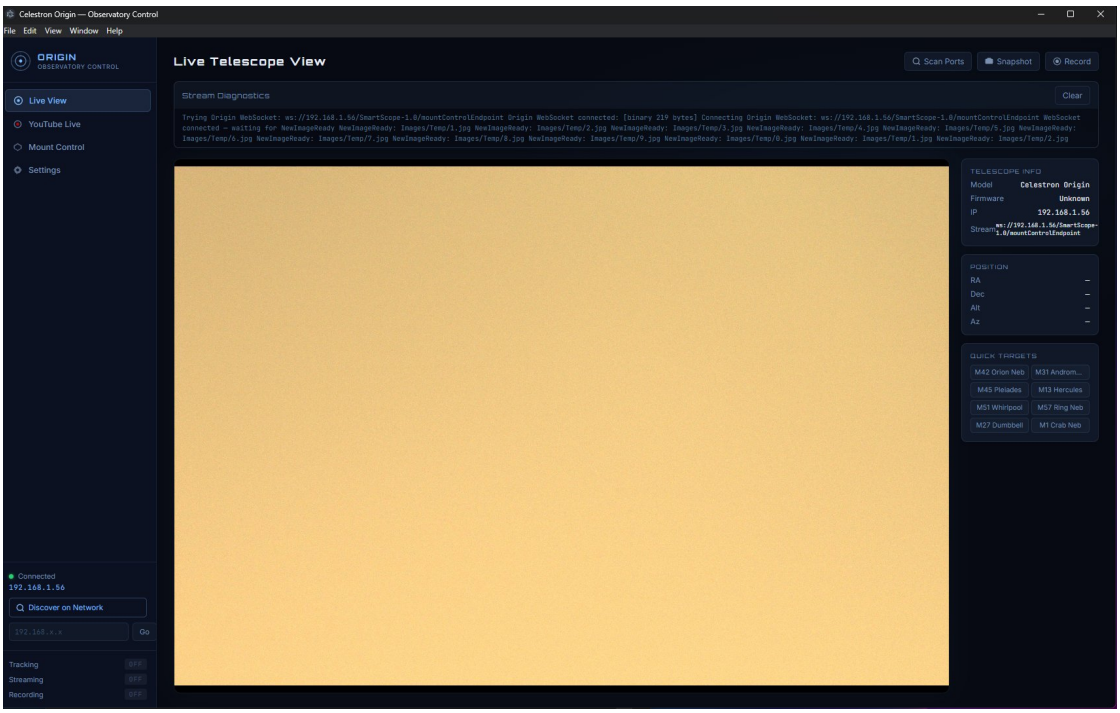
CELESTRON ORIGIN

Observatory Control

Complete User Manual



Windows Desktop Application | Electron + Node.js | Version 2.0
Compatible with Celestron Origin Intelligent Home Observatory

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1 — Getting Started

1.1 System Requirements

OS	Windows 10 or later (64-bit)
RAM	4 GB minimum, 8 GB recommended
Disk	500 MB free space
Network	Must be on same Wi-Fi network as the telescope
FFmpeg	Included automatically during installation
Node.js	Included automatically during installation

1.2 Installation

The app ships as a ZIP file containing an automated installer. No administrator rights are required.

- Extract **CelestronOriginControl-Installer.zip** to any folder
- Double-click **Install.bat** to launch the installer
- The installer will automatically download Node.js and FFmpeg if needed
- A desktop shortcut and Start Menu entry are created automatically
- To uninstall, run **Uninstall.bat** or use Windows Apps & Features

■ The installer does not require administrator privileges. All files are installed to your user folder.

1.3 Connecting to Your Telescope

The Celestron Origin creates its own Wi-Fi access point when powered on. Before launching the app:

- Power on your Celestron Origin telescope
- Connect your Windows PC to the telescope's Wi-Fi network (named **Origin-XXXXXX**)
- Launch **Celestron Origin Control** from the desktop shortcut

Once the app is open, connect using one of these methods:

- **Discover on Network** — click this button in the left sidebar to automatically scan for the telescope. This takes about 5–10 seconds.
- **Manual IP** — type the telescope's IP address directly (typically 192.168.1.56 or 192.168.68.1) and click Go.

■ *The telescope IP address is shown in the Celestron Origin mobile app under Settings → Network.*

Once connected, the sidebar shows:

Green dot + "Connected"	Telescope is connected and responding
IP Address	The telescope's current network address
Tracking badge	Shows ON when sidereal tracking is active

Streaming badge	Shows LIVE when a stream is in progress
Recording badge	Shows ON when local recording is active

2 — Live View

2.1 Live View Interface

The Live View tab shows a real-time feed from the telescope's camera. Frames are received via the SmartScope WebSocket protocol at approximately 1 frame per second. The full 3056×2048 JPEG image is transmitted and displayed scaled to fit the window.

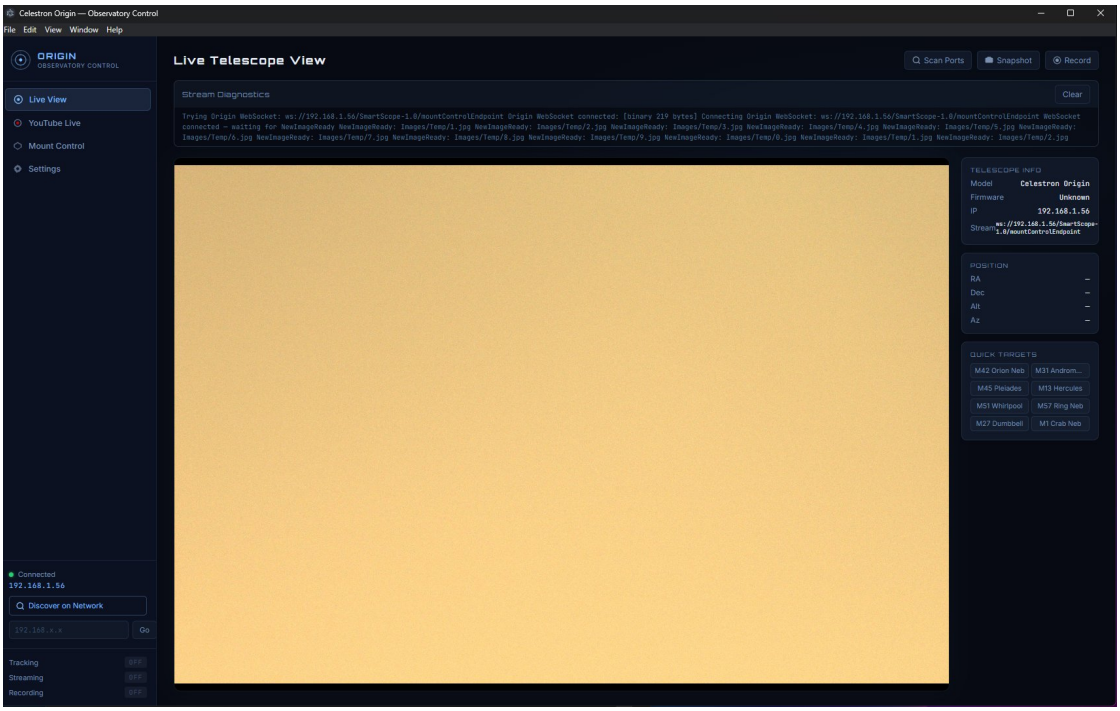

Fig 2.1 — Live View tab showing a daytime sky frame from the telescope camera.

Telescope Info Panel (right sidebar)

Model	Telescope model (Celestron Origin)
Firmware	Installed firmware version (e.g. 1.3.5330)
IP	Active network address
Stream	WebSocket endpoint URL
RA / Dec	Current right ascension and declination
Alt / Az	Current altitude and azimuth in degrees

2.2 Quick Controls

Three buttons appear in the top-right of the Live View:

Scan Ports	Opens/closes the Stream Diagnostics panel. Shows raw WebSocket log messages for debugging connection issues.
Snapshot	Saves a full-resolution JPEG of the current frame to your Documents folder.

Record	Starts/stops local MP4 recording. The file is saved to your Documents folder with a timestamp.

■ Snapshot saves the original 3056×2048 resolution image — ideal for sharing or stacking.

2.3 Tonight's Best Targets

The right sidebar displays a live-calculated list of deep sky objects currently well-positioned for observation from your location. Objects are ranked by current altitude — the higher the number, the less atmosphere you're looking through.

Object name	Messier or NGC designation plus common name
Altitude (°)	Current degrees above the horizon
GREAT badge	Object is above 50° — excellent conditions
GOOD badge	Object is between 20°–50° — acceptable conditions

Clicking any target immediately slews the telescope to that object (telescope must be connected and initialized). Location is read automatically from the telescope's Mount status, which broadcasts your GPS coordinates every second over the live WebSocket connection.

2.4 Viewing Conditions

Below Tonight's Best, the **Viewing Conditions** panel fetches live weather data from **Open-Meteo** (free, no API key required) using the telescope's GPS coordinates and calculates an overall score for how good the sky is for observing right now.

Overall Score

A circular score from 0–100 is displayed with a colour-coded arc and rating label:

80–100 — Excellent	Green — clear skies, low humidity, calm winds
60–79 — Good	Yellow-green — mostly clear with minor limitations
40–59 — Fair	Orange — some cloud or wind affecting quality
20–39 — Poor	Red — significant cloud cover or poor conditions
0–19 — Bad	Purple — overcast, rain, fog or severe weather

Scored Factors

■ Cloud Cover	Primary factor. Clear (≤10%) scores full points; overcast (>60%) loses up to 80 points.
■ Precipitation	Any rain, snow or drizzle deducts 60 points immediately.
■ Dew Risk	Compares temperature to dew point. A gap under 3°F means dew will form on optics.
■ Wind Speed	Calm (≤5 mph) is ideal. Strong winds (>20 mph) cause image blur and vibration.
■ Visibility	Atmospheric transparency. Under 5 miles indicates haze, fog or pollution.

Each factor shows a ✓ (green) or ✗ (red) indicator. Bad factors are highlighted in red so you can immediately see what is limiting your session.

■ Weather data auto-refreshes every 15 minutes. Use the ■ button to refresh manually at any time.

■ *Viewing Conditions requires an internet connection to reach the Open-Meteo weather API. The telescope Wi-Fi network must have internet access, or your PC must be connected to a separate network with internet while also connected to the telescope.*

2.5 Snapshot, Record, and Scan Ports

Snapshot

Captures the current live frame at full resolution (3056×2048). Saved as a JPEG to your Documents folder with a timestamp filename: **Origin_YYYYMMDD_HHMMSS.jpg**

Record

Starts a local MP4 recording using FFmpeg. Frames are encoded at the selected quality setting. Click Record again to stop — the file is finalized and a notification shows the save location.

■ *Recording and streaming can run simultaneously. The telescope sends frames independently to each.*

Stream Diagnostics

The diagnostics panel (toggled via Scan Ports) shows the raw WebSocket log. Use this if the live view is not appearing — it will show connection attempts, frame arrival messages, and errors. Click the **Hide** button or **Scan Ports** again to close it.

3 — Live Streaming

The Live Stream tab supports streaming to YouTube and Twitch simultaneously with optional background music. Video frames from the telescope are encoded in real-time using FFmpeg's H.264 encoder and pushed via RTMP.

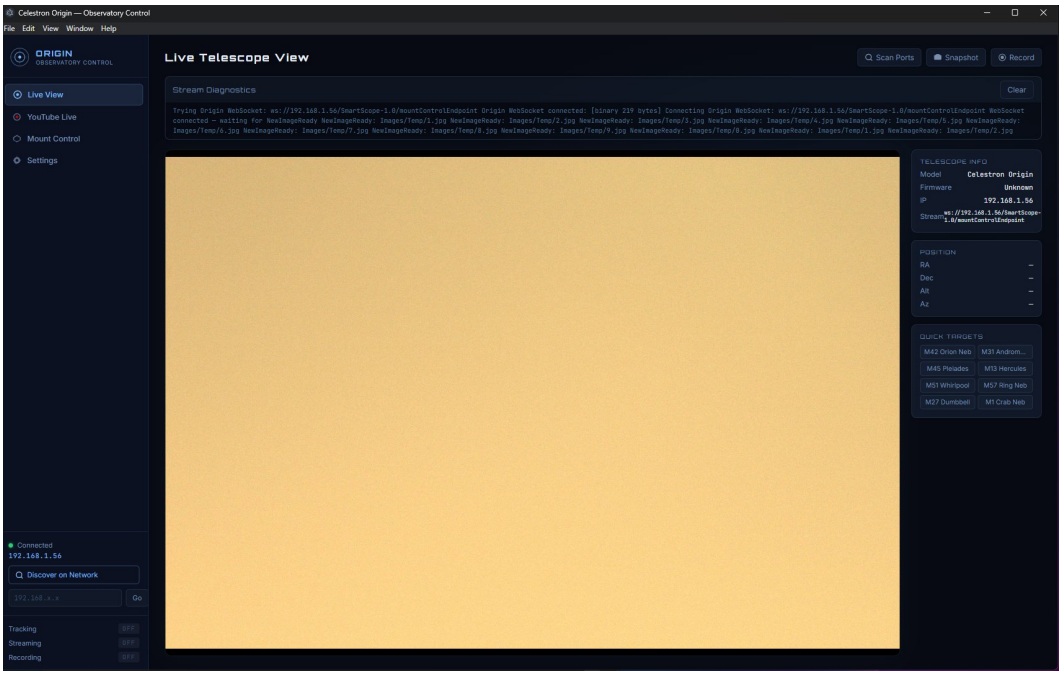

Fig 3.1 — Live Stream tab showing an active YouTube stream.

3.1 YouTube Streaming Setup

YouTube streaming requires a one-time Google Cloud OAuth setup to enable automatic stream key fetching. This takes approximately 5 minutes and only needs to be done once.

Step 1 — Create Google Cloud Credentials

- Go to **console.cloud.google.com** and create a new project
- Navigate to **APIs & Services** → **Library** and enable **YouTube Data API v3**
- Go to **APIs & Services** → **Credentials** → **Create Credentials** → **OAuth 2.0 Client ID**
- Choose **"TV and Limited Input devices"** for QR code sign-in, or **"Desktop app"** for browser sign-in
- In the **OAuth consent screen**, add your Google account as a **test user**

■ *This is a free Google Cloud tier — no billing is required for the YouTube Data API at typical usage levels.*

Step 2 — Enter Credentials in App Settings

- In the app, go to the **Settings** tab
- Under **YouTube Sign-In Setup**, paste your Client ID and Client Secret
- Click **Save Credentials**

Step 3 — Sign In

- On the Live Stream tab, click **Sign in with Google**
- If using a "TV and Limited Input" client: a QR code popup appears — scan it with your phone
- If using a "Desktop app" client: a browser window opens for normal Google login
- Once approved, the app receives your OAuth token automatically

Step 4 — Go Live

- Your stream key is fetched automatically — no manual copy/paste needed
- Select your desired quality (480p / 720p HD / 1080p FHD)
- Click **Go Live on YouTube**

■ Your sign-in token is saved and auto-refreshed, so you only need to sign in once.

3.2 Twitch Streaming

Twitch requires only a stream key — no OAuth or developer project needed.

- Click the **Twitch** button at the top of the Live Stream tab
- Go to **dashboard.twitch.tv** → **Settings** → **Stream** to find your stream key
- Paste the key into the Stream Key field (format: **live_XXXXXXXXXX_XXXX...**)
- Your key is saved automatically for future sessions
- Click **Go Live on Twitch**

RTMP Server	rtmp://live.twitch.tv/app/
Key Format	live_XXXXXXXXXX_XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
Encoder	FFmpeg libx264 (H.264)
Audio	AAC 128kbps stereo

3.3 Background Music

You can add continuous royalty-free radio to your stream via **SomaFM** — a free, ad-free internet radio service. Because it is a live radio stream it never ends, so there are no interruptions or restarts while you are live.

- Toggle the **Enable** switch under Background Music
- Click any station from the grid to select it — it highlights in blue
- Adjust the **Volume** slider (default 40%)
- The selected station appears in the "Now Playing" panel
- Click **Remove** to deselect the station

Changing stations while live: You can switch stations at any time during a stream by clicking a different station in the grid. The audio proxy seamlessly reconnects to the new station — the main stream to YouTube or Twitch never drops or restarts. There is a 1–2 second crossfade gap while the new stream buffers.

Volume control while live: The volume slider works in real time during a stream. Moving it immediately restarts the audio transcoder at the new level — the main video stream is unaffected. Changes take about one second to apply.

Source	SomaFM (somafm.com) — free, royalty-free, non-stop
License	Free for streaming and rebroadcasting — safe for YouTube and Twitch
Volume range	0% – 100% (40% recommended to keep music subtle)
Live switching	Change stations mid-stream with no interruption to viewers
Live volume	Adjust volume mid-stream — takes ~1 second to apply
Reconnect	Auto-reconnects if the radio stream briefly drops

Available Radio Stations

■ Space Station	Ambient / Space — ideal for astronomy streams
■ Deep Space One	Deep Ambient — slow, atmospheric
■ Drone Zone	Dark Ambient — minimal and hypnotic
■ Groove Salad	Ambient / Electronic — mellow beats
■ Lush	Lush Downtempo — warm and melodic
■ Cliqhop	IDM / Electronic — glitchy and rhythmic
■ Sonic Universe	Jazz / Fusion — sophisticated jazz
■ Ill Street Blues	Blues / Jazz — classic feel
■ Beat Blender	Downtempo / Hip-Hop — laid-back beats
■ Indie Pop	Indie / Pop — upbeat and melodic
■ Folk Forward	Folk / Indie — acoustic and gentle
■ Thistle Radio	Celtic / Folk — traditional

3.4 Quality Settings

480p	854×480 @ 30fps · 2500 kbps video · 96 kbps audio. Best for slow internet connections.
720p HD	1280×720 @ 30fps · 4500 kbps video · 128 kbps audio. Recommended default.
1080p FHD	1920×1080 @ 30fps · 6000 kbps video · 192 kbps audio. Requires 8+ Mbps upload speed.

■ *The telescope camera delivers ~1 fps. FFmpeg interpolates frames to reach the target frame rate. Higher quality settings require more CPU and upload bandwidth.*

4 — Mount Control

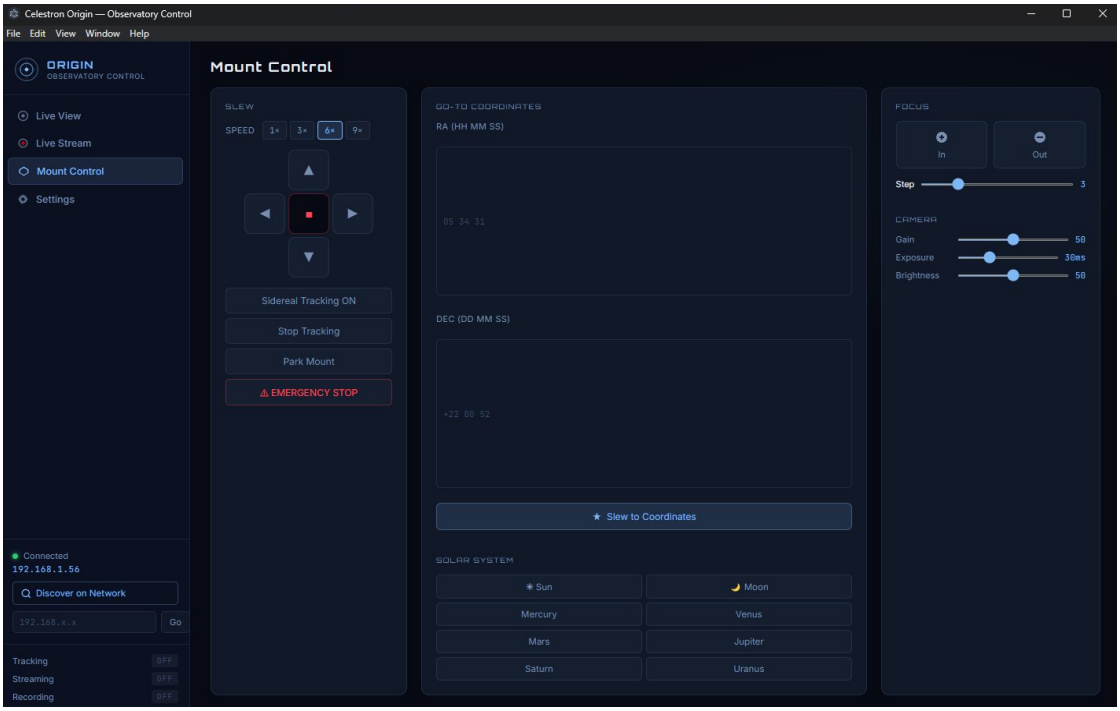

Fig 4.1 — Mount Control tab showing the D-pad, Go-To panel, and Tonight's Best Targets.

4.1 D-Pad Slew Controls

The D-pad allows manual directional control of the mount. Hold a direction button to slew; release to stop. The center ■ button sends an immediate stop command.

▲ North	Increase altitude — moves telescope up
▼ South	Decrease altitude — moves telescope down
■ West	Moves telescope west
■ East	Moves telescope east
■ Stop	Immediately halts all slew motion

Speed Control

Four speed pills control the slew rate. The telescope uses a 1–9 rate scale internally:

1×	Rate 1 — very slow, precise fine adjustments
3×	Rate 3 — slow, useful for centering objects
6×	Rate 6 — medium speed (default)
9×	Rate 9 — fast, for large movements across the sky

Tracking Controls

Sidereal Tracking ON	Enables sidereal tracking — mount follows stars to compensate for Earth's rotation
Stop Tracking	Disables tracking — mount stays stationary
Park Mount	Sends telescope to its home/park position
■ EMERGENCY STOP	Immediately halts all motion and disables tracking. Use if telescope is moving unexpectedly.

4.2 Go-To Coordinates

Enter equatorial coordinates to slew the telescope to a precise location:

- **RA (HH MM SS)** — Right ascension in hours, minutes, seconds (e.g. **05 34 31** for Orion Nebula)
- **Dec (DD MM SS)** — Declination with sign (e.g. **-05 23 28** or **+22 00 52**)
- Click **Slew to Coordinates** to begin the GoTo slew

■ Coordinates can be entered as decimal degrees too — e.g. 83.8 for RA, -5.4 for Dec.

4.3 Tonight's Best Targets

The same Tonight's Best list from Live View also appears in Mount Control. Objects are calculated in real time based on your GPS location from the telescope.

- Objects ranked by current altitude — highest first
- Only objects above 20° elevation are shown
- **GREAT** = above 50° — ideal imaging conditions
- **GOOD** = 20°–50° — acceptable conditions
- Click any target to immediately slew to it
- Click ■ **Refresh** to recalculate with current time

4.4 Focus and Camera

Focus Controls

In / Out buttons	Move the focuser in or out by the selected step size
Step slider	Controls how many motor steps per button press (1–10). Higher = faster movement.

■ *The Celestron Origin has an electronic focuser. Always use small step sizes when fine-tuning near focus.*

Camera Controls

Gain	Camera sensor gain (ISO equivalent). Higher values increase brightness but also noise.
Exposure	Exposure time in milliseconds. Longer exposures capture more light but may cause star trails without tracking.
Brightness	Post-capture brightness adjustment applied by the image processor.

5 — Telescope Settings

The Telescope tab displays live data fetched directly from the telescope's SmartScope API. All data is read when you open the tab and can be refreshed with the ■ Refresh button. Some settings can be written back to the telescope.

■ *The telescope must be connected for this tab to display any data.*

5.1 System Information

Model	Telescope model name (Origin)
Firmware	Current firmware version number (e.g. 1.3.5330)
Serial Number	Unique hardware serial number of your telescope
Camera Model	Sensor model identifier (Origin178)
Camera Firmware	Camera board firmware version
Update Channel	"stable" or "beta" — which firmware track the telescope checks
Update Available	Whether a newer firmware is available for download

Check for Updates button — forces an immediate check against Celestron's update server. If an update is found, install it through the official Celestron Origin mobile app.

5.2 Camera Settings

Sensor	Camera sensor ID
Resolution	Full sensor resolution in pixels (3056 × 2048)
Pixel Size	Physical pixel size in micrometres (2.4 µm)
ISO Range	Minimum and maximum ISO sensitivity values
Exposure Range	Minimum and maximum exposure times in seconds
Color	Whether the sensor has a color Bayer filter (Color) or is monochrome
Max Binning	Maximum pixel binning factor (2× available)
White Balance R/G/B	Current red, green, and blue balance values (0–255)

5.3 Mount Configuration

Mount Name	Mount model (Origin)
Battery Level	HIGH / MEDIUM / LOW — color coded green/orange/red
Battery Voltage	Actual battery voltage in volts (nominal ~9.9V)
Charger Status	CHARGING / DISCHARGING / CHARGED
Equatorial Mode	Whether the mount is in equatorial wedge mode
Cordwrap	Cordwrap protection — prevents cable tangling during rotation

PEC	Periodic Error Correction (not supported on Origin)
Alt Backlash	Altitude axis backlash compensation value
Azm Backlash	Azimuth axis backlash compensation value

■ A battery voltage below 9.5V indicates the battery needs charging soon. Below 9.0V the telescope may shut down during operation.

5.4 Focuser Advanced Settings

Position	Current absolute focuser position (motor steps)
Min Position	Software-limited minimum position
Max Position	Software-limited maximum position
Auto-focus after GoTo	Automatically runs auto-focus routine after each GoTo slew completes
Temp shift auto-focus	Triggers auto-focus when temperature changes by the threshold amount
Temp threshold (°C)	Temperature change required to trigger auto-focus (default 5°C)

To change focuser settings: toggle the checkboxes as desired, then click **Save Focuser Settings**. Changes are sent to the telescope immediately via the SmartScope API.

5.5 Environment & Dew Heater

Environment Sensors

Ambient Temperature	External temperature near the telescope tube (°C)
Camera Temperature	Temperature at the camera sensor (°C)
CPU Temperature	Internal processor temperature (°C) — normal operating range 40–65°C
Humidity	Relative humidity percentage — dew risk above ~80%

Dew Heater

Mode	Auto — heater managed automatically based on dew point; Manual — fixed power level
Heater Level	Current power output as a percentage (0–100%)
Aggression	How aggressively the auto mode responds to dew risk (1–10, default 5)

■ *In Auto mode, the dew heater activates automatically when the optics temperature approaches the dew point. Manual mode is useful in very humid conditions.*

5.6 Network & LED Ring

Network

Telescope IP	Current IP address of the telescope on your network
Internet	Whether the telescope has internet access (required for firmware updates)

Force Direct Connect	When enabled, telescope always creates its own hotspot instead of joining an existing network

LED Ring

The LED ring brightness can be adjusted using the slider (0.0 = off, 1.0 = full brightness). Click **Save Network Settings** to apply both the Force Direct Connect toggle and LED brightness.

6 — App Settings

6.1 YouTube OAuth Setup

This section stores the Google Cloud OAuth credentials used for YouTube sign-in. See Chapter 3.1 for the full setup guide.

Client ID	The OAuth 2.0 client ID from Google Cloud Console (ends in .apps.googleusercontent.com)
Client Secret	The corresponding client secret (starts with GOCSPX-)
Save Credentials	Stores credentials to disk — only needs to be done once

■ *Credentials are stored locally in your Windows user data folder and are never sent anywhere except to Google's OAuth servers during sign-in.*

6.2 Observer Location

Your location is used to calculate Tonight's Best Targets and Viewing Conditions. It is set **automatically** — the telescope broadcasts its GPS coordinates every second via the live Mount GetStatus notification on the SmartScope WebSocket. The app reads this within 1–2 seconds of the live view connecting, with no action needed from you.

Latitude	Your latitude in decimal degrees (e.g. 42.5787 for Massachusetts). North is positive.
Longitude	Your longitude in decimal degrees (e.g. -70.7695). West is negative.
City	Optional city name shown in the targets panel header
Save Location	Saves coordinates to disk — persists between sessions
Auto-Detect	Populated automatically from telescope GPS within seconds of connecting

■ Location is saved to disk after the first successful GPS read. On subsequent app starts it loads instantly from disk before the telescope even connects.

6.3 Connection Settings

Default IP	Pre-fills the manual IP field on app start. Set this to your telescope's usual IP address.
Timeout (ms)	How long to wait for telescope responses before giving up (default 5000ms = 5 seconds)
Auto-reconnect	When checked, the app will automatically try to reconnect if the telescope connection drops

6.4 FFmpeg

FFmpeg is the video encoding engine used for streaming and recording. It is installed automatically during app installation. This section shows the detected FFmpeg version.

FFmpeg status	Shows installed version and ready/not-found status
Default Recording Quality	Sets the default quality for new recordings (480p / 720p / 1080p)
Open FFmpeg Download Page	Opens the official FFmpeg website if manual installation is needed

■ *If FFmpeg shows as not found, re-run Install.bat to repair the installation.*

7 — Troubleshooting

7.1 No Live View (blank or frozen canvas)

- Confirm the app shows "Connected" in the sidebar with the telescope's IP
- Click **Scan Ports** to open the diagnostics panel and check for error messages
- The log should show "WebSocket connected" followed by "NewImageReady" messages
- If you see "WebSocket error": check that no other app (e.g. Celestron mobile app) is connected simultaneously — the telescope may only allow one WebSocket client
- Try disconnecting and reconnecting using the Discover button

■ *The telescope sends approximately 1 frame per second. A brief delay of 2–3 seconds before the first frame is normal.*

7.2 Stream Not Appearing on YouTube

- Ensure FFmpeg shows as ready (green checkmark in the stream form)
- Check the FFmpeg Output log for error messages after clicking Go Live
- Verify your stream key is correct — use the Fetch Key button to auto-retrieve it
- YouTube requires both video AND audio — the app always sends a silent audio track if no music is selected
- YouTube broadcasts can take 30–60 seconds to appear as "Live" after FFmpeg starts sending data
- Check YouTube Studio to confirm the broadcast was created and is in "Live" state

7.3 D-Pad Controls Not Working

- The Slew command requires the telescope to be initialized first
- Open the Celestron Origin mobile app and tap **Initialize** at least once
- After initialization, return to this app — controls should respond immediately
- The correct Slew command format (confirmed from packet analysis) uses AltRate/AzmRate values of ±1 to ±9
- Check the connection — if the telescope has disconnected, re-connect and try again

7.4 Firmware Version Shows "Unknown"

- This resolves automatically within 1–2 seconds after the live view connects
- The firmware is fetched via the same WebSocket as the live view frames
- If it still shows Unknown after 10 seconds, try disconnecting and reconnecting
- The firmware version in the Telescope tab (under System) is fetched separately and more reliably

7.5 Tonight's Best Targets Not Showing

• Location is read automatically from the telescope's live Mount GetStatus broadcast — it should populate within 1–2 seconds of the live view connecting

• If still showing "Waiting for GPS…" after 10 seconds, try disconnecting and reconnecting

• As a fallback, go to **Settings** → **Observer Location** and enter your latitude/longitude manually

• If it is daytime, objects may all be below the 20° horizon threshold — check back after dark

7.6 Viewing Conditions Not Loading

• Viewing Conditions requires an internet connection to reach api.open-meteo.com

• If connected to the telescope's own Wi-Fi hotspot, that network may not have internet access — check your network settings or enter coordinates manually and connect PC to a router with internet

• The panel shows "Fetching weather…" while loading — if it stays there, check internet connectivity

• Use the ■ Refresh button to retry after resolving connectivity

7.7 Radio Station Not Playing / No Audio in Stream

• Ensure you selected a station (it should be highlighted in the grid) before clicking Go Live

• Check the FFmpeg Output log — it should show two input streams being opened

• If the log shows a connection error for the radio URL, check your internet connection

• SomaFM streams require an active internet connection — the telescope Wi-Fi must also have internet access, or your PC must be on a separate internet connection

• Try a different station — if one is temporarily down, another will work

• Volume at 0% will mute the audio — check the Volume slider is above 0

Quick Reference

Slew Rate Scale

1×	Sidereal rate — extremely slow fine adjustment
3×	~3× sidereal — slow centering
6×	~6× sidereal — medium speed (default)
9×	Maximum rate — fast large-sky movement

Confirmed Telescope API Commands

All commands use the SmartScope WebSocket endpoint: **ws://[IP]/SmartScope-1.0/mountControlEndpoint**

Slew	Mount directional movement (AltRate, AzmRate: -9 to 9)
GotoRaDec	GoTo equatorial coordinates (Ra in hours, Dec in degrees)
GotoObject	GoTo named object (ObjectName string)
StartTracking / StopTracking	Enable/disable sidereal tracking
GetVersion	Fetch firmware version number
GetMountConfig	Mount configuration and battery status
GetCameraInfo	Full camera sensor specifications
GetCaptureParameters	Current exposure, ISO, white balance
GetFocuserAdvancedSettings	Auto-focus configuration
GetStatus (Environment)	Temperature, humidity, dew point
HasUpdateAvailable	Check for firmware updates
RunInitialize	Initialize mount with date/time/GPS

RTMP Endpoints

YouTube	rtmp://a.rtmp.youtube.com/live2/[STREAM_KEY]
Twitch	rtmp://live.twitch.tv/app/[STREAM_KEY]