

FLIGHT HEAD HORNET / MANUAL

Version 2026.V1



Welcome to the Hornet world!

THANK YOU for choosing the Flight Head Hornet stabilized remote head, engineered and developed by Ukrainian filmmakers with a long-standing tradition of excellence and many years of film engineering experience. This manual will guide you through setup, power and signal connections, and safe operation so you can get up and running quickly and confidently.

We look forward to seeing what you create with Hornet.

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1. SAFETY AND OPERATIONAL GUIDELINES

This section defines mandatory safety requirements, operational limitations, and responsibility boundaries for the Flight Head Hornet stabilized remote head. Failure to follow these instructions may result in serious injury, equipment damage, or loss of stabilization control.

1.1 SAFETY SIGNAL WORDS

This manual uses standardized signal words to identify hazards according to severity:

[WARNING] Indicates a hazardous situation which, if not avoided, could result in death, serious injury, or catastrophic equipment damage.

[CAUTION] Indicates a hazardous situation which, if not avoided, may result in minor or moderate injury or damage to the system.

[NOTICE] Indicates important operational practices or technical information not directly related to personal injury.

1.2 QUALIFIED PERSONNEL & OPERATOR RESPONSIBILITY

The Hornet stabilized remote head is a professional camera remote system intended exclusively for operation by trained, qualified, and authorized personnel.

[WARNING] QUALIFIED PERSONNEL ONLY

Operators must be familiar with:

- Stabilized remote head systems and high-speed electromechanical devices
- Professional camera mounting, balancing, and lens control systems
- Industry-standard camera remote systems safety procedures and exclusion-zone management
- Operation, adjustment, or servicing of the system by untrained or unauthorized personnel may result in serious injury, death, or equipment damage.

[WARNING] OPERATOR RESPONSIBILITY

The operator is solely responsible for maintaining a safe operating environment, enforcing exclusion zones, and ensuring that all personnel remain clear of the system's range of motion at all times.

1.3 ENVIRONMENTAL HAZARDS & CONDENSATION

[CAUTION] RISK OF ELECTRIC SHOCK OR FIRE

Condensation inside the system or on electrical connectors may cause short circuits, leading to equipment damage, fire, or electrical shock. Condensation typically forms when the system is moved from a cold environment into a warm or high-humidity environment.

CONDENSATION RULE

Do NOT power ON or operate the system or any connected accessories while condensation is present.

ACCLIMATION REQUIREMENT

When moving equipment from a cool to a warm environment, allow sufficient time for all components to fully acclimate to ambient temperature before applying power.

STORAGE GUIDELINE

Always store the system in a warm, dry location to minimize moisture accumulation.

OPERATING TEMPERATURE LIMITS

Monitor motor and electronics temperatures closely when operating in extreme environments:

Extreme heat: above 122°F (50°C)

Extreme cold: below -22°F (-30°C)

[CAUTION] Operating outside these limits may result in degraded performance or permanent damage.

1.4 ELECTRICAL & POWER SAFETY

[WARNING] ELECTRICAL PROTECTION

The battery must NEVER be connected directly to the Hornet remote head. Power must ALWAYS be supplied through a certified DC-DC converter. Direct battery connection will cause irreversible damage to electronic control boards.

[CAUTION] POWER CYCLING DELAY

After switching system power OFF, wait a minimum of 5 seconds before powering ON again. Failure to observe this delay may cause the system to boot into Safe Mode with restricted functionality.

1.5 EXCLUSION ZONE & MOVEMENT HAZARDS

[WARNING] EXCLUSION ZONE

When stabilization is enabled, all personnel must remain clear of the head's full range of motion. The system is capable of rapid and forceful movement exceeding 200°/sec without warning.

Unexpected movement may occur during:

- System initialization
- Mode changes
- Recovery from disturbances
- Software or signal interruptions

[WARNING] AXIS LOCK STATUS

Before engaging motors, perform a visual inspection of all axis latches (PAN, TILT, ROLL). Ensure all locks (sliding latches) are in the GREEN (UNLOCKED) position. Never apply motor torque while any latch is in the RED (LOCKED) position.

1.6 CONNECTIVITY, SIGNAL INTEGRITY & CABLE MANAGEMENT

Verify that the inter-frame cable connecting the Roll and Tilt modules is securely connected and fully

locked. This cable transmits high-speed data. Any interruption or intermittent contact may result in severe instability or violent system behavior.

[CAUTION] Ensure that all SDI, power, and FIZ cables include sufficient service loops. Cables must not become taut, twisted, pinched, or snagged during rotation of any axis.

1.7 TRANSPORTATION, LIFTING

[WARNING]

- Always secure the system during transport.
- Never lift or carry the Hornet by cables, motors, or moving axes.
- Use only designated mounting points and approved lifting methods.

1.8 MODIFICATIONS

[WARNING] Modification of hardware, electronics, firmware, or cabling not expressly approved by the manufacturer is strictly prohibited. Unauthorized modifications may result in unpredictable behavior, loss of stabilization, or catastrophic failure.

2. ENGINEERING NOTES AND SYSTEM LIMITATIONS

2.1 ANGULAR VS. LINEAR STABILIZATION

Flight Head Hornet is a sophisticated stabilized system but possess inherent limitations based on physics. It can only correct rotational angular movements - Pan, Tilt, Roll. It cannot compensate for linear and parallel movements (the physical up-and-down or side-to-side displacement caused by road bumps, water surface impacts, or engine vibration). When operating in challenging environments, such as high-speed, off-road tracking or marine-based filming to absorb vertical and parallel movements - it is crucial to use the Hornet in combination with a mechanical passive stabilization system (Camera Shock Absorber). A mechanical shock absorber (or wire-rope mount) acts as a high-performance "low-pass filter", absorbing high-frequency shocks and linear impacts before they reach the head.

Stabilization systems are limited by motor power and bandwidth (frequency response). Extremely fast movements required to correct the camera position may exceed the system's capabilities. This limitation is particularly evident when using longer lenses, as the inertia and mechanical advantage increase the demand on the motors. Mounting a suitable iso-damper between the Flight Head Hornet and its attachment point is essential because it:

- Absorbs fast unwanted high frequency movements.
- Slows the movements passed to the head, placing corrections within the system's acceptable frequency range.
- Decouples the head from the resonance and bending of the mounting point (e.g., crane arm flex).

2.2 MANAGING LINEAR OSCILLATIONS & PARALLAX EFFECT

Operators must account for the fact that the subject itself (e.g., a tracking vehicle on a road) is also subject to linear movements. Bumps, road surface changes, and vehicle suspension cause the subject to move linearly relative to the camera, creating an effect of "frame instability" or parallax.

When filming dynamic scenes, such as a vehicle swaying on its suspension, even perfect stabilized remote head performance cannot eliminate the unwanted visual "floating" or parallax effect if the camera is positioned too close to the subject.

Recommendations:

Expand the physical gap between the tracking camera car and the hero car to reduce the visible impact of linear movements. Use a zoom lens to compensate for the increased distance. This compresses the perspective and floating of the vehicle body nearly invisible in the frame. For optimal performance, select a balanced combination of vehicle-to-camera distance and an appropriately chosen zoom focal length that aligns with the stabilized system's performance capabilities.

2.3 GIMBAL LOCK AWARENESS

Gimbal lock occurs when two of the three axes align in the same plane, causing a loss of one degree of freedom and resulting in unpredictable movement or vibration. Operators should be aware of the

head's orientation, especially during extreme TILT angles, to avoid reaching mechanical or software limits that trigger this state.

2.4 SYSTEM RIGIDITY. THE FOUNDATION OF STABILITY

Any flexing, play, displacement or bending in the camera package setup will severely compromise stabilization performance. The entire setup, including the camera, camera cage, lens, camera on-board battery mount, and the remote head mounting point, must be as stiff as possible. Any physical flexing or bending can cause vibration or oscillation of the head, which stabilization motors cannot efficiently correct. Every attempt must be made to improve the rigidity of the camera and head mount to reduce or eliminate any flexing. The performance of the stabilized head is fundamentally limited by the weakest mechanical link in the entire setup — from the camera plate to the remote head mounting point. The way the head is mounted has a direct and significant impact on its performance. The system works best when the mounting is as stable and rigid as possible. Any mechanical play in the mounting system can introduce unwanted movement or vibration, particularly when the head reverses loads.

Sources of play also include:

- Loose leveling linkages on a camera crane.
- Play between components of a shock absorber.
- Any loose parts of the head mount.

[NOTICE] High-frequency oscillations are often a result of insufficient rigidity rather than incorrect PID settings.

2.5 DRIFT

DRIFT is a fundamental characteristic of all gyro-stabilized remote heads. It is defined as an unwanted, slow, cumulative movement of the system, resulting in the head slowly losing its fixed orientation over time. Drift occurs because the system's internal sensors gyroscopes cannot perfectly measure absolute movement or position relative to external space. The unwanted drift is mitigated by activating a specialized drift canceling function on the remote head.

2.6 ADJUSTING PID PARAMETERS

When perfect mechanical conditions (balance and rigidity) are not possible, the load may become unstable (wobbling or swinging) when stabilization is active. In such situations, it is necessary to adjust the PID (Proportional–Integral–Derivative) parameters.

The correct adjustment of electronic PID values is crucial for the proper functioning and stable performance of the system. Failure to properly tune the PID values to compensate for residual imbalance, play, or external vibration will necessitate a reduction in the motor power for a single axis. Reducing motor power for a single axis severely limits the effectiveness of the overall stabilization. The system's ability to correct aggressive movements and counter external forces will be diminished. Therefore, maximizing mechanical perfection must always be the first step.

The stabilized remote head system is a closed-loop feedback stabilization system that aims to maintain the camera's angular velocity at zero, effectively keeping the camera stationary relative to space. In real-

world stabilizers, however, there are mechanical elements —such as frame structures, shafts, mounts, and bearings — with inherent properties like stiffness, elasticity, and backlash. These elements lie between the motor (the primary source of force) and the gyroscope (the primary sensing device). This means that when the control system commands a camera rotation — whether due to external disturbances or joystick input—the motor’s energy first goes into deforming the frame, shafts, housing, and bearings. Only after these deformations reach a certain level does energy start being applied to the camera itself, the stabilized object. This process takes a measurable amount of time. After the camera reaches the commanded angle, the gyroscope reports that the target has been achieved, and the control system commands the motor to stop. However, the energy stored in the elastic deformation of the frame continues to act on the camera, often pushing it beyond the desired position. This back-and-forth process can repeat, leading to resonance phenomena and oscillations in the closed-loop system.

PID controller parameters are carefully tuned to account for these mechanical properties—frame stiffness, mount flexibility, and the mass and moment of inertia of the camera. In other words, the controller is designed to apply motor energy in a way that both prevents excessive frame deformation and compensates for external disturbances.

Because cameras vary widely in inertia and their mounts and frames differ in stiffness, it is nearly impossible to precisely measure the system’s amplitude-frequency characteristics in advance. For this reason, the system provides the user with the ability to adjust control parameters on-site to optimize stabilization for the specific camera setup.

2.7 MANDATORY BALANCE REQUIREMENT

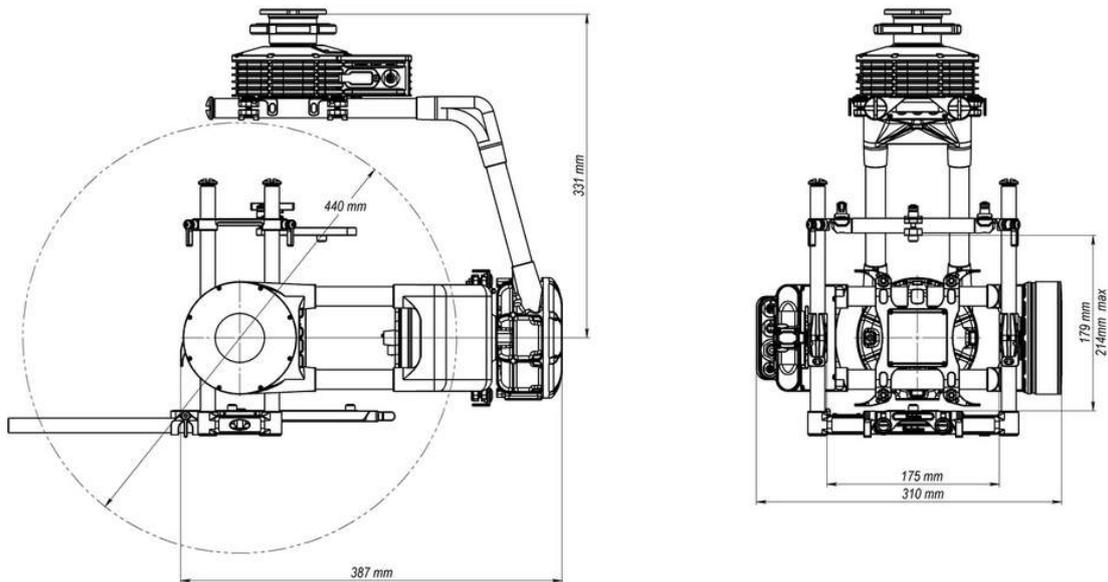
The system must be properly balanced before engaging motor torque. Operating the Hornet in an unbalanced condition will cause excessive motor heat, increased power consumption, and high-frequency oscillations.

3. TECHNICAL OVERVIEW

3.1 PRODUCT DESCRIPTION & SPECIFICATIONS

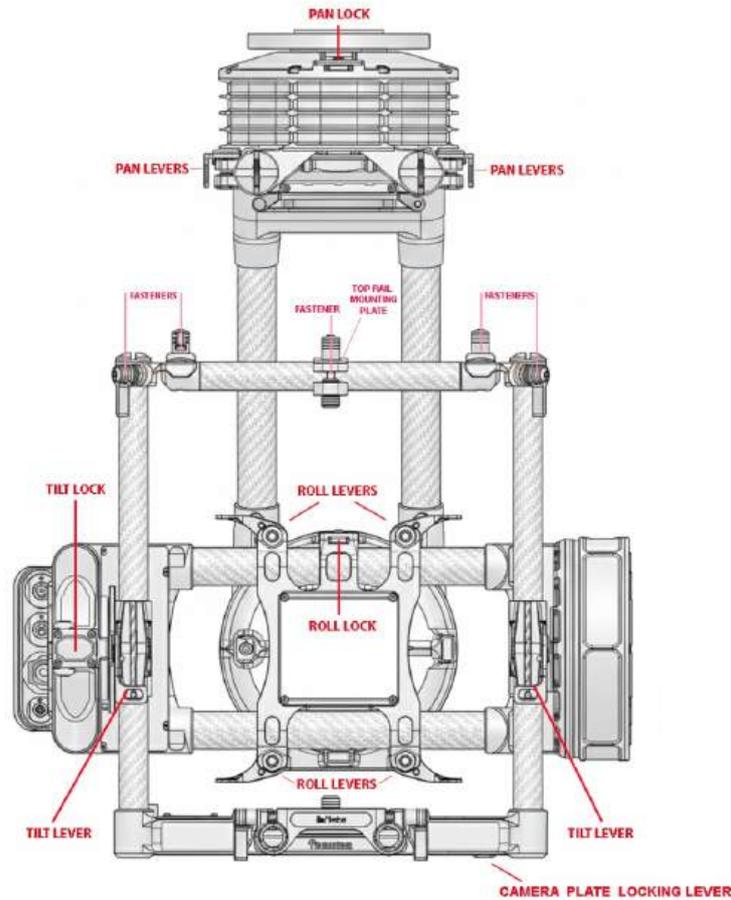
The Flight Head Hornet is a digital 3-axis gyro-stabilized remote camera head designed for dynamic, high-speed camera movements. Constructed primarily with high-strength carbon fiber components, the Hornet ensures maximum rigidity and minimal weight for its payload class.

SPECIFICATIONS



Height	652 mm / 25.67 in
Width	387 mm / 15.23 in
Depth	440 mm / 17.32 in
Weight	5.5 kg / 12.13 lbs
Length	387 mm / 15.24 in
Internal Width	175mm / 6.89 in
Maximum Payload	up to 12 kg / 26 lb
Maximum Tilt Range	+70° / -250°
Maximum Roll Range	+80° / - 260°
Maximum Pan Range	360° continuous (4 – 5 turns)
Maximum Pan Rate	200° / sec
Working Temperature	-20°C / +40°C (- 4°F / 104°F)
Power requirements:	
Head	28-32V DC standby, 1.5A dynamic, Max 15A
Joystick console (wireless)	19 - 72 VDC

DC/DC power unit:	18 - 60 VDC
Video Connectivity	HD-SDI 750hms
Note: Technical data is subject to change without notice.	



The Flight Head Hornet package includes:

1. Mount
 - 1.1 Mitchell Mount Adapter
 - 1.2 F Mount Adapter
 - 1.3 Mitchell Mount Wrench
 - 1.4 F Mount Wrench
2. Accessories:
 - 2.1 Wire-rope Isolation Damper (ISD-10)
 - 2.2 Balance Weight Set
 - 2.3 Camera Balance Plate
 - 2.4 Camera Rigging Set
 - 2.5 Lens Support (LS-20)

3. Power Supply:

3.1 DC/DC Power Supply Unit (PS-11)

4. Control equipment:

4.1 Joystick Control Console

4.2 Hand Wheels Set (x2)

4.3 Control Wheel T-Plate

4.4 Wireless Unit Set

4.5 Bracket for Wireless Unit

5. Cables:

5.1 PS-04 Power Cable (CEE7/7 - IEC-C13) - 1pc.

5.2 Console Power Cable (XLR3 m - XLR3 f) -1pc.

5.3 Power Cable (XT-90M - XT90F / 25m) - 1pc.

5.4 Power Cable (XT-90M - XT90F / 15m) - 1pc.

5.5 Power Cable (XT-90M - XT90F / 10m) - 1pc.

5.6 Data Cable (10m) - 1pc.

5.7 Data Cable (15m) - 1pc.

5.8 Data Cable (25m) - 1pc.

5.9 Interframe Cable Tilt (Gyro) - 1pc.

5.10 Power Cable for ARRI - 1pc.

5.11 FIZ Control Cable - 1pc.

5.12 CMotion Control Cable - 1pc.

5.13 Canon Lens Control Cable - 1pc.

5.14 Fujinon Lens Control Cable - 1pc.

5.15 Control Wheel Data Cable - 2pc.

6. Spare parts:

6.1 Main Board - 1pc.

6.2 Amplifier Board - 1pc.

6.4 Joystick Console Board - 1pc.

6.5 Hand Wheel Printed Board - 1pc.

6.6 Camera Power Plug Connector - 2 pc.

7. Case:

7.1 Transportation case (3)

DESCRIPTION

Flight Head Hornet Provides precise, remotely controlled movement and stabilization across all three rotational axes - Pan, Tilt, Roll. The Flight Head Hornet and its associated accessories are intended exclusively for professional use. The design includes significantly enhanced motor torque on all axis, allowing the head to effectively compensate for powerful centrifugal forces experienced during high-speed vehicle work, aerial maneuvers, or severe accelerations.

Intended Use: The Flight Head Hornet is intended as a professional camera remote system designed to achieve stable footage in challenging and dynamic environments. The head can be mounted to various camera crane systems, including U-cranes, camera cars, camera masts, jibs, dollies, or custom rigs.

Ideal Environments: Its high-torque and unlimited rotation capabilities make it ideally suited for:

- Action and Stunt Choreography
- High-Speed Vehicle and Motorsports Filming
- Sports Broadcast
- Live Event and Concert Performances

4. ISO-DAMPER



The Hornet Iso-Damper is a high-performance vibration isolation system designed to attenuate high-frequency shocks and vibrations and reduces transmission of structural resonance into the head. It serves as the mechanical dampening interface between the mounting platform (camera crane, car rig, or dolly) and the camera remote head. It utilizes stainless steel wire-rope blocks woven into coiled patterns to provide superior multi-axis vibration isolation and absorb shock. The isolator is modular; the wire-rope blocks can be removed or added to tune the damping stiffness precisely to the total load.

The ISO-damper does NOT:

- replace proper balancing.
- compensate for mechanical play.
- correct gross structural deflection.

Correct tuning of the stabilization system assumes the ISO-damper is:

- correctly rated for payload weight.
- properly installed.
- free from binding or preload errors.

Mounting: The top of the isolator is equipped with a Mitchell Mount for standardized attachment to camera cranes, jibs, or vehicle platforms. The bottom of the isolator features an F Mount for direct connection to Filmotechnic's stabilized remote heads (Hornet remote head Flight Head Colibri, Flight Head Falcon).

4.1 ADJUSTMENT

Correct isolator tension attenuates high-frequency shocks without introducing low-frequency resonance. Over-compliant (too loose) setups may increase low-frequency sway. Wire-rope blocks must always be installed in symmetrical pairs to prevent mechanical lean and parasitic motor load. Adjust the number of wire blocks to match the total mass of the camera package. A 6-block configuration is the optimal baseline for the Flight Head Hornet when using professional camera packages at underslung mode.



6-block configuration Set Up

Adjustment Procedure:

To remove a wire block: Loosen the mounting crews (DIN912) on the top and bottom plates of the specific wire block and slide the block out.

To add a wire block: Position the new wire block into the mounting slot and secure it with the designated bolts, ensuring they are torqued to prevent vibration.

[NOTICE]: Remove blocks if wires do not compress; a rigid isolator is ineffective.

Blocks must be added/removed in symmetrical pairs. Asymmetry causes a mechanical lean, creating a parasitic load.

While iso-dampers are required to absorb parallel movements using one that is too soft or incorrectly sized for the combined mass of the head and load can render the entire system too elastic. This can introduce vibrations and cause the load to swing. Always use iso-dampers with the appropriate dimensions and hardness to ensure optimal vibration isolation without compromising stability. Choosing the correct iso-damper for the specific payload and application is as important as the stabilized head itself. Always makes sure that your vibration isolator's payload capacity is sufficient for the total weight of the Flight Head Hornet and your camera package.

4.2 TORSIONAL LIMITERS

Operational Purpose: These steel limiter pins lock the rotation of the isolator plates relative to each other. This prevents the head from twisting on the wires during rapid Pan movements or high-speed maneuvers. The limiter pins can be removed in specific operational contexts for more fluid motion.

[NOTICE]: Any looseness at the interface causes low-frequency resonance that destabilizes the electronic control loop.

5. CAMERA MOUNTING ORIENTATION

5.1 Head Suspension & Orientation

Before installing the camera, the Hornet remote head must be mounted or suspended in its intended operational configuration. Install the head in its final orientation (overslung / underslung) as it will be used during operation. Ensure the mounting interface, iso-damper, and support structure are fully secured and completely free of play.



Underslung



Overslung

[NOTICE] Do NOT attempt camera installation or balancing with the head resting unsecured on a surface. Proper suspension is mandatory to prevent uncontrolled axis movement during setup.

[NOTICE] The Overslung / Underslung mode activates automatically upon detecting the head orientation.

6. CAMERA INSTALLATION & PRECISION BALANCING

PREPARE THE SUPPORT STRUCTURE:

Begin by ensuring your support platform (camera crane, camera rig, etc.) is fitted with an industry-standard Female Mitchell Mount or fMount used on Filmotechnic's cranes.

ATTACH ADAPTER TO HORNET HEAD:

Standard Mount: For typical applications, attach the Male Mitchell Adapter to the Hornet head using the six M4x12 screws (DIN 912).

Conditional Mount: If you are using an Iso Damper or mounting the head to one of Filmotechnic cranes, attach the specialized Male F Mount to the Hornet.

Mounting on a support platform:

Insert the head adapter (Male Mitchell or male fMount) into the correspondent female mount on your camera crane or camera support, ensuring proper alignment of the keyway. Hand-tighten the adapter nut first securely and then firmly secure it with the hook wrench without over torquing to lock the head in position.



Mitchell Mount



fMount

6.1 AXIS LOCKS (SLIDING LATCHES) – PAN, TILT, ROLL

The Hornet remote head is equipped with mechanical locks (Sliding Latches) on the PAN, TILT, and ROLL axes to restrain axis movement during camera installation and balancing.



Axis Locked



Axis Unlocked

RED Indicator - Lock engaged (axis restrained)

GREEN Indicator - Lock disengaged (axis free)

Engage all locks before installing the camera. During balancing, unlock only one axis at a time. Re-engage each lock before proceeding to the next adjustment.

[WARNING] Motor torque must NEVER be applied while any lock is engaged. Applying motor power against a locked axis may cause severe mechanical damage or system failure.

6.2 CAMERA INSTALLATION & STRUCTURAL BRACING

Attach the camera plate to the camera base using two special screws, 3/8"-16 screw, Size S, to ensure maximum rigidity. Secure the camera package firmly to prevent any movement, flex, or shift.



6.3 CAMERA PACKAGE PREPARATION & STRUCTURAL COMPLIANCE

Before performing precision mechanical balancing, the entire camera package must be fully assembled, mechanically rigid, and structurally compliant.

Even minimal play, weakness, or flex anywhere in the camera package can induce parasitic oscillations, cause stabilization errors, and directly compromise tuning quality and overall stabilization performance.

FASTENER INTEGRITY:

Ensure that all fasteners on the camera cage, mounting plate, bridge plate, rods, lens motors, and accessories are securely tightened and properly torqued. Any component that shifts, wiggles, or flexes under hand pressure will degrade balance and stabilization performance.

LENS MOUNT INTEGRITY:

Verify the tightness and integrity of the lens mount connection (e.g. PL mount). Inspect for any axial or rotational play (lens displacement) between the lens and the camera body.

MATTE BOX / CLIP-ON CONFIGURATION:

If a matte box or clip-on is required, install it with all necessary filters before balancing. Any change to the matte box configuration after balancing will invalidate the balance.

For vehicle-mounted, high-speed tracking shots, the use of a matte box is not recommended. To minimize wind loading and the resulting camera vibration, use a clip-on matte box or a lens-mounted filter whenever possible.

ZOOM LENS PREPARATION:

Note on Zoom Lenses: When balancing a camera package with a zoom lens, set the lens to the mid-position of its internal zoom travel before finalizing mechanical balance. This minimizes loss of Tilt balance caused by internal lens group movement when controlling zoom remotely with a lens motor.

ZOOM & LONG FOCAL LENGTH LENS SUPPORT MANDATE:

The lens must be rigidly secured. It is mandatory to use a lens support to prevent axial and lateral lens displacement under dynamic load and vibration.

MECHANICAL ASSEMBLY CHECKLIST:

- Ensure all camera cage screws, lens mount, zoom lens mounts, and accessory mounts are fully tightened.
- Insert lens rods into the bridge plate and tighten them with fasteners.
- Mount lens motors onto the rods and engage them with the lens.
- If applicable, install a lens support between the lens and the support system.
- Verify there is no play or flex between the camera body, on-board battery, lens, rods.
- Connect, route, and secure all camera-side cables (power, video, lens motor cables) so they are tidy and cannot shift during movement.

[NOTICE] Cable movement or tension can alter balance and severely degrade stabilization performance.

6.4 PRECISION STATIC BALANCING PROCEDURE

Balancing must be performed mechanically, with system power OFF and motors disabled.

6.5 TILT AXIS BALANCE (DEPTH):

- Lock all axes.
- Make sure that the camera plate locking lever is released.



Camera Dovetail Plate locking lever

- Release the camera plate safety pin and slide the camera package forward or backward along the dovetail receiver until the camera remains stationary at 0° tilt.



Camera Dovetail plate



Camera plate

- If the travel limit is reached: Install round counterweights in the rear 3/8" threaded holes of the camera plate to compensate for disbalance.



Round counterweights attached to camera plate

- Once balanced, lock the camera plate using the camera plate locking lever.

CAMERA BRACING SETUP

- Loosen the **Top Crossbar** fasteners to allow vertical and horizontal adjustment.
- Adjust the rail locking plate on the **Top Crossbar** so it seats firmly against the top of the camera body or camera cage and aligns with **threaded holes**.
- Secure the top rail locking plate to the camera using the special 3/8"-16 screw (size S) or 1/4"-20 screw (size S).



- Re-check TILT balance at approximately $\pm 45^\circ$ and make fine adjustments on **TILT** as required.
- Once tilt balance is confirmed, fully tighten all **Top Crossbar** fasteners to achieve a rigid, zero-play connection.



6.6 ROLL AXIS BALANCE

- Ensure the PAN is locked.
- Unlock the ROLL lock and quick-release levers on both sides of the ROLL yoke.
- Shift the ROLL yoke left or right until it remains level.



- Securely tighten the ROLL locking levers.

6.7 TILT HEIGHT BALANCE (VERTICAL COG)

- Confirm that **TILT** and **ROLL** are already balanced.

- Tilt the camera straight down to -90° .



- Loosen the **TILT** yoke locking levers on both sides of the yoke.
- Adjust the payload height by sliding the **TILT** yoke within its holding brackets until the camera remains stationary.

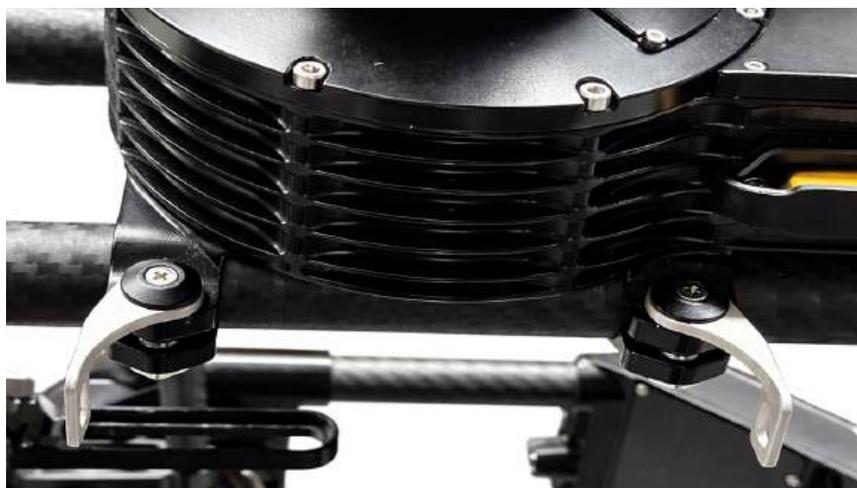
CoG too high: head returns downward

CoG too low: head returns upward

- Secure all locking levers evenly once neutral.

6.8 PAN AXIS BALANCE

- Unlock the **PAN** lock and loosen the **PAN** quick-release levers so the head can rotate freely.



- Tilt the entire head mount for about 10° and observe whether the head begins to rotate on its own.

Tilted crane autohorizon mount:



Tilted rotary mount:



If unintended PAN rotation occurs:

- Adjust the PAN balance by sliding the **PAN** frame in its mounting clamp in the direction opposite the rotation until the head remains stationary at any **PAN** position.



- Once balanced, tighten the **PAN** quick-release levers and return the head to its normal working orientation.

6.9 CABLE FREEDOM & FINAL MECHANICAL CHECK

Before applying power:

- Manually move all axes through their full range.
- Confirm no loosen parts and the camera package is stiff
- Confirm no cable pulls, snags, or applies force.
- Verify the PAN-axis cable bundle is secured by the anti-sag retention clip.
- Confirm the ROLL-to-TILT inter-frame cable is connected.

PRE-POWER-UP CHECKLIST:

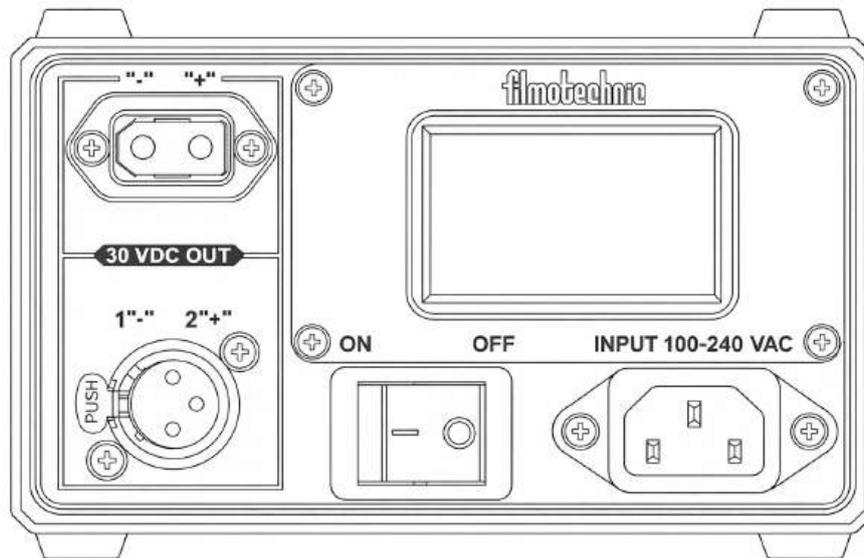
Before applying motor torque, verify the following:

- The camera package is fully secured, structurally rigid, and precisely balanced on all axes (Pan, Tilt, Roll).
- All mechanical axis locks (Sliding Latches) are disengaged and indicate GREEN.
- All cables (power, video, data, lens control) are correctly routed, strain-relieved, and secured.
- The camera power source and remote head power source are connected and within specification.
- The joystick control console is powered ON and communication with the remote head is established.
- The area surrounding the remote head is clear of personnel, tools, and obstacles.

[CAUTION] Do not proceed until all conditions above are confirmed.

7. POWER, CONTROL SYSTEM SETUP & CONNECTIVITY

7.1 AC / DC POWER UNIT OVERVIEW



The AC/DC power unit allows the Hornet remote head to be powered from mains AC sources in studio or fixed installations. This device is a universal AC-to-DC power supply with a voltage monitoring display that provides a regulated 30 VDC output for powering camera remote head. The front panel shows both the AC input section and the DC output section. Each connector has polarity labels “+” and “-”.

AC INPUT SECTION (right side)

IEC AC mains inlet (100–240 VAC): IEC C14 connector accepting global mains power (100–240 VAC, 50/60 Hz). Supports operation from household AC, generator power, or studio power.

ON/OFF switch: Rocker switch that turns the internal AC/DC converter On and Off.

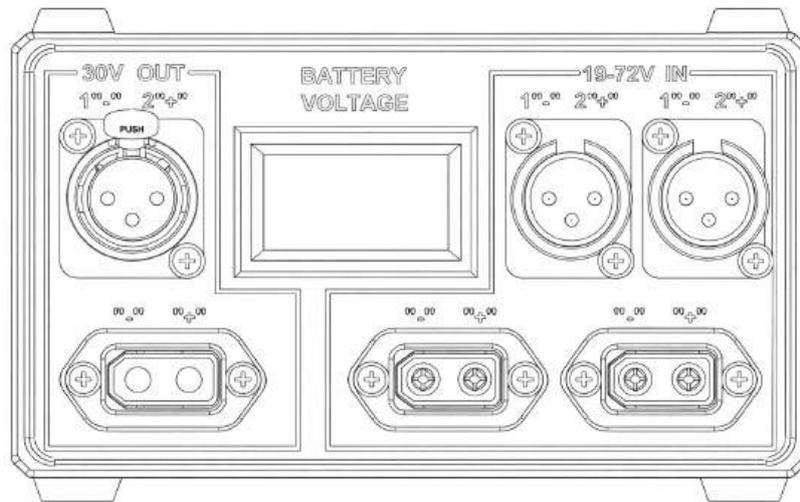
Status Backlit display indicates: Voltage, Current, Power, Energy consumption

DC OUTPUT SECTION (left side)

XT90 high-current output (top left): Provides **30 VDC OUT**. Recommended for high-current loads.

3-pin XLR DC output (bottom left): Provides **30 VDC OUT**.

7.2 DC / DC POWER UNIT OVERVIEW



The DC/DC power unit is a mandatory power conditioning device with a voltage monitoring display that supplies regulated power to the Hornet remote head when operating from battery based DC power sources. The DC/DC power unit protects system electronics from voltage instability and overcurrent conditions. Each connector has polarity labels “+” and “-”.

- **30V OUT** (top left): 3-pin XLR connector providing a 30V 16A direct current (DC) output.
- **XT90 high-current 30 V output** (bottom left): XT90 connector providing a 30 V DC output, intended for higher current loads.
- **Voltage display:** Displays the incoming power supply voltage (battery or PSU).

2 × 19 –72V IN (top right): Two 3-pin XLR input connectors that are physically connected in parallel. They are provided for convenient connection of additional user devices to a single battery, easier power distribution, and simplified cable routing and installation.

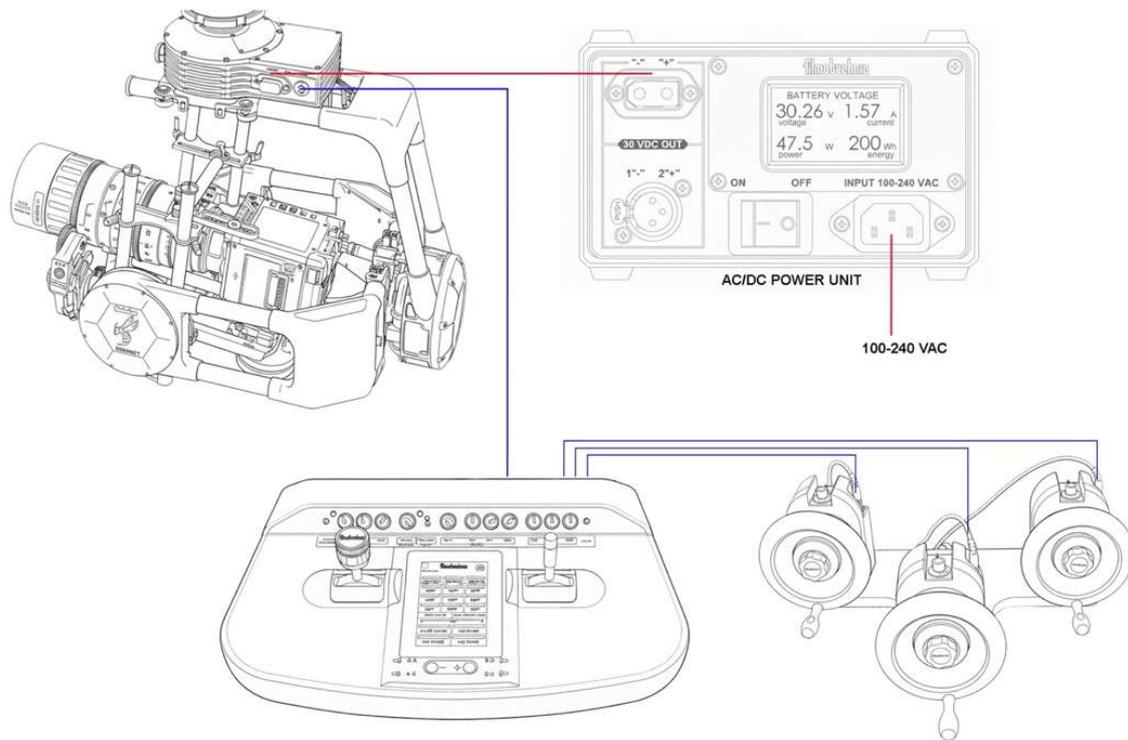
2 × 19–72V IN: Two XT90 input connectors that are physically connected in parallel. They are provided for convenient connection of additional user devices to a single battery, easier power distribution, and simplified cable routing and installation.

[WARNING] Do not use these connectors to connect batteries with different charge levels in parallel. Doing so may result in damage to the connectors, cables, and batteries, and may also cause a fire due to excessive charge/discharge currents between the batteries.

[WARNING] Never connect a battery directly to the remote camera head. To prevent equipment damage, always use a DC/DC power unit.

7.3 OVERALL SYSTEM CONNECTION DIAGRAM

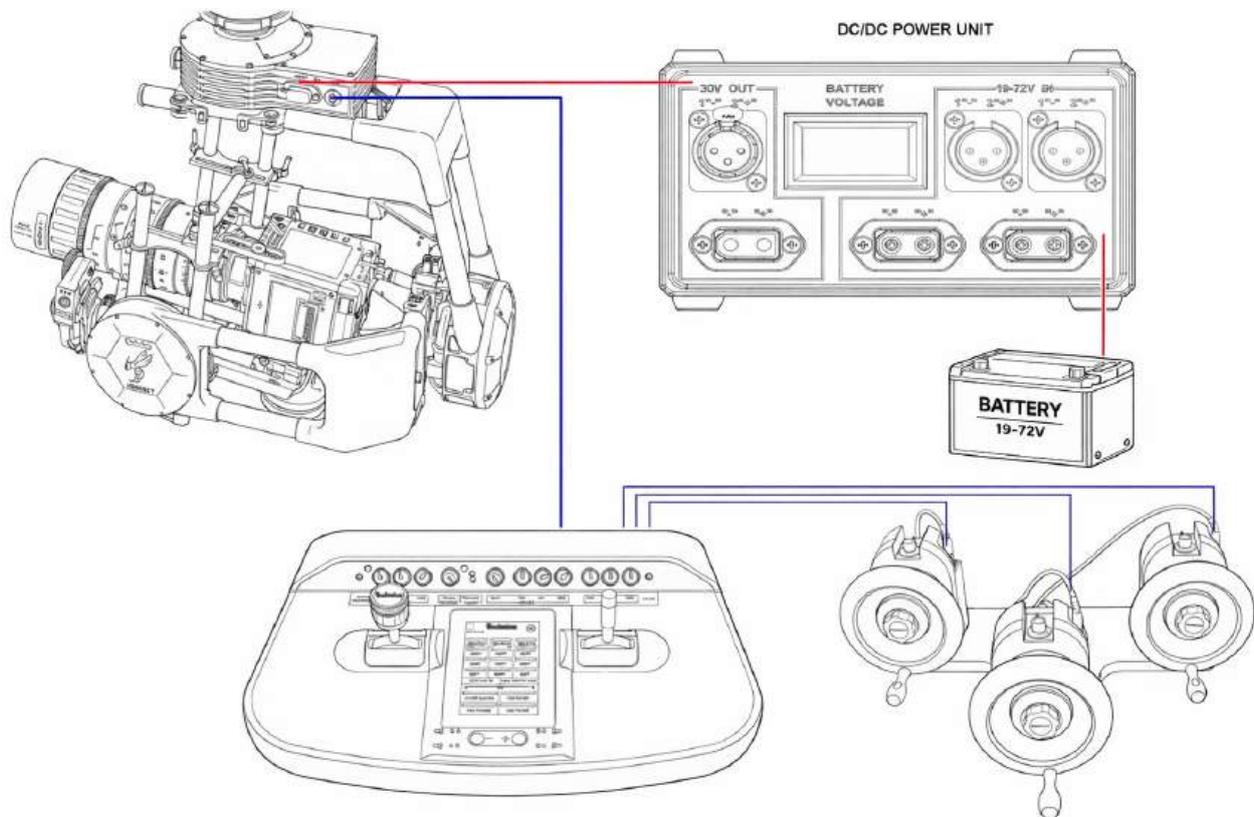
7.3.1 AC/DC POWER UNIT



HARDWIRED CONTROL:

- Connect the data cable from the **HEAD** connector on the joystick console to the **DATA** connector on the remote head.
- Handwheels: Connect the handwheels to the corresponding **PAN**, **TILT**, and **ROLL** connectors on the rear panel of the joystick console.
- Power supply: Connect the output of the AC/DC power unit to the **PWR IN** connector on the remote head.
- After the remote head and joystick console are powered on, engage the motors switch on the joystick console to begin operation.

7.3.2 DC/DC POWER UNIT. SYSTEM OVERVIEW DIAGRAM DESCRIPTION

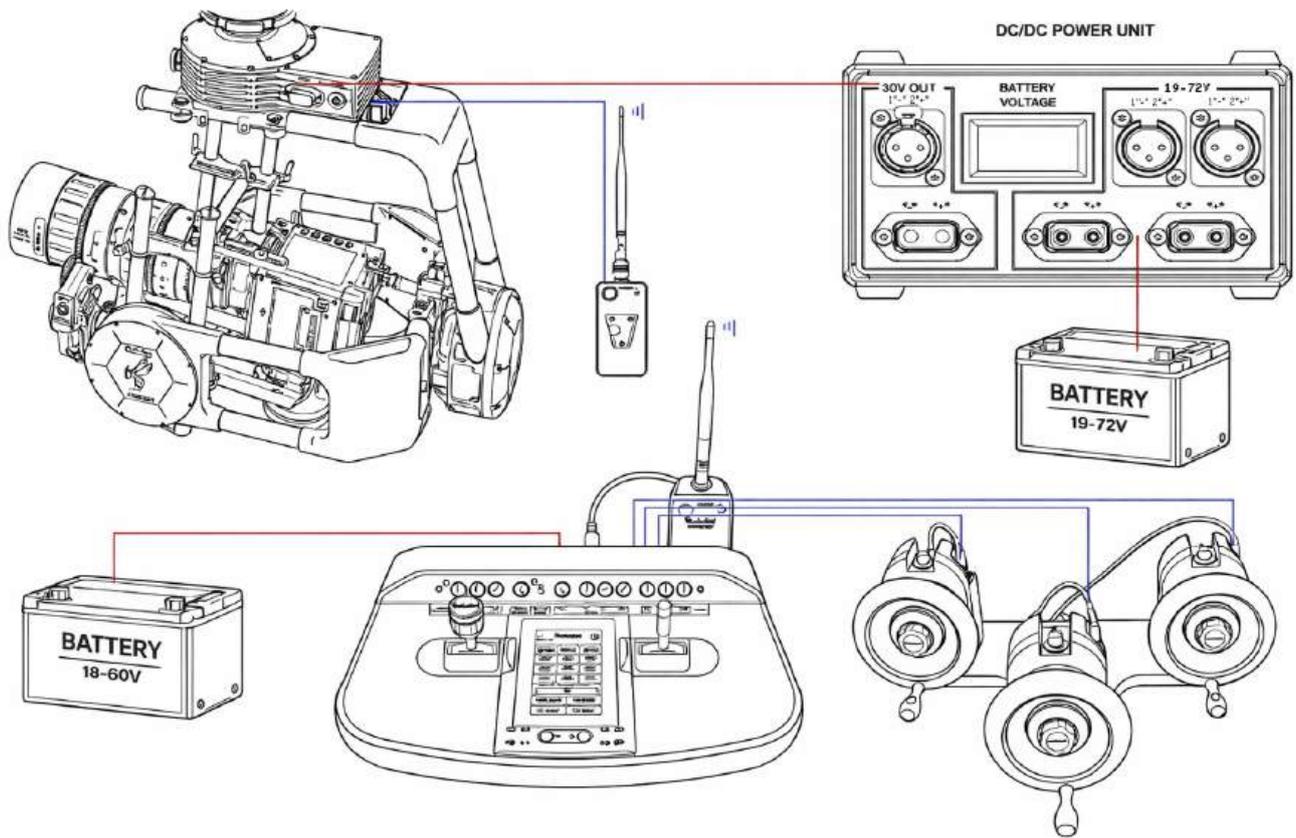


HARDWIRED CONTROL:

- Connect the data cable to the **DATA** connector on the remote head. Route the cable through the clearance hole in the **PAN** axis and connect it to the **HEAD** connector on the rear panel of the joystick console.
- Connect the power cable to the power output connector of the DC/DC power unit. Route the cable through the clearance hole in the **PAN** axis and connect it to the **PWR IN** connector on the remote head.
- Power supply: Connect a battery to the power input of the DC/DC power unit using the power cable. Voltage range: **19-72 V**.
- Handwheels: Connect the handwheels to the corresponding **PAN**, **TILT**, and **ROLL** connectors on the rear panel of the joystick console.
- After the remote head and joystick console are powered on, engage the motors switch on the joystick console to begin operation.

[WARNING] Never connect a battery directly to the remote camera head. To prevent equipment damage, always use a DC/DC converter.

7.3.3 WIRELESS MODE DIAGRAM DESCRIPTION



WIRELESS CONTROL:

- Mount the Console wireless unit (transmitter) onto the V-lock on the rear panel of the joystick console. Connect it to the **HEAD** connector using the dedicated cable.
- Attach the Flight Head wireless unit (receiver) onto the V-lock on the **PAN** axis of the remote head. Connect it to the **DATA** connector on the remote head using the dedicated cable.
- Connect the power cable to the power output connector of the DC/DC power unit. Route the cable through the clearance hole in the **PAN** axis and connect it to the **PWR IN** connector on the remote head.

Power supply:

- Connect the battery to the power input of the DC/DC power unit. Voltage range: **19-72 V**.
- Connect the second battery to the **PWR** connector on the joystick console using the dedicated power cable. Voltage range: **18-60 V**.
- Using the selection knobs, set both wireless units to **CHANNEL 8** (recommended operating channel) and allow them to establish a connection. The corresponding number will illuminate on the wireless unit's LED panels.
- After the remote head and joystick console are powered on, engage the motors switch on the joystick console to begin operation.

[NOTE] This wireless control configuration provides stable operation within a range of 30 to 50 meters. If an extended wireless control range is required, it is highly recommended to elevate the wireless modem or antennas using C-stands or a mast. This helps to reduce or avoid interference and signal reflections, improving overall link stability and reliability. Additionally, the use of high-gain antennas or directional antennas can significantly improve wireless control performance and signal quality.

[WARNING] **Never connect a battery directly to the remote camera head. To prevent equipment damage, always use a DC/DC converter.**

[CAUTION] Never power on the wireless units without antennas installed, as this may damage the RF output stage.

RADIO CHANNEL TECHNICAL SPECIFICATIONS

Channel	Frequency (MHz)	Power
1	868.075	25 mW
2	868.175	25 mW
3	868.275	25 mW
4	868.375	25 mW
5	868.475	25 mW
6	869.850	5 mW
7	869.475	250 / 500 mW
8	869.525	250 / 500 mW
9	869.575	250 / 500 mW

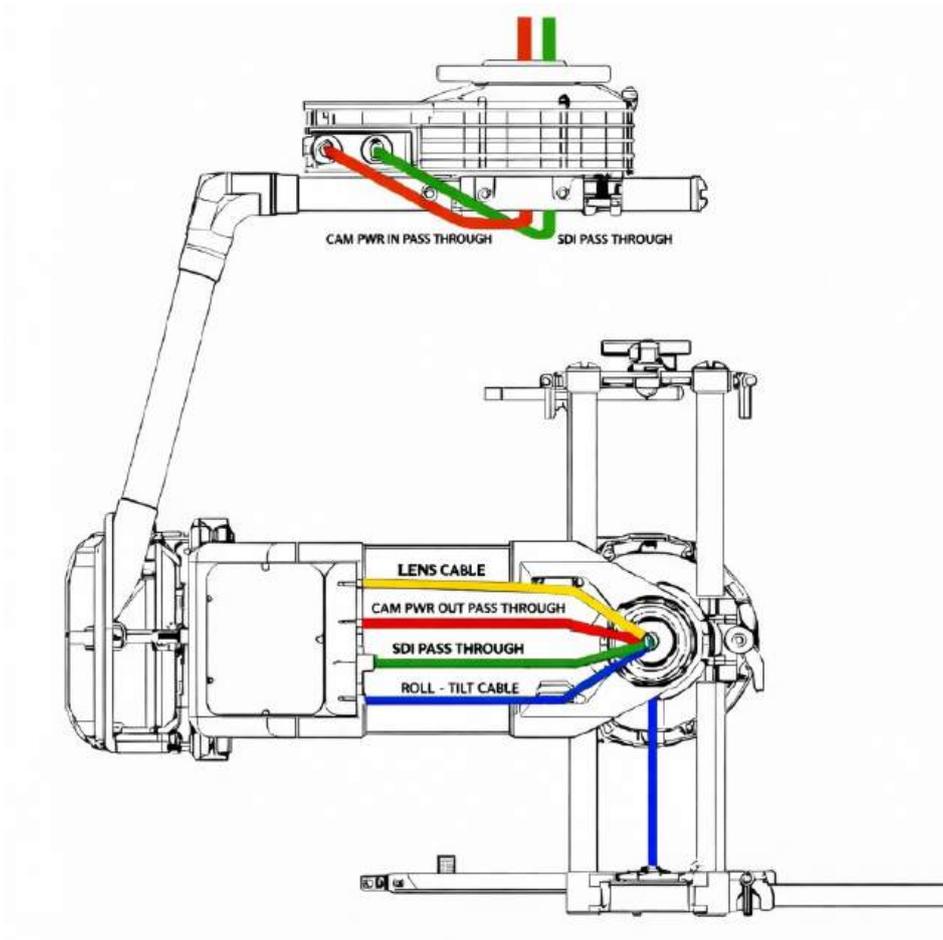
Specifications for 868mhz Radio Modules

Modulation: GFSK

Channel Spacing: 50 kHz

Polarization: linear, depends on the antenna

7.3.4 CABLE ROUTING DIAGRAM



7.3.5 CAMERA POWER PASS THROUGH LINE

The Hornet includes an internal camera power pass-through within the remote head. This allows the camera to be powered from an external power source, reducing external cabling, minimizing the risk of cable snagging during operation, and eliminating the extra weight caused by an on-board camera battery.

- Connect the dedicated camera power cable to the **CAM PWR OUT** connector on the **ROLL** frame. Route the cable through the designated **ROLL** and **TILT** clearance holes, then connect it to the camera power input connector.
- Route the designated camera power cable through the **PAN** clearance hole and connect it to the **CAM PWR IN** connector on the **PAN** axis. Then connect the other end to the camera external battery (or another approved camera power supply).

[NOTICE] The camera pass-through line is a passive pass-through and does not regulate voltage. Always verify camera power compatibility before connection. Ensure the external cables remain free of tension and does not snag throughout the full range of motion.

7.3.6 SDI PASS THROUGH LINE

The Hornet includes an internal video pass-through line that routes the SDI signal. This allows the video signal to be transmitted internally through the remote head, reducing external cabling and minimizing the risk of cable snagging during operation.

- Connect the dedicated video cable to the camera's video output and the **SDI IN** connector on the **ROLL** frame. Route the cable through the **ROLL** and **TILT** clearance holes.
- Connect the monitor or wireless video transmitter to the **SDI OUT** connector on the **PAN** axis using the designated output cable. Route the cable through the **PAN** axis clearance hole and secure it to prevent strain or snagging.

[NOTICE] Only SDI-rated BNC cables of appropriate impedance shall be used. The internal transit path minimizes external cabling across moving axes, reduces the risk of cable snagging or fatigue during operation, and ensures uninterrupted transmission throughout the full range of Pan, Tilt, and Roll movement.

7.3.7 LENS CONTROL SETUP / FIZ

The **FIZ** connector on the **ROLL** provides lens control for focus and zoom when using an ENG broadcast digital drive lens or a dedicated Filmotechnic zoom lens motor.

Connection and routing procedure:

- Connect the lens control cable to the **FIZ** connector on the **ROLL** axis.
- Route the cable through the designated **ROLL** and **TILT** clearance holes.
- Continue routing the cable to the lens and connect it to the lens drive interface.

Supported lens configurations:

- **Canon lens:** Connect the lens using the dedicated Canon lens cable with a 20-pin Hirose connector.
- **Fujinon lens:** Use the dual-connector adapter (2 × 12-pin Hirose). Connect it to the 20-pin Hirose end of the Canon lens cable to form the Fujinon interface.

[NOTICE] Ensure the cable remains free of tension and does not snag throughout the full range of motion.

7.3.8 INTER-FRAME SIGNAL CONNECTION (ROLL – TILT)

The Inter-Frame signal cable is a dedicated external frame-to-frame connection between the **ROLL** and the **TILT**. It is required for stable operation and to maintain gyro data integrity.



Connection Procedure

- Connect the Inter-Frame cable to the dedicated port on the **ROLL**.
- Route the cable externally along the **ROLL** frame and through the **ROLL** and **TILT** clearance holes to the **TILT** connection point.
- Verify that both connectors are fully seated and locked, and ensure the cable remains free of tension throughout the full range of motion.

[WARNING] A poor or intermittent inter-frame (TILT / Gyro) connection may cause severe instability or loss of stabilization.

[CAUTION] Do NOT twist, pinch, or sharply bend the inter-frame cable. Improper handling or routing may damage the cable and result in unstable system behavior. Make all connections of the remote head only when it is fully powered off. Failure to comply with this rule may cause the device to fail. In this case, the manufacturer does not bear any warranty obligations.

8. SYSTEM POWER-UP SEQUENCE

- Apply power to the **DC/DC** or **AC/DC** power source supplying the remote head.

[NOTICE] Power up the remote head only under static conditions (no movement, vibration, or physical contact).

- Power **ON** the control console.
- Allow 5 sec the Hornet system to complete its full boot and initialization sequence.
- Verify stable communication between the control console and the remote head.

[NOTICE] Do NOT enable motor torque during system boot or initialization.

Power up the remote head only under static conditions (no movement, vibration, or physical contact).

9. INITIAL MOTOR SWITCH AND MOTOR TORQUE ACTIVATION

The Hornet remote head is equipped with an on-board **Motor ON/OFF switch** that enables or disables **motor torque** directly at the head. Switching motors OFF disables torque for lens changes, camera adjustments, and mechanical rebalancing. Switching motors OFF does **not** remove system power; the head remains electrically powered while motor torque is disabled.



[WARNING] INITIALIZATION CLEARANCE

Confirm the system has fully completed boot and initialization and that communication with the control console is stable before enabling motor torque. Establish and maintain an exclusion zone and verify the surrounding area is clear of personnel and obstacles. The head may move forcefully and without warning during activation.

[WARNING] Enabling motor torque may result in sudden or unexpected movement if the system is improperly balanced, obstructed, or misconfigured. Failure to follow this procedure may cause equipment damage or personal injury.

Before enabling motor torque, confirm that:

- The system has fully initialized and communication with the control console is stable.
- All mechanical axis locks are disengaged.
- The camera package is properly balanced and structurally secure.
- Cable routing is secure and cannot snag through the full range of motion.
- The surrounding area is clear of personnel and obstacles.

Motor Torque Activation Procedure

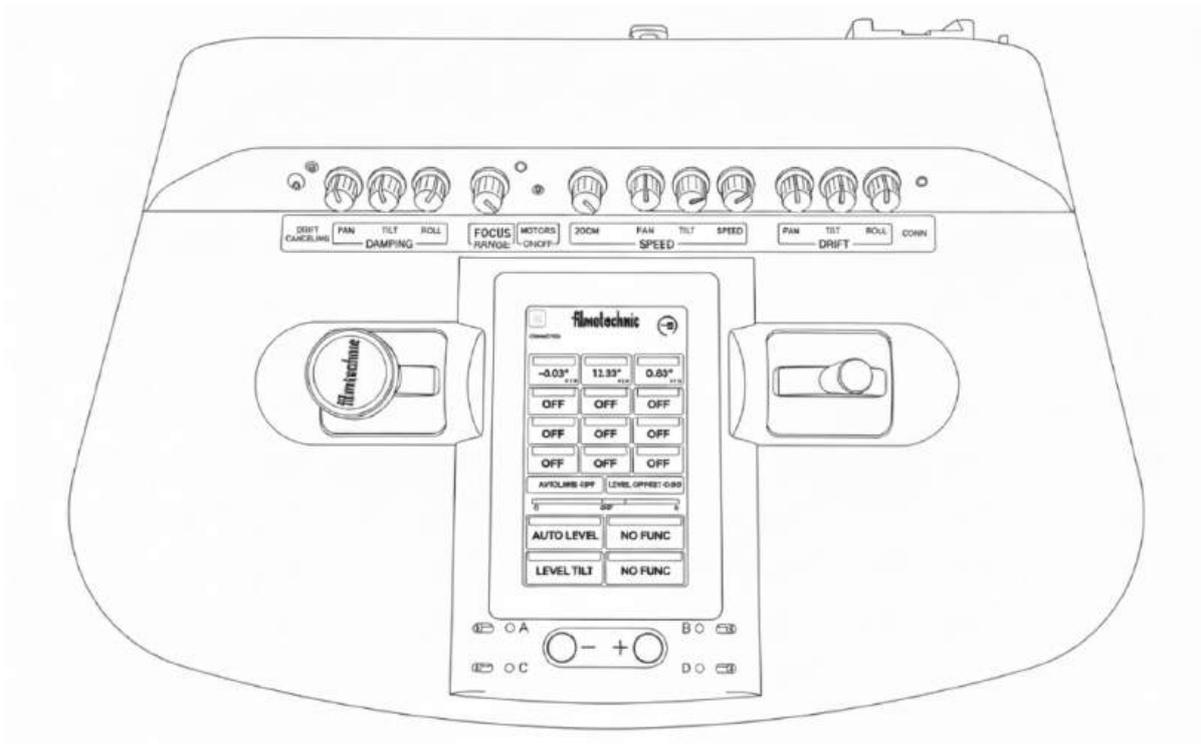
- Manually support the camera package by placing one hand firmly on the camera package
- Maintain full awareness of the remote head's entire range of motion.
- Enable motor torque using the on-board **Motor ON/OFF switch** on the remote head.
- Closely observe the head for smooth, stable behavior.
- Release manual support only after confirming stable, controlled stabilization.

Abnormal Behavior Response:

If any of the following are observed:

- sudden or aggressive movement
- oscillation or wobble
- unusual noise or vibration

Immediately disable motor torque using the on-board Motor ON/OFF switch. Do not continue operation until the cause has been identified and corrected. Verify balance, cable routing, mechanical rigidity, and system configuration before attempting reactivation.



JOYSTICK CONSOLE CONTROLS

The joystick console provides dedicated physical controls for operating and fine-tuning the remote head.

DRIFT CANCELLING SWITCH (3-Position Toggle)

A three-position toggle switch used to manage drift compensation.

DRIFT STATUS LED: Illuminates while the head is actively moving during drift compensation. When movement stops, the LED turns OFF.

- **Middle Position** (Neutral / Operational): Normal operating mode.
- **Down Position** (Momentary Hold): Temporarily pauses drift compensation. Press and hold until drift stops, then release to return to the middle position.
- **Up Position (Latch Mode):** Enables continuous drift compensation. Primarily used during calibration and PID tuning with the Flight Head Android App. Return the switch to the middle position after tuning or compensation is complete.

DAMPING POTENTIOMETERS (PAN / TILT / ROLL)

Dedicated knobs that adjust motion fluidity and stopping smoothness for PAN, TILT, and ROLL.

FOCUS RANGE POTENTIOMETER

Dedicated knob used to define or limit the working range of the focus motor (commonly used for broadcast applications).

MOTORS SWITCH AND STATUS LED

Switch used to enable or disable motor torque on the head. The status LED indicates motor state.

SPEED POTENTIOMETERS (PAN / TILT / ROLL)

Dedicated knobs used to control movement speed on each axis.

DRIFT POTENTIOMETERS (PAN / TILT / ROLL)

Three dedicated knobs that provide continuous manual trim to correct subtle drift on each axis. Use when automatic drift compensation is ineffective (for example, when operating on a moving platform such as a boat).

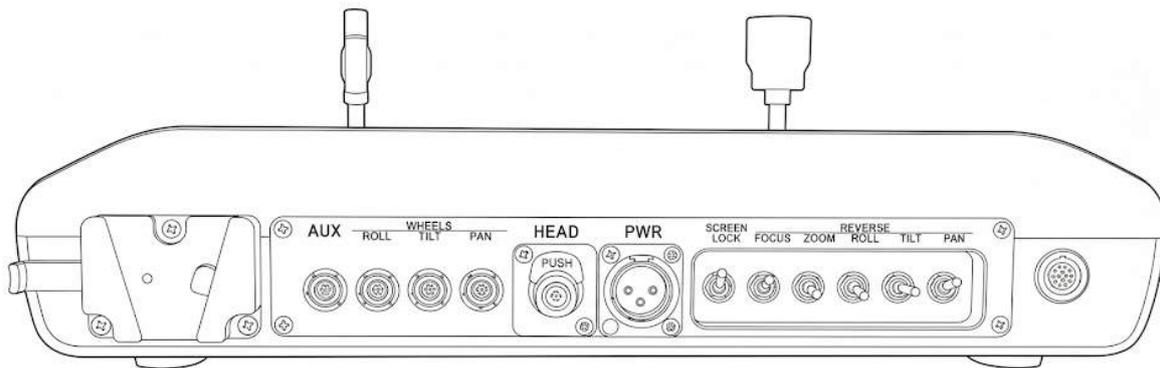
STATUS LED

Indicates system connection status and confirms parameter saving. The LED may briefly change color during save actions.

[NOTICE]: DATA SAVING PROCEDURE

When the head motors are switched **OFF** from the console, the system stores configuration changes (including presets) to non-volatile memory. During this process, the console communication LED may briefly fade (approximately one second). Do **NOT** disconnect main power during this save operation. Power loss while saving may result in loss of recent configuration changes.

10.1.3 REAR CONTROLS



V-LOCK: the mount for wireless unit (Transmitter).

AUX: Connection port for accessories (PAN bar).

WHEELS PAN/TILT/ROLL: Connection ports for hand wheels.

HEAD: Used for wired communication that also powers the console.

PWR (Power IN): Required for console power when used with a wireless communication.

SCREEN LOCK TOGGLE: Locks the screen. Activating this toggle automatically returns the display to the main screen and shows a "Screen Locked" message.

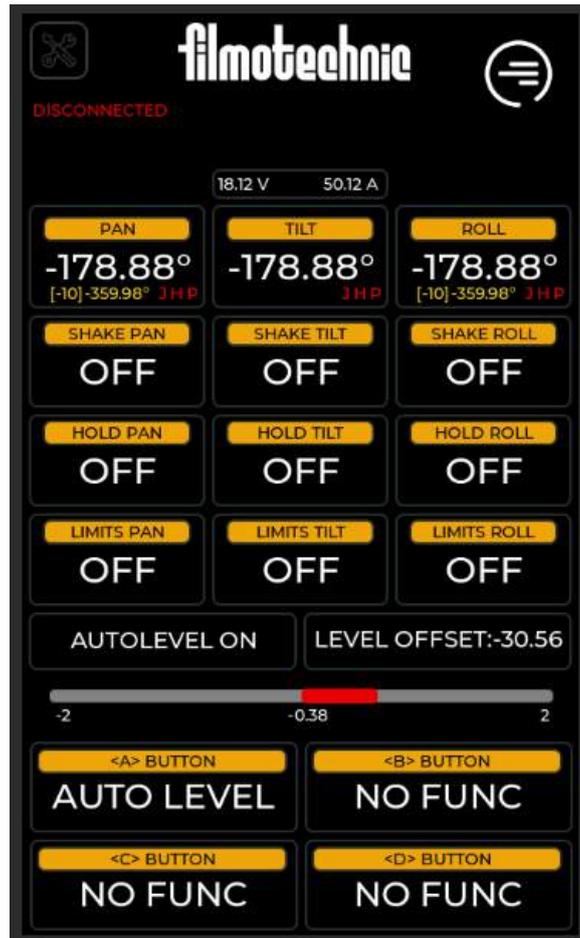
REVERSE TOGGLES: Switches for reversing motion direction on all axes and lens parameters Focus and Zoom.

LENS CONTROL OUTPUT (14-Pin Lemo receptacle connector): Output for controlling external zoom wireless systems (e.g., analoge Preston, cmotion).

11.0 MAIN CONTROL TOUCH SCREEN INTERFACE: STATUS & CORE FUNCTIONS

11.1.1 USER FUNCTIONS MENU

This screen represents the system's Touchscreen Interface and serves as the primary Status and Core Control menu for the 3-axis stabilized Flight Head Hornet. It provides the operator with real time monitoring, quick function access and navigation.



DESCRIPTION

WRENCH ICON (Top Left corner) / Service Menu:

Provides access to advanced system service settings, motor configurations, calibrations, and parameters typically adjusted by technical staff. If an error occurs, the WRENCH ICON flashes with a red outline. Pressing the icon opens the SERVICE page in the menu indicating an error.

HAMBURGER ICON (Top Right corner):

Provides access to general operational settings and monitoring.

SYSTEM STATUS & POWER:

Axis Control & Position: The headers PAN, TILT and ROLL define three vertical columns. All functions (SHAKE, LIMITS, HOLD) located directly beneath the corresponding header belong to that specific axis. These three modules provide the real-time angular position and operational status for each of the three axes.

QUICK TOGGLES: These buttons activate or deactivate key motor control features.

SHAKE PAN | SHAKE TILT | SHAKE ROLL (Shake Generator / Vibration Simulation): This function, when switched ON, intentionally introduces controlled, low-amplitude, high-frequency movement to the selected axis. This simulates a realistic "wobbly" or handheld camera look for artistic purposes. A short press on one of the boxes opens the SHAKER GENERATOR menu page, where the magnitude and frequency of the shake are configured. To exit this page and return to the main monitoring screen, select the Back Arrow Icon in the upper left corner.

- LIMITS PAN | LIMITS TILT | LIMITS ROLL: Displays the status of the LIMITS feature for each individual axis.
- HOLD PAN | HOLD TILT | HOLD ROLL: Displays the status of the HOLD feature for each individual axis.

LEVELING AND HORIZON FUNCTIONS: These controls manage the Roll axis to maintain a level horizon.

AUTOLEVEL ON: Shows the status of Roll Autolevel. Green indicates ON; White indicates inactive.

LEVEL OFFSET: Displays the current fixed angular offset applied to the Roll axis relative to the true horizon. Once the box is tapped and the box outline is highlighted, the horizon offset can be changed by pressing the - or + buttons located under the console screen.

LEVEL STATUS BAR: Displays the current level position of camera within ± 2 degrees. Displays the ROLL current position within $\pm 2^\circ$. The Red bar indicates the direction of inclination.

ASSIGN BUTTONS: This section defines the actions assigned to the A,B,C,D buttons on the primary joystick console. Activated by the corresponding toggle switches located under the control panel's screen. Press the button box once to select it first and then open the library of assigned or available functions.

- <A> BUTTON: The A button is currently mapped to toggle the Autolevel function. The letters are colored GREEN for the active state.
- BUTTON: (unassigned on the image).
- <C> BUTTON: (unassigned on the image).
- <D> BUTTON: (unassigned on the image).

BRIGHTNESS ADJUSTMENT: Use the - and + buttons under the screen to adjust the screen brightness. This function is only available while the main screen page is open.

11.1.2 MAIN SETTINGS CONFIGURATION



To return to the previous menu (User Functions Menu), use the Back Arrow Icon.

This screen page serves as the main configuration menu, accessible to the operator by selecting the Icon  on the main screen. It provides access to all critical setup modes and operational features of the remote head.

The menu begins with control modes:

AUTOHORIZON: Opens the sub menu dedicated to horizon leveling function of the Roll axis.

HOLD POSITION: Opens the sub menu dedicated to the position holding mode, locking the camera to its current orientation against external forces.

LIMITS: Opens the sub menu dedicated to settings and configuring the angular travel limits (soft limits) of all axes.

PID SETTINGS: Opens the menu for adjusting the motor control parameters (Proportional-Integral-Derivative). These are crucial, low-level settings that define the head's stabilization, responsiveness, stiffness, and damping.

JOYSTICKS: Provides access to input device settings, including customizing sensitivity curves, setting dead zones, and overall reactivity for the physical joysticks.

ASSIGNABLE BTN (Assignable Buttons): Allows the operator to map specific functions (e.g., Autohorizon, Hold Position, Shake Gen, etc.) to the physical auxiliary switches (A, B, C, D) found on the joystick console (under the screen).

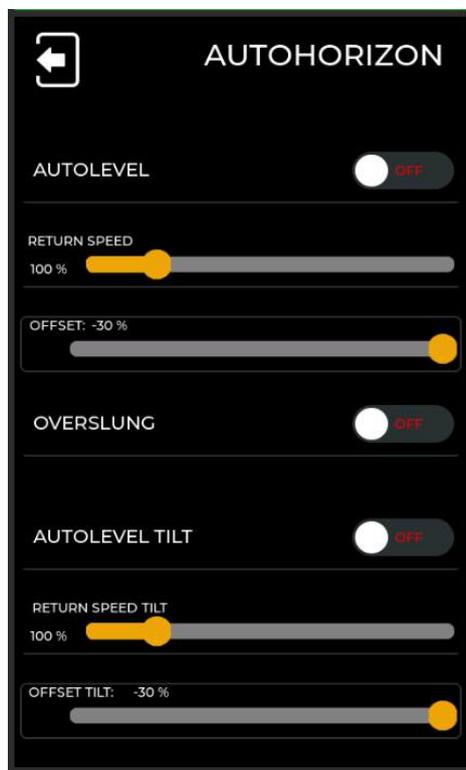
STICKS ORDER: Allows the user to reassign or swap the input mapping of the physical controllers (Joystick, Handwheel, Panbar) to different axes (e.g., swapping the control input for Pan and Tilt).

SHAKE GEN. (Shake Generator): Opens the sub-menu for configuring the vibration generator feature. This is where the user sets the frequency, amplitude, and randomness of the simulated movement to achieve a desired camera wobble effect.

RECORDER: Provides access to the built-in motion recorder and playback function, which allows the operator to record a complex movement path and play it back repeatedly for technical or effects shots.

PROFILES: Opens the menu for saving, loading, and managing custom configuration presets optimized for specific camera setups, payloads, lenses, or demanding operational scenarios.

11.1.3 AUTOHORIZON MENU: HORIZON AND LEVELING CONTROL



To return to the previous menu (User Functions Menu), use the Back Arrow Icon.

This screen page is used to configure the leveling features of the remote head. Settings are separated into sections controlling the ROLL and TILT level feature.

- **AUTOLEVEL:** This toggle switch enables or disables the automatic horizon leveling function for the ROLL axis.

If this function is assigned to one of the assign switches on the console, the toggle switch is deactivated. Prior to using these toggle, reactivate the switch by unassigning this function in the Assignable Buttons menu.

RETURN SPEED: A slider that adjusts the speed at which the Roll axis motor returns the camera to the level position after displacement. Measured in percentage. 100% is the fastest and most aggressive return.

OFFSET: A slider used to set a fixed angular bias (offset) to the level position. This sets a fixed angular deviation that the ROLL axis is instructed to maintain as the new horizontal baseline. Tap the cell to activate it, then move the slider using your finger or the - and + buttons under the console screen.

SET OFFSET (if available): Sets a horizon at the current position of the ROLL axis. The OFFSET bar will reflect the parameter value once the SET OFFSET command is executed.

OVERSLUNG mode (if available): A toggle switch that adjusts the stabilization algorithms based on the mounting orientation of the head. This must be toggled if the head is mounted Overslung (hanging upright) to ensure correct Roll stabilization direction. Ensure this toggle is set to OFF when the head is mounted Underslung (hanging inverted or downwards). In the absence of this function, the Overslung mode automatically activates upon detecting the overslung assembly.

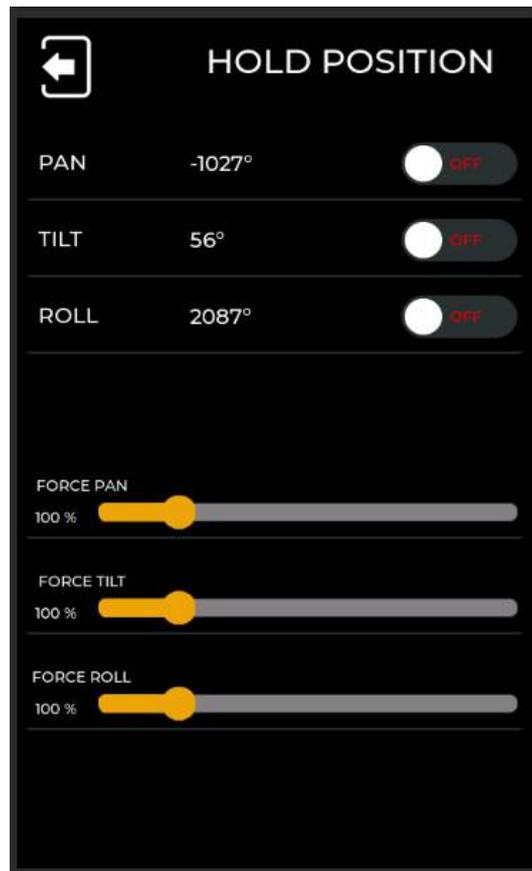
VERTICAL LEVELING: This section controls an advanced, optional feature to stabilize the camera's position along the Tilt axis:

AUTOLEVEL TILT (if available): A toggle switch to enable or disable the automatic leveling function specifically for the Tilt axis. When active, the system maintains a preset vertical angle relative to the ground plane.

RETURN SPEED TILT: A slider that adjusts the speed at which the Tilt axis returns to its preset vertical angle after external displacement.

OFFSET TILT: A slider used to set a fixed angular offset for the Tilt axis's level position. This allows the operator to set and maintain a specific, constant vertical shooting angle.

11.1.4 HOLD POSITION / BACK PAN MENU



To return to the previous menu (User Functions Menu), use the Back Arrow Icon.

This menu is used to individually activate the position hold feature for the PAN, TILT, and ROLL axes, and to set the motor force applied during this mode.

HOLD POSITION (BACK PAN) ACTIVATION AND STATUS: This section allows the operator to individually engage the position lock for each axis. The angular value displayed next to the axis name represents the current absolute encoders angle where the axis is locked, while the toggle switch controls the active status. Hold position locks the camera's orientation to counteract strong external forces, wind, and gyroscopic drift during vehicle or crane movement.

- PAN: Toggles the position hold feature for the PAN axis.
- TILT: Toggles the position hold feature for the TILT axis.
- ROLL : Toggles the position hold feature for the ROLL axis.

If this function is assigned to one of the assign switches on the console, the toggle switches are deactivated. Prior to using these toggles, reactivate the switch by unassigning this function in the Assignable Buttons menu.

Motor Force Adjustment: These sliders control the amount of motor power and torque the system dedicates to maintaining the locked position when the corresponding HOLD function is activated.

Determines the level of force with which the encoder position tracking is performed. Once the above toggles are OFF, the remote head stabilizes and holds a zero angular velocity, as the main feedback source is the gyroscope and the head holds the camera in space. Upon activating Hold Position toggle(s), the head partially tracks and locks onto the encoder angle. The intensity and speed of this tracking are controlled by the FORCE sliders for the relevant axis.

FORCE PAN: Adjusts the holding force for the PAN axis.

FORCE TILT: Adjusts the holding force for the TILT axis.

FORCE ROLL: Adjusts the holding force for the ROLL axis.

HOLDING FORCE

Holding Force defines how strongly the system keeps the camera at a fixed angle in Hold Position mode. In normal stabilization mode, the system relies mainly on the gyroscope to smoothly isolate the camera from external motion. When Hold Position is enabled, an additional encoder-based feedback loop is activated to maintain the camera's absolute position relative to the head mounting point (for example, a crane). The Holding Force parameter adjusts the balance between:

- smooth gyroscopic stabilization, and
- positional stiffness provided by the encoders.

How it works:

LOW HOLDING FORCE

The camera remains smooth and compliant.

External forces or operator input can gently move the camera, and the system will not aggressively return it to the original position.

HIGH HOLDING FORCE

The camera becomes stiff and firmly locked in place.

Any external disturbance is strongly resisted, and the system actively returns the camera to the held position.

BACK PAN behavior (special case of Hold Position)

BACK PAN is a specific use case of HOLD POSITION, where the system maintains the camera's orientation relative to the mounting point while allowing controlled movement via the joystick.

In this mode:

The user commands movement speed and acceleration with the joystick. The encoders continuously track the camera position, even if the motors are temporarily unable to follow the demanded motion.

If the commanded speed or acceleration exceeds what the motors can physically deliver (due to camera weight and torque limits), the camera may continue moving slightly after the joystick is released. This results in a correction movement, where the system gently brings the camera back to the held position once the motors regain control.

Important notes:

Encoder tracking remains active even when the motors are turned off. If the camera is manually rotated while motors are off, the system will restore the previous position when motors are turned back on. This behavior is intentional and allows lens changes without losing framing.

[CAUTION]: Be cautious when powering the motors on: HOLD POSITION (and BACK PAN) may already be active, causing the head to rotate to a previously stored position.

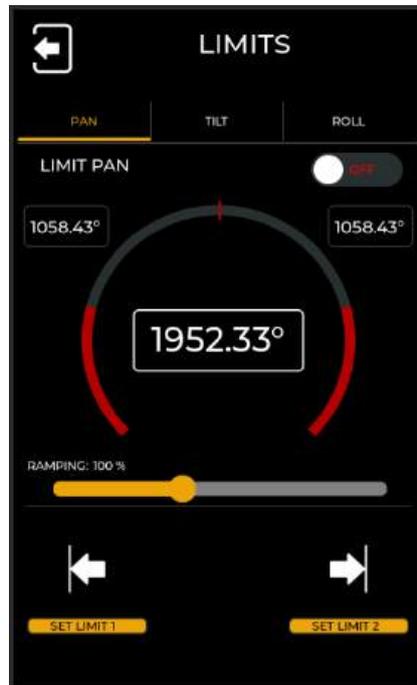
Practical use:

Use lower Holding Force for smoother motion and more forgiving operator interaction. Use higher HOLDING FORCE for precise framing, back pan effects, and strong position holding.

[CAUTION]: If, after activating the Hold function, the motors in the head are switched off (e.g., for a lens change, rebalancing, etc.), and the axes are physically displaced from their last position, the head may return at high speed to the last saved encoder position when the motors are reactivated. It is essential to observe all necessary safety measures when switching the head back on and to ensure that no one is near the head.

[NOTICE] When the HOLD POSITION function is enabled, the control system tracks the camera's position relative to the mounting point of the head (crane). This allows the implementation of the BACK PAN effect. The user controls the movement speed with joysticks. If the user sets a speed/angular acceleration higher than the motors can handle with the current camera weight (since motor power and torque are limited), the camera will continue to move slightly after the joystick is released. In other words – if the user demands more dynamic movements than the motors can physically deliver, we will see a correction effect in the frame. This happens because the motors are unable to accelerate or stop the camera as fast as the joystick input requires. The logic of the HOLD POSITION function is implemented in such a way that the head's encoders track the camera position even when the motors are turned off. A situation is possible where the user turns off the motors and manually rotates the camera several turns. When the motors are turned back on, the head will rotate the camera in the opposite direction to restore the previous position. This was designed to allow lens changes without losing the fixed position. The previous software version works the same way. Also, please be careful at the first motor power-on after the head is powered - the HOLD POSITION function may already be active. This can cause the head to rotate to a previously defined position.

11.1.5 LIMITS MENU: AXIS TRAVEL BOUNDARY CONFIGURATION



To return to the previous menu (User Functions Menu), use the Back Arrow Icon.

This screen page is dedicated to defining and managing the restricted angular travel range, often referred to as Limits for the remote head's axes. This feature prevents the camera, lens, or mounting cables from physically tangling, twisting, or colliding with the rig.

SETTING LIMITS. The interface has three primary display elements:

- Central box: Displays the current axis angle position in degrees.
- Limit Value Boxes: Two boxes display the limit settings: the First Limit (left box) and the Second Limit (right box).
- Graphic Arc Indicator: Displays the current head position.
- The left red field marks the first limit and corresponds to the left value cell.
- The right red field marks the second limit and corresponds to the right value cell.

The limits are controlled by two buttons: "Set Limit 1" and "Set Limit 2." Pressing either button sets the corresponding limit to the current axis position.

RAMPING PARAMETER: The Ramping parameter slider controls the axis braking behavior and can be adjusted manually.

- The Ramping value indicates the distance to the limit where the head begins braking.
- The higher the Ramping value, the earlier the axis starts braking when moving toward the limit.

This functionality ensures smooth braking before the current position reaches the limit, preventing jolts or overshoot. The required Ramping value mainly depends on the torque of the head motors and the inertia of the camera package.

1. PRIMARY METHOD FOR SETTING LIMITS / JOYSTICK METHOD

- Step 1: Ensure the limit toggle switch is OFF.
- Step 2: Set both limits to the current position using the Set Limit buttons.
- Step 3: Move the head using the joystick in either direction. During this movement (with the toggle OFF), the current axis position indicator will "push" the limit further out, effectively expanding the operational range of the axis.
- Step 4: After setting the desired Ramping value, activate the limit toggle. When controlling the joystick, the head will now stop before the limit, according to the Ramping value.

2. SECONDARY METHOD FOR SETTING LIMITS / MANUAL INPUT

- Step 1: To perform manual setup, tap the first or second limit angle value box (left or right of the graphic arc) to highlight its outline.
- Step 2: With the first or second limit box active, adjust the corresponding graphic arc with a finger or the manual input buttons below.
- Step 3: Repeat the process for the other limit.

The same procedure can be used for Tilt and Roll.

11.1.6 PID SETTINGS MENU: MOTOR CONTROL AND PERFORMANCE TUNING



To return to the previous menu (User Functions Menu), use the Back Arrow Icon.

The PID (Proportional-Integral-Derivative) settings menu is organized into four (sometimes five) tabs, depending on whether the system is three-axis or four-axis stabilized. For each axis, there are three adjustable parameters .

Adjusting Slider Values: You can modify parameter values on the sliders using two primary methods: manually or via precise control buttons.

- **Manual Adjustment:** Change the value by dragging the slider with a finger.
- **Precise Control Buttons:** Use the dedicated minus (-) and plus (+) buttons on the joystick console for fine-tuning.

The control buttons feature a progressive response. A single tap changes the slider reading by just one unit. If you press and hold the button, the value begins to change automatically, and the rate of change continuously increases as long as the button is held, allowing for rapid movement across large ranges.

11.1.7 PID TUNING DESCRIPTION

There is a wide variety of accepted methodologies for tuning the PID control loops of stabilized remote heads. The optimal coefficients are highly payload dependent - camera weight, lens, and accessories and application dependent - crane speed, vehicle vibration, wind exposure.

Consequently, every experienced technician or operator typically develops and refines their own tuning technique through practical experience and testing. The goal of tuning is to find the sweet spot between maximum stiffness and zero oscillation, ensuring optimal stability and tracking performance under load.

AXIS SELECTION AND PRESETS:

PAN | TILT | ROLL Tabs: Allows the technician to select which of the three main axes' motor parameters they are currently editing.

PAN II Tab (if available): refers to a secondary motor configuration for the secondary Pan axis.

PRESETS Tab: Provides access to save, load, or manage different PID configurations, allowing quick swapping of performance profiles for different camera packages, payloads, stiffness or environmental conditions (e.g., windy vs. smooth movement).

Control Sliders: These sliders adjust the key parameters that define the motor's behavior.

GAIN (Stiffness): This slider primarily controls the motor's aggressiveness and stiffness. A higher gain makes the head highly responsive, rigid, and resistant to external forces, but if set too high, it can lead to oscillation or vibration.

DIFF (Differential Gain): This slider controls the damping and stability of the motor response. It helps dampen overshoots and smooths the motion, preventing the motor from overshooting the target position. It is critical for a smooth stop.

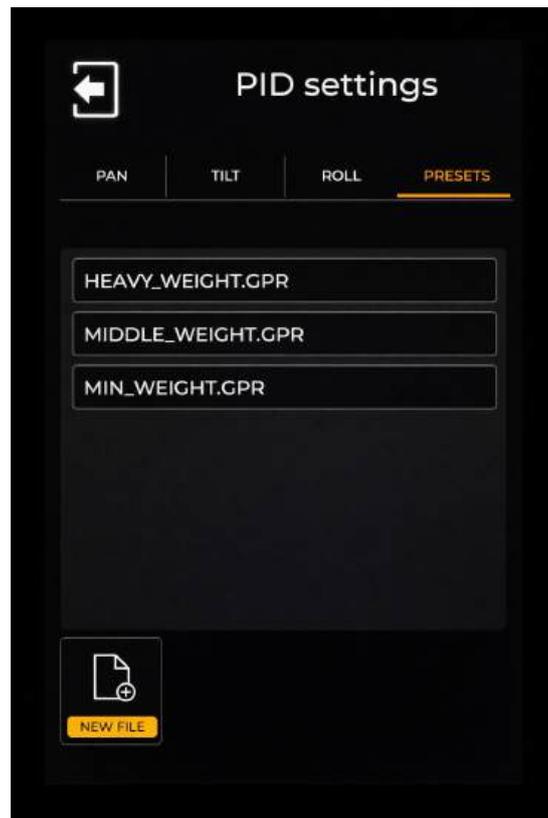
FREQ (Frequency): This slider controls the motor control loop's operating frequency or a low-pass filter frequency. It essentially determines how quickly the motor controller reacts to incoming data and helps filter out high-frequency noise and vibrations (shake).

[NOTICE] Tuning the PID parameters (GAIN, DIFF, FREQ) is critical for performance but requires specific camera package preparation for maximum stiffness.

For precise tuning, it is highly recommended to have the following:

- A live video monitor displaying the camera feed to visually inspect for oscillation, jitter, stop smoothness and stability.
- The primary control input devices (joystick or handwheel/panbar controller) to test the start/stop response and overall feel.

11.1.8 PRESET MANAGEMENT



The PRESETS tab displays a list of configuration files. The files are stored on the SD card located within the User Interface (UI) module of the controller unit, specifically within a dedicated folder. If the file list is longer than the screen capacity, scroll up and down to view all stored preset files.

FILE OPERATIONS: When you tap a preset file in the list, operation buttons appear. The name of the currently selected preset file is reflected in the top row. The available operations include:

REWRITE: This function saves the current active PID controller settings into the selected file, overwriting its previous contents.

ENTER: This function applies the settings stored in the selected file to the current active PID setup.

DELETE: This removes the selected file permanently.

NEW FILE: This creates a new file and automatically records the current active PID settings into it.

Creating a New Preset File: When NEW FILE is selected, a keyboard interface appears. This interface includes an entry field for the name, and two control buttons: CANCEL and ENTER.

- Pressing CANCEL returns you to the previous menu without creating a file.
- Pressing ENTER confirms the name, creates the new file with the current settings, and adds it to the list.

Note: All File Managers PID Controller Presets, Shake Generator Presets, User Profiles / Custom Settings. operate in the exact same manner:

11.1.9 PID TUNING PROCEDURE OVERVIEW

The objective of PID tuning is to achieve maximum mechanical stiffness, precise positional control, and clean motion stops while maintaining motor stability, low audible noise, and safe operating margins. PID tuning is a broad and scientifically grounded topic rooted in engineering disciplines and classical control theory. As a practical example and reference, the following simplified initial PID tuning method can be used. In practice, a full PID tuning procedure is rarely performed. Instead, technicians typically make minor adjustments to existing settings based on the known behavior of the head, or apply pre-configured preset files prepared in advance. It is also important to note that a properly tuned controller is valid for a range of camera setups, not just a single configuration. This range depends on the stiffness of the camera package, the quality of fixation between camera components, and how securely the camera is attached to the head frame.

BASELINE PREPARATION

Before tuning, ensure the system is mechanically sound. Confirm the camera and lens are correctly balanced on all axes. Verify all fasteners, mounts, and mechanical interfaces are secure. Power the system and allow motors and electronics to reach normal operating temperature.

PID CONTROLLER TUNING PROCEDURE

Tune each axis individually. Before starting the tuning process, ensure that the remote head is correctly and precisely balanced with the mounted camera. During tuning, apply gentle taps or short pushes to the axis by hand. This controlled manual disturbance helps to observe the dynamic response of the system and evaluate damping behavior. Primary tuning is performed in three stages.

GAIN. INITIAL SETUP

- Set the DIFFERENTIAL GAIN (DIFF) and FREQUENCY (FREQ) parameters to zero. Do not set the GAIN parameter to zero. Setting the GAIN to zero completely suppresses the feedback loop and may result in uncontrolled axis rotation.
- Gradually increase the main GAIN parameter until the axis begins to oscillate at a low frequency, approximately two oscillations per second.

DIFFERENTIAL GAIN

- Gradually increase the DIFFERENTIAL GAIN until the axis starts oscillating at a higher frequency, approximately ten oscillations per second.

If a single, well-damped dynamic response, a mechanically stiff (solid to the touch) axis, and a stable, high-quality image are achieved at this stage, the third tuning step may be omitted and the FREQUENCY parameter can remain set to zero. This situation commonly occurs with lightweight cameras that are rigidly mounted to the stabilized head.

FREQUENCY (Damping compensation)

- Increase the FREQUENCY until all oscillations are fully compensated and the axis shows the desired response to an external manual push. The axis should react with a single response to one push, without any residual oscillations, ringing, or vibrations.

This behavior can be visually confirmed using the camera image. This step establishes the balance between maximum perceived mechanical stiffness of the remote head frames and the absence of vibrations or decaying oscillations.

After completing these steps, verify controller stability by operating the head with a joystick or handwheels, simulating normal shooting conditions. If necessary, increase the GAIN if the stabilization performance is insufficient, or reduce the GAIN if the head produces audible noise, buzzing, or visible oscillation.

GOAL

Achieve clean, precise stops with no bounce or delay. Retain maximum stiffness while ensuring smooth, controlled motion. Avoid excessive DIFF, as over-damping can introduce latency and reduce responsiveness. Ensure stability at rest, proper behavior during fast moves, and clean motion stops.

FINAL SYSTEM VERIFICATION

Once tuning is complete for all axes, perform a comprehensive system check. Using the joystick or handwheel, rotate the head through its full range of motion on all axes and observe for oscillation, vibration, or instability at specific angles or velocities. While observing the monitor, introduce vibration or shaking into the head's carrier, such as a crane, vehicle, or rigging mount, and confirm that stabilization remains effective and free of induced oscillation. If necessary, zoom in on the lens to evaluate stabilization quality at high magnification, where subtle vibrations are more visible.

LOAD AND ENVIRONMENT CONSIDERATIONS & TROUBLESHOOTING

The following rules apply when changing the physical load on the head and during troubleshooting. If the level of stabilization or the quality of stops is unsatisfactory, repeat the PID tuning procedure. When switching to a heavier camera setup, it is essential to increase the GAIN and DIFF settings to compensate for the increased inertia. If the camera setup is significantly lighter, decrease the GAIN and DIFF to prevent the motors from becoming overly aggressive. In case of oscillation on the TILT axis, immediately re-verify the rigidity of the camera package and, if necessary, improve stiffness with additional camera bracing and re-balance the remote head to ensure perfect static balance, then repeat the PID tuning procedure. Once PID settings are complete, drift may be noticeable; initiate a drift cancelling procedure by activating the Drift Cancelling switch on the joystick console.

11.1.9 PID TUNING PROCEDURE OVERVIEW

The objective of PID tuning is to achieve maximum mechanical stiffness, precise positional control, and clean motion stops while maintaining motor stability, low audible noise, and safe operating margins.

BASELINE PREPARATION

Before tuning, ensure the system is mechanically sound:

Confirm the camera and lens are correctly balanced on all axes. Verify all fasteners, mounts, and mechanical interfaces are secure. Power the system and allow motors and electronics to reach normal operating temperature.

PID CONTROLLER TUNING PROCEDURE

Tune each axis individually. Before starting the tuning process, ensure that the remote head is correctly and precisely balanced with the mounted camera. During tuning, apply gentle taps or short pushes to the axis by hand. This controlled manual disturbance helps to observe the dynamic response of the system and evaluate damping behavior.

PID tuning is a broad and scientifically grounded topic rooted in engineering disciplines and classical control theory. As a practical example and reference, the following simplified initial PID tuning method can be used.

Primary tuning is performed in three stages:

GAIN. INITIAL SETUP

Set the DIFFERENTIAL GAIN (DIFF) and FREQUENCY (FREQ) parameters to zero. Gradually increase the main GAIN parameter until the axis begins to oscillate at a low frequency, approximately 2 oscillations per second.

Do not set the GAIN parameter to zero. Setting the GAIN to zero completely suppresses the feedback loop and may result in uncontrolled axis rotation.

DIFFERENTIAL GAIN

Gradually increase the DIFFERENTIAL GAIN until the axis starts oscillating at a higher frequency, approximately 10 oscillations per second.

If a single, well-damped dynamic response, a mechanically stiff (solid to the touch) axis, and a stable, high quality image are achieved at this stage, the third tuning step may be omitted and the FREQUENCY parameter can remain set to zero. This situation commonly occurs with lightweight cameras that are rigidly mounted to the stabilized head.

FREQUENCY (Damping compensation)

Increase the FREQUENCY until all oscillations are fully compensated and the axis shows the desired response to an external manual push. The axis should react with a single response to one push, without any residual oscillations, ringing, or vibrations. This behavior can be visually confirmed using the camera image.

This step establishes the balance between maximum perceived mechanical stiffness of the remote head frames, and absence of vibrations or decaying oscillations.

After completing these steps, verify controller stability by operating the head with a joystick or handwheels, simulating normal shooting conditions.

If necessary:

- Increase the GAIN if the stabilization performance is insufficient.
- Reduce the GAIN if the head produces audible noise, buzzing, or visible oscillation.

GOAL:

- Achieve clean, precise stops with no bounce or delay.
- Retain maximum stiffness while ensuring smooth, controlled motion.
- Avoid excessive DIFF, as over-damping can introduce latency and reduce responsiveness.
- Stability at rest
- Behavior during fast moves
- Cleanliness of motion stops

In practice, a full PID tuning procedure is rarely performed. Instead, technicians typically make minor adjustments to existing settings based on the known behavior of the head, or apply pre-configured preset files prepared in advance.

It is also important to note that a properly tuned controller is valid for a range of camera setups, not just a single configuration. This range depends on the stiffness of camera package, the quality of fixation between camera components, and how securely the camera is attached to the head frame.

FINAL SYSTEM VERIFICATION

Once tuning is complete for all axes, perform a comprehensive system check.

FULL-RANGE MOTION TEST

Using the joystick or handwheel, rotate the head through its full range of motion on all axes. Observe for oscillation, vibration, or instability at specific angles or velocities.

VIBRATION TEST

While observing the monitor, introduce vibration or shaking into the head's carrier (e.g., crane, vehicle, or rigging mount). Confirm the stabilization remains effective and free of induced oscillation.

ZOOM INSPECTION

If necessary, zoom in on the lens to evaluate stabilization quality at high magnification, where subtle vibrations are more visible.

LOAD AND ENVIRONMENT CONSIDERATIONS & TROUBLESHOOTING:

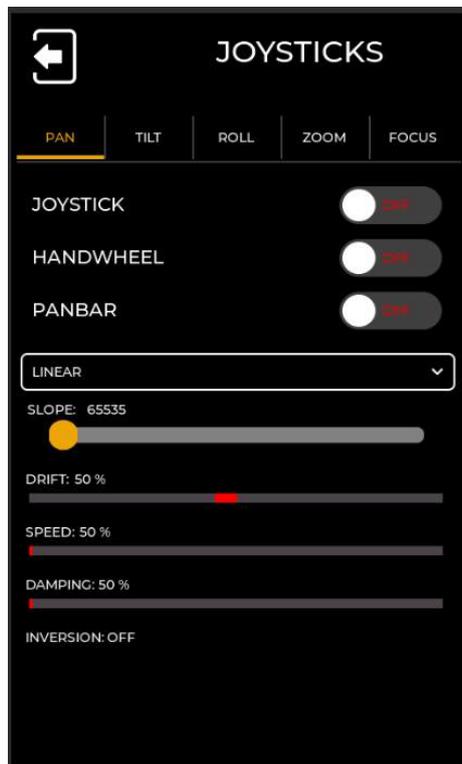
The following rules apply when changing the physical load on the head and during troubleshooting:

If the level of stabilization or the quality of stops is unsatisfactory, repeat the PID tuning procedure.

- Increasing Payload (Heavier Camera / Lens): When switching to a heavier camera setup, it is essential to increase the GAIN and DIFF settings to compensate for the increased inertia.
- Decreasing Payload (Lighter Camera or Lens): If the camera setup is significantly lighter, you must decrease the GAIN and DIFF to prevent the motors from becoming overly aggressive.
- TILT Axis Oscillation: In case of oscillation on the TILT axis, immediately re-verify the rigidity of the camera package and, if necessary, improve stiffness with additional camera bracing and re-balance the remote head to ensure perfect static balance. Then repeat PID tuning procedure.

Once PID settings are complete, drift may be noticeable. Initiate a drift cancelling procedure by activating the Drift Cancelling switch on the joystick console.

11.1.10 JOYSTICKS: INPUT CONFIGURATIONS



To return to the previous menu (User Functions Menu), use the Back Arrow Icon.

This screen is dedicated to configuring the input behavior and responsiveness of the external control devices — Joystick, Handwheel, and Panbar — specifically when controlling the primary movement axes (Pan, Tilt, and Roll). The configuration shown applies to the PAN axis.

INPUT DEVICE TOGGLES: The menu uses five tabs — PAN, TILT, ROLL, ZOOM, and FOCUS — to select the axis or setting whose input properties are currently being viewed and edited. The toggles for

JOYSTICK, HANDWHEEL, and PANBAR determine which specific physical control device is active for the selected axis.

JOYSTICK MENU CONFIGURATION: The menus for the ROLL, TILT, and PAN axes are identical. For each axis, users can independently control the activation of the physical input devices:

JOYSTICK Toggle: Turns the physical joystick ON or OFF.

HANDWHEEL Toggle: Turns the physical handwheel ON or OFF.

PAN BAR Toggle: Turns the physical Pan Bar ON or OFF.

CONTROL CURVE SELECTION: Users can select the control characteristic:

JOYSTICK CURVE: Select either QUADRATIC (Default) or LINEAR.

QUADRATIC defines a nonlinear response curve for the controller input. This means the system output (motor speed) is controlled by a squared function, offering dual sensitivity:

Near Center: The curve is flat, providing significantly slower and more precise movement for subtle changes in the shot. Near Edges (Full Throw): The curve accelerates sharply, allowing the operator to rapidly reach the maximum programmed speed for fast pans or whips.

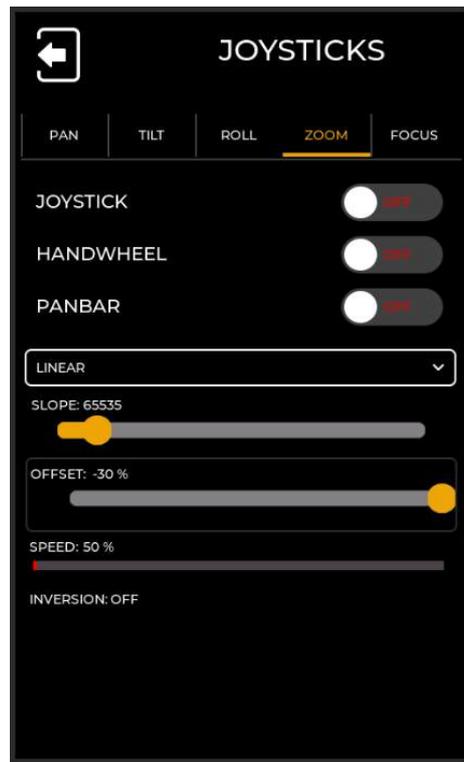
LINEAR means the output speed is directly proportional to the controller movement.

SLOPE / Joystick Steepness: This slider allows adjustment of the aggressiveness of the Quadratic curve. This control has no effect when the curve is set to Linear.

Indicators: The bottom part of the menu displays the current status of the following potentiometers and switches for diagnostic purposes:

- Drift Indicator Bar
- Speed Indicator Bar
- Damping Indicator Bar
- Inversion Indicator (Reverse Toggle Switch Position indicator) for the currently selected axis (PAN,TILT, ROLL) as well as setting ZOOM, FOCUS ON / OFF (primarily used for troubleshooting diagnostics).

11.1.11 JOYSTICKS: ZOOM AXIS SETTINGS



To return to the previous menu (User Functions Menu), use the Back Arrow Icon.

JOYSTICK, HANDWHEEL, and PAN BAR Toggles: Enable or disable the ZOOM function for the specific control unit currently in use. Allows the operator to toggle Zoom control independently for different input devices.

DROPDOWN MENU (LINEAR): Selects the response curve of the input device. LINEAR means the output zoom speed is directly proportional to the controller movement.

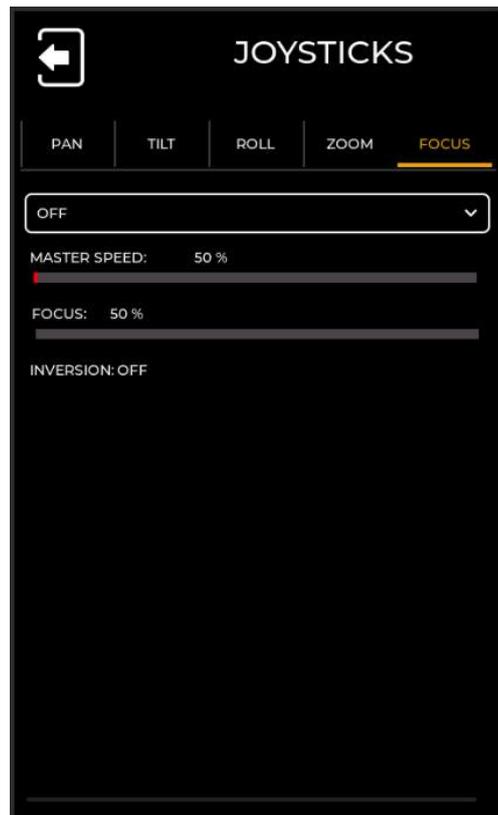
DROPDOWN MENU / QUADRATIC: Selects the nonlinear response curve for the controller, the zoom output speed will be related to the input device position by a squared function, rather than a linear (straight-line) function.

OFFSET Adjustment: This setting helps prevent lens drift, especially with broadcast lenses. The offset value can be set in two ways: by manual input or by using precision adjustment buttons on the joystick console – and +.

RESET FUNCTION: The offset value can be quickly reset to zero by press-and-holding (long touch) the ZOOM OFFSET box which is confirmed with a vibration alert.

INVERSION INDICATOR (Reverse Toggle Switch Position Indicator) for ZOOM: ON / OFF.

11.1.12 JOYSTICKS: FOCUS SETTINGS



To return to the previous menu (User Functions Menu), use the Back Arrow Icon.

The FOCUS tab differs by offering a selectable signal source via a Source Signal dropdown menu:

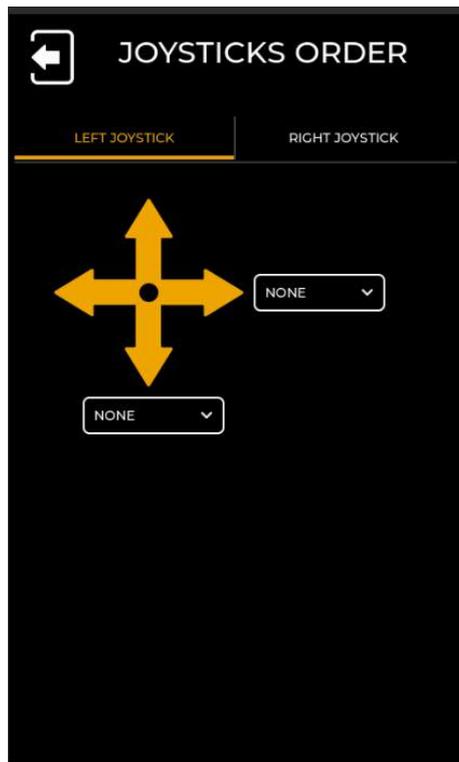
Source Signal Options: The menu allows selecting which physical controller provides the focus signal:

- OFF (No focus source)
- JOYSTICK
- PAN BAR
- HANDWHEELS (if available)

FOCUS INDICATORS: The menu includes two main indicators:

- FOCUS ZONE INDICATOR: Allows for the adjustment of the focus zone, primarily used when working with old generation Filmotechnic analog focus lens motors without internal calibration.
- CURRENT FOCUS POSITION: Displays the current focus position value on the joystick console.
- Inversion Indicator (Reverse Toggle Switch Position Indicator) for FOCUS: ON / OFF.

11.1.13 JOYSTICKS ORDER



To return to the previous menu (User Functions Menu), use the Back Arrow Icon.

This screen is dedicated to the JOYSTICKS ORDER menu, which is used to assign the physical directions of a control device (joystick) to the control axes of the remote head. This allows the operator to customize the control scheme. This functionality is essential for operators who wish to tailor the control experience, such as assigning ZOOM to the vertical movement of the joystick or swapping PAN and TILT controls.

JOYSTICK ORDER CONFIGURATION: The Joystick Order menu allows for the remapping of the physical joysticks to control different axes on the head. This is particularly useful for accommodating different operator preferences, such as left-handed users.

The menu is divided into two tabs: Left Joystick and Right Joystick.

AXIS ASSIGNMENT: Within each tab, a directional cross graphic displays the current assignment. The user can select the desired axis for both the horizontal and vertical directions of the physical stick.

Two dropdown menus are used to assign the control axes:

VERTICAL AXIS / UP/DOWN: The dropdown menu below the vertical arrow pair is used to assign the physical Up/Down movement of the joystick to one of the following remote head control axes: NONE (unassigned), PAN, TILT, ROLL, ZOOM

HORIZONTAL AXIS / LEFT / RIGHT: The dropdown menu next to the horizontal arrow pair is used to assign the physical Left/Right movement of the joystick to one of the available axes: NONE (unassigned), PAN, TILT, ROLL, ZOOM.

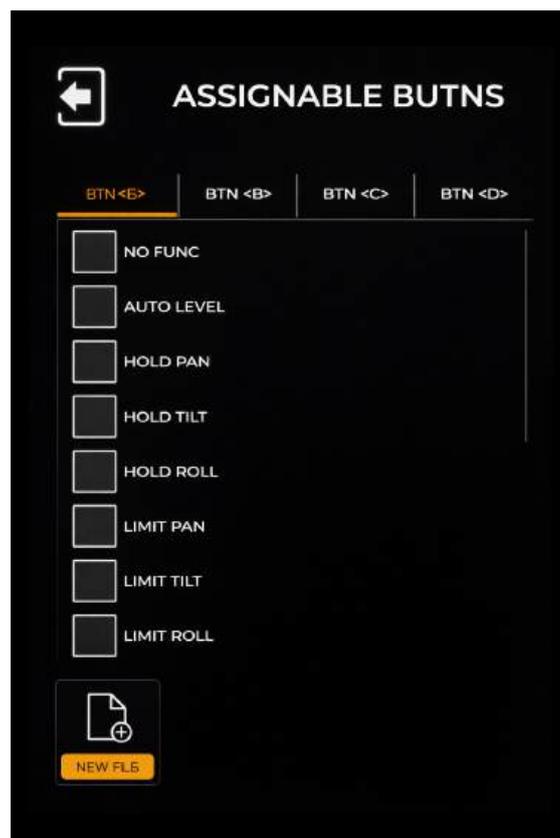
- Example of Assignment: The system allows mapping to any of the available axes (e.g., setting the horizontal direction to Roll and the vertical direction to Zoom). This determines which axis is controlled by the physical movement of the joystick.

Compatible Axes: The list of available axes for assignment includes all axes that utilize a return-to-center mechanism (spring-loaded joysticks).

EXCLUSION OF FOCUS: The Focus axis is explicitly excluded from this list because it is typically controlled by an input device that has no return-to-center mechanism. Assigning Focus to a spring-loaded joystick would cause the axis to continuously rotate, as the operator would be unable to stop the movement without a center detent.

The assignment process and available options are identical for both the Left Joystick and the Right Joystick tabs.

11.1.14 ASSIGNABLE BUTTONS MENU



To return to the previous menu (User Functions Menu), use the Back Arrow Icon.

This screen is dedicated to the ASSIGNABLE BUTTONS menu, which allows the operator to customize the function of the physical auxiliary buttons located on the joystick console. This feature enables quick access to frequently used features.

The menu uses four tabs — BTN <A>, BTN , BTN <C>, and BTN <D> to select the individual physical auxiliary button that operator wishes to configure.

The menu displays a comprehensive list of functions available for assignment to user-configurable switches. When a button tab is selected, a menu appears below the tabs which allows the user to select the function to assign. Available functions typically include:

0. NO FUNC
1. AUTO LEVEL
2. HOLD PAN
3. HOLD TILT
4. HOLD ROLL
5. HOLD ALL
6. LIMIT PAN
7. LIMIT TILT
8. LIMIT ROLL
9. LIMIT ALL
10. SHAKE PAN
11. SHAKE TILT
12. SHAKE ROLL
13. SHAKE ALL
14. CAM RS
15. PAN JSTK
16. TILT JSTK
17. ROLL JSTK
18. ZOOM JSTK
19. JOYSTICKS
20. PAN WHL
21. TILT WHL
22. ROLL WHL
23. HANDWHEELS
24. LEVEL TILT
25. PANBAR

Function List: The menu presents a single, extensive list of functions. This list is dynamically generated by the software and may vary depending on the specific head model being used.

Assignment Logic: Functions assigned to one toggle become mutually exclusive across the other toggles.

For example, if the Auto Level Tilt function is assigned to Toggle A, the corresponding checkbox for Auto Level Tilt in the tabs for Toggle B, C, and D will become inactive (greyed out). If Hold Position Pan is then assigned to Toggle B, the checkboxes for both Auto-Level Tilt and Hold Position Pan will be inactive for Toggle C and D tabs. This logic prevents the same function from being activated by multiple toggles simultaneously.

11.1.15 USER PROFILES MENU



To return to the previous menu (User Functions Menu), use the Back Arrow Icon.

This screen, the USER PROFILES menu, is essential for managing and saving custom system settings. It allows the operator to save, load, overwrite, and delete specific configurations that contain the following operating parameters:

- Auto Horizon Mode
- Roll Return-to-Horizon Speed
- Roll Horizon Offset
- Hold Mode
- Hold Strength – Pan
- Hold Strength – Tilt
- Hold Strength – Roll
- Limit Mode
- Pan Limit Value 1
- Pan Limit Value 2
- Tilt Limit Value 1
- Tilt Limit Value 2
- Roll Limit Value 1
- Roll Limit Value 2
- Pan Ramping Value
- Tilt Ramping Value

- Roll Ramping Value
- Joystick Enable – Pan
- Pan Response Curve
- Joystick Enable – Tilt
- Tilt Response Curve
- Joystick Enable – Roll
- Roll Response Curve
- Joystick Enable – Zoom
- Zoom Response Curve
- Zoom Offset (Drift)
- Joystick Focus Settings
- Function Assigned to Switch A
- Function Assigned to Switch B
- Function Assigned to Switch C
- Function Assigned to Switch D
- Joystick Order

This is vital for quickly swapping setups for different camera packages or complex operational scenarios.

Naming and File Display: The top of the screen features a text input field labeled NEW FILE (max 40 chars), allowing the user to name a new profile before saving it. The large central area serves as the File Display Area, listing all currently saved user profiles. The user selects a profile from this list to perform an operation (load, rewrite, or delete).

File Management Operations: The four buttons at the bottom control the file management functions:

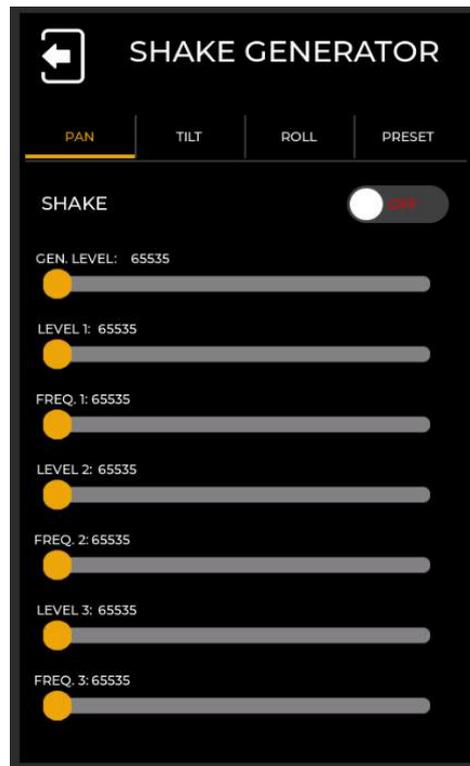
NEW FILE: Used to save the current working configuration to a new file, using the name entered in the text field.

REWRITE: Used to save the current working configuration over the top of the profile currently highlighted in the File Display Area.

ENTER: Used to load the profile currently highlighted in the File Display Area into the system. This immediately changes all operating parameters to the values stored in that file.

DELETE: Used to permanently remove the profile currently highlighted in the File Display Area.

11.1.16 SHAKE GENERATOR



To return to the previous menu (User Functions Menu), use the Back Arrow Icon.

This screen is dedicated to the SHAKE GENERATOR menu, which allows the operator to configure the built-in intentional vibration or "shake" feature.

SHAKE GENERATOR CONFIGURATION: The settings are divided into four tabs: Pan, Tilt, Roll, and Preset. The tabs allow the operator to select which axis's shake parameters they are currently viewing and editing. The PRESET tab allows saving or loading pre-configured shake patterns. The SHAKE toggle is the main switch used to enable or disable the shake generation feature for the selected axis.

Generator Activation and Basic Controls: Each axis tab allows to activate or deactivate the shake generator for that specific axis.

The first setting is the GENERAL LEVEL, which determines the overall amplitude of all combined shake components for the selected axis.

SHAKE COMPONENTS AND CUSTOMIZATION: The system allows configuration of three independent shake components per axis.

GEN. LEVEL : The general amplitude of all components of SHAKE GENERATOR.

FREQUENCY: Sets the rate of oscillation for that component.

Each of these three components has two following adjustable parameters:

LEVEL 1 (AMPLITUDE 1)

FREQ. 1 (FREQUENCY 1)

LEVEL 2 (AMPLITUDE 1)

FREQ. 2 (FREQUENCY 2)

LEVEL 3 (AMPLITUDE 1)

FREQ. 3 (FREQUENCY 3)

These three components are summed together to create the final pseudorandom motion of the axis. This resulting motion can be adjusted from smooth to aggressive. The setup and component parameters are identical for the Pan, Tilt, and Roll axes.

[WARNING] A CRUCIAL SAFETY WARNING APPLIES TO THE SHAKE GENERATOR:

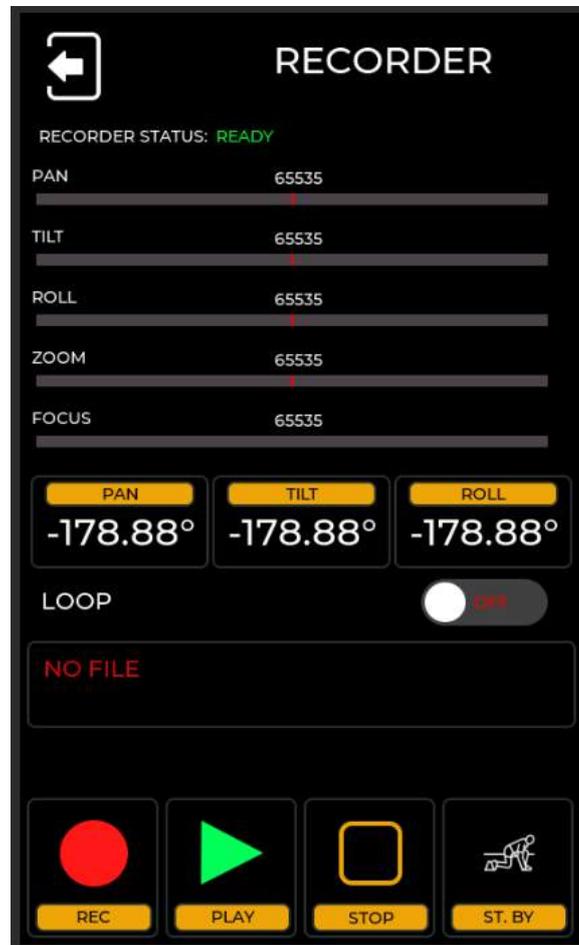
The sharpness and intensity of the shake are limited by the motor capabilities of the head and the inertia and weight of the camera package. The system allows users to set parameters that may exceed the motor's operational limits for the installed camera payload. If the generator is configured to be more active than the head can physically manage with the current camera weight, the motors might overheat. Users must observe extreme caution when adjusting the Shake Generator settings.

Preset Management: The PRESET tab allows users to save and recall successful shake configurations:



- This functions similarly to the system's general preset management.
- To save a preset, select "New File," enter a name for the preset, and confirm. This action saves all currently configured shake component parameters (amplitude and frequency) for all three axes (Pan, Tilt, and Roll).
- Saved presets can be loaded for later use.

11.1.17 RECORDER MENU



To return to the previous menu (User Functions Menu), use the Back Arrow Icon.

The Recorder Menu is used for motion capture and playback, and it is a key tool for system diagnostics.

DIAGNOSTICS AND STATUS INDICATORS: The top of the menu displays several indicators:
Record Status: Shows the current readiness of the recorder.

AXIS POSITION INDICATORS (PAN, TILT, ROLL, ZOOM, FOCUS): These display the real-time position values transmitted by the control inputs (joysticks and Focus knob). Observing these values is crucial for diagnosing control input failures.

ENCODER INDICATORS: Three “yellow boxes” display the head's current encoder angles. These values can be reset to zero by performing a Long touch on the respective box.

LOOP PLAYBACK TOGGLE: It determines if playback should repeat continuously (Loop active) or stop after one full cycle.

RECORDING AND PLAYBACK CONTROLS: The control buttons remain inactive until a USB storage device is successfully connected.

- REC (Record): Initiates and initiates motion capture.
- PLAY: Changes the status to begins playback of the selected motion file.
- STOP: Halts recording or playback.
- ST.BY (StandBy): Returns the head to the file's initial starting position. When active, the status changes to Holding Start Position, indicating the head is maintaining the position locked to the encoders.

FILE MANAGEMENT: The system requires a motion file to be selected or created before recording can begin.

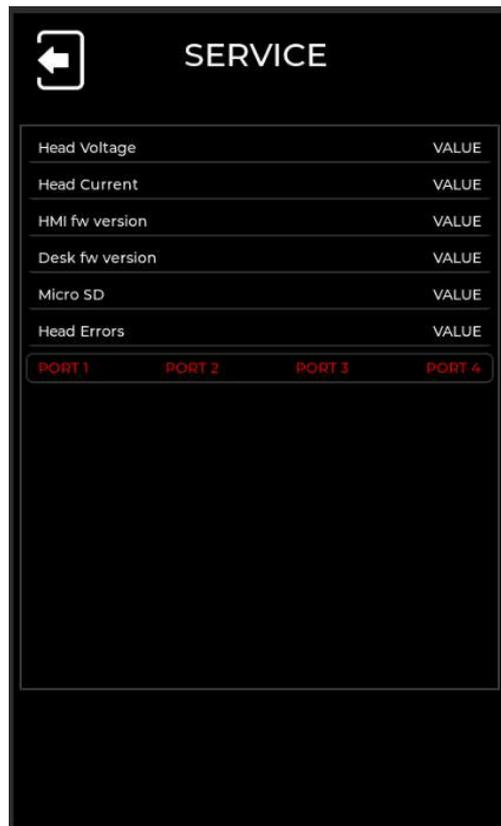
- File Selection: Pressing the file name area (e.g., where "No File" is shown) opens a list of saved movement presets.

CREATION / SELECTION: Users can select an existing file for playback or overwriting, or create a new file. File creation utilizes a standard keyboard input identical to other menus.

OPERATION: After selecting a file, its name appears in the status area. Recording can then be started with the REC button.

PLAYBACK: During playback, if the Loop function is active, the movement will repeat until the STOP button is pressed. If Loop is inactive, playback will cease automatically at the end of the file

11.1.18 SERVICE MENU / DIAGNOSTICS AND SYSTEM STATUS



To return to the previous menu (User Functions Menu), use the Back Arrow Icon.

The SERVICE MENU provides essential diagnostic and status information about the head and console.

Head Status displays Voltage, Current, HMI Software Version (fw), Console Software version, Micro SD displays the status of the internal storage used for presets (0 indicates no error), Head Errors: Displays the current error status of the head. Any active error will be indicated by its name.

The following errors may be displayed:

Pan Gyro Disconnected
 Tilt Gyro Disconnected
 Roll Gyro Disconnected
 Pan II Gyro Disconnected

Pan Amplifier Disconnected
 Tilt Amplifier Disconnected
 Roll Amplifier Disconnected
 PAN II Amplifier Disconnected

Pan Temperature sensors error

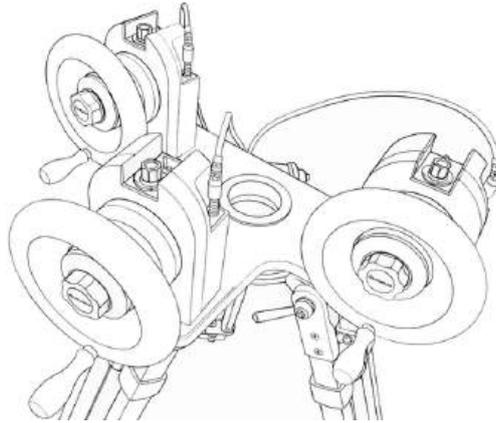
Tilt Temperature sensors error
Roll Temperature sensors error
Pan II Temperature sensors error

Pan motor OverHeated
Tilt motor OverHeated
Roll motor OverHeated
Pan II motor OverHeated
Level Sensor disconnected

Pan motor overcurrent
Tilt motor overcurrent
Roll motor overcurrent
PAN II motor overcurrent

Accessory Ports Status (Port 1, Port 2, Port 3, Port 4): These ports are located on the rear of the console and are used for accessories (Handwheels, Pan Bar). When a device is successfully connected, the corresponding port indicator changes to Green.

12. HANDWHEELS OVERVIEW



The Handwheels serve as the primary interface for achieving highly accurate and intuitive remote operation of a camera head. This system is designed to provide a mechanical, tactile, and muscle-memory friendly feel, which is essential for executing complex cinematic camera movements with high precision. The heavy steel handwheel offers precise positioning due to its large moment of inertia, which results in smooth, highly controlled movement. This design delivers superior operational comfort and a satisfying tactile feel during use.

The control is fundamentally based on three dedicated handwheels that offer complete spatial orientation of the camera: Pan, Tilt and Roll.

The control block features two electronic adjustments:

- **Speed Potentiometer:** This is a rotary dial numbered 1 to 12. It regulates the overall maximum speed and sensitivity of the handwheel input. A setting of 1 is for maximum precision and slowest speed, while 12 is for fastest speed and quick re-framing.
- **Reverse Switch:** This switch allows the operator to instantly invert the direction of movement for the controlled axis.

DRAG ADJUSTMENT: The rotating knobs on the Handwheels allow for the adjustment of the wheel's movement drag. This lets the operator set the desired physical resistance of the handwheel itself.

The Handwheels are connected via a cable connection to the Joystick console (hand wheel Input connectors), which serves as the central processing hub for communication with the camera head.

AXIS ACTIVATION: Each Handwheel axis must be individually activated via the main console's menu to take control:

- Navigate to the JOYSTICK page of the MENU on the Joystick Console.
- Select the desired axis Pan, Tilt or Roll.
- Turn ON the HANDWHEEL toggle to activate a correspondent axis.
- Turn OFF the JOYSTICK toggle or leave it ON if your jobs requires both controls to be active.
- The system confirms activation by displaying a GREEN indicator with the symbol H next to the corresponding axis.

NOT RECOMMENDED FOR USE IN CAMERA CARS OR ANY MOBILE PLATFORMS:

To operate handwheels effectively, the operator's hands and arms must maintain a relatively firm grip or contact with the wheels. This creates a direct mechanical path for any external movement - such as vehicle bumps, engine vibration, or even the operator's own breathing and muscle tremors - to be transferred straight through the wheels and into the head's control signals. Since handwheels rely on large, continuous rotations, any slight, involuntary hand movement caused by vehicle motion, especially jarring bumps, can be amplified into visible jitters or unwelcome acceleration/deceleration in the final camera shot.

13. TRANSPORT, STORAGE & MAINTENANCE

13.1 TRANSPORT PREPARATION

Before transporting the Hornet remote head:

- Disable motor torque and power down the system completely.
- Remove the camera and all accessories unless transport with payload is explicitly approved.
- Secure all loose cables and connectors to prevent movement or damage. Remove or secure external components such as control cables, antennas, and wireless modules.
- Verify all axis locks (Sliding Latches) are DISENGAGED (UNLOCKED) on Pan, Tilt, and Roll.
- Pack the head into its dedicated transportation case. Confirm the head is correctly seated in the foam/supports and that the case provides the restraint (not the axis locks).
- Close and secure the transportation case before moving or lifting.

[NOTICE] Do not transport the head outside of its transportation case. Do not transport the head with any axis latches engaged. Transporting with locked axes may load the mechanisms during shock or vibration and can result in mechanical damage.

13.2 TRANSPORT HANDLING

- Use only approved transport cases or protective packaging.
- Ensure adequate padding to prevent shock and vibration.
- Avoid placing heavy objects on top of the head or transport case.
- Protect connectors and exposed mechanical components from impact.

During vehicle transport:

- Secure the transport case to prevent movement.
- Avoid prolonged exposure to extreme temperatures.

13.3 STORAGE CONDITIONS

Store the Hornet remote head in a clean, dry, and temperature-controlled environment.

Recommended storage conditions:

- Temperature: +10 °C to +30 °C (50 °F to 86 °F)
- Low humidity, free from condensation

- Protection from dust and corrosive atmospheres

13.4 MAINTENANCE & SERVICE

The Hornet remote head contains no user-serviceable internal electronic components.

- Do not disassemble the system beyond procedures described in this manual.
- Unauthorized service, modification, or adjustment voids warranty.
- Firmware updates or internal service must be performed only by authorized service personnel.

If abnormal behavior persists after correct setup and verification:

- discontinue operation,
- secure the system,
- contact authorized service support.

13.5 ROUTINE INSPECTION

Before each operating day:

- Inspect all mechanical components for signs of wear or damage.
- Verify integrity of all connectors, cables, and locking mechanisms.
- Check axis locks for proper engagement and visual indication.
- Confirm that all fasteners are secure.

Any damaged or worn components must be replaced before operation.

13.6 CLEANING

- Use a clean, dry, lint-free cloth for routine cleaning.
- Do not use solvents, aggressive cleaners, or compressed air directly on electronics.
- Ensure all connectors are dry and free of debris before reconnection.

[NOTICE] Moisture or contamination inside connectors may lead to intermittent faults or permanent damage.

14. TROUBLESHOOTING

Recommended troubleshooting order: Safety → Mechanical integrity → Balance → Cable management → Calibration → Tuning (PID / stiffness).

Symptom / Indicator	Likely Cause(s)	Corrective Action(s) (perform in order)	Prevention / Notes	Escalate to Service if...
Head drifts	<p>Normal sensor(s) drift (temperature change, warm-up).</p> <p>Neutral offset in joystick controls.</p> <p>Drift compensation disabled.</p> <p>Insufficient on moving platforms.</p>	<p>Confirm joystick returns to true center; recalibrate inputs if applicable.</p> <p>Use Drift Compensation switch; verify Drift Status LED behavior.</p> <p>Apply manual drift trim.</p> <p>Allow system to reach operating temperature; re-initialize if drift persists.</p>	<p>On boats or vehicles, manual trim may be more effective than automatic compensation.</p>	<p>Drift cannot be corrected with trim or worsens over time despite stable temperature.</p>
Image not stable / stabilization quality degraded	<p>Loose hardware, play.</p> <p>Out-of-balance payload.</p> <p>Lens movement shifting CG.</p> <p>Cable tension.</p> <p>PID tuning not matched to payload.</p>	<p>Identify affected axis.</p> <p>Tighten all clamps/rods/plates/ lens support/ accessories.</p> <p>Recheck and correct balance on all axes; rebalance after any payload change.</p> <p>Verify lens mount integrity and operating zoom/focus CG shift.</p> <p>Re-route cables (no tension, add service loops).</p> <p>Retune PID only after mechanical and balance issues are resolved.</p>	<p>Most instability issues are mechanical or balance related; tune last.</p>	<p>Stability cannot be achieved at normal tuning ranges.</p>
Horizon not level	<p>Imbalance/uneven mass distribution.</p> <p>Calibration / initialization required.</p>	<p>Confirm balance.</p> <p>Perform horizon/level calibration.</p>	<p>Long lenses amplify small horizon errors; verify with a level grid on stable ground.</p>	<p>Horizon cannot be held after reset / calibration or repeatedly returns to incorrect level.</p>

<p>One axis not operational / axis does not respond</p>	<p>Axis lock engaged. Axis disabled in settings. Motor/encoder cable not seated or damaged.</p>	<p>Verify locks are released. Confirm axis enabled. Power down, reseal motor/encoder connections, restart. Inspect for bent pins; replace damaged cables.</p>	<p>Avoid payload changes with motors enabled.</p>	<p>Axis still does not move after restart and cabling checks.</p>
<p>Head buzzing / oscillating (audible vibration)</p>	<p>Over-aggressive tuning. Mechanical play/insufficient stiffness. Payload out of balance. Resonance.</p>	<p>Identify oscillating axis. Tighten/secure camera plate, rods, lens support, brackets, mounting. Rebalance in all orientations. Reduce stiffness and re-test.</p>	<p>Disable stabilization before adjustments if oscillation is violent.</p>	<p>Oscillation persists at low tuning values or occurs with multiple payloads.</p>
<p>Overshoot / bounce when stopping</p>	<p>Stiffness too high. Payload inertia exceeds torque margin. Stop/smoothing settings too aggressive.</p>	<p>Reduce stiffness/gain. Increase damping/smoothing. Reduce maximum speed if required. Recheck balance and reduce cantilever; add lens support.</p>	<p>Long lens/large payloads may require added support.</p>	<p>Overshoot remains severe at practical settings or induces repeated faults.</p>
<p>Linear high-frequency shake visible (vehicle/rig vibration)</p>	<p>Linear vibration outside correction capability. Mount resonance/insufficient isolation. Wind loading on accessories.</p>	<p>Add mechanical isolation (wire-rope isolator and/or shock absorber). Inspect mount rigidity and resonance sources; avoid long unsupported structures. Minimize wind loading; streamline payload.</p>	<p>For high-speed vehicle shots, avoid large matte boxes; use clip-on or lens-mounted filter.</p>	<p>Shake persists after isolation improvements.</p>
<p>Excessive wind-induced vibration / “sail effect”</p>	<p>Matte box/large accessories creating wind load. Loose flags/filters.</p>	<p>Remove matte box where possible; use clip-on matte box or lens-mounted filter. Secure flags/filters before balancing and operation. Rebalance after changes.</p>	<p>Any change to matte box/filters after balancing invalidates balance.</p>	<p>Vibration remains severe even with minimized frontal area and correct balance.</p>

<p>No communication / control console not responding</p>	<p>Comms cable disconnected/damaged.</p> <p>Connectors not locked or pins bent.</p>	<p>Reseat console-to-control-unit cable; verify locking rings.</p> <p>Inspect connectors; clean/replace as needed.</p> <p>Restart control unit and head; verify Status LED indicators.</p>	<p>Avoid tight bends near connectors.</p>	<p>Connection drops intermittently after cable replacement or across multiple consoles.</p>
<p>Video signal loss (SDI/HD) / intermittent video</p>	<p>Loose/damaged SDI cable.</p> <p>Cable strain (if used).</p> <p>Unsupported format/incorrect camera output.</p>	<p>Verify camera output format compatibility.</p> <p>Reseat SDI connections (camera → slip ring if used → monitor/receiver).</p> <p>Swap to known-good cable; minimize adapters.</p> <p>Re-route cables to prevent strain and add service loops.</p>	<p>If failures occur at specific pan angles, inspect slip ring path (if used) and routing.</p>	<p>Video fails on multiple cables/cameras or only at certain pan angles.</p>
<p>No power to the head</p>	<p>Power cable not seated.</p> <p>Power source off /undervoltage/brownout.</p> <p>Protection tripped.</p> <p>Damaged cable.</p>	<p>Confirm power connectors seated/locked.</p> <p>Verify source voltage under load.</p> <p>Inspect/replace cable/connectors.</p> <p>If protection tripped, remove load, correct cause, reapply power.</p>	<p>Maintain power headroom for peak motor current.</p>	<p>Head repeatedly loses power with known-good power source and cabling.</p>
<p>Head hot to touch / motors overheating</p>	<p>Out-of-balance payload.</p> <p>Axis lock partially engaged.</p> <p>High ambient temperature/low airflow.</p> <p>Continuous high torque.</p>	<p>Immediately correct balance.</p> <p>Confirm locks disengaged. Allow cooling/add airflow/relocate.</p> <p>Reduce sustained torque demands (smoother moves; lower stiffness if appropriate).</p>	<p>Overheating commonly linked to imbalance; rebalance after changes.</p>	<p>Overheat alarms persist after balancing or a motor disables repeatedly.</p>
<p>Axis fails to initialize / restricted movement at startup</p>	<p>Mechanical obstruction/hard stop.</p> <p>Cable snag. Lock engaged.</p> <p>Sensor/encoder fault.</p>	<p>Power down and confirm axes move freely (as permitted).</p> <p>Remove obstructions/release</p>	<p>Ensure full motion clearance before power on, especially in tight mounts.</p>	<p>Initialization fails repeatedly after clearance and cabling checks.</p>

		locks/correct cable routing. Restart on stable surface with full motion clearance.		
Motor torque is weak / axis feels soft / cannot hold position	Motors disabled/low-torque. Low supply voltage/current limiting. Overheat protection limiting output. Incorrect payload profile/preset.	Verify Motors switch ON and motor status LED indicates enabled. Check supply voltage under load; use higher-capacity source if needed. Allow cooling. Confirm correct payload profile/preset; retune if required.	Weak torque often power-related; confirm cable gauge/connector condition.	Torque remains low with correct voltage and after cooling.
Controls feel sluggish / latency / overshoot	Speed/damping/smoothing settings incorrect. Wireless interference (if applicable). Tuning not matched to operator preference.	Check speed potentiometers and damping settings. If wireless, reduce interference or test hard-wired. Adjust smoothing/follow/tuning incrementally; test between changes.	Maintain known-good presets for common shot types.	Latency increases suddenly or only when specific equipment is powered (possible EMI).
Parameters/settings not saved	Power removed during save cycle.	After switching head motors OFF from the console, keep main power applied until save indication completes (communication LED may fade briefly).	Do not disconnect main power during the save operation.	Settings repeatedly revert after correct save procedure.
Alarm / fault shown on display or Service page	Sensor/encoder/temperature/communication fault. Blocked axis. Abnormal consumption.	Record fault text and conditions. Restart system. Reseat relevant Export logs if available and contact service.	Wrench icon flashes with a red outline on error; press to open Service page.	Fault persists across restarts or temperature/encoder faults reappear quickly.
Unexpected reboot / system resets under load	Power source cannot supply peak current. Loose power connector. Excessive voltage drop in cabling.	Verify supply capacity; test alternate source. Inspect/replace power cable; ensure connectors lock. Measure voltage at head during operation.	Use adequate power headroom and proper cable gauge.	Resets persist with known-good power source and cabling.

		Reduce peak load temporarily to confirm power limitation.		
Head hits limits / cannot reach commanded angles	Mechanical interference with payload/cables. Insufficient clearance or mounting orientation issues.	Verify no collisions through full range of motion. Reposition accessories/cables to clear axes. Adjust soft limits if available.	Perform full-range motion check before each shoot day.	Hard stop impacts occur or collisions repeat (risk of damage).
Vibration during high-zoom / long lens operation	High magnification amplifies vibration. Insufficient lens support/flex. Inadequate isolation.	Add lens support; shorten rods and increase stiffness. Improve isolation at mount; check rig resonance. Balance at operating zoom/focus positions.	Balance and tune with lens configured as used (filters, clip-on, focus motor).	Acceptable stability cannot be achieved at practical operating zoom levels.

15. PROHIBITION OF REVERSE ENGINEERING, ANALYSIS, AND UNAUTHORIZED TRANSFER

The Hornet stabilized remote head incorporates proprietary mechanical designs, electronic circuitry, firmware, software, and control algorithms that constitute confidential and protected intellectual property of the manufacturer. Reverse engineering, decompilation, disassembly beyond authorized service procedures, signal probing, firmware extraction, software analysis, or any attempt to analyze, derive, replicate, or bypass system functionality is strictly prohibited without explicit written authorization from the manufacturer. Transfer, loan, rental, sublicensing, or provision of the system, in whole or in part, to any competing company or entity for the purpose of analysis, benchmarking, testing, evaluation, or replication is strictly prohibited without prior written consent from the manufacturer. Any violation of these restrictions may result in unsafe operation, loss of stabilization control, immediate voiding of warranty, termination of manufacturer support, and exclusion from future service or upgrade programs.