for those using the virtual serial ports (VSP) instead of the default REST API. If you use REST API you can skip this section. Also note Virtual Ports tab is hidden when using REST API.

An unfortunate aspect of serial ports is that they create unique point to point connections which exclude more than one application at a time from connecting to the mount. This limitation is more than outweighed by the robustness and dependability of serial connections, and these qualities are why serial connections are still the preferred method of control in industrial applications.

The Astro-Physics V2 ASCOM driver allows multiple ASCOM applications to connect but it does not allow multiple non-ASCOM applications to communicate to the mount using the mount's native protocol. To allow APCC to talk to multiple applications, APCC provides 4 virtual COM ports that allow (up to 4) applications to use the mount's native command protocol simultaneously. Such applications may include the AP V2 ASCOM Driver, PulseGuide, and Software Bisque's TheSky6/X or other non-ASCOM programs.

**Note**: Be sure that you are running all of your applications (MaximDL, etc) at a regular level and not "as administrator." If you run a mixture, you will get two ASCOM driver instances (one for regular users and one for administrator) and that will cause problems. This is not caused by an issue with the driver or APCC, but the way Windows COM interop functions.

The normal configuration is to devote the first Virtual Port to the AP V2 ASCOM Driver. This was explained in the <u>Getting Started Section</u>. We highly recommend that you follow this practice. As mentioned in the Getting Started Section, selection of COM numbers for your virtual ports should not be done without some thought and planning. We have found that it is a good idea to reserve the lower port

numbers for "real" serial ports. These include actual serial ports in the computer as well as all of your USB to serial adapter ports. As a suggestion, start your virtual port numbering with COM11, or even COM21 if you have many serial devices. This prevents conflicts if you need to change a USB to serial adapter and don't want to fight with the Windows port assignments.

- It is fine to define all of your ports ahead of time, but only create the ports that you will actually be using during a session.
- If you plan to use PulseGuide through a virtual port, note that it only allows COM numbers up to COM 10

APCC's virtual ports communicate with the mount in an intelligent way, routing commands from each virtual COM port to the mount and back out to the originating virtual port. This prevents the commands from different virtual ports from getting mixed up.

The status of the COM port and the virtual ports is displayed near the bottom left of the main window. You can select a virtual port to be potentially created from the drop-down list next to each *Create* button. Once you define a virtual port, you will see the port name appear in gray letters on a black background. If no virtual port is defined, the *Create* button will be disabled and the label will say *None* in the virtual port status labels. Here is a table showing the different color states:

No virtual port is defined.	None
Virtual port defined but not created.	COM13
Virtual port defined and created but not opened by any application.	COM12
Virtual port defined, created, and an application is connected to it.	COM11
Communication error	Blinking

NOTE: The Connection Box shown on this screen shot is out of date, however the changes are not important to this discussion. They will not be updated at this time due to the complex labeling.

💌 A	stro-Physics Co	mmand Center Pro						—		×
File	Settings To	ols Help								
				Virtual Port M	anagement					2
		Virtual Port	Bytes Received	Bytes Sent	SYNC -> RCAL Trans	lation RA	Precision De	c Precision		Ĩ
	Delete	COM13	188691	139595	Translate	-	1 🌲	0 🌲		
	Delete	COM14	0	0	Translate	-	1 🌲	0 🌲		
	Create	COM15	0	0	Translate	-	1 🌲	0 🌲		
	Create	None 💌		0	Translate	-	1 🌲	0 🌲		
	Create A	Delete All	Delete Residu	al Virtual Ports						
Seria Hosti 192 Prima COI	al/USB name / IP Address (GT 168.0.100 ary Port Backu Mut None Mount Auto-Connect Create Virtual Ports first	CCCP4) Trneout (msec) 100 ↓ Port Port Auto-Connect Auto-Connect Disconnect	Virtua create the AP V is con	al Port ed and /2 driver nected	Virtual port created but no connection established	Vi defii ye	irtual port ned, but no at created	t		
Parke	0M4 None Tracking	ECOM13	COM14 COM19 Rate = 1.00x PE	5 None	Comm Events Status	Window	oggle Tracking	EMER	GENCY S	TOP
Pri M Con	imary ount nection	Backup Mount Connectior								

**Create**: Creates a virtual port when clicked. You must have an available port selected from the corresponding Virtual Port dropdown list. Once a virtual port is created, it's color changes to a dim yellow with black letters and this button changes to *Delete*. **YOU MUST click the "Create" button to create the port in your system!** This isn't simply an APCC option, but goes to the heart of the PC's operating system.

Delete: Click button to delete the virtual port.

**Virtual Port:** The drop down list from which to select a virtual port. Don't choose a port the same as another port or that already exists on your computer.

Create All: Click button to create all defined virtual ports.

Delete All: Click button to delete all created virtual ports.

**Delete Residual Virtual Ports**: You can try this option if virtual ports remain even after an attempt to delete them fails. If this does not work rebooting should remove the virtual ports.

Auto-connect Driver when APCC connects: Check this option if you plan to start APCC first before using any ASCOM client applications. This will allow ASCOM clients to connect more quickly the first time they try to access the ASCOM driver. Uncheck this option if you want to have the driver start APCC when the first ASCOM client tries connecting to the mount. Most people with permanent or remote setups will want to keep this checked. This is one of a trio of check-boxes that are normally either all checked, or all un-checked. Those are:

Auto-Connect when started - on the Main Window's Connections group box

Auto-Connect Driver when APCC connects - on the Virtual Ports tab Create Virtual Ports first, even if not connected - on the Advanced Settings window

**Bytes Received:** This is the number of bytes received on the virtual port from an application. You can use this field as an indicator that an application is communicating correctly.

**Bytes Sent:** This is the number of bytes sent out the virtual port to an application connected on the virtual port. You can also use this and Bytes Received to verify that an application has successfully disconnected and is no longer communicating. When an application disconnects, the values will no longer be changing.

**SYNC -> RCAL Translation:** Use this option to convert SYNC commands to RCALs. Usually you want to set this to *Translate* to prevent SYNC commands from being issued inappropriately from other applications when the correct function is RCAL. Most programs do not employ the RCAL command and will instead send a SYNC in all circumstances, regardless of whether it is appropriate. Improper use of SYNC, particularly when the mount is in a counterweight-up position, as it might be if you are using the Meridian Delay feature, will cause the mount to become lost since SYNC defines the pier side. This translation feature will help to prevent incorrect commands.

Please read the <u>Sync Explained in Detail and Compared to Recalibrate</u> section for a comparison of these functions.

**RA Precision:** The maximum number of digits precision to use on the virtual port for hour angle values. Later versions of the GTOCP4 and GTOCP5 firmware can output 2 decimal digits of precision in RA and other hour angle values, however some client applications expect only one digit and may even consider the format corrupted. Setting RA precision to 1 digit can prevent this.

**Dec Precision:** The maximum number of digits precision to use on the virtual port for degree values. Later versions of the GTOCP4 and GTOCP5 firmware can output 1 decimal digit of precision in Declination and other degree values, however some client applications expect no decimal digits and may even consider the format corrupted. Setting Dec precision to 0 digits can prevent this.

One last thing - Hovering the mouse over a connected virtual port will show the path of the application that is connected on that port.

📕 Au	tro-Physics Comm	rand Center Pr									
Ele	Settings In	als <u>H</u> idp									
(Virtual Port Management)											
		Virtual Part		Ewies Received	Byles Sent	SYNC > RCAL 14	analation	Disconnet Driver			
	Delicite	COLUMN 1	-	29430	10,1%5	Transiene		Autorosennest to AGCOM Hiver on Ant Virtual Port			
	Delete	COM12	-			Transiane					
	Create	CICW13	-			Transiette					
	Create	Nisne				Translate	1	Delete Residual			
	Create All	Dalete A		Auto-Connect C	Off port and creati	Withol Ports when	attactional	Valual Ports			
Set	up Sile Park	GaTa/ReCal	Faile	Settinge, Horizon	Meridian Vieta	Patts Painting H	lodal (PEW) (	Other GPS			
	Connection	0		Hove Scope	0		Talescope 7	hailian 🕘			
-	en Clarke, Bala	nh NE	N þ	RW FA			u	20h 56m 34.5s			
Test.	Heverin	a tha Ma						A 01h 00m 16.4s			
1.00	Connect	ed Virtua	use I CO	OVER A			883) W 🚥	c 00° 00' 00°			
100					Quar			21* 02* 01*			
⊢	_		e wa	CTM TRUCK BOARD				1107.02.547			
	Disconnect Part	Swap	EM	Swap N/S		30.00		110 32 31			
С	OM14 CO	M1 C	<b>OM</b> 1:	2 COM13	None	Status Mindow	Toggle Tracitio	EMERGENCY STOP			
Unpa	arked (AP) T	rac C:\Program	n Files	(x86)\Common File	s\ASCOM\Telesco	pe\AstroPhysicsV2 D	river.exe	EC Rate = 0.00000			

# 6.8 Site Tab



## **Mount Location**

The information in this group box is information that is polled from the mount.

**Latitude**: The current latitude value last read from the mount. This value is refreshed when you switch to the *Site* tab or click the *Refresh* button.

**Longitude:** The current longitude read from the mount. Note that longitudes west of the meridian will display as positive values. This value is refreshed when you switch to the *Site* tab or click the *Refresh* button.

**Refresh:** Clicking this button will refresh the latitude and longitude from the mount. This is a troubleshooting aid that allows you to confirm that another device or piece of software has not sent erroneous latitude and longitude information to the mount. The latitude and longitude of the Site Information and Mount Location group boxes should match.

Mount Time: Display of date and time data from the mount control box. The time updates continuously.

**Time Offset:** Display of current offset. This value is refreshed when you switch to the *Site* tab or click the *Refresh* button.

## Site Information

The information in this group box comes from the selected site data saved in APCC. Note that you can select a site in this group box WITHOUT sending its information to the mount. Site information is only sent to the mount during initialization.

**Select Site:** This drop-down list box allows you to select a site, which includes Latitude/Longitude/Elevation information. You can create or edit a site by clicking *Manage Sites*.

Latitude: The selected site's latitude value.

Longitude: The selected site's longitude value.

Elevation: The selected site's elevation value, if the data was entered.

**Time Offset:** The selected site's time offset, which will include an adjustment for Daylight Savings Time when appropriate.

Meters: If checked elevation is shown in meters. Otherwise, elevation is in feet.

**Manage Sites**: Clicking this will open the <u>Manage Sites Dialog</u>. From that dialog you can create and edit sites.

**TIP**: If you have a GPS connected through a USB port to your computer you may be able to create a new site on the <u>GPS</u> tab.

# 6.8.1 Manage Sites Dialog

📕 APCC - N	Mana	ge Sites						x
🕐 Site Na	me					Other		
Home			Tim	e Offset	New			
Description	(optio	onal)				5.0	Save	
Backyard O	bserva	atory at Home			Ele	vation (ft)		
	_	Latitude		Longitude		456 🌲	<u>D</u> elete	е
Get From	De	a 40 🚔	Dea	90 🚔	Ter	nperature (F) 55		
MOUIL		12		12	Pro	nouro (mb)		
	Mi	n 12 🖵	Min	12 🔽	FIG.	1010		
	Se	c 34.0 🚖	Sec	34.0 🍦				
	۲	North 💿 So	outh 💿 W	/est 💿 East		Metric	Close	e
Site Name		Latitude	Longitude	Time Zone	Elev (ft)	Temp (F)	Pressure	
Home		40° 12' 34"	90° 12' 34"	-5.0	456.00	55.00	1010	
Club		40° 34' 56"	90° 34' 56"	-5.0	499.00	55.00	1010	
W.S.P.		24° 38' 58"	81° 18' 37"	-4.0	2.00	70.00	1010	
T.S.P.		30° 36' 18"	103° 56' 54"	-5.0	5040.00	65.00	1010	
			4					

**Site Name:** Enter a name for the site. This would be the name you normally use when referring to the site.

**Description:** Enter an optional description of the site.

**Get From Mount**: Click this button to fill the Latitude and Longitude fields with the mount's current Latitude and Longitude, if that is appropriate.

**Latitude:** This group box contains the values for latitude in degrees, minutes, and seconds, as well as a North/South selection. Refer to the tip below to enter decimal values. Do NOT enter negative numbers. Instead, use the North or South button.

**Longitude**: This group box contains the values for longitude in degrees, minutes, and seconds, as well as a East/West selection. Refer to the tip below to enter decimal values. Do NOT enter negative numbers. Again, use the East or West button instead.

**TIP**: You can enter or paste a decimal degrees value into the degrees field for Latitude and Longitude. If you do, the appropriate minutes and second values will be calculated and displayed.

**Other:** In this group box you can set default values including *Time Offset* (i.e.,. Time Zone), *Elevation, Temperature and Pressure.* You may have noticed that there is no way to enter your clock time. APCC uses your computer time when sending time information to the mount. You may wish to utilize time server software to keep your computer time as accurate as possible, if that is important to your operation.

**New:** Click this to create a new site. Be sure to edit the *Name* field to reflect the site. When you click it a new site will be added to the Site table.

Save: Click this to make permanent the changes you have made to any of the site parameters.

Delete: This will delete the selected row in the table. To select a row click it with your mouse.

**Close:** This will close the window. If site information is not saved a pop-up window will give you the option to save the site, not save the site, or cancel the close window operation.

**Site Table**: Click a row in the table to select a site. It's values will be loaded into the Latitude, Longitude, and Other group boxes. You can then edit the values if you desire.

# 6.9 Homing/Limits Tab

**Note:** The RA Limits that you set here will override any custom Meridian Limits you may have set on the Meridian Tab. These limits are the preferred choice for those using automation software that cannot accommodate the varied limits from the Meridian Tab anyway. Users who are more "hands on" may wish to keep these RA limits OFF and use the customizable limits from the Meridian Tab.

Dec Limits should almost always be ON.

octangs room	i icip		_			
			Mo	unt Homing		
imits			Home	]	Mechanical Position	Configure <u>Home</u>
RA Limits Enabled	75.0	Mins from meridian	HA	-03h 42m 38.4s	Right Ascension Axis	and Limits
Dec Limits Enabled	-47.78	Degrees (Declination)	Dec	-31° 05' 32"	Declination Axis	
					121° 05' 22"	
Action when limit reach	ed			F: 111		
Home and Park		-		Find Home		

**Note:** APCC Home and Limits will display only if you have a non-encoder mount. If you have a mount with Absolute Encoders, the AE Home and Limits Tab will be displayed instead.

## Introduction and Operation Basics

Celestial coordinates are somewhat dynamic in an astronomical mounting. We regularly tweak our celestial pointing positions following a plate-solve, or after centering a star. This ability to modify the pointing coordinates, while mostly advantageous, can lead to errors and mistakes. The result of a "bad" Sync or ReCal can be a lost mount.

The Astro-Physics GTO Servo System is smart! As long as the clutches remain fully engaged, it can determine the true mechanical position as well as knowing the celestial coordinates. Because celestial coordinates are subject to error, the mechanical position can be used for independent Home and Limits.

In brief, here are the steps to establishing Home and Limits on any mount that does NOT have Absolute Encoders:

 <u>GTOCP3 ONLY!</u> If you have a GTOCP3, you will most likely need to run the <u>APCC\_Personality\_Update.exe</u> program that is incorporated into APCC. APCC will restrict all other functions of the Homing/Limits tab until this is done. The Personality Update will be your only live option from the tab. This only needs to be done the very first time you set up with Home and Limits. It never needs to be done again, and will, in fact, not be offered as an option again on this particular GTOCP3. It will direct you as needed, and only modify settings that are needed.

- a. Start APCC
- b. Click on the Homing/Limits Tab.
- c. Click the Update Mount Personality button at the top.
- d. Follow the simple instructions.
- e. Be sure that you restart APCC and power-cycle the mount (OFF wait ON) as instructed at the end.
- 2. <u>ALL CONTROL BOXES</u> Your mount should be fully set up and calibrated. All operations that might involve the clutches should be finished.
- 3. Click on the Homing/Limits Tab in APCC.
- 4. Click Configure Home and Limits button.
  - a. Select a Home Position
  - b. Set limit parameters
  - c. Click Set Home Position
  - d. Wait for the message saying that the configuration is finished.
- 5. Activate limits or not as you wish. (Dec limits should almost always be turned ON.)

That's really all there is to it. From this point forward, as long as the mount is not moved via the clutches, it will have a "Home" position that will always correctly re-establish pointing position, and it will have available limits to prevent an axis from moving into a dangerous position.

- Click Find Home to send the mount to the Home position and reestablish pointing.
- Select Limit Action
- Turn RA limits on or off as needed with the check-box.
- Turn Dec limits on or off as needed with the check-box.

Warning: Moving the mount via the clutches will invalidate your Home and Limit positions. You are certainly free to use the clutches if needed, but just remember that you must reconfigure Home and Limits when you are finished and properly recalibrated again.

# APCC Personality Update Program - GTOCP3 Control Boxes

The Home and Limits system that we have developed for APCC uses some of the features and capabilites that were originally designed for the 3600GTO's Home and Limit System and for the Absolute Encoder's Home and Limit functions. These capabilities are present in the Rev V and later chips that are required for APCC, but they are dormant in mounts that have not been configured for these advanced features. The small APCC\_Personality\_Update program updates the personality configuration to make these capabilities available.

**Note:** The APCC\_Personality\_Update program is designed to be harmless to your system. It is safe to run regardless of whether the mount is already configured for the Home and Limits. (You may not know for sure!) It does not corrupt or change any of your other vital personality parameters.

This program is for GTOCP3 Control boxes ONLY. It is not needed, and will not run on GTOCP4/5 Control Boxes.

To run the program, first start APCC. APCC should be connected to the mount, and should already be configured to work with the AP V2 ASCOM Driver. You should not have other ASCOM client programs running or connected at this time. When you start APCC, it polls for the relevant personality setting. APCC therefore knows whether to allow Homing/Limits tab access, or whether the update program is required. Once you are ready to go, simply click on the Homing/Limits tab. If you need the update, the Homing/Limits tab will look like the screen below.



First, the program will gather all the personality data that is currently in your GTO control box. The program temporarily saves this information. The following window will appear:



Clicking Cancel will exit WITHOUT MAKING ANY CHANGES. Clicking OK will tell the program to proceed. After a few seconds, you should get the following message:

APCC	<b>×</b>
Mount Person Click O	is parked! ality Reset Routine Complete. K To Continue.
	ОК

Clicking OK then opens a window with these final instructions:



It is important that you follow all three instructions in order:

1. Disconnect the AP V2 Driver, and then APCC from the GTO Control Box by clicking the Disconnect buttons in the Connections Box.



- 2. Close APCC. You may need to disconnect any other ASCOM client programs that are still connected before you can close.
- 3. Power-cycle your mount. Allow at least 15 seconds between power-down and power-up.
- 4. You are now ready for all normal operations of the mount, including taking advantage of the APCC Home and Limits Feature.

## **Configure Home and Limits**

The next step in using the Home and Limits Tab is to configure the Home positions and choose limits. This topic is presented in its own separate section.



Please click on this link to go to the Configure Home and Limits page of these instructions.

**Note:** Be sure to return to this page for additional important information on using the Home and Limits Features after you have visited the Configure Home and Limits page!

## Clutches warning

## **Limits Box**

Astro-Physics Command C	enter Pro (El	evated)	
File Settings Tools	Help		
Limits			
RA Limits Enabled	75.0	Mins from meridian	
Dec Limits Enabled	-47.79	Degrees (Declination)	
<u>R</u> eset Limi	<u>R</u> eset Limit Triggers		
Action when limit reacher Home and Park	ed	<b>•</b>	
Setup Virtual Ports Site	Park Ho	ming/Limits Go <sup>-</sup>	

The Limits Box is where you enable or disable the limits you have configured. It is also where you set the action that will occur should you slew or track into a limit. To enable or disable the RA or Dec limits, simply check or uncheck the appropriate box.

Note: The displayed values might seem a bit confusing at first, especially in light of what you entered when you configured the Home and Limits.
The RA value is the distance in RA minutes that you allow the mount to go past the meridian. It is consistent with the value you entered when you configured Home and Limits. In the example above, the mount can travel 75 minutes (1 hour 15 minutes) past the meridian in either direction before activating the RA limit.
The Dec value is where most people get confused. The Dec limit is basically determined by your latitude. It will correspond somewhat to the Dec value at the Park 4

position. However, to allow a bit of cushion, you are allowed to set a bit of additional travel before the limit is activated. The displayed value is the declination of this "cushioned" limit.

Action when limit is reached: The drop-down box at the bottom of the Limits Box gives you options for what happens when a limit is reached.



The options shown above are relatively self-explanatory, but there are a few things that we want to point out. In all cases, when a limit is reached, a warning box like the following will appear. The exact text of the warning will depend on the action-option chosen.

WARNING RA limit was reached!	
Click here to close	

- Just Warn No action will be taken apart from the display of a warning box. This could be useful if you are present at the mount and can take action yourself as needed.
- **Stop Slew** A slew that hits the limit will be stopped, but tracking into a limit will only generate the warning box. Sidereal tracking will be allowed to continue past the limit. This may be useful for a somewhat attended mount where protection during a slew is desired, but where you also want the freedom to continue tracking with the APCC meridian limits providing the next line of defense.
- Stop Slew and Tracking A slew in progress will be stopped when the limit is hit. Tracking will also be stopped when the limit is hit. Motors will remain energized since the mount will NOT be put into a parked state.
- Stop Slew and Tracking. Park in place. A slew in progress will be stopped when the limit is hit. Tracking will also be stopped when the limit is hit. The mount will be placed into a parked state where it stopped, but will not be moved to a predefined park position.
- **Home and Park** Mount motion will be stopped, and the Find Home sequence will be initiated. The mount will end up parked and recalibrated at the home position.
- Bounce back within limits. Park When a limit is hit, the mount will stop, and then "bounce" back out of the limit (a short move in the opposite direction to clear the limit). It will then enter a parked state.

Most users should use the **"Home and Park"** or the **"Bounce back within limits. Park"** option. For totally remote users, the Home and Park option is probably safest, especially if there is an issue with roof closure. The bounce option can be useful in that it provides both safety and still allows you to see where you were when a problem may have occurred.

## Home Box

_	Home	۔ ۲
	HA -11h 54m 00.6s	
	Dec 48° 06' 31"	
	<u>F</u> ind Home	
GoT	o/ReCal Rate Settings Horiz	Z

The Home box tells you the coordinates of your Home position. Coordinates are given in Hour Angle and Declination.

## Find Home - What Happens?

The "Find Home" button is used if you have somehow gotten the mount lost. It starts a sequence of events that end up with the mount in its home position, and with the celestial coordinates correctly reestablished. Here is a summary of the sequence following a click of the "Find Home" button:

- Tracking is stopped.
- The RA axis is moved to the RA Home position.
- Once RA is finished, the declination moves to its Home position.
- When both axes are "Home", the Home celestial coordinates are commanded and then a full Sync is done.

## **Mechanical Position Box**



The Mechanical Position box tells you the current distance in degrees, minutes and seconds from the defined Home position. These values are especially useful when you define Home to be at Park 3, with the counterweight shaft pointing down and the scope pointing at the pole. For other home positions, you may need to do a bit of mental arithmetic to relate to the mechanical position.

# 6.9.1 Configure Home and Limits

Select Home Position:	RA Limit	Dec Limit
Custom Home Position Current APCC Park Position Current Mount Position Custom (Enter HA/Dec or Alt/Az): HA -3.711	Enter single allowable limit in minutes of RA that the mount can go past the meridian or start ahead of the meridian. NOTE: This RA-minute value must be related to the gear angle on BOTH sides of the mount!!	Northern Hemisphere: Dec = (-1)*[(90 -Lat)+0*10:00] Southern Hemisphere: Dec = (-1)*[(- 90-Lat)-0*10:00] Both of the above coords are designed to give a 10 arc-minute cushion to the Park4 position. Enter additional adjustment below:
Dec         -31.092         →         Az         135.00         →           Set Home Position         Image: Control of the second secon	RA limit: 75 🔄 Minutes	Additional 5 🚔 Arc-Minutes

# Introduction

The Configuration Window is where you will set the position you wish to call "Home." It is also where you can set parameters for your limits in both RA and Dec.

• It is a good idea to think about this before you actually make the configurations, although you can always redo them. You will want to decide on the position you wish to use for "Home." Do you want

"Home" to point to a flat-field light-box? Do you have roof closure issues? Do you prefer to have "Home" point at the zenith, or the pole, or maybe a distant light on a radio tower? Or maybe you prefer to have "Home" be equivalent to an AP Park Position that you already use.

- Know ahead of time how far past the meridian you want to set your RA Limit. Since limits are easily enabled and disabled from the Homing/Limits Tab, you will probably want to set this as a "worst case" limit. Remember also that a 1200X slew is moving the mount at 5 degrees per second. The system needs time to react and decelerate to stop if you slew into the limit. These are, after all, software limits. They are not physical barriers.
- One doesn't usually think of the need for a Dec Limit in a German Equatorial mount, but there is a zone at the rear of the mount, basically on either side of the opposite pole, where a properly operating Dec axis will simply never go. The size of this zone is determined by your latitude. In a nutshell, if your Dec axis crosses into this zone, then something is wrong, and corrective action needs to be taken.

When you first click on the Configure Home and Limits button at the top right of the Home/Limits Tab in APCC, you will be given the following warning:



You must be calibrated with the sky before you configure your Home position. The more accurate the calibration, the more accurate any homing recovery operation will be. For the greatest accuracy, you can do a plate-solve and ReCal on an object that is on the same side of the meridian as your chosen home position, and is also high enough in the sky to avoid too much refraction. Also, avoid doing your ReCal at a high declination (low declination in the southern hemisphere) where RA lines are compressed and lose resolution. A good practice is to choose a target on the same side of the meridian as "Home" that is between the zenith and the celestial equator (0 Dec).

# **Select Home Position Box**

The Select Home Position box is where you set where "Home" will be. There are three approaches that can be taken to selecting your home position.

1. Use your own custom Home position. If you select this option you will need to enter either an Hour Angle (HA) / Dec set of coordinates, or else an Alt / Az set. This is done in the boxes below the

three radio selection buttons. The example above might be for a dome with a flat-field light-box located southeast of the pier.

- 2. Use the Current APCC Park Position. This automatically enters the coordinates for the park position you have selected in the Park Tab. You can then select Park to the Home position in the Park Tab, and all future parks will use the homing function rather than the normal park sequence. This might be especially advantageous for remote observers in that it will correct any errors that might have happened during the night's remote session. If you have chosen Park 4, for example so that your roof will close, the mount will park precisely to Park 4 even if something got the mount a bit lost while you were asleep.
- 3. Select the current mount position. This might be the easiest way to precisely aim the mount at a flat-field box, a laser safety switch, or a distant known terrestrial target unless you already know the exact coordinates. Simply toggle the tracking to STOP, move the mount into the exact position you want, and then proceed to set the Home position.

Once you decide on, and select your Home position, click the Set Home Position button. The following warning will appear:



If you selected #1 or 2 above, clicking OK will slew the mount to the chosen home position for verification. If you chose #3, you are already there, and no slew will take place. Once at your "Home" position, APCC will configure the position in the GTO Servo Control Box. When finished, the following will appear to indicate success.



You now have a configured Home position that will remain valid until the mount is moved via the clutches.

## **RA Limit Box**

The RA Limit Box allows you to set how far past the meridian you want to allow your mount to travel. Only a single value is allowed. It is therefore best to consider a worst-case scenario on both sides of the mount. Set the RA Limit that you would want for UNMONITORED operation of the mount. If you will be sitting at the computer during the night's session, you can easily uncheck the RA Limits on the main <u>Homing/Limits Tab</u> if you wish to take advantage of the Meridian Limits you have set on the <u>Meridian Tab</u>.

Your limits are set in RA minutes. (Each RA minute = 15 arc-minutes. 4 RA minutes = 1 degree.) When deciding on the limit value, bear in mind that you need a safety cushion to accommodate a potential errant slew in progress. Tracking presents no problem, but when slewing at 1200X, the mount is moving at 5 degrees per second. The gear angles are polled by APCC once per second. In addition, the mount will need a small amount of time to decelerate to a stop. If you could hit the pier at 1h 40m past the meridian, you might want to set the limit at 1h 10m or 70 RA minutes to provide the safety margin. You can decrease the safety margin and thereby increase the distance past the meridian by using a slower slew speed like 600X.

You can either type in the number of RA minutes you wish to set or use the up/down arrows on the entry box to arrive at the desired value.

## **Dec Limit Box**

The very idea of declination limits may seem counter-intuitive. After all, the Dec. must slew all over on both sides of the pole. However, in a properly operating German Equatorial mount, there is a zone around the opposite pole from your hemisphere where the axis should never go. The size of this zone is dependent upon your latitude, and the absolute value is calculated for you by APCC.

Violation of this zone is not a sure sign of imminent disaster as it may be in right ascension. However, it **is** a sure sign that something is wrong and that you have done something to get the mount lost. We recommend that the Dec. Limit always be activated. The only valid reason we can think of for disabling the Dec limit is if you have moved the mount via the clutches, and have not yet reestablished home and limits.

The calculated value provides a 10 minute safety margin so that Park 4 will not accidentally trigger the limit. If you use Park 4, you may add an additional cushion if you wish, but it is only rarely needed, and we suggest keeping any additional limit to a minimum.

You can either type in the number of arc-minutes you wish to add to the provided cushion or use the up/down arrows on the entry box to arrive at the desired value.

# 6.10 AE Tab



## **AE Actions**

Encoder Correction: Enables/disables the encoders. NOTE: This control is not available for the Mach 2. Encoder correction is always enabled for this mount.

**RA Limits:** Enables/Disables the RA Limits. You must click the ON/OFF button to enable/disable RA limits

**Dec Limits:** Enables/Disables the Dec Limits.You must click the ON/OFF button to enable/disable Dec limits

## **Configure Home**

Before Find Home becomes available, the home position must be configured.

Clicking the **Configure Home** button will bring up this dialog box below if you are using APCC Pro. If you are using APCC Standard there will be no button for **No - Start Auto-APPM Routine**.

APCC - Calibrate for AE Home/Limits	
WARNING!	
The mount MUST be calibrated with the night sky.	
YES - Calibration is Correct	
NO - Start Auto-APPM Routine	
CANCEL	

**YES - Calibration is Correct:** Click this button if the mount's calibration has been established, such as by doing a RECAL on plate solved coordinates.

**NO - Start Auto-APPM Routine:** (APCC Pro Only) Starts APPM if it is not already running, tries to connect to the mount and camera and does a plate solve and RECAL.

**CANCEL:** Exits the dialog box and cancels the Configure Home operation.
APCC - Configure AE Home				
Select Home Position:				
Current APCC Park Position (Park 3)				
Custom Ho	Custom Home Position			
Custom (Enter HA/Dec or Alt/Az)				
HA	-6.00000	Alt	37.41194	-
Dec	89.99972 🚽	Az	0.00035	<u>↓</u>
Current Home Position: HA= -6.00000 (-06:00:00.00), Dec =89.99972 (+89*59:59.0)				
<u>S</u> et Home Position				
<u>Cancel</u>				

Select the appropriate home position and click **Set Home Position**.

NOTE: The MACH 2 mount has a fixed HOME position so it uses a simplified interface that only allows resetting HOME to the Park 3 position.

Click **OK** to exit after setting the home position.

You can click **Cancel** to abort configuring Home.

# **Find Home**

If your mount is lost then you can use the **Find Home** feature to recover its position.

IMPORTANT: For this feature to work on non-clutch aware encoder mounts (e.g., 1600AE, 1100AE), you must never loosen the RA or Dec clutch and move the telescope after having configured home. If you must loosen one of the clutches and move the scope you will need to configure the home position again. For clutch-aware mounts like the Mach2, this step is not required: The mount remembers its home position even if the clutches are loosened and the scope moved.



Clicking the **Find Home** button will pop up a confirmation dialog:

🙈 АРСС	- Confirm FIND HOME	×
	Please confirm!!	
	YES - FIND HOME	
	NO - Cancel FIND HOME	
		.4

**YES - FIND HOME:** Will slew the mount to the home position and perform a sync.

**NO - Cancel FIND HOME:** Will cancel the find home operation.

# **Configure RA Limits**

APCC - Configure AE RA Limits				
Set RA Fixed Limit				
Fixed RA Limits should represent the "worst case" scenario.				
Enter a single fixed pier-side East Limit in minutes of RA that is past of the meridian.				
East RA Limit 60 🚔 Minutes of RA				
Enter a single fixed pier-side West Limit in minutes of RA that is past of the meridian.				
West RA Limit 60 🚔 Minutes of RA				
Enable RA Variable Limits 📃				
To use variable limits, you MUST have limits fully defined and enabled in the Meridian Tab. Variable Limits supercede Fixed Limits during operation.				
Limit Action Just Warn				
<u>S</u> et Limits <u>C</u> ancel <u>C</u> lose				

**Limit Actions:** options include Just Warn, Stop Slew, Stop Slew and Tracking, Park in Place, Home and Park, Bounce back within Limits, and Park.

Enable RA Variable Limits: Uses the configured meridian limits for East and West sides.

**Configure Dec Limits** 

APCC - Configure AE Dec Limits			
<b>Set Declination Fixed Limit</b>			
The Declination axis needs a large amount of freedom for movement. However, there is a small region where the Declination should NEVER point, and through which it should never travel during a slew. If your Dec enters this region, something is wrong, and a limit error needs to be thrown.			
The exact coordinates of this region depend on your altitude, and will be calculated by APCC. We provide the option to include a bit of "cushion" or "fudge factor" to the declination limits.			
North CCW Limit <sup>0</sup> 🚔 Arc-minutes cushion			
South CW Limit 0 🚔 Arc-minutes cushion			
Limit Action Just Warn			
Set Limits Cancel Close			

**Limit Actions:** options include Just Warn, Stop Slew, Stop Slew and Tracking, Park in Place, Home and Park, Bounce back within Limits, and Park.

# **Status and Info Fields**

Home Status:	HOME
Encoder Status:	ENABLED
RA Limits:	FIXED
Dec Limits:	ENABLED

Home Status:

Encoder Status:

### RA Limits:

Dec Limits:



# 6.11 ELS Tab

The ELS tab is only for the 3600GTO and 3600GTOPE mounts, which utilize the functions of the GTOELS secondary control box. The ELS Tab allows you to configure the limit and home switches as well as the R.A. precision encoder settings, if your mount has these features. It also has a provision for making extremely accurate home position determinations. This allows pointing recovery from the home position to be within a few arc minutes.

# 3600GTO and 3600GTOPE Models

Review the following information regarding these mount models and how the ELS Control Box is used for each. You may also wish to refer to this document on the Astro-Physics website for further information and ordering instructions: *Limit/Homing Switch System for the 3600GTO and 3600GTOPE* 

**3600GTOPE** <u>without</u> optional Limit/Homing Switch System: The ELS Control Box was included with the 3600GTOPE mounts to enable control of the R.A. precision encoder, which was installed in these mounts during initial manufacture (the R.A. precision encoder cannot be purchased as an upgrade). The Configure group box of the ELS tab allows the R.A. encoder to be enabled or disabled and allows a trim rate to be set. The remaining functions related to the Limit/Homing Switches cannot be utilized unless these components are purchased as an optional upgrade and installed by the user.

**3600GTOPE** <u>with</u> optional Limit/Homing Switch System: In addition to the control of the R.A. precision encoder described above, the ELS Tab enables full control of the limit/homing switch system, including activation of the software limits.

**3600GTO** <u>with</u> optional Limit/Homing Switch System and <u>with</u> GTOELS Control Box: This mount can utilize all functions related to limits and home position available on the ELS Tab. Since the mount does not have the R.A. precision encoder, the *Encoder* and *Encoder Trim* functions are not available.

**3600GTO** <u>with</u> optional Limit/Homing Switch System <u>without</u> GTOELS Control Box: Since this mount does not have the GTOELS Control box, it cannot take advantage of the ELS tab. Consult the user manual for the limit/homing switch system for operational instructions. The GTOELS Control Box is available as an option and can be purchased separately and installed by the user. Contact Astro-Physics for details. This mount does not have the R.A. precision encoder, so the *Encoder* and *Encoder Trim* functions are not available.

**3600GTO** <u>without</u> optional Limit/Homing Switch System: The GTOELS Tab is not useful for this mount. The limit/homing switch system and GTOELS Control Box are available as an option and can be purchased separately and installed by the user. Contact Astro-Physics for details.

Astro-Physics Command Center Pro	ELS Tab for 3600GTO Moun	ts 📃 🗆 🔍 🗶	
Limit Switches Bounce RA and Park Set Encoder	Status ?   Limit Switch Config RA Home Status   Bounce RA and Park Not Homed   Encoder Config RA Limit Status	Mechanical Position   ?     RightAscension Avis   Declination Avis     -61.37917   21.54806	
Enabled Set Encoder Trim (arc-sec/hr) 0 & Set	Enabled Not At Limit   Trim (arc-sechr) Dec Home Status   1 Not Horned   ELS Firmware Version: 05	Home Position ?   Config: Pre-Home Slew: HA⇒5 00 Dec= 15.00   Normal ✓   Settings   Establish Home	
Setup Time Site Park GoTo/ReCal Rate Settings Horizon Meridian Virtual Ports Pointing Model PEM Other ELS GPS			

**TIP:** Be sure to look at the <u>General work flow for precise recovery</u> <u>using the Home Position</u> section at the bottom of this page.

#### Configure

The Configure box is basically where you turn the ELS features on and off.



Limit switches: This drop-down list box has several options:

lgnored	The limit switches will be ignored.
Zero RA on Switch	RA tracking will stop when the switch is reached. The R.A. axis will only move in the direction of the home position.
Bounce RA and Park	The motion that caused the limit switch to activate will be stopped, and a short slew or "bounce" in the opposite direction will be made to disengage the limit switch. RA tracking will stop and the mount will be in a parked state.

**Encoder:** This drop-down list box configures the encoder operation. There are two options: *Enabled* and *Disabled*.

**Encoder Trim:** You can adjust the encoder-based trim rate with this setting. Encoder trim can be set to adjust for the apparent non-sidereal tracking rate of objects due to atmospheric refraction, polar misalignment, flexure and other causes.

Encoder trim is entered in arc-seconds per hour, and will trim the R.A. tracking rate without affecting the R.A. coordinates in the servo. *DO NOT use any encoder trim if you are also using the APCC pointing model!* Use the tracking correction in the Pointing Model instead. See your 3600-LSS-PE-instructions for more details.

**Set:** For all of the above configuration settings you need to click the appropriate **Set** button to save the change. You *must* press the set button after selection for the changes to take place.

**Set Encoder Trim value on connect:** When enabled APCC will automatically set the encoder trim value when you connect to the mount.

# **Status**

The Status box is where information is read directly from the mount.

Statu	ıs ?
Limit Switch Config	RA Home Status
Stop RA on switch	Not Homed
Encoder Config	RA Limit Status
Enabled	Not At Limit
Trim (arc-sec/hr)	Dec Home Status
1	Not Homed
ELS FirmwareVers	ion: 05

Limit Switch Config: This is the read back of the limit switch setting.

lgnored	The limit switches will be ignored.
Zero RA on Switch	RA tracking will stop when the switch is reached. The R.A. axis will only move in the direction of the home position.
Bounce RA and Park	The motion that caused the limit switch to activate will be stopped, and a short slew or "bounce" in the opposite direction will be made to disengage the limit switch. RA tracking will stop and the mount will be in a parked state.

**RA Home Status:** Either *Homed* or *Not Homed*. The "Homed" response will be given whenever the home switches are activated. This does not necessarily imply that the mount is precisely at the home position that you will define below with the Establish Home routine. It simply means that the respective Home Switch has been closed.

Encoder Config: Either Enabled or Disabled.

RA Limit Status: Either Limit or Not at Limit.

**Trim:** The currently set encoder trim value in arc-sec/hour. Please note that a returned value that is different from the entered value by one or two arc-seconds per hour is not uncommon. The value internal to the encoder system will be correct.

**Dec Home Status**: Either *Homed* or *Not Homed*. As with the R.A. Home Status above, the "Homed" response will be given whenever the home switches are activated. This does not necessarily imply that the mount is precisely at the home position that you will define below with the Establish Home routine.

ELS Firmware Version: The version of firmware in the GTOELS box.

### Mechanical Position

Mechanical Position			
Declination Axis			
21.54806			

**Right Ascension Axis:** The internal mechanical angle (degrees) of the Right Ascension Axis. The mechanical position is relative to the established home position.

**Declination Axis:** The internal mechanical angle (degrees) of the Declination Axis. This mechanical position is also relative to the established home position.

#### **Home Position**

**Overview:** The Home position is a mechanical position that roughly mimics the Astro-Physics Park 2 position for conventional scope orientations (Park 3 for side-by-side setups). Its precise position can be adjusted by a small amount via the actuators on the mount, and we have developed a routine to establish a precise mapping to celestial coordinates. The <u>general work flow description</u> will be provided below the information for each of the individual components in the home position box.

APCC Home Settiings



**Config Drop-down Box:** This selection tells *APCC* whether your telescope is set up in the conventional orientation (Home roughly equivalent to the AP Park 2 position) or in a side-by-side setup (Home roughly equivalent to Park 3). A third "Custom" setting is also available. This configuration then provides you with default values for the settings described immediately below.

**Settings:** The settings defined in this window determine how the mount will perform its Establish Home and Find Home routines.

General Setting	sQ		
Iterations	5 🚔		
Slew Rate (x Sidereal)	200 🚔		
Slew Settle Time (Seconds)	5.0 🚔		
Custom Slew Coordinates before Homing			
Hour Angle	5.00 🚔		
Deslimition	15.00		
Declination.	10.00		
Declination.	10.00		

**Iterations:** This is the number of homing slews that will be used to create the average value in the Establish Home routine. Five iterations is a good value to use with three being the minimum number of iterations that we would recommend. This setting does NOT apply to the Find Home routine.

**Slew Rate:** (In sidereal units) Because the homing function involves the closing of mechanical switches, precision is improved by using slower slew rates than you might for normal GoTo operation. We have found 200X to be a good compromise between accuracy and speed for this procedure. This rate will be used in BOTH the Establish Home routine and in the Find Home routine if you get the mount lost at a later time. This slower rate ONLY applies to the final short slews into the home position.

**Slew Settle Time:** Set a value to allow the mount to settle at its position before the next action is undertaken. For the Establish Home routine, this is the settle time before

coordinates are read into memory for averaging. For the Find Home routine, it is the settle time before the saved average home coordinates are used to calibrate the GTO Servo Control Box's pointing position.

**Custom Slew Coordinates before Homing:** *APCC* uses these coordinates as the "jumping off point" for going home. They are used as the coordinates to which the mount slews between iterations in the Establish Home routine, and they are the coordinates used before the final approach to home in the Find Home routine. The recommended Custom Slew coordinates are in the table below.

	Northern Hemisphere - Conventional	Northern Hemisphere - Side-by-side	Southern Hemisphere - Conventional	Southern Hemisphere - Side-by-side
Hour Angle	-5:00	7:00	-5:00	7:00
Declination	15°	75°	-15°	-75°

**Establish Home:** If you have home and limit switches installed with GTOELS support, clicking this button will perform multiple same-direction slews to the home position. Before using this procedure, make sure that you are accurately polar aligned and have recently re-calibrated or synched. You only need to perform the establish home routine once unless you subsequently move the mount via the clutches or move the mount physically as in redoing the polar alignment. Changing the positions of the actuators will also necessitate redoing the Establish Home routine. However, you may repeat the procedure as often as you like - it simply isn't necessary unless the system has been moved manually.

When you click the Establish Home button, the mount performs a number of pairs of slews into and out of the home position. These short slews always come from the same position and are done at the same rate to improve consistency. By having an accurate calibration before you start, and then by averaging the celestial coordinates of the home positions, an extremely accurate mapping can be made between the physical position of the mount when homed by the switches, and the sky. These averaged coordinates are stored in *APCC* for future use if you ever get your mount lost and need to use the Find Home routine.

The Establish Home routine should be considered as one of the final parts of your system setup. It is something you perform after the mount is fully polar aligned and the system is fully loaded and balanced. Once completed, it seldom needs repeating.

**Find Home:** If you have home and limit switches installed with GTOELS support, clicking this button will move the mount to the Home position. Before you can do this you must have previously defined the Home position by using the Establish Home routine. Clicking this button will cause the mount to slew to the home position at the normal slew rate. *APCC* will then perform a full Sync on the saved coordinates and then slew out to the Custom Slew Coordinates before Homing. Finally *APCC* will slow to the slew rate selected in the Home Settings Window and make a final slew into the home switches. The mount will be allowed to settle, and then it will be re-calibrated on the saved average

home coordinates from the Establish Home routine. In testing, first GoTos after intentionally getting totally lost and then running this routine have resulted in pointing that was within a few arc-minutes.

### General work flow for precise recovery using the Home Position:

#### Part 1 - Establishing your Home Coordinates

1. Adjust your Home Switch Actuators using a 3/32" hex wrench.

For best results, adjust the R.A. actuator all the way to the east in its fine tuning adjustment slots, regardless of the hemisphere you are in. Note that the hemispheres are opposite in terms of leftright, but are consistent in terms of the cardinal direction EAST. In the northern hemisphere, adjust the Dec. actuator as far clockwise when viewed from above the axis as possible. In the southern hemisphere, move the actuator as far counter-clockwise as possible. These settings will ensure that the home position is at a positive altitude and a



**Declination Home Switch & Actuator** 

small distance away from a quadrant boundary.

Northern Hemisphere

Southern Hemisphere



- 2. Make sure you are fully polar aligned. If you refine your polar alignment in the future, you may wish to repeat the Establish Home routine.
- 3. Your system should be completely assembled and balanced with the clutches tightened to their operational level. If you move the mount via the clutches at a later time, you will need to repeat the Establish Home routine.
- 4. Calibrate on a star just on the east side of the meridian and just on the celestial equator side of your zenith. For best results, use the "Plate Solve and ReCal" feature in APPM, if you are using the Pro version of APCC.
- 5. Select the ELS Tab.
- 6. Choose your scope configuration Normal, Side-by-side, or Custom
- 7. Click the Settings Button.
- 8. Set the various parameters in the Settings window according to the instructions above. Then click OK to accept.
- 9. Click the Establish Home button. The following dialog box will appear:



Click OK to proceed.

- 10. Wait while the mount performs the number of homing slews that you chose under "Iterations" in the Settings window.
- 11. When APCC is finished with the routine, the following dialog box will appear (with somewhat different values):

APCC - Est	ablish Home
4	Average Altitude = 1.32124 degrees, RMS (Arc-mins) = 2.36 Average Azimuth = 89.26559 degrees, RMS (Arc-mins) = 1.99 Click OK to save these Home coordinates.
	OK Cancel

12. Click OK to save the averaged coordinates.

# Part 2 - Finding Home if you get your mount lost.

You do NOT need to use the home functions in normal operation of your mount. You only need to use the Home function if you have caused your mount to become lost. The Home function should not be thought of as an alternative method of parking the mount.

1. Select the ELS Tab.

2. Click the Find Home button. The following dialog box will appear:



- 3. Click OK to proceed.
- 4. Wait while the mount slews to the home position. IT WILL SLEW TO THE HOME POSITION TWICE! The first slew will be at your normal slew rate. Then the mount will slew the short distance to the Custom Slew Coordinates before Homing. And finally, the mount will slew back to the Home position at the slower rate that you selected in the Home Settings window. When it has settled, the following dialog box will appear:

AstroPhysi	csCommandCenter
Î	Your mount should now be at the Home position. Press OK to exit or CANCEL to retry the Find Home operation.
	OK Cancel

- 5. Click OK to recalibrate the mount at the Home coordinates.
- 6. Go to any star or coordinates, center and recalibrate.

# 6.12 Park Tab

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**Important:** If you unpark your mount with APCC, you must park it with APCC or through the AP V2 ASCOM Driver. Do not try to park it with your Keypad or any other non-ASCOM program. DO NOT use the Keypad to unpark the mount if using APCC.

**Tip:** We advise you to use the same "Park to" and "Unpark" positions in both APCC and the AP V2 ASCOM Driver. For normal operation, Unpark should always be set to Last Parked.

#### Unpark

This group box allows you to unpark the mount. Clicking *Unpark* will unpark from the position specified. The park positions include *Last Parked*, *Park 1*, *Park 2*, *Park 3*, *Park 4*, *Park 5* and *User Defined Alt/Az*. Refer to the illustrations and explanation of the four <u>predefined park positions 1,2,3,4 and 5 below</u>.

Note: This feature is very useful for a modified version Astro-Physics Daytime Polar Alignment Routine that is outlined in your keypad manual.

Use Unpark from Last Parked for all normal operations.

### Park

**Park**: Parks the mount to the park position specified. The park positions include *Current Position, Park 1, Park 2, Park 3, Park 4, Park 5, User Defined Alt/Az and Home Position.* Park 1-5 are illustrated below.

**Park to this Position:** The park positions include *Current Position, Park 1, Park 2, Park 3, Park 4, Park 5, User Defined Alt/Az and Home Position*. The next time you initialize the mount, this selection will be remembered and automatically used. If your situation changes before your next session, you can alter your selection in the APCC <u>Initialize Mount</u> window at the time you initialize. Note that Park 4 is now the recommended reference park position, and that Park 1 is considered obsolete (see below).

**User Park Position:** You can manually set park position to a *User Defined Alt/Az* position via the *Alt* and *Az* fields. Simply click the up-down arrows or enter the number directly into the field. This is a useful feature if you must park your mount in a certain position so that your observatory roof will close without striking your telescope. It is also useful for aiming the scope at a flat-fielding box.

Set User Park as Current Alt/Az: Clicking this button will set the mount's current Alt/Az position as the *User Defined Alt/Az*. The position can be at a negative altitude (below horizon) and/or in a counterweight-up position. However, note that the Safety Park feature cannot park to a counterweight-up position.

**Confirm before parking:** When this option is checked, APCC will ask you if you are sure you want to park the mount. You must click the OK button for the park command to continue.

APCC	×
This will park the mount to Park 3. Click 'OK' to park or 'Cancel' to abort.	
<u>OK</u> <u>Cancel</u> Auto-closing in 8 seconds. Default Action: Cancel	

Unchecking this option will initiate the park command without first asking you.

# **Safety Park**

**Safety Park (mins):** When checked, APCC sends a special command to the mount approximately every 10 seconds. The special command resets a "watchdog timer" internal to the mount's servo control box. The mount will be automatically parked after the time interval if the special command is not sent to the mount during that time period. This watchdog timer feature will prevent the mount from tracking your telescope into the pier should the computer freeze or crash or even if the serial connection is broken or fails.

When active, the current time countdown (before the mount is automatically parked) is shown above the numeric input box.

#### Safety park to this position:

In Place - The mount will park at its current position.

**Home Position** - The mount will park to the home position. This option is only available to mounts with P02-xx firmware and a GTOCP4 and GTOCP5 controller.

**Configured park position** - The mount will park to the configured park position in the **Park** group box. This option is only available to mounts with P02-xx firmware and a GTOCP4 and GTOCP5 controller.

Important: the Safety Park feature cannot park to a counterweight-up position.

# Special Note for TheSkyX Users

If parking from TheSkyX, you will need to set up the park position in BOTH TheSkyX and the two Astro-Physics programs - APCC and the Driver.

- 1. In TheSkyX, first clear the park position.
- 2. Using APCC or the driver, park to your chosen park position.
- 3. In TheSkyX, set park position.

You should now be able to park from TheSkyX Note that the mount will appear to park twice, although there should hopefully only be one slew.

#### Safety Park

**Enable Safety Park:** This feature has been added to APCC as a mandatory safety feature. It will assure that if power is lost to the mount and your computer, the mount will automatically enter a parked state at its current position. If power resumes, the mount will not start tracking.

#### **Park Positions**

In the past, Astro-Physics always had three defined park positions, cleverly named Park 1, Park 2 and Park 3. We have now added fourth and fifth park positions. Park 4 has relegated Park 1 to "obsolete" status. It is our intent that Park 4 should replace Park 1. Park 4 is a reference park position, like Park 1 was. However, while retaining all of those benefits, it eliminates the problems that existed with Park 1. Park 4 is on the east side of the mount and the commencement of sidereal tracking will therefore not immediately put the mount into a counterweight-up position. Slews out of the Park 4 position will almost never swing the scope below the horizontal as they often would do when slewing from Park 1 to positions west of the meridian. Park 4 is safer and equally useful. If you have your heart set on still using Park 1, it can be used, but please use caution and heed our warnings.

Park 5 is like Park 4, except with the scope pointing North in Northern hemisphere, and South in the Southern hemisphere.

Park 1, 2, 3, 4, and 5 are described below:











# 6.13 GoTo/Recal Tab

# GoTo/ReCal to RA/Dec

The **GoTo/ReCal to RA/Dec** group box allows you to enter your own coordinates for a slew. Coordinates can also be loaded from previously saved coordinates on the dropdown list, or the your current coordinates can be loaded directly from the mount for saving. These features are especially useful for a number of imaging tasks:

- If you have framed an object at coordinates that are not quite those that are from a catalog, simply load the current "framed coordinates" and save them. Future GoTos to the saved coordinates will place the object in your framing.
- Do you have the perfect focus star for your object? Go to the star, center it, and then load and save the star's coordinates for subsequent focus runs.

**Entering Coordinates:** Coordinates can be entered manually into the coordinate fields either in sexagesimal (HH:MM:SS or DD:MM:SS) form, or in decimal (HH.hhhhhh or DD.dddddd)form.

If you enter in decimal form, you might see a small warning exclamation point next to the field. The warning is simply to get your attention to be sure you intend the decimal entry. Simply press enter or click into the next field to see the decimal converted to sexagesimal. If entering in normal sexagesimal form, you can use your computer's Tab key to progress through the fields. Declination values can range from -90° to +90°. RA values can range from 0 to 23:59:59.

You can also enter a decimal value in the **Mins** fields for both RA and Dec. The decimal portion will be converted into seconds automatically when you press the enter key or leave the field.

The RA field can also be used as an hour angle field by checking the Hour Angle checkbox. The hour angle is most easily thought of as the distance from the meridian (meridian = LST) in RA. Positive hour angles are west of the meridian. Negative hour angles are east. The hour angle at any point in time is simply the meridian coordinate minus the RA coordinate (HA = LST - RA). Hour angles are especially useful if you are not tracking. If the mount is tracking, RA remains constant while the hour angle (and the meridian) keep changing with time. If you are stopped (not tracking), your hour angle remains constant, but the RA value will keep changing with time. Park positions, for example, are ideal candidates for coordinates expressed in HA and Dec. Hour angle values can range from -12:00:00 to +12:00:00. To specify an hour angle that is east of the meridian by under an hour (i.e., less than 60 arcminutes), enter -0 for hour angle.

Lastly the entered coordinates can be entered in either the **J2000** epoch or **JNow** (**local apparent**). The **J2000** check box identifies the epoch of the coordinates.

**To JNow** - converts coordinates from the **J2000** epoch (**J2000** check box enabled) to local apparent (**JNow**). This is extremely useful for entering catalog coordinates which are almost always in J2000.

**To J2000** - converts coordinates from the **JNow (local apparent)** (**J2000** check box disabled) to the **J2000** epoch. This is normally used after loading the current Mount coordinates to compare them to a set of catalog coordinates.

**To Alt/Az** - converts coordinates to Alt/Az and fills the fields in the **Goto/Recal to Alt/Az** group box. If **J2000** is checked the coordinates will be converted to local apparent first, then converted to Alt/Az.

**Clear Meridian Delay**: Normally you will want this check box enabled as it can prevent a pier collision. When enabled, the resulting slew position will always be with the telescope counterweight down.

However, if you want to slew to a counterweight-up position, then you may need to disable this option and set the mount's <u>meridian delay</u> appropriately. **Care should be taken to prevent a pier collision!** 



**<u>Goto:</u>** Clicking this will slew the mount to the RA/Dec position you have entered. A confirmation dialog box will appear. Click OK to initiate the slew.

😹 АРСС		×
0	Are you sure you want to slew to:	
	Epoch = J2000.0	
	RA = 05h 36m 45.82s Dec = -05d 23m 15.6s?	
	<u>OK</u> <u>C</u> ancel	
Auto	closing in 56 seconds. Default Action: Cancel	

The <u>Emergency Stop Window</u> will appear if you have clicked the appropriate check box on the <u>Setup</u> <u>Tab</u>. You can disable the Emergency Stop Window using the check box, if you wish.

Note that when the mount is slewing, the values in the <u>Telescope Position</u> group box will change as the slew progresses and the word "SLEW" will flash. Note that the E and W in the upper corners of the graphic indicate the pier side. Click on <u>3D View</u> to watch a representation of your telescope as it moves.

**ReCal:** Clicking this will Recal the mount to the RA/Dec position you have entered. In most circumstances, you will want to ReCal rather than Sync. ReCal is used to recalibrate the position of the mount if an object does not appear in the center of the field. Recalibrate can be used even when the object is past the meridian and the telescope is below the mount. ReCal recalibrates on the last object to which the telescope was sent.

NOTE: You can only use the ReCal option if APCC has the target object in its memory, i.e. you just gave a slew command and APCC already knows it should be at a particular position. You cannot use the ReCal option if you manually move the telescope to another position, since APCC has no way of knowing the position of that object. In this situation, use Sync as described below. For more detailed discussion, refer to the section below entitled: <u>Sync Explained in Detail and Compared to Recalibrate</u>.

**Sync**: Clicking this will Sync the mount to the RA/Dec position you have entered. Since misusing Sync is a common occurrence, a warning will display when you make this selection. In particular, be very careful that the mount is not in a counterweight-up position when syncing, as it might be if you are using the Meridian Delay feature. For more detailed discussion, refer to the section below entitled: <u>Sync</u> Explained in Detail and Compared to Recalibrate.

Please read the warning, think carefully and make the appropriate selection.



Save: This will save the RA/Dec coordinates to the drop-down list.

- 1. First, manually enter the coordinates or **Load Current** (see below) the coordinates that you wish to save.
- 2. Confirm the coordinates that populate the coordinate fields.
- 3. Select the **Save** button.
- The Saving GoTo Position window will prompt you to enter an optional title. If you do not enter a title, one will be created for you based on the position in the drop-down box, for instance: Saved #9.



5. Click **Save** or **Save New**. **Save** will update the currently selected entry, while **Save New** will create a new entry.



6. If you decide that you want to remove any items from the list, select that item from the drop-down box and click the **Delete** button.

**Load:** Select the desired target from the drop-down list box. When you click the **Load** button, the RA/Dec coordinates with the selected values from your target object will populate the RA/Dec fields.

**Load Mount RA/Dec:** Polls the mount for its current position and then loads the RA/Dec fields with the mount's current coordinates.

# GoTo/ReCal to Alt/Az

Altitude and Azimuth coordinates are entered in much the same way as the RA and Dec coordinates described above. Here too, entries can be in sexagesimal or decimal form. Valid entries for altitude are from -20 to + 90 degrees, although it is very unlikely that you will ever use negative altitude values. Azimuth values can range from 0 to  $359^{\circ}59'59''$ . Az = 0 is always due north (regardless of your hemisphere). Az = 90 is due east. Az = 180 is due south. And Az = 270 is due west.

As with RA/Dec, you can enter a decimal value in the **Mins** fields. The decimal portion will be converted into seconds automatically when you press the enter key or leave the field.



All of the actions and buttons below are like the ones above where they are explained in greater detail.

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**Clear Meridian Delay**: Normally you will want this check box enabled as it can prevent a pier collision. When enabled, the resulting slew position will always be with the telescope counterweight down.

However, if you want to slew to a counterweight-up position, then you may need to disable this option and set the mount's <u>meridian delay</u> appropriately. **Care should be taken to prevent a pier collision!** 

Goto: Clicking this will slew the mount to the Alt/Az position you have entered.

**<u>ReCal</u>**: Clicking this will recalibrate the mount to the Alt/Az position you have entered.

**Sync**: Clicking this will sync the mount to the Alt/Az position you have entered. Be very careful that the mount is not in a counterweight-up position when using this.

**Save:** If you want to save the position, click the **Save** button. You will be prompted to enter a title, if you wish. Click **Save** to change the selected position, or **Save New** to save as a new entry in the list. The Alt/Az coordinates will be added to the description. You may also cancel or clear, if you change your mind about saving the item.

If you decide that you want to remove any items from the list, select that item from the drop-down box and click the Save button. Then click the Clear button.

**Load:** Select the desired target from the drop-down box. This will load the Alt/Az coordinates for the target object into the Alt/Az fields.

**Delete**: If you decide that you want to remove any items from the list, select that item from the dropdown box and click the **Delete** button

**To RA/Dec:** Converts the displayed Alt/Az coordinates to RA/Dec and fills the fields in the RA/Dec group box with the coordinates.

**Load Mount Alt/Az:** Polls the mount for its current position and then loads the Alt/Az fields with the current coordinates.

#### Sync Explained in Detail and Compared to Recalibrate

Sync and Recalibrate are often used as synonyms in everyday use, but to APCC and the GTO Control Box directing the movements of your mount, they are different and distinct. Understanding this distinction will aid you in enjoying your Astro-Physics GoTo system.

The Sync command is typically used at the beginning of an observing or imaging session. Sync tells the mount where it is pointing and defines which is the telescope side and which is the counterweight side. It is a powerful command in that it disregards earlier slewing commands and starts over. It does not take the last entered position into account, but tells the mount – "You are here," based on the object (actually, the coordinates) displayed on the keypad or computer screen. It assumes that the telescope is correctly pointed with the sync object and the telescope on opposite sides of the meridian.

Each time you use sync, you redefine the orientation of the telescope and counterweight to the mount. If used in the wrong way, the sync command will cause the mount to slew incorrectly and possibly cause damage to equipment. It should therefore be used with caution.

Why is the Sync command a potential problem if used incorrectly? There are two main reasons. The first reason comes from the fact that both axes of the mount are full 360° circles that are not restricted in their motion. The second comes from the fact that the mount must rely on the information it is given: in particular, the date, time, daylight savings and location data to know where the meridian is. As smart and sophisticated as these systems are, they cannot see the sky or their own orientation and must rely on the operator to give them their proper start.

Let's examine the first issue. Why would the full circular nature of the axes create a problem potential? First, if you loosen your clutches, and then remove your telescope, mounting hardware and counterweight shaft, you can simply turn both axes round and round to your heart's content. Since the clutches were disengaged, the servo drive system can not possibly have any idea where the axes are pointing before you tell it by syncing the mount. This is a critical problem because of the fact that for any location in the sky, there would be two possible ways to point at it if there were no obstructions (like a pier) in the way. See the illustration below:



Both images show a telescope pointing at the same object. The image on the right is obviously wrong, and no experienced astronomer would position his or her mount like this, but the mount cannot know which alternative has been chosen. The software was therefore written to subsequently slew the mount assuming the sync position was correct as shown on the left. It bases its assumption of where the meridian is and where the pier is on the correct orientation of the system when it is synced.

Well, you might ask, if no one would be dumb enough to sync with their mount positioned like the one on the right in the illustration above, why even bring it up? The reason is that things aren't always as easy as the above illustration – it was designed to make the point obvious. Take a look at the next illustration. Is it OK to use sync in either of these situations? The answer is maybe, but I wouldn't really advise it.



This brings us to the second main reason that sync can be a problem if used incorrectly. The illustration above shows that it can be difficult to tell which side of the meridian you are pointing at when pointing near the meridian. This assumes that the meridian is where it's supposed to be. Now wait a minute, you say. We all know that the meridian is the north – south line that is straight up: directly overhead. It goes through the zenith. It has to be where it's supposed to be! That is true, but the mount can't see like you and I can. It can't look up and see the meridian; it has to calculate the meridian based on the data we give it. That data is the location, the date, the time and whether or not daylight savings is in effect. Errors in this data will result in errors in the calculated position of the meridian with respect to the object being synced.

Daylight savings is an easy example to understand. It changes our clocks by one hour, forward each spring, backward each fall. Each hour is equivalent to 15° of sky. Therefore, a simple mistake in the entered value (off or on) for daylight savings will throw the calculated meridian off by a whopping 15°. The next illustration shows this.



The telescope is 10° east of the true meridian. If syncing on a star with the telescope in this position, you would (and it should be on=1), the calculated meridian will be 5° too far to the east to sync! Likewise, just entering the wrong location (i.e. your back yard location number instead of your dark site location number) can throw you off by enough to make any sync close to the meridian worth reconsidering.

Sync is a very important, handy and powerful command. Don't be scared to use it, just follow these safe guidelines now that you understand how it works:

1. Your mount MUST be polar aligned. Since sync establishes the mount's orientation with respect to the telescope, counterweight shaft and pier, polar alignment is a prerequisite.

2. NEVER sync if your counterweight shaft is pointing up. Avoid syncing if your counterweight shaft is close to horizontal. Remember that the sync object and the telescope must be on opposite sides of the mount / meridian.

3. Do not use sync if your meridian delay feature is turned on. Meridian delay overrides the mount's orientation / clock information and can lead to the same problem as syncing when the mount is improperly oriented.

4. Compare the current LST value the R.A. value for the star you will be syncing on. Remember that the LST value changes along with time; you can't use the LST value you remember from several hours ago. If the R.A. number is larger than the LST value, the star is east of the mount's calculated meridian and the scope should be on the west side of the mount. If the R.A. value is smaller, the star is west of the calculated meridian and the scope should be on the scope should be on the east. This is an especially good way to check, since it uses the mount's calculated meridian and therefore bypasses any errors in time or location data.

5. To verify that everything is set correctly once you have synced, go to the RA and Dec entry screens on this GoTo/ReCal tab and enter the current LST value. For the DEC value, enter your latitude. Press GOTO. After slewing, your counterweight shaft should be perfectly horizontal. and the scope will be pointing straight up as well. This is a good test because it also indicates whether your time and location data are correct.

6. Your sync will result in greater pointing accuracy if you sync to a single star that is close to the celestial equator, rather than close to your pole. This has nothing to do with the sync command itself, but instead is because of the geometry of the celestial sphere. Think of the longitude lines on a globe, how they are widest at the equator, but converge at the poles. A small error in centering a star near the pole would translate into a larger R.A. error than the same centering error on a star near the celestial equator.



In summary, you use the sync command once in an observing or imaging session unless the telescope gets physically moved by hand or by accident (as opposed to moved with the N-S-E-W buttons). While it can be used to tweak pointing accuracy, we prefer to use recalibrate for that. We also recommend that you Sync on objects that are at least 15 deg. (1 hour) from the meridian. This will help safeguard you from a potential clock related problem - i.e. you forgot about daylight savings time, and it makes it easier to see that the object and telescope are on opposite sides of the meridian. If you are permanently mounted and do not disturb the scope position, you do not need to use it after the very first setup.

Recalibrate is the "tweak" command. It is quick and easy and is perfect for fine-tuning your pointing accuracy during your observing or imaging session. Rather than telling the mount where it is pointing, recalibrate corrects its minor pointing inaccuracies. Recalibrate works on the object in memory that the mount thinks it is already pointing at. Since it does not re-establish the mount's position in memory, it doesn't matter if the telescope and ReCal object are both on the same side of the meridian. It is therefore a safer command to use during your session.

Remember that for both commands, the preferred object of choice will always be a single bright star because it is a single point source. Avoid double or multiple stars if possible. Solar system objects can be useful for daylight syncing or recalibrating. In addition, remember that pointing accuracy is also dependent on the accuracy of the polar alignment and the orthogonality of the entire system.

CAUTION: It is important to note that external software programs may not make the same distinction between the 2 terms, so be careful when syncing or recalibrating (or whatever they call it) with other programs. For safety sake, we recommend that you utilize the SNYC -> RCal Translation safeguard described on the <u>Virtual Ports</u> tab.

# 6.14 Rate Settings Tab

# **Rate Settings**



Use the drop-down menus to select from among the available rates in each category. Note that the current rate is the rate that is currently set in the mount (as read from the mount), and is not necessarily the rate displayed in the drop-down menu. Click the Set Now button to set the rate to the one you have selected. The value in the Current field will change to reflect your choice.

Tracking Rate: Sets the tracking rate to the selected value when you click the Set Now button.

Guide Rate: Guide rate is fixed at 1.00x for Astro-Physics mounts

**Slew Rate:** Sets the slew rate to the selected value when you click the *Set Now* button. Available slew rates in the pulldown menu will change based on the mount type connected (auto-fill slew settings requires version P02-01 or later).

Note that for older 400GTO and 600EGTO mounts, the slew rates and the faster button rates may be a bit slower than what is displayed, depending on the gear heads that were used in your mount. The rates for the 3600GTO will also be slower due to slew scaling that was programmed into the control box settings for this mount.

All current mounts as well as all 900GTO and 1200GTO mounts will move at the rates that are displayed.

Button Rate: Sets the move button rate to the selected value when you click the Set Now button.

Set All Now: Sets all of the above rates with one click.

#### **Rate Settings When Initializing APCC**

When APCC is initialized at the beginning of your session, the rate settings that are set in the Initialization Window are the ones that will be sent to the mount. Please refer to the <u>Initialization Window</u> section for additional information.

#### Rate Settings in the ASCOM V2 Driver

APCC does not use these settings during the initialization routine since APCC is the program that initializes the mount, then calls the ASCOM V2 driver. The settings in both programs are independent of one another. When updates are made to one program, they do not change in the other program. We recommend that you always refer to the APCC status readings to determine the current settings that are active.

# Custom Tracking Rates



Rate Units: Choices are Sidereal, Arc-Secs/Sec, and Arc-Sec/Hour.

**RA Rate Relative to:** Choices are Sidereal and Zero Rate. It is normal in astronomical thinking to treat sidereal as the basic default condition of a tracking mount with regard to RA. Therefore, RA tracking rates are generally relative to sidereal. As such, with sidereal being the null condition, an RA rate of zero is in fact the sidereal rate when the rates are relative to sidereal. Relative to sidereal, a stopped mount has a tracking rate of -1.00 x sidereal. Relative to zero is as its name implies, and relates the rate to a stopped mount.

**RA Rate:** Enter the RA rate and click *Set* to set the rate. You can either use the up-down arrows or enter the desired number.

**Dec Rate:** Enter the Dec rate and click *Set* to set the rate. You can either use the up-down arrows or enter the desired number.

Set Both Now: Sets both the RA and Dec rates simultaneously.

RA Drift: This is the current rate read back from the mount using the setting for "RA Rate Relative To".

Dec Drift: This is the current rate read back from the mount.

Reset Tracking to Sidereal: Resets tracking back to sidereal rate and the Dec rate back to zero.

# 6.15 Horizon Tab

# **Overview**

The Horizon Tab opens the Horizon Tracking Limits Window. Horizon Tracking Limits are limits that you set to represent your actual horizon at your observing location. With Horizon Limits activated, you can leave an imaging setup running unattended with the knowledge that the mount will take the action you have selected when the scope reaches your defined horizon.

The horizon limits act upon a mount that is tracking. They do NOT prevent slews that will point the scope below your defined horizon. However, a slew into an area below the defined horizon limit will cause the mount to take your chosen action once the slew is completed and tracking commences. The horizon limits will NOT, however, save you from an errant slew command. See Notes at bottom of this page.

Use the Horizon Tracking Limits in conjunction with the Meridian Tracking Limits to define all of the allowable sky at which your scope can be pointed. Note that you should use the meridian limits to define the horizon in situations where the scope is past the meridian. Because these counterweight-up / scope-past-the-meridian positions will have higher usable horizons, you will not want the same limits as you will when the scope is in a traditional position. For users with the Pro version of APCC, the Horizon and Meridian Tracking Limits are also extremely useful in point mapping for the pointing and tracking correction functions.



# Northern Hemisphere

# **Southern Hemisphere**



Your particular horizon can be edited and saved in the <u>Horizon Tracking Limits Editor</u>. Multiple horizons can be saved for different favorite locations and the particular horizon for a specific location can be associated with that location's <u>full group of settings</u> for ease of setup.

# Operation

**Enable Horizon Tracking Limits:** This enables horizon tracking limits once you have a set of limits defined. Think of it as the On / Off switch for the horizon tracking limits. When a limit is reached while tracking (not slewing) the mount will do the appropriate action as described in the next paragraph. You will note that enabling the horizon limits causes the horizon to appear on the small sky map in the Telescope Position section at the lower right side of the main window. The horizon will not appear on the sky map if the limits are disabled.
Operation ?					
Action when limit reached Park Mount					
Time before limit reached					
09h 36m 00s 7:23:18 AM					

Action when limit is reached: Choices are Stop Tracking, Park Mount or Just Warn. If Park Mount is selected, APCC will park to the park position selected on the <u>Park tab</u>. When the limit is reached, the Horizon Limits Indicator in the Telescope Position section of the main window will begin to flash alternatively between the dark red and yellow



**Time before limit reached:** Shows the estimated time before the Horizon limit is reached. This box is only active if the limits are enabled. (See Operation Controls screen above).

Starting with version **1.5.1.0** the clock time at which the limit will be reached is also displayed.



### Horizon Tracking Limits - Altitude/Azimuth

The Altitude / Azimuth box on the Horizon Tab gives you a graphical representation of the sky with your horizon limits. It shows the telescope position, a rectangular Alt / Az grid, and the corresponding R.A. and Dec. lines.

**Useful Tip:** A very useful feature of both the main tab graph, and the Horizon Limits Editor graph is that you can double-click on a spot on the graph to slew to that position.



**Note:** You can double-click a point in the graph to slew to that position as shown in the northern hemisphere view above.

## 6.15.1 Horizon Limits Editor

### **Overview**

The window shown below under #3 is where you will actually describe your horizon graphically and save it for APCC to use. There are several ways to create your horizon from a simple drawing which can be done in under a minute for a one-time portable setup, to a detailed mapping with precisely accurate horizons for a permanent observatory. The detailed mapping will, of course, take a bit longer!

### Shortcut for defining a fixed horizon limit

If all you need is a horizon at a fixed altitude (for example if you only want to image above a certain altitude, or you do not have any obstructions that you want to map in your horizons) using the Fixed Limit may be the easiest approach.



This is found on the Horizon tab main screen:

To use the Fixed Limit, simply enable the checkbox and enter a desired minimum altitude (in degrees). You will see your Horizon limit updated in the graphical representation.

To reset your horizon limit to 0, simply enter 0 for the fixed limit altitude.

### Instructions for creating and / or editing your custom horizon.

- 1. Click on Horizon tab in APCC main window.
- 2. Click on <u>E</u>dit button to lower right of horizon limit graphical representation. This opens the Horizon Tracking Limits Editor Window.

Astro-Physics Command Center Pro File Settings Tools Help	o 		Horizon Tracki	na Limits /	Altitude/Azim	uth)	-	
Enable Horizon Tracking Limits	90 <sup>N</sup> NE	E	SE	S	SVV	w	NW	N 90
Action when limit reached Park Mount  Time before limit reached  02h 24m 20s 7:22:29 AM	80 70 60 50 40 20 20					Ø		Open Horizons Limit Editor
Setup Site Park Homing/Limits	GoTo/ReCal Pointin	90 Ide (degs) ).0 🗲	135 Double cli Settings Ha	180 ck to slew to	225 a point. idian GPS	270	315	Edit

own above is from a Northern Hemis

3. The Horizon Tracking Limits Editor Window. Your custom horizon will be created and displayed in the Horizon Tracking Limits Graph. Graphs for each hemisphere are shown below.



- Horizontal Axis: The horizontal axis of the Horizon Tracking Limits Editor represents the full-circle panorama of your observing location. The scale at the top of the graphic represents the compass points, and the scale at the bottom is in degrees of azimuth. It is conventional in astronomy to always set the 0/360 azimuth point as due north with the circle going around to the east, regardless of the hemisphere you are in.
- Vertical Axis: The vertical axis represents the altitude from zero to the zenith. (0=unobstructed horizon; 90=zenith)
- R.A. and Declination lines. The curvy lines are the R.A. and Declination lines as they are mapped onto the rectangular Alt/Az grid.

• The Horizon Controls and File Controls that are identified in the images above are explained below.

### Setting up Your Limits - Simplest Method

Draw approximate horizon on Horizon Tracking Limits Editor Window of APCC. This may be the preferred method for star parties and portable setups. You can have a workable result in a minute or less. To draw your horizon, start by noting the horizon surrounding your mount. Take note of the average horizon level you will wish to use, and also the possible differences in sky glow in different directions. Use the old astronomer's trick of using fingers on an outstretched hand to estimate the height of the usable horizon.



Finally, note any obstructions like buildings or trees that will create "bumps" in your horizon. Then simply follow these steps:



- 1. Place the mouse pointer at a point that will be on your horizon.
- 2. Click and hold down the left mouse button and drag to start drawing.
- 3. Edit or change what you've drawn by simply clicking on or near your drawn horizon line and redrawing. You can erase your results by dragging the mouse along the 0 line on the bottom.
- 4. You may find it easiest to start by draw the primary line first, and then go back and edit to deal with trees, buildings or other obstructions.
- 5. If you wish to save the horizon limits, click the Save As... button on the right side of the controls.
- 6. If you simply wish to use the limits for the one night, then just click the OK button without saving. It is probably advisable to go ahead and save anything that you have invested some time in, even as a temporary file just in case your computer crashes during the night.
- 7. You can always go back and edit the active horizon limits whether you have saved them or not by simply clicking the Edit button from the Horizon tab of the main APCC window.

#### Horizon Controls - a more precise method

Use the Horizon Controls or keypad or both to move around and add points.

- 1. Temporarily turn OFF meridian limits and pointing and tracking corrections if applicable.
- 2. Click the Zero Tracking button in the lower left of the horizon editor screen.



- 3. Start at Azimuth zero and estimate your horizon-altitude at that point.
- 4. Adjust altitude incrementally until you find the horizon. Since R.A. and Dec. do not move conveniently in Alt/Az, it is often easiest to use the increment feature in the horizon editor. With this feature you can simply click a single button to point the telescope up (+) or down (-) by the chosen incremental value in degrees. Your altitude increments will probably be smaller than the azimuth increments you will use (probably in the 1 5 degree range). Both R.A. and Dec. will move so that the azimuth will be maintained as the altitude is adjusted.



As an alternative, you can also simply enter the altitude in the box to the left of the increment box. The value can be typed in or adjusted via the up/down arrows.



5. When you are satisfied with the pointing position, add the current point to your limits. Simply click



the **base second** button at the bottom center of the window. The Horizon Editor will draw a line connecting this new point to the previously added point (once you are past the first point at azimuth=0)

- 6. Increment to next azimuth and repeat. This is done in the same manner as the altitude increments described above except, of course, that you will use the lower set of Azimuth controls. Azimuth increments can be quite large, especially if there is a region of your horizon that is relatively straight. The line that the Horizon Editor will draw can slope up or down, so the important thing is that the horizon forms a straight (not necessarily flat) line without bumps or dips.
- 7. Continue with this process until the azimuth circle has been completed.

### Hints and Tricks:

- Skip large chunks of azimuth where the horizon is flat or has a straight line (i.e. roof line) by either entering an azimuth manually followed by clicking the GoTo Az/Alt button, or by double-clicking a spot on the graph at the approximate azimuth where the horizon changes. This is especially useful for the long straight walls of roll-off-roof observatories.
- As an example: I built a very accurate horizon limit model for inside AP's roll-off-roof observatory with only 9 well placed points. The observatory is a double roll off that divides in the middle with the roof halves rolling off to the north and the south respectively. The following should be considered an example only. The exact sequence of steps will probably not be ideal for your situation.



o 1st point was at Azimuth=0 and was the peak of the north roof segment.

- o 2nd point where roof met east wall (NNE).
- o 3rd point due east.
- $\circ$  4th point where east wall met southern roof segment (SSE).
- o 5th point due south at peak of southern roof segment.
- $\circ$  6th point where roof meets west wall (SSW).
- o 7th point due west.
- $\circ$  8th point where west wall meets north roof segment (NNW).
- o 9th point back to peak of north roof segment.

Note that this particular test setup was not centered in the observatory.

This is the reason for the minor asymmetry in the horizon graph.

• You may find it easiest to move to a spot with the keypad's direction buttons. Then click the Load Alt/Az:



- Another really good trick is to double-click your best guess as to the next point on the graph. The mount will slew to the Alt/Az of the clicked point. Then adjust the position with your keypad. The keypad is handy because it allows you to sight along your OTA as you make the fine adjustments. When you are happy with the point location, go back to the Horizon Tracking Limits Editor and:
  - a. Click the Load Alt/Az button
  - b. Click the Add Current Alt/Az Point button
  - c. Go to the next point.

This can be especially useful for getting the azimuth of an obstruction right. Once the scope is pointing to the correct azimuth, load the Alt/Az coordinates and then adjust the altitude using the incremental moves described above.

- When double-clicking on the graph in the Horizon Tracking Limits Editor, be aware of the points where there would normally be a meridian flip. (0°/360° and 180°) If you try to click exactly on the line, you may or may not go to the side you wish because of the limits of your screen resolution. Instead, at 0° and 360°, click just inside the line (barely inside the graph window). For the 180° point entry, do one just to the left, and then do one just to the right of the line.
- When clicking on the graph in the Horizon Tracking Limits Editor, keep your sky glow in mind! There is no sense in outlining a detailed horizon in a direction where light pollution effectively raises the usable horizon above all the trees, buildings etc. that you so carefully outlined. This is an easy error to make if preparing the horizon limits during daylight.

### File Controls - Manage your Horizon Tracking Limits

- Click the Save As button to save the newly drawn or edited limit. Multiple horizon limits can be saved for different locations. Please be sure to double check that the path for your saved horizon limit is correct. Horizon Limit files will have the suffix: .hrz. We have found it advantageous to give all settings files for a given location the same or a similar name.
- · Click Load to bring up a previously saved horizon limit.
- Click OK to place the newly drawn limit into APCC for immediate use.
- Click Cancel to close the window without saving the limit or placing it into APCC.

# 6.16 Meridian Tab

### Introduction

The Meridian Limits are one of the most powerful and useful features of Astro-Physics mounts when used in conjunction with the Astro-Physics Command Center (APCC). They open up the possibility of imaging on both sides of the meridian WITHOUT wasting time on a pier flip at declinations where the scope will not strike the pier. The limits, when properly configured, allow you to track safely past the meridian up to the limits you set based on your unique instrument package. In addition, they allow you to begin an image ahead of the meridian by safely slewing you into a counterweight-up position to start an imaging series that can then simply continue through the meridian. However, like any powerful feature, you MUST understand how the meridian limits work. It is vital that you understand what they CANNOT do as well as understanding what they can do!

Warning: Please take special note of the following:

- The Meridian Limits, are primarily tracking limits in the west, and counterweight-up slewing guides for APCC's advanced slew logic in the east. They will **NOT** prevent you from slewing into your pier with an incorrect slew, or from running into the pier with direction buttons.
- **DO NOT** use any other method for setting a meridian delay while you are using the meridian limits. When properly configured, the APCC meridian tracking limit logic will maintain the correct meridian delay in the system.
- Allow the "Counterweight Up Slews within: East Limits" feature (see *Operation* below) to safely slew your mount into a meridian advanced position east of the meridian. Do not try to "outsmart" the system and finagle this yourself.
- We suggest that you do your Horizon limits before doing your meridian limits.

**Understanding East vs. West limits.** People can get confused with the East and West limits. This is in part due to the conventions used in German Equatorial mounts regarding pier side. In APCC's Meridian Limits, East and West define <u>where the scope is pointing</u>. In both cases, the limits apply when the counterweights are up with the scope on the wrong side of the pier in a position that is not considered "normal". (Normal being with the counterweights down, but the scope on the other side of the pier.)

Think of West Limits as SAFETY LIMITS. These are the limits that protect you from tracking into the pier, and most people would consider them to be the most important. A normal scenario would be that you start pointing to a target in the east with the counterweight in the normal down orientation. Then, as you track the object across the sky, the telescope reaches and then crosses the meridian and the counterweight goes into an "up" orientation. These limits determine how far you can track past the meridian without getting into trouble.

Think of East Limits as OPPORTUNITY LIMITS. With an AP mount, you have the opportunity to start tracking an object that is in the east from a counterweight "up" orientation, and then tracking through the

meridian into a normal counterweight "down" position to finish tracking on to your horizon. This allows you to avoid the need to flip at the meridian.

#### Operation

*PulseGuide*, the *AP V2 ASCOM* Driver, and the mount's keypad each have the ability to set a meridian delay which controls the flip point of the mount. APCC adds some powerful new capabilities. Three of these new features apply to *West Meridian Limit* points. The *West* limits come into play when a scope's counterweight is in the up position (scope under the mount) and the scope is pointing West of the meridian. This normally occurs when the scope is allowed to track past the meridian. The fourth feature below applies to east meridian limits and provides a unique and powerful tool for safely starting images in the east from the east side (counterweight up) using the meridian advance.

- Instead of just a single meridian limit for all declinations, you can configure an arbitrary number of different limits at different declinations. This is useful because at each declination there can be a different hour angle at which the telescope will touch the pier. In declination regions where the telescope can theoretically go the full 6 hours past in the west, the meridian limits can establish horizon tracking limits for the practical distance past the meridian where you can reasonably continue to work. Likewise, in the east, they can set the practical horizon ahead of the meridian where you can reasonably start an image.
- When a meridian tracking limit is reached, tracking can be automatically stopped; the scope can be "flipped"; the scope can be parked; or no action can be taken other than a warning.
- Meridian tracking limits can also be used to create a safe zone around your pier if it interferes with even reaching the zenith, similar in a way to the safe zone in the Astro-Physics GTO keypad. The keypad's safe zone, however, is a GoTo slew limit, rather than a tracking limit. Remember that an APCC Meridian Limits safe zone that does not allow the scope to reach the Meridian must be stopped or parked. It cannot be flipped.
- When east limits are properly configured and employed, slews to targets within the east limits will automatically be made using meridian advance and APCC's safety slew logic to place the system in a counterweight-up position with the scope on the east for uninterrupted imaging through the meridian. The safety slew logic ensures that all mount movement with the counterweight up is with the RA only. Using the East Limits, the scope can image through the meridian and on for another 6 hours before the telescope reaches the horizon. See: **Counterweight Up Slews within: East Limits** below.



The ability to work past the meridian into the west, or to start ahead of the meridian in the east has always been a hallmark of Astro-Physics mounts. Both the keypad and the earlier PulseGuide program provided the ability to work beyond the meridian. However, with both of these control methods, the user would want to be present at the mount for safety. APCC creates meridian limits that can allow the user

to safely exceed the meridian without hovering over the mount to protect the scope and imaging equipment from a potential crash. Remotely controlled observatories can now also safely image through the meridian (where declination permits it).

**Enable Meridian Tracking Limits:** This check box enables the meridian tracking limit functionality allowing tracking to safely continue beyond the meridian until the west limit is reached..

**Action when limit reached:** This defines the action taken when the mount tracks into the West limit. The choices are to:

- Stop tracking. The mount simply stops where it is and waits for user input.
- $\circ$  **Park mount**. Parks the scope at the park position defined on the Park tab,
- **"Flip" scope**, The mount will perform a safety slew into a CW down position and then a normal slew back to the target, but in the conventional CW down position.
- **Just Warn**. APCC will place a warning on the top of your screen to inform you that the limit has been exceeded. Use this option only if you are watching the scope! It can be handy if you start an image that will last just beyond the limit, but that you think will still be within your safety margin.

In their traditional role, the meridian limits just act as a safety stop when tracking and the East limits effectively are not used. However, you can elect to use the east limits to safely slew the mount into a counterweight-up position to maximize imaging time of a single target as it tracks past the meridian. To do that you would use this:

**NOTE:** The following two checkboxes should ONLY be checked if you are using your mount "hands on". At the present time, automation software has not been written to fully accommodate these features in APCC. Programs like ACP and CCDAutoPilot cannot yet take full advantage of these capabilities. This will require cooperative development between the respective software developers.

DO NOT check these options if operating remotely via ACP or CCDAP! A Warning box will appear when these boxes are checked to help prevent problems.

Limit to Meridian: Limits the Flip Offset to be at most set to the sky's real life meridian.

**Flip Offset:** This defines a period of time during which the mount can be "flipped" before the actual **Meridian Limit** is reached. This may be useful when using third party applications so they can perform a meridian flip before reaching the **Meridian Limit**, which may trigger tracking to stop or parking the mount.

**Flip Offset Padding:** This adds or subracts time (in minutes) to the Flip Offset value sent to Sequence Generator Pro.

**NOTE**: Limit to Meridian, Flip Offset, and Flip Offset Padding only apply when the mount pier side is West (pointing East with counterweight "down", or West with counterweight "up").

The **Meridian Limit** usually varies with declination. The **Flip Offset** adjusts the meridian flip point a number of minutes from the configured **Meridian Limit** at the current declination. If this option is enabled and the meridian flip point would be pushed past the actual sky meridian, the meridian flip point will be instead limited to the sky meridian.

#### Counterweight Up Slews within:

- East Limits: When pier side is East then slews to coordinates between the meridian and East limit values will result in the mount ending up in a counterweight-up position pointing East. This will allow the target to be tracked through the meridian into a conventional counterweight-down mode without needing to be flipped. This is the automated way to start your image ahead of the meridian, and is a classic technique for many experienced Astro-Physics imagers. Short focus slews to a nearby focus star will also not result in a pier flip, but they WILL result in a safety slew in most instances. This is a necessary safety feature.
- West Limits: When pier side is West then slews to coordinates between the meridian and West limit values will result in the scope ending up in a counterweight-up position pointing West. This will avoid a meridian flip until the West limit is reached. However, if the mount is already on the East side pointing West, and within the West limits, the mount will not flip. This can be considered a "dynamic meridian delay", because the delay automatically changes based on declination. The primary use of this feature is to facilitate small slews for focusing while the mount has tracked past the meridian without instigating a pier flip.

**Time before limit reached:** This is a countdown timer. It gives the time remaining until the meridian tracking limit is reached at the current Declination. It is only enabled when meridian tracking limits are enabled.

Starting with version 1.5.1.0 the clock time at which the limit will be reached is also displayed.

**Send Limit to SGPro:** If Sequence Generator Pro (SGPro) is running and declination changes, the current meridian delay value is sent to SGPro. SGPro can use that delay to determine how far before or after the meridian that a pier flip will occur. SGPro will only attempt to do the pier flip once the meridian delay value is reached.

### Meridian Tracking Limits - Hour Angle/Meridian Inclination

The *Meridian Inclination* is the angle measured along the meridian line from the Southern horizon to the Northern horizon in the Northern hemisphere, and from the Northern horizon to the Southern horizon in the Southern hemisphere. *Meridian Inclination* = 0 at the horizon opposite your pole (ignoring the effects of refraction) and *Meridian Inclination* = 180 at the horizon below your pole. Use of Meridian Inclination gets around the ambiguity of some declination values underneath the pole compared to those above the pole. For example, in the northern hemisphere at 50 degrees latitude, 85 degrees declination meets the meridian at two positions, one above the north celestial pole, and one below the north celestial pole. The Celestial pole is always at Meridian Inclination = 180 - latitude. At this 50 degree latitude, the pole is at a meridian inclination of 180 - 50 = 130. And 85 degrees declination occurs at meridian inclinations of both 125 (above pole) and 135 (below pole).

**Edit:** Allows you to configure the East/West Meridian limits. Clicking will bring up the <u>Meridian Tracking</u> <u>Limits Explorer</u>.

Show East Limits: When checked, shows the East Limits.



Show West Limits: When checked, shows the West Limits.



Hour Angle Scale: Allows you to magnify the hour angle values.



### **Meridian Delay**

The ability to advance or delay the meridian to avoid a meridian flip has been a hallmark of the Astro-Physics GTO system since its initial development. Starting with APCC and the Rev. "S" firmware in 2012, the method for employing this feature has been changed in the GTO Servo Control Box. The delay is no longer accomplished by "fooling" the clock in the servo. It is now an independent function with associated commands that does not change the mount's time.

**Note:** The earlier method employed by the keypad and PulseGuide will still work. APCC only uses the new method. The V2 ASCOM Driver can use either and will choose its method based on the firmware version it detects. *The important thing to remember is to NOT mix methods! Do not set a meridian delay with APCC and then try to undo it with the keypad, or vice versa.* 



**Current**: The current meridian delay as polled from the mount. Note how this value changes at different declinations if APCC's Meridian Limits are enabled. This is the manifestation of the "dynamic meridian delay" described earlier.

**WARNING!** Do not make manual meridian delay adjustments if you have activated meridian limits. Allow APCC to set and control the meridian delay. The *Hours* field and the *Clear* and *Set* buttons described below are intended for manual control without active limits.

Clear: Clears the meridian delay back to zero.

**Hours**: The meridian delay value to use when **Set** is clicked. Positive values move the local meridian to the east for meridian advance. This allows you to start an image from the "wrong" side and then track through the meridian into a normal orientation without a flip. Negative values move the logical meridian to the west and allow you to "delay" the flip point of the mount.

Set: Sets the meridian delay to the value in the Hours field.

**Clear Meridian Delay on Exit:** This will restore the meridian delay to 0 when exiting so that the mount's flip point is not in an unexpected position. It is recommended that you keep this checked.

**Override ASCOM:** APCC will override the ASCOM Driver's meridian delay setting. This will allow the more precise meridian adjustments that are possible with APCC's Meridian Limits. If you have set good Meridian Limits in APCC, you should let it handle the meridian and keep this box checked so that an ASCOM client doesn't set an incorrect meridian delay value.

### 6.16.1 Meridian Limits Explorer - Introduction

#### Warning: Please take special note of the following:

• The Meridian Limits, are primarily tracking limits in the west, and counterweight-up slewing guides for APCC's advanced slew logic in the east. They will **NOT** prevent you from slewing into your pier with an incorrect slew, or from running into the pier with direction buttons.

- **DO NOT** use any other method for setting a meridian delay while you are using the meridian limits. When properly configured, the APCC meridian tracking limit logic will maintain the correct meridian delay in the system.
- Allow the "Counterweight Up Slews within: East Limits" feature (see <u>Meridian Limits - Operation</u>) to safely slew your mount into a meridian advanced position east of the meridian. Do not try to "outsmart" the system and finagle this yourself.

**The Need for Many Limits** A single fixed meridian limit is not usually optimal because while it may provide the maximum meridian travel at a single declination, it might be limited at another declination where the mount could track farther past the meridian. For example, when declination is near 0 degrees, the scope can usually pass underneath the mount without any possibility of collision. However, as the scope's declination moves further away from 0, the telescope can start to protrude enough that it can strike the pier under certain circumstances. There is a tradeoff between simplicity (setting one limit and being done with it) and optimizing how your mount handles meridian flips so it can track longer without needing to flip.





**Meridian Limits and the Horizon** In situations where the scope will not hit the pier, the limiting factor becomes the horizon. Take note that in observatory settings, this horizon can differ significantly in its Alt and Az values from the horizon values you established earlier with the Horizon Limits Editor. The following two screens - both identical views, and both at a declination of 10 degrees - show this difference:





The **Meridian Tracking Limits Explorer** helps you setup custom meridian tracking limits for each declination. You record a series of limit values, and the Explorer interpolates a full curve from these points to give you defined limits throughout the sky. The Meridian Tracking Limits Explorer Window is shown below. To access this screen, click on Edit to the lower right of center on the Meridian Tab.



There are five ways to build your meridian limits curve with the Explorer:

- Use the Set Constant Limit to create a fast, simple fixed limit for the entire side of pier. Constant limit value is entered in Hour Angle (e.g., a value of "1.00" is 1 hour or 15 degrees). When you press the Set Constant Limit, it will create the limit on the West side. If you wish to set a constant limit on the East, you will first need to create it on the West, then "Reflect West" to copy it over to the East, and then you can change your West limit if desired.
- 2. Use the Explorer's semi-automated method for drawing the limit curves. This method is detailed in the <u>Using the Meridian Tracking Limits Explorer</u> sub-section (next section) of this Help file and involves steps 1 through 3 as shown in the screen shot above.
- 3. Draw a limit. This is performed just like drawing a custom <u>Horizon Limit</u> by clicking and holding the left mouse button while you trace out your limit. This is NOT recommended unless you are very familiar with meridian limits and how they should look. It is really most useful as a way to quickly modify an existing limit curve to reflect a minor change in the limit determining factors.
- 4. Manually Add Points. Clicking on the Manually Add Points button on the lower right side of the Explorer Window will open up the Add Meridian Tracking Limit window. This will be detailed in the <u>Manually Add Meridian Tracking Limit Points</u> sub-section below.
- 5. Edit the Table Manually. You can go into the actual interpolated data table of an existing Meridian Tracking Limits curve and edit the values at each meridian inclination. This is also recommended only for advanced users.

In addition, please note the following:

• There are some instances and situations where you may wish to combine the methods above. The simplest example is tweaking a mapping done with the Explorer using the "draw" feature.

- The two **Reflect** buttons can be a HUGE time saver. It "reflects" the data points on one side of the meridian to the other. This is useful when your telescope is symmetrical (single scope) instead of a side by side configuration with two different telescopes
- The **More** button allows you to **Copy East to West**, and **Copy West to East**. These are different operations than **Reflect**. These copy the values from one side to the other side of pier. This will force the mount to always flip at a declination's meridian limit at the same hour angle regardless of which side of pier the mount is on.
- The screen shot below is provided to further explain the graphical representation of the limits shown in the Meridian Tracking Limits Explorer (labeled as Step 3 Define Meridian Tracking Limit Points). It shows the graph as it would look part way through a typical meridian limit mapping run using the Meridian Tracking Limits Explorer.



# 6.16.2 Using the Meridian Tracking Limits Explorer

#### Warning: Please take special note of the following:

- The Meridian Limits, are primarily tracking limits in the west, and counterweight-up slewing guides for APCC's advanced slew logic in the east. They will **NOT** prevent you from slewing into your pier with an incorrect slew, or from running into the pier with direction buttons.
- **DO NOT** use any other method for setting a meridian delay while you are using the meridian limits. When properly configured, the APCC meridian tracking limit logic will maintain the correct meridian delay in the system.
- Allow the "Counterweight Up Slews within: East Limits" feature (see <u>Meridian Limits - Operation</u>) to safely slew your mount into a meridian advanced position east of the meridian. Do not try to "outsmart" the system and finagle this yourself.

### **Getting Started**

The Meridian Tracking Limits Explorer allows you to create a detailed limits curve using relatively simple steps. The idea is to slowly slew the scope while watching it at each declination value until it is about to hit the pier. The hour angle at which pier collision is about to occur is saved for each declination value that you try. The Meridian limit between sampled declination values is interpolated between measured values. If there is no measured value or a declination higher or lower than a measure declination then it is assumed to be zero (that is, the Meridian). Take note of the following:

- The Meridian Tracking Limits employ the concept of the **Meridian Inclination**. Meridian inclination is a universal concept that is not affected by a persons's latitude. Meridian inclinations, as one might expect, are measured along the meridian. With meridian inclination, the zero point is the horizon directly opposite the pole, and a meridian inclination of 180 is the horizon point directly below the pole.
  - In the north, the zero meridian angle has a declination of: -(90 Latitude). In the south it is: -(-90 Latitude)
  - The zenith has a meridian inclination of 90. The 90 degree meridian inclination has a declination equal to your latitude.
  - $_{\odot}$  Currently, the meridian limits can only be defined up to your pole.
- It is advisable to have your horizon limits established before you try to set your meridian limits. You will want to take note of the altitude value for the horizon limit opposite your pole: Az = 180 for the northern hemisphere, Az = 0/360 for those "down under." Note that the altitude at these azimuth values will be equivalent to the meridian inclination.

- NOTE: Although you want to have set your horizon limits, be sure you have disabled them by unchecking the "<u>Enable Horizon Tracking Limits</u>" check box in the horizons tab before you begin your Explorer mapping.
- Make sure that your equipment is fully installed and oriented as it will be for usage. If you have a rotator for imaging equipment, be aware that you will want to always rotate the imaging system into its worst case position with respect to the pier.
- Make sure that you do NOT have a meridian delay in effect!



Click the "Clear" button. "Current" should be set to "0.00."

• Uncheck the Tracking check box in the lower left corner of the Explorer window if it is checked. (Unchecked is the default.)



### Your First Point on a Side

Your first point on each side of the mount will be handled a bit differently from the subsequent points on that side.

 Begin by deciding which side of the mount you wish to map first. Click the appropriate button in the upper left of the Step 1 Box. It does not matter which side you do first. Many people will start with the West limits since the tracking direction is westward. However, don't simply forget about the East limits. As described earlier in the <u>Meridian Tab</u> section, you can allow the mount to automatically start in safe positions in the east with the CW up for "flip-free" imaging through the meridian!

- Enter the altitude value from your horizon limits as described above into the Meridian Inclination field. Observe that the Target Declination will change to reflect the newly entered Meridian Inclination value. Please note that this value does NOT yet include the Dec. Increment.
- 3. Click the "Go to Meridian" button. The mount will slew to the meridian on the chosen pier side at the entered meridian inclination. **Important:** Before you slew to Meridian, make sure your scope is can reach the meridian without a pier crash. There are situations where the telescope may not reach the meridian if you have a very long telescope, a large filter wheel, etc.



4. For this first point, DO NOT move the mount further with the E-W buttons. Instead, simply click the "Add Point" button at the bottom of the Step 2 box.



### Subsequent Points on a Side

Now that you have set your starting point at the horizon opposite your pole, you are ready to map your meridian limits in earnest!

 Select the declination increment you wish to use at the start. This is the number of degrees delta in declination to slew with each click of the *Next Position* button. For most people, the limits starting out can be rather coarse, in the 5 to 10 degree range. (The max is 20°) You may want to tighten this up as you get closer to the pier.



- Click the "Next Position" button.
   Once you click the "Next Position" button:
  - a. The mount will begin to slew;
  - b. The Meridian Inclination will update;
  - c. And the Target Dec. will also update.
- 3. During the slew to the "Next Position," the direction buttons will be grayed out. Once they become available, move the mount east or west, depending on the side you are mapping, until you either reach the pier, or point to the horizon. You can use any button control that you have available, but the most convenient are usually either the buttons right there in the "Step 2 Explore Limit" box, or else the buttons on the keypad. We have found that it is often quickest and easiest to use the direction buttons in the Meridian Tracking Limits Explorer at higher speed (600x or 1200x) to get close, and then to finish with the keypad at 64x. The keypad allows you to stand where you can see the scope and pier more clearly. Allow yourself a bit of "safety margin," but since these are tracking limits, you don't need a lot.



- 4. Decide on next Dec Increment in the Step 1 Slew to Meridian box. Change if necessary.
- 5. Return to step #2 Next Position above.

#### Some Hints:

- In general, the North and South buttons are not used, but they can come in handy if an obstruction is just narrowly missed at a given point. The subsequent Dec Increment will be calculated from the new, adjusted Dec. value, not from the original value to which the mount slewed.
- If you are taking your limit mapping all the way to the pole, be sure to compare the current declination to the declination increment. This is explained further in the next heading Finishing at the Pole.

### Finishing at the Pole

Meridian Tracking Limits are not currently defined below the pole in APCC. Future releases may add this feature if it is demanded. Because the program cannot define the limits below the pole, you must stop your mapping just before the pole. See the screen shot below:



There are two options at this point.

1. You can skip this last small increment and go to the other side, or finish if this is the second side already. See Below:

2. You can enter a last "adjusted" increment. In the example from the screen shot above, I would enter an increment of 4.3° (4° 18'). { Note that 4.4° (4° 24') would overshoot the pole by 42". }

After the Last Point on a Side When you have added your last point for the side, there are several options:

- If this is the first side of the mapping, return to step 1 of the "Your First Point on a Side" section.
  - At step 1, choose the other side, and then proceed with the rest of the "Your First Point on a Side" instructions. Continue as before.
- If this is the first side of the mapping, you can map the other side by "reflection." Reflecting will precisely copy the mirror image of the mapping you just completed onto the other side.





Note that the button is for the side being reflected, not the side to which you are reflecting! Also Note: Reflected mappings can be further edited and refined using any of the methods for mapping described in these instructions.

- Save the Meridian Limits File (\*.mlm) The mapping you create will automatically be kept in a file named Default.mlm. You will not lose it, but any changes you make to a limit mapping will overwrite the Default.mlm file with the changed data. Default.mlm is always the currently loaded limit file in whatever edit condition you have placed it. If you have invested the time to do a detailed mapping, take the time to save it so that you can retrieve it later. Saved files can always be loaded and edited or changed later and re-saved.
- Some additional notes:
  - There is no requirement that you start at the horizon away from your pole and then work your way
    poleward. You can even set negative increments to go backwards. However, we have found that
    after trying various methods of setting up these limits, starting at the horizon away from the pole has
    become the method we prefer ourselves.
  - You do not need to carry your limits all the way to the pole. Remember, however, that zero limit values will not allow you any tracking past the meridian at those declinations. An easy and quick way around this is to simply carry the "worst case" value at the pier the rest of the way poleward in one jump.

### 6.16.3 Manually Add Meridian Tracking Limit Points

The Manually Add Points button on the right side of the Meridian Tracking Limits Explorer opens a new window for adding points to your limit mapping.



There are two primary situations where the manual method may be more appropriate:

- 1. You have already created a data set, perhaps on a spreadsheet, that you would like to easily transfer into the Meridian Tracking Limits Explorer.
- 2. You want to move the mount with the keypad to quickly put together a "rough" set of limits for a star party or portable setup.

In general, we recommend using the conventional method in the previous section: <u>Using the Meridian</u> <u>Tracking Limits Explorer</u>. This method is primarily for advanced users and for those who prefer keypad operations with their mount.

Clicking the Manually Add Points button will open the following window:



We will look at three procedures for making use of the "Add Meridian Tracking Limit Point" window:

- 1. Making a quick set of limits with the keypad, or similar button control
- 2. Entering data from an existing table
- 3. Editing part of an existing curve to reflect a change.

### Making a quick set of limits with the keypad, or similar button control

You can make a surprisingly effective set of meridian limits for a star party or other short-term setup with the keypad and this window in a very short time.

#### The First Point

1. Start with a cleared Meridian Tracking Limits Explorer window by pressing the "Reset All Limits" button.



- 2. Slew to a spot above the horizon away from your pole that you consider your "horizon limit." A very easy way to do this is to go to the <u>Horizons Tab</u> and double click the approximate point on the horizon graph where you wish to go.
- 3. As long as you are close to the meridian, and on the correct side, simply adjust the declination to your acceptable horizon height. Don't worry about RA if you are relatively close.
- 4. UNCHECK THE INTERPOLATE CHECKBOX IN THE STEP 3 PANE!
- 5. Click the "Read Mount Position" button
- 6. Enter 0.0 as the hour angle in the Step 2 Pane to overwrite the hour angle read from the mount.
- 7. Click "Add Point."
- 8. RE-CHECK THE INTERPOLATE CHECKBOX IN THE STEP 3 PANE!

#### **Subsequent Points**

- 9. Slew to the next point you wish to add. Move in both RA and Dec.
- 10. Click the "Read Mount Position" button
- 11. Click "Add Point."
- 12. Return to step #9, and repeat until you are done or have reached the pole.

The Last Point on a Side Remember that you cannot cross the pole!

- 13. Adjust the RA and Dec while watching the hour angle values in the Meridian Tracking Limits Explorer window. If you pass the pole, the hour angle value will change sign and jump 12 hours, for example from +2 to -10 hours.
  - a. Adjust the Dec to be as close to 90 as you care to make it (does NOT need to be real close!) without jumping to the below-the-pole hour angle.
  - b. Adjust the RA to your limit.
- 14. Click the "Read Mount Position" button
- 15. Click "Add Point."
- 16. Set the Declination value in the Step 1 pane to 89.9 (Northern Hemisphere) { -89.9 in the south }
- 17. Set the Hour Angle to 0.0 in the Step 2 pane.
- 18. Click "Add Point." This will finish the side.



Last Point

Unless you have a very lopsided camera setup or pier, you can probably simply reflect this limit for the other side. Otherwise, repeat the procedure STARTING WITH STEP #2 - NOT STEP #1!

### **Entering Data from an Existing Table**

If you created a table or list of data that gave the "safe" and "unsafe" declinations for your system, you can copy that information into the "Add Meridian Tracking Limit Point" window.

- 1. UNCHECK THE INTERPOLATE CHECKBOX IN THE STEP 3 PANE!
- 2. Enter an hour angle of 0.0, and a Dec. or Meridian Inclination for your horizon away from the pole.
- 3. Click "Add Point."
- 4. RE-CHECK THE INTERPOLATE CHECKBOX IN THE STEP 3 PANE!
- 5. Enter the next values of hour angle and Dec. from your data.
- 6. Click "Add Point."
- 7. Return to step #5, and repeat until you are done or have reached the pole.
- 8. Set the Declination value in the Step 1 pane to 89.9 (Northern Hemisphere) { -89.9 in the south }
- 9. Set the Hour Angle to 0.0 in the Step 2 pane.
- 10. Click "Add Point." This will finish the side. (See screen shot above)

Unless you have a very lopsided camera setup or pier, you can probably simply reflect this limit for the other side. Otherwise, repeat the procedure STARTING WITH STEP #2 - NOT STEP #1!

### Editing Part of an Existing Curve to Reflect a Change

The trick to using the "Add Meridian Tracking Limit Point" window to edit an existing set of Meridian Tracking Limits is to get into the limit mapping, and then out of the mapping without creating a problem.

- 1. Load the Limit file that you wish to edit or modify.
- 2. UNCHECK THE INTERPOLATE CHECKBOX IN THE STEP 3 PANE!
- On the graph for the limit in the Meridian Tracking Limits Explorer window, hover the mouse over the exact spot where you wish to START your edit. A white data box will appear with the coordinates for that spot.
- 4. Note the Hour Angle and Dec. or Meridian Inclination for the spot.
- 5. Enter these values in the Step 1 and Step 2 panes
- 6. Click "Add Point." A blinking square dot will appear on the graph to show you where you are.
- 7. RE-CHECK THE INTERPOLATE CHECKBOX IN THE STEP 3 PANE!
- 8. Make your edits and changes. After the last change proceed to Step 9 below.
- On the graph for the limit in the Meridian Tracking Limits Explorer window, hover the mouse over the exact spot where you wish to END your edit. A white data box will appear with the coordinates for that spot.
- 10. Note the Hour Angle and Dec. or Meridian Inclination for the spot.
- 11. Enter these values in the Step 1 and Step 2 panes
- 12. Click "Add Point." You are done
- 13. Save the edited limit if you wish.

# 6.17 GPS Tab

*APCC* has the ability to read a GPS device that is connected to your computer. Most standard GPS units that create a virtual COM port on a computer should work. *APCC* also supports reading GPS information from the <u>Astromi.ch MGBoxV2</u>.

*APCC's* GPS parser looks for a specific NMEA message, GPGGA, which contains time, latitude, longitude, and altitude values. Once it finds one of these records it will fill in the information in the GPS Status group box.

Connection ?	GPS Status ?	Actions ?
COM Port COM5	Latitude GPS Fix Quality	<u>C</u> reate New Site
Baud 4800 🚔	Longitude UTC Time	
<u>C</u> onnect	Elevation Satellites	

### **GPS** Connection

**COM Port:** For *APCC* to read a GPS device, the GPS device must have a virtual COM port assigned to it. Usually the driver for the GPS device will automatically create such a virtual COM port, so you just need to select the proper port.

If you have a Astromi.ch MGBoxV2, then select "MGBoxV2" in the COM port drop down list (it should be the first entry). For it to work you must install the MGBox V2 ASCOM Observing Conditions driver from <a href="https://www.astromi.ch/product/mgbox-v2/">https://www.astromi.ch/product/mgbox-v2/</a> and configure the proper virtual port for the driver to use. Please consult the documentation for the MGBoxV2 driver for more information.

**Baud:** The typical baud rate for GPS devices is 4800 baud. (Note: This field is ignored when configured for MGBoxV2.)

**Connect:** Click this button to try to connect to the virtual port of the GPS. Once connected, the button will say "Disconnect".

**NOTE:** If the GPS data cannot be read, ensure that your GPS device is set to NMEA mode. Your GPS device may also need time after power on to acquire and lock on to a GPS signal

### **GPS Status**

Displays information obtained through your GPS device.

#### **Actions**

**Create New Site:** Click this button to create a new site with the current latitude, longitude and elevation last acquired from the GPS. This will open the <u>Manage Sites</u> dialog window.

# 7 3D Scope Window

There are several ways to monitor the position of your telescope via the <u>Telescope Position Group Box</u>, which is always visible on the Main Window.


- Altitude and azimuth position values: These values are dynamic and change as your mount moves.
- Virtual Sky Window View: When APCC is connected to the mount, the scope's position is shown by a red square in the Virtual Sky Window view. The pier side is shown in the upper left and right with either an *E* or *W* within a yellow box.
- **3D View:** This button will bring up a new window that provides a graphical representation of your mount and telescope based on the data that you provide in the 3D Scope Editor and position data. Note that dimensions of the mount itself cannot be edited at this time. However critical dimensions of the telescope, dewcap, focuser, camera, counterweights and pier can be specified. Refer to the <u>3D</u> <u>Scope Editor</u> section for specific details.



• **Opening Calibration Warning and Clutch Reminder:** When you open up the 3D View Window, a warning box will appear to ensure that the mount is correctly calibrated. In order for the 3D View's Error Warning to function, the mount must be correctly calibrated with the night sky when the window is opened. This warning and reminder are intended for portable users who must set up anew each time they go out. When you click the button to open the 3D View Window, the following box will appear:



If you have not yet re-calibrated the mount on a star, then click NO - Calibration is still needed. Both the warning and the 3D View will close, and you will be given the opportunity to get calibrated.

If your calibration is correct (...and it does NOT need to be plate-solve perfect for this!) click on the "YES - Calibration is Correct" button. If you are in a permanent setup where your mount is always properly calibrated, check the "Do not show again: check-box so you don't have to bother with this each time you open the 3D View Window.

When you click the "YES - Calibration is Correct" button, a reminder box appears. It is important that you understand, and that you remember that the validity of the calibration only remains as long as the mount is not moved via the clutches.



Again, we have provided a check-box for permanent installations so that you don't need to check this each time you open the 3D View window.

**TIP:** If you need to use the clutches to move the mount for rebalancing or some other purpose, simply close the 3D View window. Once you are finished with the clutches, just recalibrate in any normal fashion (i.e. reference park position or calibration on a star), and then open the 3D View window back up.

## **Error Warning**

Please refer to the separate Error Warning Section for details

## **Perspectives**

Select the perspective that you wish to view: Top, North, South, East, West or Trimetric. Examples are shown below.







File Sync File Sync Top North South East West Trimetric ? East View





**Trimetric View** 

In the Trimetric view, 3 axes have different angles from each other. Note that in addition to the red zenith arrow, the north and east arrows display as well.

## **Functional Icons**

In order to fully understand how you can utilize these icons, we encourage you to experiment. When you activate each icon, the cursor will change to suit the function and the icon button will turn blue.



**Zoom Window:** Allows you to create an enlargement window for a specific portion of your 3D model. Left click on the icon to activate the crosshair. Scroll to move the crosshair to the desired starting position, click and draw a box, much like a crop tool in photo editing software. When you release your mouse button, the blue marked area will enlarge. To return your model to the default position, select the Zoom Fit icon.

**Zoom:** Allows you to zoom in gradually to the center of your 3D model. Left click on the icon to activate the magnifying glass flanked by "+" and "-" signs. Scroll across the screen to enlarge or decrease the size of the image. To return your model to the default position, select the Zoom Fit icon.

**Pan:** Allows you to move the 3D model to a different position within the box. This may be useful if your telescope is long or your pier is tall and you wish to fit your model within the box to its best advantage. As you move the model up and down, the perspective will shift slightly. To return your model to the default position, select the Zoom Fit icon.

**Rotate:** Allows you to freely rotate your 3D model to suit your needs. Note that the arrows that designate zenith, north and east will move in a corresponding manner. In this case, the Zoom Fit icon will center the mount within the frame, however does not return the position to your starting position. We suggest that you select one of the Top, North, South, East, West or Trimetric buttons to return to their default orientation.

**Zoom Fit:** Typically, this selection will undo the changes that were made by one of the other icon selection.

## **Menu Selections**

Refer to the separate <u>Menu Items</u> section for information regarding the *File* and *Sync* drop-down selections.

# 7.1 Error Warning

The 3D View Error Warning is an exciting safety feature that we have added to APCC. When you opened up the 3D View, APCC tied the celestial coordinates of the mount to the mechanical coordinates (gear angles) in the servo. Celestial coordinates can be changed by user error, but the user does NOT have any way to change the mechanical coordinates, so they are very safe and stable. APCC uses this relationship to verify that the celestial coordinates in the mount are reasonable. If an error is made, and you calibrate on Vega when you are really pointing at Arcturus, APCC will detect this and warn you.

We debated how best to implement this safety feature, and the choice seemed obvious in short order. Someone who is in the middle of an imaging run probably has numerous windows open. Once a session is under way, we often minimize the APCC main window and the driver window to conserve desktop real estate. However, many of us like to use the 3D View window as our "sanity check" on where the mount is pointing since it is a small unobtrusive window and is visual rather than numeric in nature. The 3D View is often the only APCC window that we keep open all the time on our desktop. Now, there is an even better reason to follow this approach!

# 7.2 3D Scope Editor

The 3D Scope Editor allows you to create an approximate representation your telescope and imaging system on your Astro-Physics mount. It will give you a good idea of where and how the telescope is slewing and its relationship to the pier. However, DO NOT rely on the 3D model to determine how close to the pier you can slew safely. We do not provide all of the parameters, i.e. specific mount model and mounting plates, so it is not possible to create a totally accurate model.

If you are operating your telescope in an observatory and you cannot see it directly from your computer, we recommend that you install a web cam to monitor your instruments.

## **Open the 3D Scope Editor**

The 3D Scope Editor can be accessed by selecting Edit from the File drop-down menu as shown. For an explanation of other selections in the drop-down menu, refer to the <u>Menu Items</u> section.



## **Telescope Tab**



Diameter, Length: Adjust dimensions with slider, arrows or number entry.

**Center:** Allows you to simulate a balance point of the telescope on the mount by moving the graphical telescope forward or back in relation to the mount.

**Color:** The drop-down box allows you to change colors. Alas, there is no good representation of Astro-Physics cream white.





Diameter, Length, Drawtube Extension: Adjust dimensions with slider, arrows or number entry.

**Camera Visible:** You can specify whether or not the camera should be visible in your graphic. This will impact how your focuser displays.

Color: The drop-down box allows you to change colors.

**Dew Shield Tab** 



Outside Diameter, Length: Adjust dimensions with slider, arrows or number entry.

**Center:** Allows you to simulate the position of the dew shield relative to the tube, i.e. whether it is retracted or not.

Visible: Check the box to indicate whether or not the dew shield should be visible.

**Color:** The drop-down box allows you to change colors. Alas, there is no good representation of Astro-Physics cream white.

## **Camera Tab**



Thickness, Diameter: Adjust dimensions with slider, arrows or number entry.

Camera Shape: Select the closest option from the drop-down list.

Camera x Offset and Camera Y Offset: Use these controls to adjust the camera position.

Visible: Check the box to indicate whether or not the camera should be visible.

Color: The drop-down box allows you to change colors.



APCC - 3D Scope Editor	×
Counterweights	0
Thickness (Inches)	20 =
Diameter (Inches)	2.0
· · · · · · · · · · · · · · · · · · ·	6.0 📑
Center (Inches)	6.0 🛨
Count: 4 🚍 Color:	
Telescope Focuser Dew Shield Camera CW Pier Dem	10

Thickness, Diameter: Adjust dimensions with slider, arrows or number entry.Center: Adjust the position of the counterweights on the shaft.Count: Specify the number of counterweights on the shaft.Color: The drop-down box allows you to change colors.

**Pier Tab** 



**Height, Diameter:** Adjust dimensions with slider, arrows or number entry. Consider entering a lower pier height since entry of larger numbers may push the scope out of the view. Unless your telescope is so long it might strike the floor, this is not an important parameter of your setup.

Color: The drop-down box allows you to change colors.



## Demo Tab

This Demo window allows you to experiment with latitude, RA and Dec values to create a graphic model without actually moving the scope to a particular position. This feature has been useful for us to create graphics.

**Override mount and allow local adjustments:** Check this box to ignore the input from the mount position data and activate the entry fields. When you are ready to resume your observing session, remember to uncheck this box to resume the input of actual position data.

Latitude, Right Ascension Axis, Declination Axis: Adjust values with slider, arrows or number entry.

## 7.3 Menu Items



## File

**Open:** Allows you to open .sdef file that you created previously for particular telescope and camera setup.

**Save:** Save the parameters that you have set using the 3D Scope Editor so that you can retrieve it at a later date.

**Save As:** Save the parameters that you have set using the 3D Scope Editor so that you can retrieve it at a later date.

View: Two choices give you different view.

Perspective - Includes grid lines to give you a sense of your mount/scope in space.

Orthograpic - Does not include the grid lines.

**Always on Top:** Keeps the 3D viewer on top of your programs when you are carefully monitoring the scope position. Screenshot has not been updated to show this option.

Edit: Brings up the 3D Scope Editor

Reset Scope: Resets parameters.

Close: Closes 3D Scope View window.

#### Sync

Re-Sync 3D View:

# 8 Emergency Stop Window

This window will be activated during slews if the Show Emergency Stop Window box is checked on the Setup Tab.



The Emergency Stop Window gives you a quick way to stop a slew in an emergency and lock out further slews. It is actually a big button that stops any GoTo or Park slews in progress and prevents any further GoTo or Park slews until the mount is unlocked. It does NOT prevent button moves, nor does it stop tracking. It differs from the normal "Slewing" stop button in that it cannot be overridden by client software, which may simply resend the slew command if it detects that a slew has been interrupted.

It was originally designed for our "extreme" beta testing, especially those tests that featured the mount going well beyond the meridian. We liked the feature well enough to leave it in as an added safety option It is of primary value when setting up the meridian limits and running the APPM point mapping with points beyond the meridian (CW - up points) included. Once you get to normal everyday (everynight) usage, you may wish to disable the feature.

The Emergency Stop Window initially flashes up large and obvious so that you won't miss it. A normal procedure, if you will be keeping it active, is then to grab a corner and shrink it to a more manageable size and drag it off into a corner of the desktop where it is out of the way, and yet immediately accessible if something goes awry. As long as you don't actually close the window, it will remain small and in the corner until that evening's session is done.

Show Emergency Stop Window: Check or uncheck as you wish.

**Close it when done slewing:** Check if you would like the window to close once you have reached your target.



You will notice that when you mouse over the window, the color will change from red to yellow. If you click the window to stop a slew, the text inside will change, and the button will flash between red and pink.

Tracking is not stopped immediately so that any client applications connected through the ASCOM driver won't start to throw exceptions or quit. This might happen if tracking has been set to an unexpected state (turned off). However, as a safety feature, tracking will stop after about two minutes if you take no action. A countdown timer at the bottom (see picture below) will indicate how long before tracking will be stopped.

If you need to stop tracking immediately you can conveniently click the countdown text and it will toggle tracking. If you restart tracking you will have another two minutes before tracking will automatically stop. We feel this is the best compromise of safety and ASCOM client application compatibility.



Once you click the main part of the window to unlock the slews again, you will need to restart the slew unless the client software that originally sent the command is very persistent!

# 9 Terminal Interface Window

## **Terminal Interface Window**

There are times when using a direct connection to the mount is beneficial. This feature will allow you to make specific tests of the mount or to check commands when writing your own mount control software.

Terminal interface is found under the Tools drop-down menu on the main APCC window. When you select this function, you are provided with a "clean slate" on which to write your commands. It is necessary to know the Astro-Physics command language found in the <u>Technical Support</u> section of the Astro-Physics website.

APCC - 1	erminal Interface	:	
Options			
Command:	:pS#		✓ <u>S</u> end
Num	Transmit	Time	Received
1	:GA#	0.041	+00*16:10#
2	:GZ#	0.039	+90*16:28#
3	:GS#	0.023	00:15:01.8#
4	:Sr03:29:43.5#	0.323	1
5	:Sd+86*21:06#	0.322	1
6	:MS#	0.323	0
•			•

**Options:** Click on *Options* to reveal the following choices:

Clear Display: Removes the commands that have been sent to the mount from the display window.

*Always on Top:* Provides the choice to hold the window in the foreground over other applications or to let it drop behind them. It can be toggled on and off.

Always Show Last Command: Displays the last command sent to the mount.

**Command:** This is the space in which one types the commands that one wishes to send to the mount. Once the command is written, click the *Send* button to send it to the mount. The command will then appear listed below. The drop-down arrow allows you to choose an entered command and resend it.

Send: Clicking the Send button will send the command to the mount.

#### **Command Window:**

Number: Refers chronologically to the sent commands.

Transmit: Displays the command that was sent.

Time: Displays the duration of sending and receiving the command.

Received: Displays the response from the mount.

# 10 Log\_Window

#### **Command Log Window**

This window displays a running log of the communications to and from the mount. It shows commands and inquiries issued to the mount indicated by the ">" symbol and the mount's response indicated by the "<" symbol. Maintaining a log is vital when troubleshooting and/or providing a record of events.

The *Log Window* can be accessed from the Menu: Tools > Log Window.

The <u>Setup Tab</u> includes a checkbox to *Enable Logging to disk*. It is not possible to uncheck the box at this time. We want to assure that log files are created so that we can better assist you if you encounter any issues.

🛃 APCC - Command Log	x
Options	
Always show last line 🛛 Show GOS Queries 📝 Show G	ther
Show RA/Dec Queries V Show Side of Mount Queries	?
Show Only Move Commands	
2016-05-07 00:31:49.440 > :GOS#	<u>~</u>
2016-05-07 00:31:49.440 < 1990002C2E000#	
2016-05-07 00:31:49:442 < 00:00:00.0#	
2016-05-07 00:31:49.444 > :HRG#	
2016-05-07 00:31:49.444 < -43*38:25# 2016-05-07 00:31:49.446 > HDG#	
2016-05-07 00:31:49.446 < +228*53:03#	
2016-05-07 00:31:49.461 > :Rr#	
2016-05-07 00:31:49.461 < 54148# 2016-05-07 00:31:49.462 > :Rd#	_
2016-05-07 00:31:49.463 < 0#	
	<u> </u>
Clear	

**Options:** Click on *Options* to reveal the following choices:

Clear Window: Removes the activities that have taken place from the display window.

*Always on Top:* Provides the choice to hold the window in the foreground over other applications or to let it drop behind them. It can be toggled on and off.

*Save to File:* Allows you to name and save a record of this activity in the folder of your choice. It will capture the events up to the moment of saving the file.

Always Show Last Line: If checked, automatically scrolls to show the current communications.

Show RA/Dec Queries: If checked, activates the display of RA and Dec position status.

Show GOS Queries: If checked, activates the display of the operational status of the mount.

**Show Side of Mount Queries:** If checked, activates the display of the mount's east or west positioning.

Show Other: If checked, activates the display of all the other mount queries.

**Show Only Move Commands:** Check this box is you only want to see the move commands that are sent to the mount.

**Clear button:** Clicking the *Clear* button will clear the record, allowing you to begin a fresh command log. This is convenient when you want to isolate specific events and mount behavior.

If you wish to zip the log file for future reference or send for analysis, refer to the <u>Log Zipper Window</u> section.

# 11 Log Zipper Window

## Log Zipper Window

The APCC Log File Zipper provides a convenient access to all related log files. It allows you to selectively zip files of specific types, if it becomes necessary to forward them for analysis.

**IMPORTANT:** When sending log files for analysis of a problem, you must provide specific information regarding:

- Description of the problem.
- Sequence of events leading up to the problem. Be specific!
- Approximate time when problem occurred. The logs contain megabytes of data and it is important to quickly find the code relating to the problem. Each log entry is date/time stamped.

The Log Zipper Window can be accessed from the Menu: Tools > Log Zipper Window.

APCC Log File Zipper		[	- 0	8
Zip files from this many previous days: 1 🖨 🗸 APCC L	APPM P APPM L	NT Files og Files	?	
File Name	File Type	Date	Size	
Settings.apcc	APCC Settings	2/18/2013 2:41:46 PM	16K	=
SiteList xml	Site list	2/18/2013 2:55:15 PM	469	
Mer Test 4.mlm	Meridian Limits	2/21/2013 5:15:19 PM	7K	
Mer Test 3.mlm	Meridian Limits	2/21/2013 4:34:01 PM	7K	
Mer Test 2.mlm	Meridian Limits	2/19/2013 5:23:52 PM	9K	
Mer Test 1.mlm	Meridian Limits	2/19/2013 4:57:48 PM	7K	
Default.mlm	Meridian Limits	2/19/2013 4:56:54 PM	7K	
🔽 ap.ini	ASCOM INI	2/22/2013 11:54:57 AM	2K	
APCC-2013-03-13-134017.txt	APCC Log	3/13/2013 1:40:17 PM	1410K	
APCC-2013-03-13-133440.txt	APCC Log	3/13/2013 1:34:40 PM	8K	
APCC-2013-03-12-150713.txt	APCC Log	3/12/2013 3:07:13 PM	18796K	
Recc-2013-03-12-121032 txt	APCC Log	3/12/2013 12:10:32 PM	371K	Ŧ
Show Full Filename		Zip Files	Close	e

**Zip files from this many previous days:** This allows you to show a range of dated files so that one day or many days of files can be selected.

**APCC Log Files:** Check to include these files. It is checked by default when the *Log File Zipper* window is opened.

**ASCOM Log Files:** Check to include these files. It is checked by default when the *Log File Zipper* window is opened.

**APPM PNT Files:** Check to include these files. It is checked by default when the *Log File Zipper* window is opened.

**APPM Log Files:** Check to include these files. It is checked by default when the *Log File Zipper* window is opened.

**Show Full Filename:** Checking the *Show Full Filename* box will reveal the full path to the file so that you may easily trace the location of a given file.

**Zip Files:** The *Zip Files* button will zip and ready the files that you have chosen for sending for review and analysis. It will allow you to save them in the location of your choice.

## 12 Known Issues

## **Saving Resized Windows**

**Problem:** If you are using Windows XP and possibly Vista (we have not verified this issue with Vista as of this writing), you may not be able to utilize the <u>Save Window Positions</u> if you resize the window. We have found that windows that have been <u>resized</u> and saved, do not open up correctly in the next APCC

session. Typically, the window will reload at the correct saved size, however the contents will not load properly. For instance, a large blank space may appear above the <u>Status Bar</u> or, alternatively, the lower portion of the window contents may be missing. This problem cannot be fixed using the <u>Resize to</u> <u>original Window Size</u> setting. This problem is likely due to a .net configuration issue. We will review this issue in the future to determine if it can be resolved.

Note, that if you do not resize the window, the Save Windows Positions feature can be used successfully.

Solution: Deactivate the Save Window Positions setting, exit and reopen APCC.

# 13 Troubleshooting

## 13.1 FAQ

## **Questions for All Versions of APCC**

#### How can I find out if I have the OpenGL 1.5 or later version?

OpenGL support is usually determined by the graphics card in your system. There are probably many ways to find out but here is one free utility you can use:

http://www.geeks3d.com/20120927/gpu-caps-viewer-1-17-2-released/

APCC has a sophisticated meridian limits mechanism that will allow you to define the limit the mount can track past the meridian at multiple declination values. Will this also prevent slews to these positions? I will often be starting imaging east of meridian but would like reasurance that GOTOs with a negative meridian delay won't hit anything.

APCC (and also the ASCOM driver) have "safe slews" built into them to prevent slews that cause collisions in "counterweight-up" conditions. The slews occur in multiple stages. If you are starting a slew from a counterweight up position (i.e. you have tracked past the meridian), the first part of the slew will be in right ascension only. The mount will move in RA until the mount enters a normal, counterweight down orientation. It will then slew in both axes until the RA reaches the meridian, and the Dec fully completes its slew. Finally, with the Dec having arrived at its safe position, it will then complete the slew in RA only to the starting point east of the meridian with the counterweight up.

# The feature that allows windows to be resized and saved does not seem to be working properly.

Please refer to the explanation Saving Resized Windows.

# I am having problems when I shut down APCC or alternatively when I start up APCC with the AP V2 ASCOM Driver. The driver appears to lock up and stops responding.

Open the AP V2 ASCOM Driver's Telescope Setup Window. In the COM Port Details group box, you will find a setting to "Use ASCOM Serial Object." If this is checked, uncheck it. If it is not checked, try checking it. The driver has two low-level serial DLL drivers - one from ASCOM, and one that is native to our driver that is written in C++. Some computers and USB serial adapters seem to prefer one over the other.

## **APCC Pro Version Questions**

#### Do I need the full version of PinPoint or can I use the version that comes with MaxIm DL?

To do plate solving you need the full version of PinPoint. This is only required if you plan to use APCC Pro. You do not need PinPoint for the standard version of APCC.

## Can TheSkyX be used in place of the full PinPoint?

No, for now only PinPoint is supported.

# **13.2 Troubleshooting Tools**

Refer to the detailed sections regarding the Log Window and Log Zipper Window .

# 14 Horizons

Horizons allows your Astro-Physics mount to accurately follow solar system objects such as Comets, Asteroids, Planets, and even the moon and sun. It uses data that you import from the JPL Horizons Ephemerides web site to calculate the precise tracking rates needed to follow a target without any guiding. For example, this means you can do longer unguided exposures of a comet without it blurring. Or, in the case of fast moving asteroids, you don't need to worry about keeping your scope centered because Horizons will send commands to your AP GTO mount to keep the target centered.

Horizons requires APCC (Standard or Pro edition) to operate. Horizons will work best with APCC Pro because Pro includes tracking rate corrections based on the pointing model in use. Of course a pointing model must be in place for the target's tracking rate to be appropriately adjusted to compensate for things like polar misalignment, refraction, mount/scope flexures, etc.

When you open Horizons it should look something like this:

## 240 Astro-Physics Command Center (APCC) Help File

Astro-Physics Horizons	- 🗆 X
File Ephemeris Data Mount Track Help	
Step 1: Click link and configure, target, date and time: Step 2: Copy and Paste Object Ephemeris data below Note: In Table Settings select Quantities=2,3,4,7,9 (others ok) Display/Output as "plain text".	JPL Horizons Ephemeris     Load JPL File     Clear
Ephemeris Values: Mount Information:	
"Save" to save data to ephemeris data to disk for later use "Load" to load previous data "Test" to run a simulated run "Track Object" immediately (or delays until a time) issues a GOTO and starts tracking	Save Load     Test Tracking     Track Target

NOTE: you don't need to be online to the internet when you actually track the object as you can pre-download and save as many targets as you want.

**Connect** to the mount to either immediately track the target or test tracking. **Test tracking** allows you to pick a time in the time span of the Ephemeris data set and the mount will slew the scope to where the target will be at that time. It is useful to confirm in advance that there are no obstructions (like trees and buildings) at the time you intend to image your target.

**Track Target** allows you to immediately slew to the object and start tracking, or, alternatively, start tracking at a future time.

**NOTE**: the three smaller windows on the main application can be resized by clicking the edge and dragging to size the windows. The edges are highlighted in yellow in this image:

ile Ephemeris Data Mount Track Help		
Step 1: Click link and configure, target, date and time: Step 2: Copy and Paste Object Ephemeris data below Note: In Table Settings select Quantities=2,3,4,7,9 (others ok) Display/Output as "plain text".	JPL Horizon     Load JPL File	s Ephemeris Clear
Revised: April 12, 2021 Jupiter 5 PHYSICAL DATA: Mass x 10^22 (g) = 189818722 +- 8817 Density (g/cm^3) = 1.3262 +00 <	003	>
Ephemeris Values:   View Ephemeris Data Mount Information:	? Connect	Disconnect
Target Name       = Jupiter (599         Start (UT)       = 10/1/2021 12:00:00 AM         Stop (UT)       = 10/2/2021 12:00:00 AM         Interval       = 00:01:00         Lat/Lon       = 37.338 238.110         Current Alt/Az       = 0.000 0.000         Current Hr Ang       = 00h 00m 00.00s         Current RA       = 00h 00m 00.00s         Current Dec       = +00d 00m 00.00s		~
Save" to save data to ephemeris data to disk for later use Load" to load previous data Test" to run a simulated run Track Object" immediately (or delays until a time) issues a GOTO and starts tracking	Save     Test     Track	Load Tracking < Target

## **Ephemeris Values**

Ephemeris Values:		I View Ephen	ICIIS Data
Target Name	=	Lovejoy (C/2013 R1	
Start (UT)	=	11/27/2013 12:00:00 AM	
Stop (UT)	=	12/7/2013 12:00:00 AM	
Interval	=	00:01:00	
Lat/Lon	=	37.338 238.11	0
Current Alt/Az	=	68.486 67.80	5
Current Hr Ang	=	-01 49 30.84	
Current RA	=	14 01 04.17	
Current Dec	=	+42 24 27.80	

Once data has been loaded the following information is displayed about it:

**Target Name -** The name of the target. Double check this to be sure you have the correct target loaded.

Start (UT) - The start time and date in Universal time of the loaded Ephemeris data set.

End (UT) - The end time and date in Universal time of the loaded Ephemeris data set.

**Interval** - the interval between data elements in Hours: Minutes: Seconds. It is recommended that a1-minute interval (00:01:00) be used for highest accuracy.

**Lat/Lon** - The latitude and longitude of the site for which the ephemeris data applies. Make sure it corresponds to the location of the telescope.

**Current Alt/Az** - the target's current Altitude and Azimuth.

Current Hr Ang - the target's current Hour Angle. This will be negative if it is East of the meridian.

Current RA - the target's current Right Ascension.

**Current Dec** - the target's current Declination.

## Mount Information

Mount Information:		Connect Disconr	nect
LST	= 12 0	09 02.21	
Hour Angle	= 04 5	58 47.81	
RA	= 07 1	0 14.40	
Dec	= +10 3	31 22.00	
RA Rate (a-s/s)	=	0.00000	
Dec Rate (a-s/s)	=	0.00000	
			Ŧ

**LST** - The current Local Sidereal Time. LST is defined to be the Right Ascension value currently at the meridian.

Hour Angle - The current hour angle. A negative value means the scope is pointing east of the meridian.

**RA** - The Right Ascension.coordinate that the scope is currently pointing to.

**Dec** - The Declination coordinate that the scope is currently pointing to.

**RA Rate** - the rate relative to sidereal that the mount is tracking at in Right Ascension, in arc-secs/second.

**Dec Rate** - the rate relative to 0 that the mount is tracking at in Declination, in arcsecs/second.

## Actions

Ephemeris Values:	? View Ep	hemeris Data	Mount Information:		?	Connect Disco	nnect
Target Name Start (UT) Stop (UT) Interval Lat/Lon Current Alt/An Current Hr Ang Current RA Current Dec	= Lovejoy (C/2013 R1 = 11/27/2013 12:00:00 = 12/7/2013 12:00:00 A = 00:01:00 = 37.338 238 = 68.209 67 g = -01 51 01.31 = 14 01 03.12 = +42 24 29.07	AM M .110 .860	LST Hour Angle RA Dec RA Rate (a-s/s) Dec Rate (a-s/s)	= 12 : = 04 ! = 07 : = +10 : =	L0 11.35 58 47.85 L1 23.50 31 22.00 0.00000 0.00000		*
'Save'' to save data to e 'Load'' to load previous ( 'Test'' to run a simulated 'Track Object'' immediat	phemeris data to disk for later use lata run ely (or delays until a time) issues a	acking		?	Save L Test Tracking Track Target	.oad	

**Save** - Saves the currently loaded Ephemeris data to a disk file. Once saved to disk you do not need an internet connection to use Horizons. Simply load a previously saved data set and start using it.

Load - Loads a previously saved Ephemeris data set.

**Test Tracking** - Using the loaded Ephemeris data set you can test tracking an object of any date and time that's in the data set's time span. This allows you to check in advance that there won't be any obstructions during an actual event.

**Track Target** - allows you to immediately go to the targets actual position or to delay to a certain time before going to it. Once tracking has been started it will continue until stopped.

# 14.1 Retrieving data from the JPL Horizons Web Side

To use Horizons you just need to follow some simple steps.

Note: you will need an internet connection to download the Ephemerides data but you don't need to have an internet connection later, when tracking.

1) Click the link in the Horizons program that opens a web browser to the JPL Horizons Ephemerides site.



The top-level web page should look something like this:



## **Target Body**

You can select the target by clicking the **Edit** button for **Target Body**. Enter the target by its full or partial designation and click the **Search** button. If the match is exact it will automatically used. Otherwise you will have to select the target from the list and click **Select Indicted Body**:

Jet Propulsion Laboratory California Institute of Technology	nics
Specify the Target Body	icel
Choose a method for specifying the target body: Search for a specified body   Lookup the Specified Body  Search Search Search all available bodies (default)  To restrict your search to only small-bodies or only major-bodies, use the pulldown menu to the right of the Search button above to select the desired filter. Show Examples	
Can 2 Edit Target Body: Jupiter	ncel
3 Edt Observer Location: San Jose, CA (121°53′24.0″W, 37°20′16.1″N)	
4 Edit Time Specification: Start=2021-10-01 UT , Stop=2021-10-02, Step=1 (minutes)	
5 Edit Table Settings: <i>custom</i>	
After specifying settings above (items 1 to 5), generate an ephemeris by pressing the "Generate Ephemeris" button below. If you plan to use one of the "batch" modes to a Horizons, the batch-file corresponding to the settings above can be viewed by using this link. Generate Ephemeris	iccess

## **Observer Location**

Once there you can configure your geographic position by clicking the **Edit** button for **Observer Location**:



Which brings up this page where you can enter your location (e.g., City, State, or Latitude/Longitude, etc.).

A Harizans System X +	$\sim$	-		×
$\leftarrow \rightarrow \mathbb{C} \ \bigtriangleup \ \text{issuiplinasa.gov/horizons/app.html#/} $	☆	0	* B	
Solar Syst	em	Dyr	amic = mic	$= -\frac{1}{r^2}r + a_y = \frac{1}{dr}$
Specify Observer Location			Cancel	
Current Location: <b>Geocentric</b> [code: 500]				
Choose a method: Search for a Location				
Lookup the Specified Location				
Examples:				
<ul> <li>675 to search for Palomar Observatory (code 675)</li> <li>paris to search for locations matching, such as "Paris France" or "Paris, IL"</li> <li>@mars to select Mars body-center (same as 500@mars)</li> <li>apollo@301 to list available Apollo sites on the moon</li> <li>@hst to select the Hubble Space Telescope (same as @-48)</li> <li>@phobos to select the center of the Martian moon "Phobos" (same as @401)</li> </ul>				
The search string is case-insensitive. The wildcard 💌 is not allowed (the search string will match words as well as substrings).				
To see all sites available for a specific body, use "@body where body is body ID. For example, "@499 will show all pre-defined sites on Mars. See the documentation" @ on "Coordinate Center (Observing Site) Selection" for more information.	e Hori	izons		
			Cancel	

## **Time Specification**

Next, you should change the time span to the time range you are interested in. To do this click the **change** link for **Time Span**.



The fields you need to edit are marked with red boxes below:

1) Set the **Start Time** and **Stop Time** fields, or click one of the buttons: **10 day**, **30 day**, or **60 day**.

2) For the best accuracy be sure to set the **Step size** to **1 minute** so that APCC can more accurately interpolate position. In the case of a fast-moving artificial satellite you should instead select "**Equal Intervals (unitless)**" and specify enough steps to produce output positions at 1 -second intervals.

3) Be sure to click Use Specified Times. If you don't, the time values will NOT be used.

Jet Propulsion Laboratory California Institute of Technology	Solar System Dynamics
Time Specification	Cancel
Choose a method for specifying output times:          Specify time span         Specify a Time Span	
Start time:       2021-12-26       1600-01-10 00:00 (min. for current target body)         Stop time:       2021-12-27       2200-01-10 00:00 (max. for current target body)         Step size:       1       minutes         Optionally, select one of the presets below to set the time-span from today to the indicated number of days later at 1-day steps.         10 day       30 day         Use Specified Time Span	
5 Edit Table Settings: <i>custom</i>	Cancel
After specifying settings above (items 1 to 5), generate an ephemeris by pressing the "Generate Ephemeris" button below. If you plan to Horizons, the batch-file corresponding to the settings above can be viewed by using this link. Generate Ephemeris	use one of the "batch" modes to access

# **Table Settings**

In order for **Horizons** to operate correctly it needs to have certain table fields selected:



Horizons System × +	∨ - □ X	
← → C △ ( ssd.jpl.nasa.gov/horizons/app.html#/	ie 🛧 🕞 🗰 🕄	
Jet Propulsion Laboratory California Institute of Technology	Solar System Dynamics	
Home	About Orbits & Planets Planetary Small Bodies Tools Extras Ephemerides      · Satellites      · · · · · · · · · · · · · · · · ·	
Home / Tools / Horizons System		
About App Manual Tutorial Time Spans News		
Horizons Web Application		
Save/Load Settings	Set Defaults	
1 Ephemeris Type: Observer Table		
2 Edit Target Body: Jupiter		
3 Edit Observer Location: San Jose, CA (121°53′24.0″W, 37°20	)′16.1″N)	
4 Edit Time Specification: Start=2021-10-01 UT , Stop=2021-10	-02, Step=1 (minutes)	
5 Edit Table Settings: custom		
After specifying settings above (items 1 to 5), generate an ephemeris by pressing the "Generate Ephemeris" button below. If you plan to use one of the "batch" modes to access Horizons, the batch-file corresponding to the settings above can be viewed by using this link.		
Generate Ephemeris		

The picture below shows the options that must be selected. It is OK to include other fields. Make certain to click **Use Specified Settings** after changing any fields.

		<u> </u>	
Horizons System X	( +		
← → C ① <sup>a</sup> ssd.jpl.nas	sa.gov/horizons/app.html#/	🖻 🖈 💬 🗯 🖪 :	
Jet Propulsio California Institut Observer Table S	n Laboratory te of Technology Settings	System Dynamics Cancet	
Ontionally preset observer	quantities selection using one of the following:	S	
Default Planets Satelli	tes Small-bodies All None		
1 Astrometric RA & DEC     2 Apparent RA & DEC     3 Rates; RA & DEC     4 Apparent AZ & EL     5 Rates; AZ & EL     6 Satellite X & Y, pos. ar     7 Local apparent sidere     8 Airmass & extinction     9 Visual mag. & Surface     10 Illuminated fraction     11 Defect of illumination     12 Satellite angular sepa     13 Target angular diamet     14 Observer sub-lon & st     15 Sun sub-longitude & s     16 Sub-Sun position ang     Notes:     * affected by optional atn     > statistical value that use	C       17.       North Pole position angle & distance       33.       Galactic longitude & latitude         18.       Heliocentric ecliptic lon. & lat.       19.       Heliocentric ecliptic lon. & lat.       19.       Local apparent SOLAR time         19.       Heliocentric range & range-rate       36.       RA & DEC uncertainty         20.       Observer range & range-rate       38.       POS uncertainty         21.       One-way (down-leg) light-time       37.       Plane-of-sky error ellipse         33.       Galatic longitude & latitude       38.       POS uncertainty         21.       One-way (down-leg) light-time       37.       Plane-of-sky error ellipse         33.       Galatic longitude & latitude       38.       POS uncertainty         34.       Sun-Target-Target Target Observer ~PHASE angle       39.       Range & range-rate 3-sigmas         41.       True anomaly angle       40.       Doppler & delay 3-sigmas         42.       Local apparent hour angle       41.       True anomaly angle         43.       PHASE angle & bisector       41.       Apparent longitude Sun (L_s)         r/vis.       28.       Orbit plane angle       44.       Apparent longitude Sun (L_s)         ub-lat       30.       Delta-T (TDB - UT)       46.	Its	
Additional Table Setting	s	s	
Reference frame: 2			
Date/time format: 0	calendar format		
Time digits: 😧	HH:MM:SS V		
Angle format: 😢	sexagesimal format (hours/degrees minutes seconds) V		
Refraction model: 🕜	standard atmospheric refraction model (Earth only) V		
Range units: 😧	astronomical units (au) 🗸		
Suppress range-rate: 🝞			
Elevation cutoff: 🚱	(deg) [ -90 to 90 ]		
Skip daylight: 😯			
Airmass cutoff: 🕜	[1.0 to 38.0]		
Hour-angle cutoff: 😧	(angular hours) [ 0.0 to 12.0 ]		
Solar elongation cutoff: 🚱	(deg) [min:max], min= 0.0 to 180.0, max= min to 180.0		
Angular rate cutoff: 0			
Extra procision: 0			
RTS flag: 0	disabled		
CSV format: 0			
Object summary: @			
Make sure to click after			
Use Specified Settings	making changes abovel		

All of this information should be remembered by the JPL site the next time you return.

## Generate Ephemeris

To create the ephemeris data click Generate Ephemeris.

Horizons System × +	∨ – □ ×		
← → C △ a ssd.jpl.nasa.gov/horizons/app.html#/	🖻 🖈 💬 🇯 🖪 :		
Jet Propulsion Laboratory California Institute of Technology       Solar Sy         Home       About       Othils &       Planets       Planetary       Small	rstem Dynamics		
Home / Tools / Horizons System			
Horizons System About App Manual Tutorial Time Spans News Horizons Web Application			
Save/Load Settings	Set Defaults		
1 Ephemeris Type: Observer Table			
2 Edit Target Body: Jupiter			
3 Edit Observer Location: San Jose, CA (121°53′24.0″W, 37°20′16.1″N)			
4 Edit Time Specification: Start=2021-10-01 UT , Stop=2021-10-02, Step=1 (minutes)			
5 Edit Table Settings: custom			
After specifying settings above (items 1 to 5), generate an ephemeris by pressing the "Generate Ephemeris" button below. If you plan to use one of the "batch" modes to access Horizons, the batch-file corresponding to the settings above can be viewed by using this link. Generate Ephemeris			

The web page should look something like that below.
Horizons System x +	- 🗆 ×
← → C △ ● ssd.jpl.nasa.gov/horizons/app.html#/	💬 🗯 🖪 🗄
	$\frac{1}{\mathrm{d}t} = \frac{1}{r^2}$ $\frac{\mathrm{d}r}{r^2} = \frac{1}{r^2}r + u_0$ $c\sin(E)$
Home About Orbits & Planetary Small Bodies To Planetary Small Bodies T	ools Extras
Home / Tools / Horizons System	
Horizons System	
About App Manual Tutorial Time Spans News	
About App Manual Futurial Fille Spans reews	
Horizons Web Application	
Save/Load Settings	Set Defaults
1 Ephemeris Type: Observer Table	
2 Edit Target Body: Juniter	
3 Edit Observer Location: San Jose, CA (121 5324.0 W, 37 2016.1 N)	
4 Edit Time Specification: Start=2021-12-26 UT , Stop=2021-12-27, Step=1 (minutes)	
5 Edit Table Settings: <i>custom</i>	
After specifying settings above (items 1 to 5), generate an ephemeris by pressing the "Generate Ephemeris" button below. If you plan to use one of the "batch" m access Horizons, the batch-file corresponding to the settings above can be viewed by using this link	iodes to
Generate Ephemeris	
	Delete
	Delete
Download Results 2	
Revised: April 12, 2021 Jupiter 599	
PHYSICAL DATA:	
Mass x 10^22 (g) = 189818722 +- 8817 Density (g/cm^3) = 1.3262 +0003	
Equat. radius (1 bar) = 71492+-4 km Polar radius (km) = 60854+-10 Vol. Mean Radius (km) = 69911+-6 Flattening = 0.06487	
Geometric Albedo = 0.52 Rocky core mass (Mc/M)= 0.0261	
Sid. rot. period (111)= 9n 55m 29.71 s Sid. rot. rate (rad/s)= 0.00017585 Mean solar day, hrs = ~9.9259	
GM (km^3/s^2) = 126686531.900 GM 1-sigma (km^3/s^2) = +- 1.2732	
Equ. grav, ge (m/s^2) = 24.79 Pol. grav, gp (m/s^2) = 28.34 Vis. maenitude V(1.0) = -9.40	
Vis. mag. (opposition)= -2.70 Obliquity to orbit = 3.13 deg	
Sidereal orbit period = 11.861982204 y Sidereal orbit period = 4332.589 d Mean daily motion = 0.0831204 deg/d Mean orbit sneed km/s= 13.0607	
Atmos. temp. (1 bar) = 165+-5 K Escape speed, km/s = 59.5	
A_roche(ice)/Rp = 2.76 Hill's sphere rad. Rp = 740	
Solar Constant (W/m^2) 56 46 51	
Maximum Planetary IR (W/m^2) 13.7 13.4 13.6	
Minimum Planetary IR (W/m^2) 13.7 13.4 13.6	

After the file has downloaded, click **Load JPL File** in the Astro-Physics Horizons application:

Astro-Physics Horizons ile Ephemeris Data Mount Track Help	– 🗆 X
Step 1: Click link and configure, target, date and time: Step 2: Copy and Paste Object Ephemeris data below Note: In Table Settings select Quantities=2,3,4,7,9 (others ok) Display/Output as "plain text".	IPI Horizons Ephemeris     Load JPL File     Clear
<     Ephemeris Values:	Connect Disconnect
	~
Save" to save data to ephemeris data to disk for later use Load" to load previous data Test" to run a simulated run Track Object" immediately (or delays until a time) issues a GOTO and starts tracking	Save Load      Test Tracking      Track Target

After selecting the file you should see the Ephemeris values displayed in the bottom left text box. They will be dynamically updating.

#### 14.2 Test Tracking

The Test Tracking feature is extremely easy to use. The window has one line per each line. Lines that are grayed-out are below the horizon and cannot be used. Double click any line that is not grayed out to test out tracking of the target at that time.

dex	Local Time	UTC	RA	Dec	RA rate (a-s/hr*cos(Dec))	Dec rate (a-s/hr)	Azimuth	Altitude	Magnitude	
81	12/1/2013 7:00:00 PM	12/2/2013 3:00:00 AM	15.071358	39.829250	343.18990	-110.37800	322.85	0.64	0.00	
82	12/1/2013 7:01:00 PM	12/2/2013 3:01:00 AM	15.071497	39.828750	343.18500	-110.37600	323.00	0.52	0.00	
83	12/1/2013 7:02:00 PM	12/2/2013 3:02:00 AM	15.071633	39.828222	343.18010	-110.37400	323.15	0.40	0.00	
84	12/1/2013 7:03:00 PM	12/2/2013 3:03:00 AM	15.071772	39.827722	343.17520	-110.37100	323.30	0.28	0.00	
85	12/1/2013 7:04:00 PM	12/2/2013 3:04:00 AM	15.071911	39.827194	343.17020	-110.36900	323.45	0.17	0.00	
86	12/1/2013 7:05:00 PM	12/2/2013 3:05:00 AM	15.072047	39.826694	343.16510	-110.36700	323.60	0.05	0.00	
87	12/1/2013 7:06:00 PM	12/2/2013 3:06:00 AM	15.072186	39.826194	3 16000	-110.36400	323.75	-0.07	0.00	
88	12/1/2013 7:07:00 PM	12/2/2013 3:07:00 AM	15.072322	39.825667	343 15490	-110.36200	323.90	-0.19	0.00	
89	12/1/2013 7:08:00 PM	12/2/2013 3:08:00 AM	15.072461	39.825167	343. 4970	-110.35900	324.05	-0.30	0.00	
90	12/1/2013 7:09:00 PM	12/2/2013 3:09:00 AM	15.072600	39.824639	343.1 450	-110.35700	324.21	-0.42	0.00	
91	12/1/2013 7:10:00 PM	12/2/2013 3:10:00 AM	15.072736	39.824139	343.13 30	-110.35400	324.36	-0.54	0.00	
92	12/1/2013 7:11:00 PM	12/2/2013 3:11:00 AM	15.072875	39.823639	343.13410	-110.35200	324.51	-0.65	0.00	
tus info	mation: 📃 Disa	able closed loop com dions								
Got	rayed-out lines indi bject is BELOW the and cannot be sel	cate the horizon ected.			Double-click line that is no you to sin starting	the mouse of t grayed will mulate tracking at that entry	n any allow ng		Stop	)

When you double-click a line you will be prompted for with a confirmation dialog. If you click OK the scope will slew to the target position and start tracking. Horizons uses closed-loop tracking, which means that it checks and adjusts the RA and Dec to make sure it matches the RA/Dec coordinates of the object. You can disable this be clicking **Disable closed loop corrections.** If you do this the tracking rate will still be constantly adjusted to match the target's rate but you can then recenter the scope without Horizons interfering and recentering the target.

Idex	Local Time	UTC	RA	Dec	RA rate (a-s/hr*cos(Dec))	Dec rate (a-s/hr)	Azimuth	Altitude	Magnitude	
381	12/1/2013 7:00:00 PM	12/2/2013 3:00:00 AM	15.071358	39.829250	343.18990	-110.37800	322.85	0.64	0.00	
382	12/1/2013 7:01:00 PM	12/2/2013 3:01:00 AM	15.071497	39.828750	343.18500	-110.37600	323.00	0.52	0.00	
383	12/1/2013 7:02:00 PM	12/2/2013 3:02:00 AM	15.071633	39.828222	343.18010	-110.37400	323.15	0.40	0.00	
384	12/1/2013 7:03:00 PM	12/2/2013 3:03:00 AM	15.071772	39.827722	343.17520	-110.37100	323.30	0.28	0.00	
385	12/1/2013 7:04:00 PM	12/2/2013 3:04:00 AM	15.071911	39.827194	343.17020	-110.36900	323.45	0.17	0.00	
386	12/1/2013 7:05:00 PM	12/2/2013 3:05:00 AM	15.072047	39.826694	343.16510	-110.36700	323.60	0.05	0.00	
387	12/1/2013 7:06:00 PM	12/2/2013 3:06:00 AM	15.072186	39.826194	343.16000	-110.36400	323.75	-0.07	0.00	
388	12/1/2013 7:07:00 PM	12/2/2013 3:07:00 AM	15.072322	39.825667	343.15490	-110.36200	323.90	-0.19	0.00	
389	12/1/2013 7:08:00 PM	12/2/2013 3:08:00 AM	15.072461	39.825167	343.14970	-110.35900	324.05	-0.30	0.00	
390	12/1/2013 7:09:00 PM	12/2/2013 3:09:00 AM	15.072600	39.824639	343.14450	-110.35700	324.21	-0.42	0.00	
391	12/1/2013 7:10:00 PM	12/2/2013 3:10:00 AM	15.072736	39.824139	343.13930	-110.35400	324.36	-0.54	0.00	
392	12/1/2013 7:11:00 PM	12/2/2013 3:11:00 AM	15.072875	39.823639	343.13400	-110.35200	324.51	-0.65	0.00	
atus info est T	mation: Disa ime = 12/2/2013 3: a = 45.628	03:45 AM(UT)							^Stor	_
lapse		arc-sec/sec ( 34	3.171 arc-	sec/hr * 0	Cos (D) )					_

To stop tracking click the **Stop** button.

The Status Information window shows the following information:

**Test Time** - the simulated time at which the target will be located at the current RA/Dec scope position.

Elapsed - Elapsed time since start of the simulation.

**RA Rate** - the scope's current RA Rate.

Dec Rate - the scope's current Dec Rate.

HA Expected - the expected hour angle position of the target.

**HA Delta** - the difference between actual and expected position. This can vary slightly because the mount's position cannot be continuously and instantaneously polled.

Dec Expected - the expected declination of the target.

**Dec Delta** - the difference between actual and expected declination. This can vary slightly because the mount's position cannot be continuously and instantaneously polled.

#### 14.3 Tracking a Target

To track a target you need to:

1. Be connected to the mount by clicking the "Connect" button on the main window

2. Have loaded a target's ephemeris data into the main windows from the JPL Horizons web site. Alternatively you could also load a previously saved data set.

From this window you can track a target now or at a future time. In order to track an object the ephemeris data must have time entries available for the time during which you want to track it.

Start Tra Nov	Stop Tracking	Start tracking at: 9:45:39 PM		Stop after (hour	rs):	Sidereal Rate	Tum Mount Tracking Off	Park	6
Index	Local Time	UTC		RA	Dec	RA rate (Sider	real*cos(Dec))	Dec rate (Sider	ei 4
1	12/18/2015 5:00:00 PM	12/19/2015 12:00:0	MA 0	14.300836	1.631889	-0.00	0006	0.00268	-L
2	12/18/2015 5:01:00 PM	12/19/2015 12:01:0	MA 0	14.300833	1.632556	-0.00	0006	0.00268	
3	12/18/2015 5:02:00 PM	12/19/2015 12:02:0	MA 0	14.300833	1.633222	-0.00	0006	0.00268	
4	12/18/2015 5:03:00 PM	12/19/2015 12:03:0	MA 0	14.300833	1.633889	-0.00	0006	0.00268	
5	12/18/2015 5:04:00 PM	12/19/2015 12:04:0	MA 0	14.300831	1.634583	-0.00	0006	0.00268	
	12/19/2015 5:05:00 PM	12/19/2015 12:05:0	0.000	14.000001	1 625250	-0.0	0006	0.00268	
r	12/10/2013 3.03.001 M	12/13/2013 12:03.0	MA U	14.300831	1.000200	0.00	0000	0.00200	
7 Tatus ir	12/18/2015 5:06:00 PM	12/19/2015 12:06:0 12/19/2015 12:06:0 III ec Move Direction	0 AM 0 AM ] Invert [	14.300831 14.300831 Dec Correctio	1.635917 0ns	-0.00	0006 Show Native	0.00268 Scope Rates Ab	ove
itatus ir	12/10/2013 5:06:00 PM	12/13/2013 12:05:0 12/19/2015 12:06:0 ///	0 AM 0 AM ] Invert [	14.300831 14.300831 Dec Correctio	1.635250 1.635917	-0.00	0006 Show Native	0.00268 Scope Rates Ab	ove
7 1 İtatus ir	12/18/2015 5:06:00 PM	12/19/2015 12:06:0	IO AM	14.300831 14.300831 Dec Correctio	1.635917	-0.00	0006 ] ☑ Show Native	0.00268 Scope Rates Ab	ove
itatus ir	12/18/2015 5:06:00 PM	12/13/2013 12:03:0 12/19/2015 12:06:0 III ec Move Direction	0 AM 0 AM ] Invert [	14.300831 14.300831 Dec Correctio	1.635250 1.635917	-0.00	0006 ✓ Show Native	0.00268 Scope Rates Ab	ove
7 Atatus ir	12/10/2013 5:06:00 PM	12/13/2013 12:03:0 12/19/2015 12:06:0 III ec Move Direction	0 AM 0 AM	14.300831 14.300831 Dec Correctio	1.635917	-0.00	0006 ✓ Show Native	0.00268 Scope Rates Ab	ove
itatus ir	12/18/2013 5:06:00 PM	12/19/2015 12:06:0	0 AM 0 AM	14.300831 14.300831 Dec Correctio	1.635917	-0.00	Show Native	0.00268 Scope Rates Ab	bove
atus ir	12/18/2013 3.03.00 PM	12/19/2015 12:06:0	0 AM 0 AM	14.300831 14.300831 Dec Correctio	1.635917	-0.00	Show Native	0.00268 Scope Rates Ab	
itatus ir	12/10/2013 3.03.00 PM	12/19/2015 12:06:0	0 AM 0 AM	14.300831 14.300831 Dec Correctio	1.635917	-0.00	Show Native	0.00268 Scope Rates Ab	
itatus ir	nformation:	12/19/2015 12:06:0	0 AM	14.300831 14.300831 Dec Correctio	1.635917	-0.00	Show Native	0.00268 Scope Rates Ab	
A Fine 1	12/10/2013 3.03.00 PM	12/19/2015 12:06:0	Invert [	14.300831 14.300831 Dec Correctio	1.635917	-0.00	Show Native	0.00268 Scope Rates Ab	

**Start Tracking Now -** Click to immediately start tracking the target. The mount will slew the telescope to the target, perform a short calibration, slew one more time, then start tracking. The **Status Information** field will indicate status as this happens.

Stop Tracking - Click to stop tracking. It is only active when tracking is active.

**Start tracking at:** - Click to start tracking at a specific time. The time and date can be set in the field directly under this button.

**Stop after (hours)** check box - if checked mount tracking will be completely stopped after the interval in hours in the field below this check box. This field applies both to the **Start Tracking Now** and **Start Tracking at** buttons. The time is measured from when tracking actually begins. This field is "live", meaning you can turn it on or off, or change the **hours** value while tracking Be careful if you lower the value while tracking as you can trigger a stop tracking event.

**Sidereal Rate** - click to set the mount to Sidereal tracking rate. Best used when tracking is off as **Horizons** can change the rate while tracking.

Turn Mount Tracking Off - turns tracking completely off.

**Park** - parks the telescope.

#### **Tracking Table**

Index	Local Time	UTC	RA	Dec	RA rate (a-s/hr*cos(Dec))	Dec rate (a-s/hr)	Azimuth	Altitude	Magnitude	
1	11/26/2013 4:00:00 PM	11/27/2013 12:00:00 AM	13.830889	42.610361	476.51770	-42.12410	308.93	20.01	0.00	
2	11/26/2013 4:01:00 PM	11/27/2013 12:01:00 AM	13.831089	42.610167	476.51780	-42.13840	309.04	19.85	0.00	
3	11/26/2013 4:02:00 PM	11/27/2013 12:02:00 AM	13.831289	42.609972	476.51780	-42.15270	309.14	19.70	0.00	
4	11/26/2013 4:03:00 PM	11/27/2013 12:03:00 AM	13.831489	42.609778	476.51780	-42.16690	309.25	19.55	0.00	
5	11/26/2013 4:04:00 PM	11/27/2013 12:04:00 AM	13.831689	42.609583	476.51780	-42.18110	309.36	19.40	0.00	
6	11/26/2013 4:05:00 PM	11/27/2013 12:05:00 AM	13.831889	42.609389	476.51780	-42.19520	309.46	19.24	0.00	
7	11/26/2013 4:06:00 PM	11/27/2013 12:06:00 AM	13.832089	42.609194	476.51770	-42.20930	309.57	19.09	0.00	
8	11/26/2013 4:07:00 PM	11/27/2013 12:07:00 AM	13.832289	42.609000	476.51770	-42.22330	309.68	18.94	0.00	

This table contains relevant entries from the target's Ephemeris data. The table contains:

Index - line number in the table.

Local Time - local time for the entry in the table.

**UTC** - universal time for the entry in the table.

**RA** - the target's Right Ascension value.

**Dec** - the target's Declination value

**RA Rate** - the instantaneous RA rate of the target at the time.

**Dec Rate** - the instantaneous Dec rate of the target at the time.

**Azimuth -** azimuth of the target at the time.

Altitude - altitude of the target at the time

Magnitude - if magnitude is available, the estimated magnitude of the target at the time.

#### **Status Information**

This shows the the tracking status of the target. Values with light green backgrounds signify a positive value (greater or equal to zero). Negative values, except for **HA Expected** and **Dec Expected**, have a dark red background with white text.

```
UTC Time = 12/1/2013 10:51:28 PM (UT)

Elapsed = 9.13 seconds

HA Last = 04 25 33.03 -- Dec Last = +39 57 23.00

HA Expected = 04 25 30.88 -- Dec Expected = +39 57 21.94

HA Delta = 00 00 02.15 -- Dec Delta = +00 00 01.06

RA Average = 9.02 -- Dec Average = 1.93 (arc-secs)

RA Rate = 0.00831 arc-sec/sec ( 343.771 arc-sec/hr * Cos(D))

Dec Rate = -0.03047 arc-sec/sec ( -109.680 arc-sec/hr)
```

#### **Other options**

**Invert Dec Move Direction** check box - used for debug. Will reverse declination move direction.

**Invert Dec Corrections** check box - also used for debug. Check this box if you experience a "Declination runaway" in the closed loop logic.

**Show Native Scope Rates Above:** when checked the native Astro-Physics mount tracking rates are shown (recommended).

**Disable closed-loop corrections** check box - **Horizons** uses closed-loop tracking, which means that it checks and adjusts the RA and Dec to make sure it matches the RA/Dec coordinates of the object. After checking this option **Horizons** will still constantly adjust tracking rate to match the target's rate but it will not recenter the target. You could then place the target anywhere in the field of view without Horizons trying to recenter the target.

**RA Fine Tune (arc-sec/hr):** If you are not using **APCC Pro** or not using an APPM pointing model then tracking might not be perfect because of polar misalignment, flexure, refraction, etc. You can fine-tune the RA tracking rate with this setting in units of arc-seconds per hour.

**Dec Fine Tune (arc-sec/hr):** If you are not using **APCC Pro** or not using an APPM pointing model then tracking might not be perfect because of polar misalignment, flexure, refraction, etc. You can fine-tune the Dec tracking rate with this setting in units of arc-seconds per hour.

**Offset Target at Current Position** button - This option is only available with **APCC Pro**. It allows you to offset a target for better image composition. To use it do the following: 1) Reposition your target.

2) Click the Offset Target at Current Position button.

To exit this mode you need to stop and restart tracking the target.

**Tracking Graph** button - available only with **APCC Pro.** This opens a graph showing the tracking delta values over time.

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