ROSS ROBOTICS

Blackbird S2/SE Pedestals

Technical Manual

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Our mission is to:

1. Provide a Superior Customer Experience
   - offer the best product quality and support
2. Make Cool Practical Technology
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Ross has become well known for the Ross Video Code of Ethics. It guides our interactions and empowers our employees. I hope you enjoy reading it below.

If anything at all with your Ross experience does not live up to your expectations be sure to reach out to us at solutions@rossvideo.com.

David Ross
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Ross Video Code of Ethics

Any company is the sum total of the people that make things happen. At Ross, our employees are a special group. Our employees truly care about doing a great job and delivering a high quality customer experience every day. This code of ethics hangs on the wall of all Ross Video locations to guide our behavior:

1. We will always act in our customers' best interest.
2. We will do our best to understand our customers' requirements.
3. We will not ship crap.
4. We will be great to work with.
5. We will do something extra for our customers, as an apology, when something big goes wrong and it's our fault.
6. We will keep our promises.
7. We will treat the competition with respect.
8. We will cooperate with and help other friendly companies.
9. We will go above and beyond in times of crisis. *If there's no one to authorize the required action in times of company or customer crisis - do what you know in your heart is right. (You may rent helicopters if necessary.)*

Technical Manual for the BlackBird S2/SE Pedestals

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Patents

Ross Video products are protected by patent numbers US 7,034,886; US 7,508,455; US 7,602,446; US 7,802,802 B2; US 7,834,886; US 7,914,332; US 8,307,284; US 8,407,374 B2; US 8,499,019 B2; US 8,519,949 B2; US 8,743,292 B2; GB 2,419,119 B; GB 2,447,380 B. Other patents pending.

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Contents

Welcome

Welcome to the ***BlackBird S2/SE Pedestals Technical Manual***.

This manual provides a general overview of the system, technical specifications, basic maintenance procedures, and safety information.

For information about operating the system, see the ***SmartShell User Guide*** **(5100DR-002-xx)**.

NOTE: The BlackBird PTL (Pan/Tilt/Lift) pedestals are available in three different models: BlackBird C2, BlackBird S2 and BlackBird SE. This manual only covers the two S-series models: BlackBird S2 and BlackBird SE models. For information about the C-series model, BlackBird C2, please consult the ***BlackBird C2 Pedestals Technical Manual (5100DR-095-xx)*** or the Ross Video web site.

Text Formatting Conventions

Special text formats are used in this Technical Manual to identify parts of the user interface, text that a user must enter, or a sequence of menus and sub-menus that must be followed to reach a particular command.

Text Format	Meaning
Bold text	Bold text is used to identify a user interface element such as a dialog box, menu item, or button. For example: In the **Presets** panel, tap **Add**.
`Courier text`	Courier text is used to identify text that a user must type. For example: In the address bar, type `localhost` and press **Enter**.
Italic text	Italic text is used to identify the titles of referenced guides, manuals, or documents. For example: For more information, refer to the ***SmartShell Computer Quick Start Guide***.
>	Menu arrows are used in procedures to identify a sequence of menu items that you must follow. For example, if a step reads "**Display** > **Widgets**," you would tap the **Display** menu and then tap **Widgets**.

Contacting Technical Support

At Ross Video, we take pride in the quality of our products, but if problems occur, help is as close as the nearest telephone.

Our 24-hour Hot Line service ensures you have access to technical expertise around the clock. After-sales service and technical support is provided directly by Ross Video personnel.

During business hours (Eastern time), technical support personnel are available by telephone any time. Emergency after hours calls are answered by an answering service (live person) who will patch your call to the on-call support specialist. In the event that the on-call person is assisting another customer, the answering service will contact the back-up support specialist.

Our team of highly trained staff is available to react to any problem and to do whatever is necessary to ensure customer satisfaction.

- **Toll Free Technical Support 24/7:** 1-844-652-0645 (North America), or +800 1005 0100 (International)
- **Technical Support:** (+1) 613-652-4886
- **E-mail for Technical Support:** techsupport@rossvideo.com
- **ROSS VIDEO | HELP CENTER:** https://support.rossvideo.com/hc/en-us
- **E-mail for General Information:** solutions@rossvideo.com
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Important Notices

This section contains important notices.

Korean Class A Notice

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The preceding statement applies to the following Ross Video components, and may also apply to others:

- **5100AR-252-01** — 6-Axis Unified Robotics Control Panel

Safety Instructions

The following table contains important safety instructions and notices. Before using this product and any associated equipment, read and keep these instructions and notices. Heed all warnings and follow all safety instructions.

Caution	This equipment must be operated by trained personnel only. This equipment must be operated in a controlled and restricted-access environment only.
Warning	The safe operation of this product requires that a protective earth connection be provided. A grounding conductor in the equipment's supply cord provides this protective earth. To reduce the risk of electrical shock to the operator and service personnel, this ground conductor must be connected to an earthed ground. Use only power cords specified for this product and certified for the country of use. Do not defeat safety purpose of the grounding-type plug. A grounding type plug has two blades and a third grounding prong. The third prong is provided for your safety. If the provided plug does not fit in to your outlet, consult an electrician for replacement of the obsolete outlet. Protect power cord from being walked on or pinched, particularly at plugs, convenience receptacles, and points where they exit from the apparatus.
ESD	**ESD Susceptibility** — This symbol on the equipment or within the equipment manual indicates that an electrical or electronic device or assembly is susceptible to damage from an ESD event.
Warning	**Hazardous Voltages** — This symbol on the equipment or within the equipment manual indicates the presence of uninsulated “dangerous voltage” within the product enclosure that may be of sufficient magnitude to constitute a risk of shock to persons.
Warning	Indoor Use: “WARNING – TO REDUCE THE RISK OF FIRE OR ELECTRIC SHOCK, DO NOT EXPOSE THIS APPARATUS TO RAIN OR MOISTURE” Do not use this apparatus near water. Do not block any ventilation openings. Install in accordance with manufacturer’s instructions. Do not install near heat sources such as radiators, heat registers, stoves, or other apparatus (including amplifiers) that produce heat. Only use attachments/accessories specified by the manufacturer. Unplug this apparatus during lightning storms or when unused for long periods of time. Clean only with a dry cloth.
Warning	Refer all servicing to qualified personnel. Servicing is required when the apparatus has been damaged in any way, such as power-supply cord or plug damage, liquid has been spilled or objects have fallen into the apparatus, the apparatus has been exposed to rain or moisture, does not operate normally, or has been dropped.
Warning	To reduce the risk of fire, replacement fuses must be the same type and rating.

Warning	This product contains safety critical parts, which if incorrectly replaced may present a risk of fire or electrical shock. Components contained within the product's power supplies and power supply area are not customer-serviceable and should be returned to the factory for repair.
Caution	Ensure that proper cable management techniques are used at all times. Bundle and wrap cables neatly, and provide adequate strain relief and slack where necessary. Test your cable installation by slowly moving the robotic units through their entire range of motion and observing the cables, to ensure that they do not become taut, or snag on anything. Avoid running cables along floors in places where they may present a tripping hazard. Clearly mark areas where cables may present a tripping hazard, and keep personnel away from such areas. Inspect cables periodically for damage, and to ensure that proper cable management is maintained.
Warning	Damaged or improper cables may cause electric shock and/or fire. Ensure that all cables and connectors are of suitable type for their purpose, and that all power cable conductors are of adequate gauge for the voltage and current required. Inspect all cables periodically to check for damage. If a cable becomes damaged, turn off power to the system immediately, and then replace the damaged cable.
Warning	Serious injuries can result from people tripping over equipment, such as cables. Methods of reducing such risks include, but are not limited to, the following: • Erecting signs at studio entrances to remind people about tripping hazards and other studio hazards. • Training personnel about safety procedures and proper cable management techniques. • Showing personnel and guests the locations of cables equipment, and explaining that robotic cameras and cables attached to them may move at any time. • Escorting guests at all times while in the studio. • Ensuring adequate lighting when working in the studio. • Marking safe paths and/or restricted areas, to keep people away from moving robots and potential tripping hazards.
Caution	Loose or overtightened bolts may cause equipment damage. When servicing, tighten bolts to specified torque.
Warning	Moving parts may present a pinching hazard. Keep all personnel away from robots when they are operational. When a robotic head, pedestal, or lift moves, fingers touching or near the unit or the payload may become pinched. When installing or adjusting the payload, ensure that power to the system is turned off. When operating a robotic pedestal locally, touch only the pan bars and the local control unit (if equipped).
Warning	When servicing or moving equipment, always observe safe handling practices. Get help to move heavy items. Use safe lifting techniques. Follow all safety rules of your workplace.
Caution	Loose payloads may slip, causing equipment damage and injury. Periodically check all bolts that fasten the payload, to ensure that they are tightened to specified torque. If the payload is loose or slips, ensure that it is properly balanced and fastened before operating the robot.
Caution	Imbalanced payloads may cause equipment damage and may present a tipping hazard. Ensure payloads are properly balanced. If you adjust a payload, always rebalance it.

Safe Handling Techniques

When manually handling the Blackbird pedestal, it's important to follow these guidelines to ensure operator safety and prevent equipment damage:

- **Use the Designated Handles**
  Always push the pedestal from the designated handles or lift points to avoid strain and prevent damage to sensitive components such as the lift column or robotic head.
- **Maintain Control**
  Maintain control of the pedestal at all times, especially when navigating turns or tight spaces. Avoid sudden movements that could destabilize the pedestal.
- **Work in Teams**
  Always move the pedestal with assistance. Having at least one other person help when navigating uneven or tight spaces will reduce the risk of tipping or equipment damage.
- **Pushing on Inclines**
  Use extra caution when pushing the pedestal on slopes or inclines. Ensure that the pedestal is fully under control to prevent runaway movement.
- **Balance the Load**
  Ensure the pedestal's payload is properly balanced before pushing. An imbalanced payload increases the risk of tipping or excessive strain on one side of the pedestal. Regularly check the balance and adjust as necessary.
- **Floor and Conditions**
  Keep the floor and clear of debris to prevent the pedestal from snagging or jamming during movement.

Product Overview

The S-series of the BlackBird PTL (Pan/Tilt/Lift) pedestals are manually driven and can easily be positioned and locked in place, which makes them ideal for studio applications where cameras are typically required to be in the same floor position for the duration of a show.

The S-series of the BlackBird PTL (Pan/Tilt/Lift) pedestals are available in two models:

- ***BlackBird S2 -*** A manual pedestal base equipped with a **two-stage robotic lift system** that has a range of 19" (49cm) and can be fitted with either the **VR600 or X350** robotic pan and tilt head.
- ***BlackBird SE -*** A manual pedestal base equipped with a **three-stage robotic lift system** that has a range of 34" (87cm) and can be fitted with either the **VR600 or X350** robotic pan and tilt head.

The pedestal's robotic lift and pan and tilt head can be controlled by a variety of technologies, including Ross Video's SmartShell control application and joystick panel, production switchers such as Ross Video Acuity, and broadcast automation systems such as Ross Video OverDrive. These systems allow you to remotely operate or automate the adjustment of the camera height, as well as combine smooth vertical movement with pan and tilt to create dynamic on-air moving shots.
The S-series models also output accurate and reliable Virtual Tracking data for virtual and augmented reality.

Important: Before operating or servicing any Furio system, please refer to and carefully read the ***Furio Safety Guide (5100DR-304-02)*** to ensure safe handling and operation.

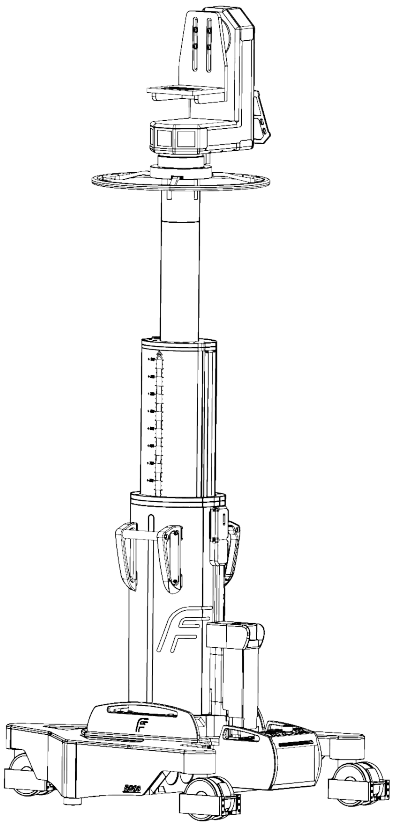


Figure 1 *The BlackBird S-Series Pedestals (with SE lift and VR600 shown)*

The following topics provide more details about the BlackBird S2/SE pedestal's components:

- ***"BlackBird Pedestal Base" on page 2–11***
- ***"Field Replaceable Unit (FRU)" on page 2–13***
- ***"BlackBird S2 Two-Stage Robotic Lift" on page 2–16***

- ***"BlackBird SE Three-Stage Robotic Lift" on page 2–16***
- ***"X350 Robotic Pan and Tilt Head" on page 2–17***
- ***"VR600 Robotic Pan and Tilt Head" on page 2–18***

NOTE: For information about site requirements for installing and using Blackbird S2/SE pedestals and compatible control systems, please refer to "**Site Requirements**" on page 2–19.

BlackBird Pedestal Base

The BlackBird pedestal base provides a solid, stable foundation allowing you to safely move the pedestal into position, as well as produce shake-free on-air camera moves when the lift and/or pan and tilt head are in motion.

The three double-caster wheels allow you to easily roll the BlackBird S2/SE pedestal into position on the studio floor. Once in the desired location, engaging the foot-activated wheel locks ensures that the pedestal remains in position during the show. If the pedestal's position is to be used for future shows, the four alignment LEDs along the bottom of the base can be used to place floor markers to reference. To return to the pedestal to exact location, simply align the LEDs to the floor markers.

Even at a maximum payload and full extension, safety features incorporated into the base's design ensure that the BlackBird S2/SE pedestal can be moved with virtually no risk of injury or damage to equipment due to tipping. A wide wheel base, two anti-tip feet and stability weights provide an ultra-stable and safe platform and the adjustable cable guards on each of the wheels prevents any snags or damage to cables and other objects.

Figure 2 and the table below it identify and describe the features of the BlackBird S2/SE pedestal base.

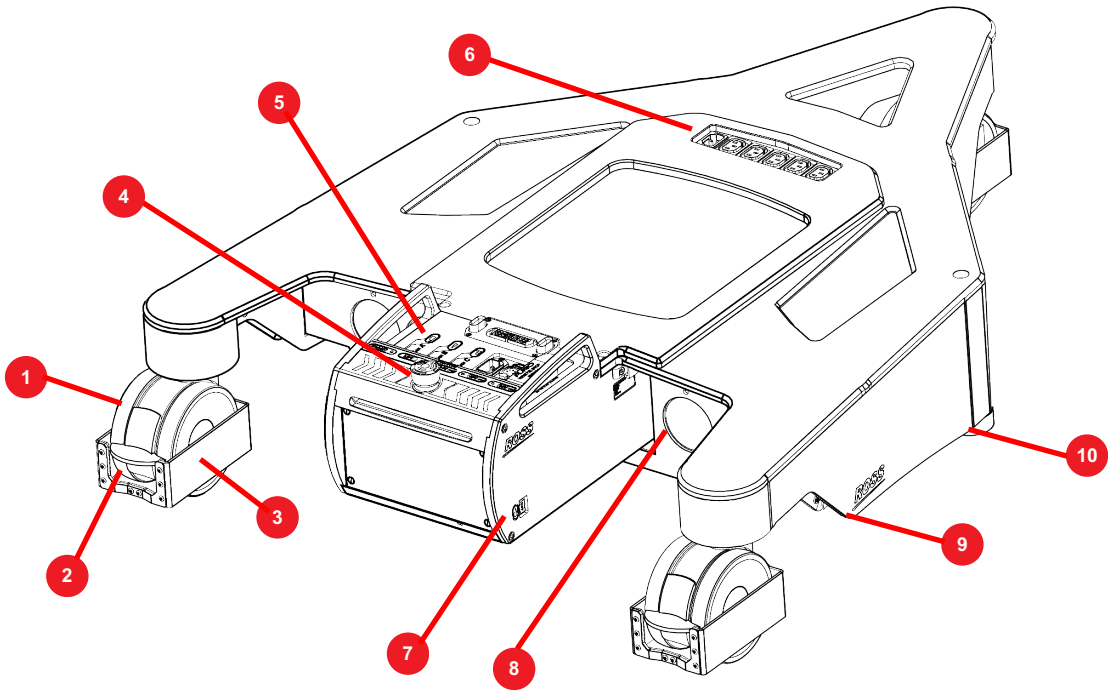


***Figure 2** The BlackBird S2/SE Pedestal Base*

Label	Description
1	**Double Caster Wheels** Three sets of double caster wheels provide a wide and stable wheel base and ensures ease of movement when repositioning the pedestal.

Label	Description
2	**Wheel Locks** Each of the pedestal's wheels features a foot-activated wheel lock, which locks or frees up movement of the wheel. To engage the wheel lock, simply use your foot to press down on the wheel lock lever to prevent the pedestal from moving from its current position. To release the wheel lock, use your foot to lift up the wheel lock lever.
3	**Cable Guards** Each of the three wheels is equipped with an adjustable cable guard. The guards ensure that when the pedestal moves across the studio floor, it pushes cables or other obstacles aside rather than running over them. The cable guards should be set to the lowest height possible that does not result in the guards themselves contacting the studio floor.
4	**E-Stop** The Emergency Stop (E-Stop) button immediately disconnects power to the lift and head so that they both immediately stop moving. This ensures maximum safety. To activate, press down on the E-stop button. The head becomes free-wheeling and the lift stays in its current position (although a heavier payload may cause the lift to descend slightly over time). A visual indication that E-Stop is engaged is that the E-stop button is in its lower position and the green LED (input power) on the head is not illuminated. To deactivate the E-Stop, twist and pull the button upwards. Power is restored and the pedestal initializes, which may involve the lift lowering and/or raising to its home position.
5	**FRU Connection Panel** The pedestal's electrical circuits are contained within a single Field Replaceable Unit (FRU). The FRU features a connection panel into which all network and power connections are made to/from the pedestal base, lift, and head. For more information, see "**Field Replaceable Unit (FRU)**" on page 2–13.
6	**Integrated power strip** The integrated power bar provides power for cameras, prompters, monitors, clocks, and more.
7	**Manual Lift Control Switch** A switch that allows you to raise or lower the lift locally without a network connection or control system (the network connector for the head, CAN B, must be disconnected). The manual lift control switch enables you to lower the lift to its absolute bottom position so you can engage the lift lock for shipping or storage.
8	**Stability Weights (BlackBird SE only)** Up to four stability weights can be used to lower the center of gravity of the pedestal for improved stability. The weights can be easily removed for shipment and transport. These weights are not required for the BlackBird C2 and S2 models.
9	**Alignment LEDs** Located along the bottom of each side of the base, the alignment LEDs help you position the pedestal to an exact referenced location after having been moved. Once a desired position is determined for the pedestal, the illuminated spots made by the LEDs (2 on each side) can be marked on the floor as reference points. To return to the pedestal to exact location, simply align the LEDs to the reference points.
10	**Anti-tip Feet** Two adjustable anti-tip feet are located under the left and right side of the chassis. If the pedestal begins to tip, these feet are first to make contact with the floor and prevent the pedestal from tipping further. Before moving the pedestal, twist the anti-tip feet to raise them for maximum clearance. Once the pedestal is in position, twist the anti-tip feet so that they are lowered close to the floor for maximum stability.

Field Replaceable Unit (FRU)

The base of the BlackBird S2/SE pedestal features a single **Field Replaceable Unit (FRU)** which contains all the control electronics. All network and power connections for the pedestal base, lift, and head are through the FRU's connection panel (**Figure 3**). The FRU receives its input power from an extension cable plugged into the pedestal's integrated power strip (**Figure 2** on **page 11**).

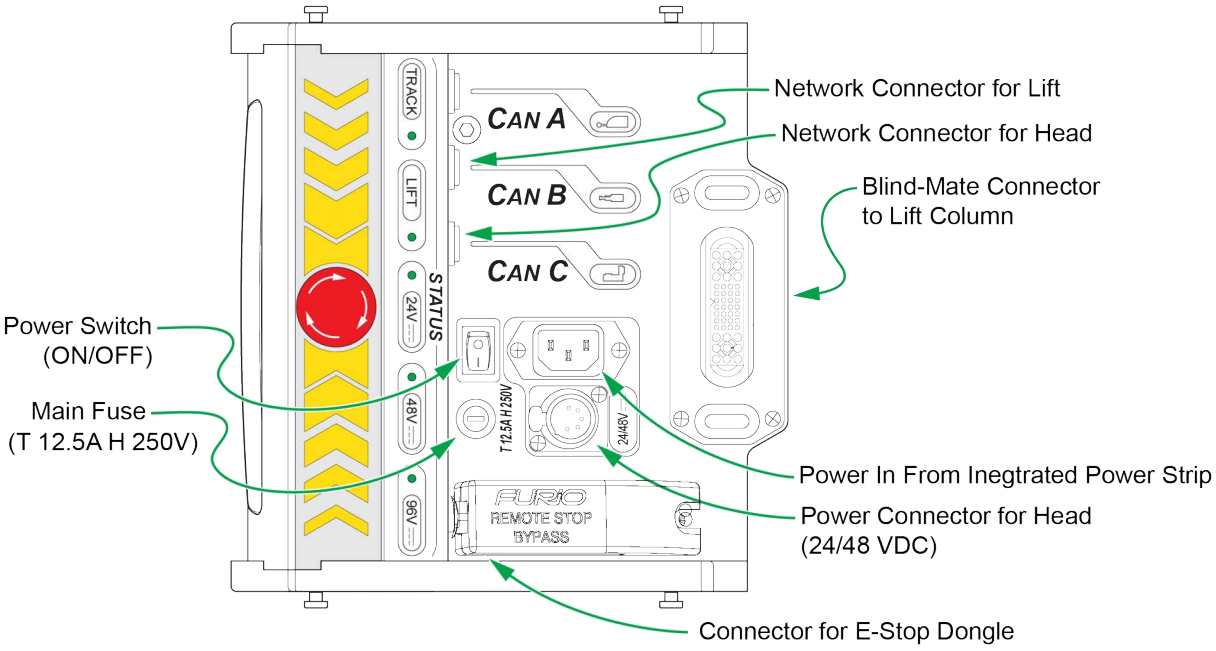


***Figure 3** - BlackBird S2/SE FRU Connection Panel*

Figure 4 shows CAN and E-STOP connectors, and LEDs that are not visible in (**Figure 3**).

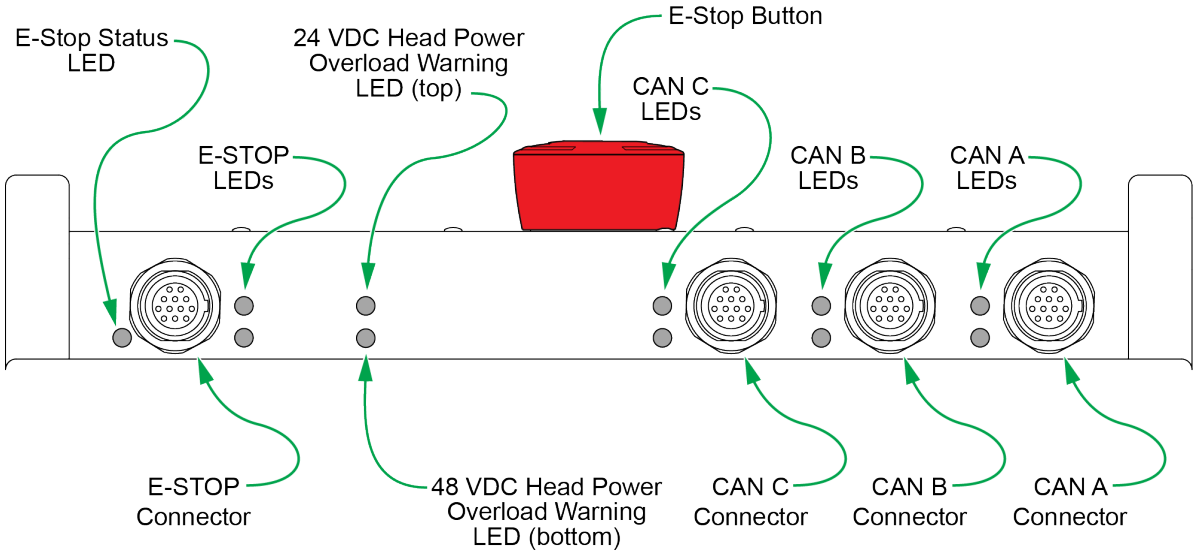


***Figure 4** - CAN connectors and LEDs on the FRU Connection Panel*

The following table describes LEDs on the FRU connection panel (**Figure 3** and **Figure 4**).

LED	Description / Meaning
LIFT	Lift axis status: • green: operational • red: disabled or faulty See also **Note 1**, after this table.
24 V	24 VDC power supply status: • green: good • off: undervoltage or no power
48 V	48 VDC power supply status: • green: good • off: undervoltage or no power
96 V	96 VDC power supply status: • green: good • off: undervoltage or no power
CAN A — 24 VDC overload warning (top LED beside CAN A connector)	Not used. Reserved for future use.
CAN A — 48 VDC overload warning (bottom LED beside CAN A connector)	Not used. Reserved for future use.
CAN B — 24 VDC overload warning (top LED beside CAN B connector)	24 VDC overload warning for lift encoder CAN connection: • off: no overload • red: overload or short-circuit
CAN B — 48 VDC overload warning (bottom LED beside CAN B connector)	Not used. Reserved for future use.
CAN C — 24 VDC overload warning (top LED beside CAN C connector)	24 VDC overload warning for robotic head: CAN connection: • off: no overload • red: overload or short-circuit
CAN C — 48 VDC overload warning (bottom LED beside CAN C connector)	Not used. Reserved for future use.
24 VDC head power overload warning (top LED adjacent to the main fuse)	Overload warning for VR100 head: • off: no overload • red: overload or short-circuit See also **Note 2**, after this table.
48 VDC head power overload warning (bottom LED adjacent to the main fuse)	Overload warning for VR600 head: • off: no overload • red: overload or short-circuit See also **Note 2**, after this table.
E-STOP — 24 VDC overload warning (top LED right of E-STOP CAN connector)	Not used. Reserved for future use.
E-STOP — 48 VDC overload warning (bottom LED right of E-STOP CAN connector)	Not used. Reserved for future use.
E-STOP status warning (left of the E-STOP CAN connector)	Operations status for E-STOP safety: • off: operational • red: E-STOP activated, and must be reset before operation can resume. **Note**: If there is no E-STOP box, an E-STOP dongle must be inserted for normal operation.

Additional notes about LEDs described in the preceding table:

1. The **LIFT** axis status LEDs turn red under any of the following conditions:
   - Amplifier fault
   - Amplifier over temperature
   - Motor phasing error
   - Motor over temperature
   - Under voltage
   - Over voltage
   - Short circuit
   - Phase not initialized
   - Command input fault
2. The power connector for the head (24 VDC / 48 VDC) is protected against overcurrent by resettable fuses. Each of the associated LEDs (adjacent to the main fuse) turns red when its fuse trips (top LED for 24 VDC VR100 supply, bottom LED for 48 VDC VR600 supply).

   When the faulty cable or device is unplugged, the associated LED turns off but the fuse may take up to one minute to cool completely and reset.

BlackBird S2 Two-Stage Robotic Lift

The BlackBird S2 is fitted with a Furio two-stage robotic lift, which has an impressive vertical range of 871 mm (34.3"). This allows for a maximum height of 1803 mm (71”) to optical center when mounted on a BlackBird SE pedestal and using a VR600 head, and 1705 mm (67.1”) with a X350 head.

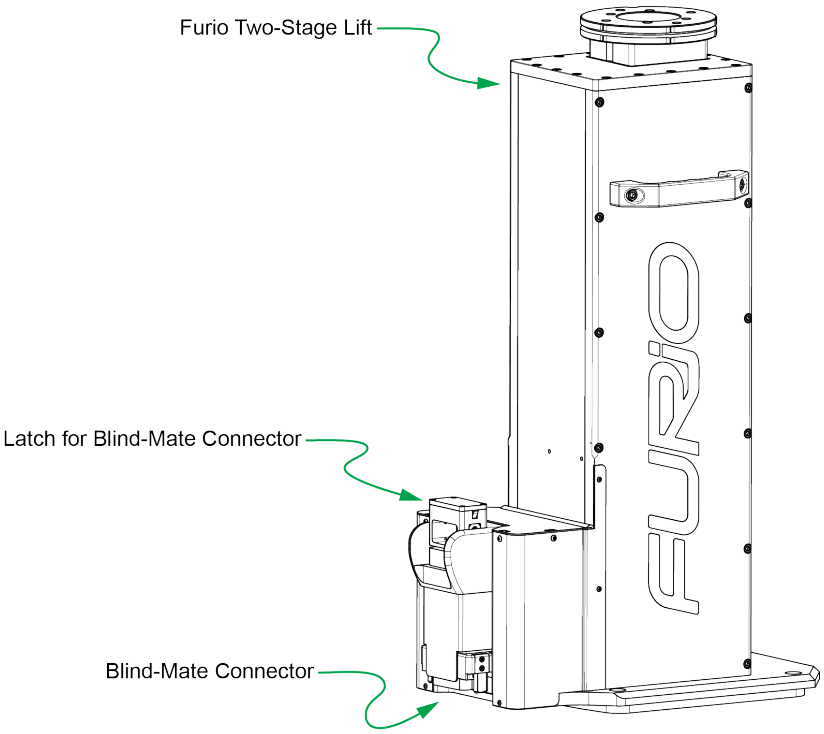


Figure 5 *- BlackBird S2 - Furio Two-Stage Lift (fully retracted)*

The FRU on the pedestal’s base is equipped with a manual lift control switch (**Figure 2** on **page 11**) that enables you to raise or lower the lift locally without a network connection or control system (the network connector for the head, CAN B, must be disconnected). The manual lift control switch enables you to lower the lift to its absolute bottom position. This can help provide a better working height for servicing the robotic head, or make the overall size of the lift smaller to facilitate shipping.

BlackBird SE Three-Stage Robotic Lift

The BlackBird SE is fitted with a Furio three-stage robotic lift, which has an impressive vertical range of 871 mm (34.3"). This allows for a maximum height of 2208 mm (86.9”) to optical center when mounted on a BlackBird SE pedestal and using a VR600 head, or 2110 mm (83.0”) with a X350 head.

The sleek carbon-fiber body of the Furio three-stage lift has been carefully sculpted to ensure that cables never snag as the head or lift are repositioned. Internal linear guides maintain superior column alignment over the life of the system, with zero maintenance required.

Integrated cable management features permit cables to be neatly and safely secured to the lift, and a blind-mate electrical connection between the lift and the pedestal further reduces cable clutter.

A failsafe brake mechanism keeps the lift in position during power loss (or when an e-Stop is triggered), ensuring the camera does not drop if on-air.

The FRU on the pedestal’s base is equipped with a manual lift control switch (**Figure 2** on **page 11**) that enables you to raise or lower the lift locally without a network connection or control system (the network connector for the head, CAN B, must be disconnected). The manual lift control switch enables you to lower the lift to its absolute bottom position so you can engage the lift lock for shipping or storage.

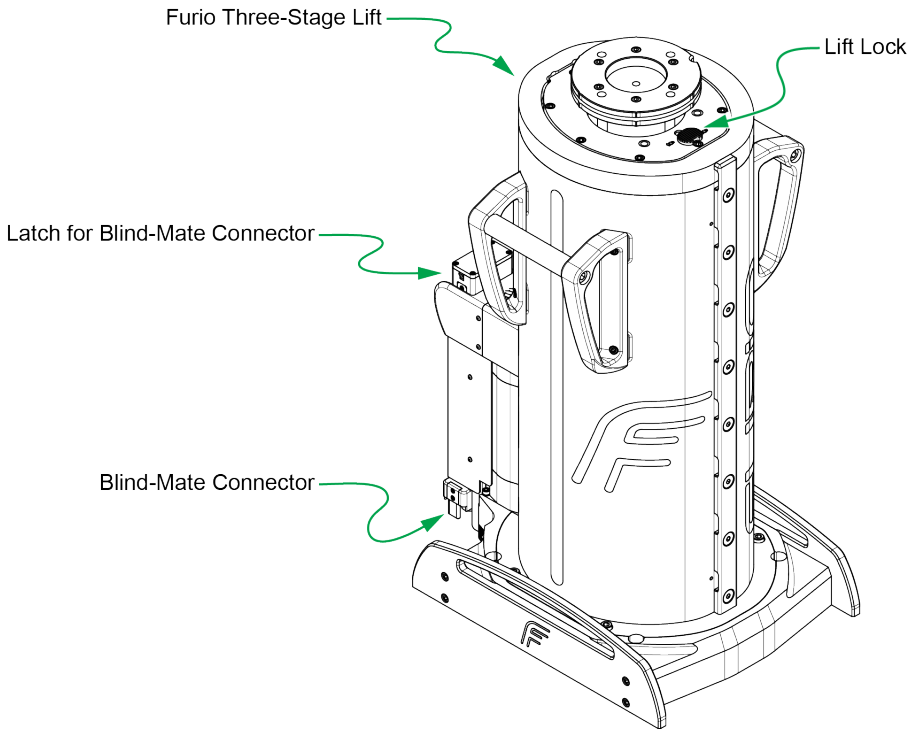
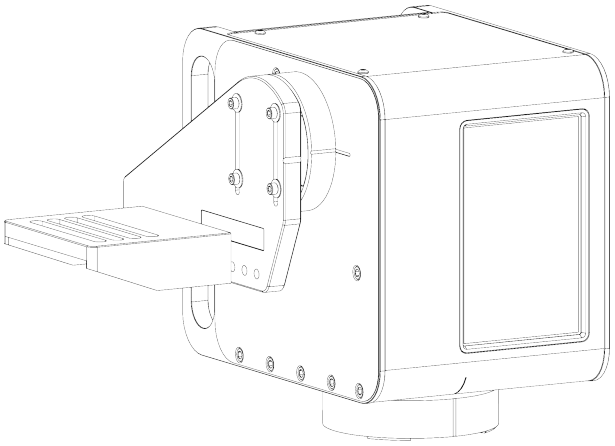


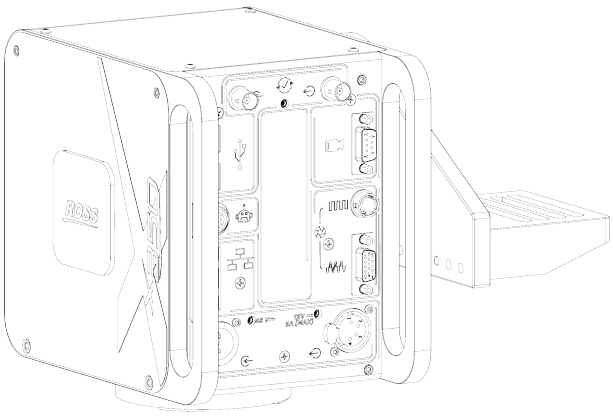
Figure 6 *- BlackBird SE - Furio Three-Staged Lift (fully retracted)*

X350 Robotic Pan and Tilt Head

The X350 robotic pan & tilt head is compact, affordable, and perfect for robotic camera applications where no prompter is required. With a 15 lb (6.8 kg) payload capacity, it can handle practically any ENG or box camera and lens combination. Based on decades of robotic pan & tilt head design experience, the X350 offers the smooth, accurate movement that you've come to expect from Ross Robotics, while also incorporating all of the advanced motion control benefits of MotionDirector technology, including keyframed moves (when controlled by SmartShell).



X350 PT Head (front angle view)



X350 PT Head (back angle view)

Figure 7 *X350 Robotic Pan and Tilt Head*

Figure 8 shows the X350 connection panel.

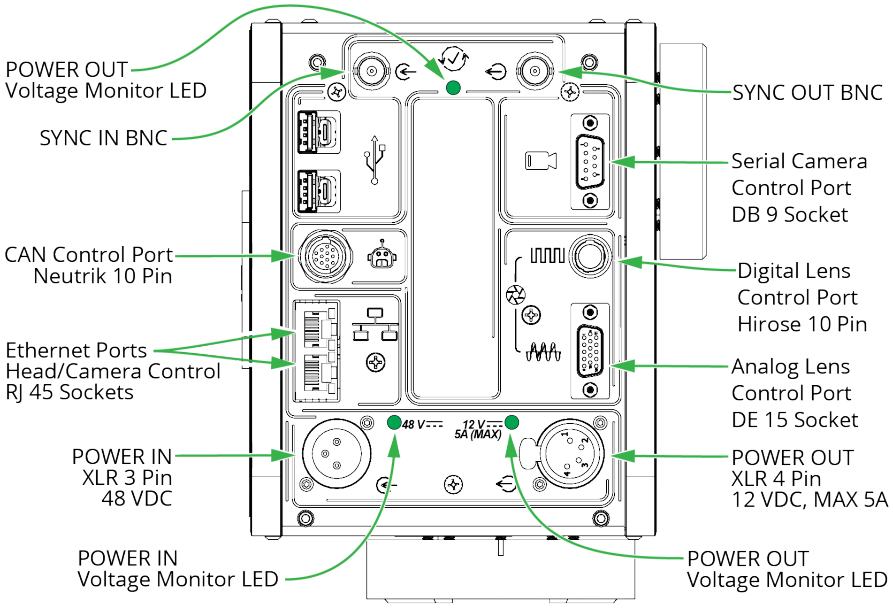


Figure 8 *X350 Robotic Pan & Tilt Head - Connection Panel*

VR600 Robotic Pan and Tilt Head

The VR600 robotic pan and tilt head accepts a net payload of up to 66 lbs (30 kg). The pan and tilt motors have high-resolution encoders, making the VR600 ideal for Virtual Set and Augmented Reality (VS/AR) applications.

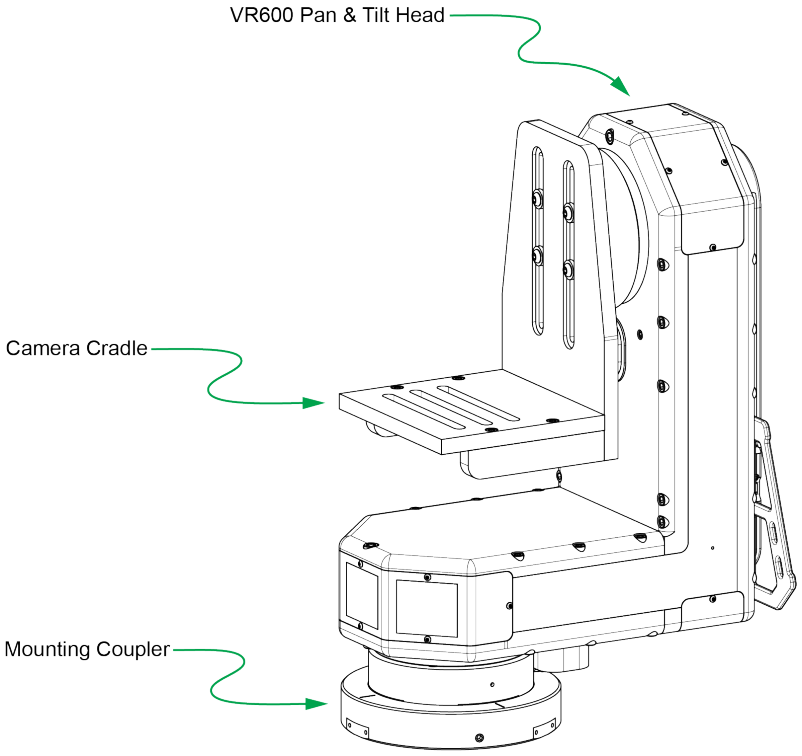


Figure 9 *- VR600 Robotic Pan and Tilt Head*

Figure 10 shows the VR600 connection panel.

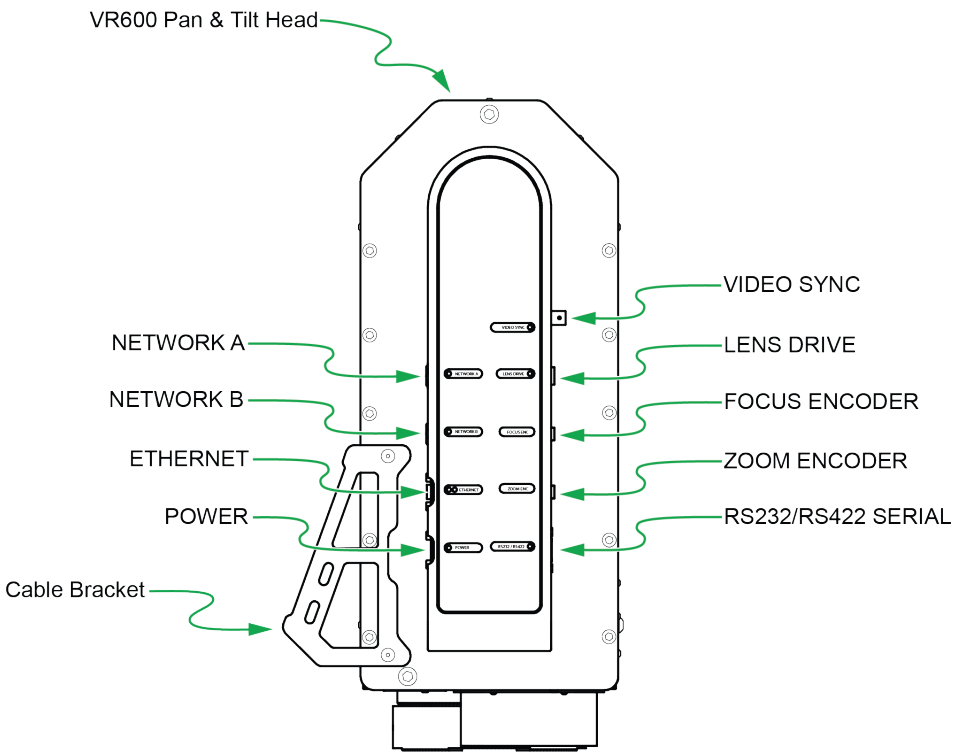


Figure 10 *- VR600 Robotic Pan and Tilt Head - Connection Panel*

Site Requirements

The following documents provide information about site requirements for installing and using Blackbird S2/SE pedestals and compatible control systems:

- ***BlackBird Studio Site Requirements (5100DR-02x-xx)***

  Applies to Ross Robotics systems that use the BlackBird pedestal base.
- ***Control Room Site Requirements for Standard Control Station (5100DR-021-xx)***

  Applies to Ross Robotics systems that use a Standard SmartShell Control Station (RRB-CTL-3 or RRB-CTL-6).
- ***Control Room Site Requirements for Standalone Control Station with Integrated Server (5100DR-032-xx)***

  Applies to Ross Robotics systems that use a Standalone SmartShell Control Station with Integrated Server (RRB-CTL-3-SRV or RRB-CTL-6-SRV).

To obtain electronic copies of these documents, contact your Ross Video sales representative.

Anti-Tipping System Assembly Procedure

This section outlines the assembly steps and safety measures required to install the anti-tipping features effectively.

- **Balanced Payload**
  To maintain system stability, always ensure that the payload is balanced both vertically and horizontally. An imbalanced payload may lead to tipping hazards and negatively affect the smooth operation of the pedestal. Regularly inspect the balance and adjust as needed before operating the system.
- **Clean and Well-Maintained Floor**
  Maintaining clean floors is crucial for smooth pedestal movement and preventing wobbling

or instability. Frequently clean the pedestal wheels using a dry foam brush with a water-dampened cloth to remove dirt and debris

Caution: Do not operate the BlackBird without the anti-tipping safety features described in this manual.

Control Systems

The BlackBird S2/SE pedestals feature an open API that allows them to control the lift and head via a variety of technologies, including Ross Video's SmartShell control application and joystick panel, production switchers such as Ross Video Carbonite, and broadcast automation systems such as Ross Video OverDrive.

This section contains the following topics about controlling BlackBird S2/SE pedestals:

SmartShell Control Application

The main interface for controlling Ross Video BlackBird S2/SE pedestals is SmartShell, an easy-to-use touch-screen interface that enables you to control camera systems automatically using stored presets, and manually using a joystick panel and/or buttons in the user interface.

The SmartShell computer comes with a touch screen monitor. You can also use the provided mouse and keyboard.

See the ***SmartShell User Guide (5100DR-002-xx)*** for detailed information.

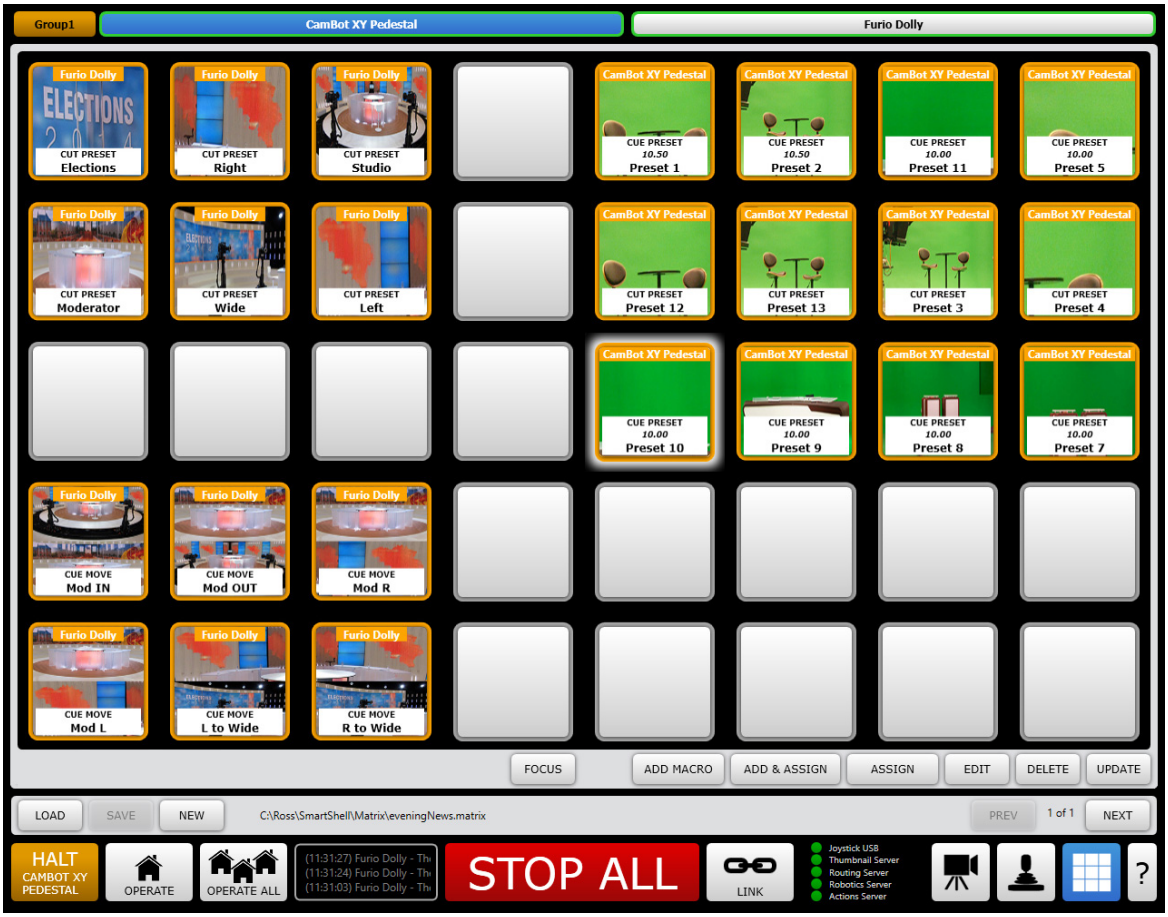


Figure 1 *- The SmartShell Control Application (in Matrix View for Panel Mode)*

The Joystick Panel

You can remotely control BlackBird S2/SE pedestals using the joystick panel (see **Figure 2**). The joystick panel enables you to move multiple axes of a camera system simultaneously, for smooth camera operation.

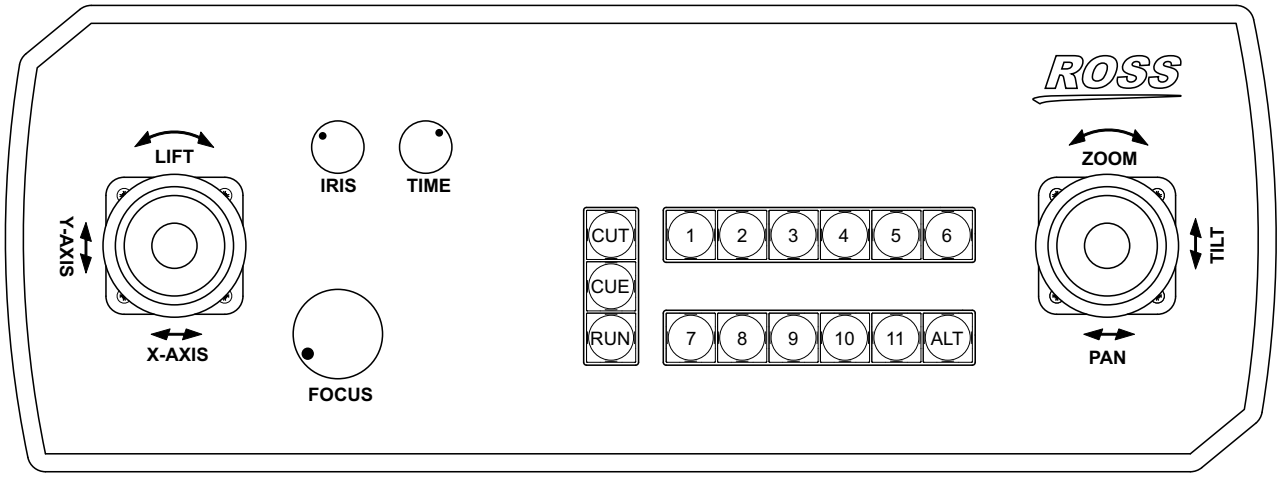


***Figure 2** - Joystick Panel (may not appear exactly as shown)*

During a show, operators typically use the joystick panel in conjunction with the matrix view in SmartShell. Alternatively, you can use the **Axis Control** panel in SmartShell to control camera systems manually. For more information, see the ***SmartShell User Guide (5100DR-002-xx)***.

Joystick Panel Controls

This section describes how the joystick controls work. Joystick controls include:

- **Camera Selection buttons (1 - 11)** — Each button selects/deselects a camera to control. Only one camera can be selected at a time.
- **Left Joystick** — Controls lift column height.
- **Right Joystick** — Controls pan, tilt, and lens zoom. The right joystick button temporarily disables variable zoom (ZOOMVAR).
- **Joystick buttons** — Not supported for the BlackBird S2/SE pedestals.
- **IRIS knob** — Reserved for future use. Not supported in the current software version.
- **TIME knob** — Rotate to adjust the recall duration for presets before you run them. You can also use the **TIME** knob to specify duration when creating presets.
- **FOCUS knob** — Rotate to adjust the lens focus, or press the knob enter or exit Quick Focus mode.
- **CUT button** — Moves the selected camera system to the preset position as quickly as possible.
- **CUE button** — Prepares a preset before you recall it.
- **RUN button** — Moves the camera system to the preset position in the specified time period, if possible.
- **ALT button** — Enables you to perform alternative functions, including the following:
  - › Enables the **TIME** knob to modify the duration of a running preset. To modify the duration, press and hold the **ALT** button, and then turn the **TIME** knob clockwise to increase the duration or counter-clockwise to decrease it.

    In SmartShell, the matrix button for the preset shows the remaining duration. The progress bar shows the elapsed time and the new total duration.

    Tip: When operating a camera system, the **ALT** button is normally yellow. When you press the button, it turns green unless the camera is on-air, in which case it turns red. The red on-air indicator applies only if your system includes tally integration.

Maintenance

BlackBird S2/SE pedestals are designed to require very little maintenance, but there are a few preventative maintenance tasks that you can perform to minimize wear and ensure proper functioning.

This section contains the following topics about maintaining BlackBird S2/SE pedestals:

General Inspection and Cleaning

Perform the following inspection and cleaning tasks periodically on the BlackBird S2/SE pedestals:

- **Clean the pedestal and robotic head.**

  Turn off the pedestal and then use a slightly water-dampened rag and a mild liquid detergent to clean the pedestal and the head.

  Do not use abrasive cleansers or chemical solvents!

  Do not get any connectors wet!

  Ensure that the pedestal and head are completely dry before turning it back on!

- **Inspect cables for damage**

  Inspect the bundle of cables that extends from the pedestal, looking for signs of excessive wear on the cable sleeve.

  If the cable sleeve is damaged, inspect the cables to ensure that no conductors are exposed or damaged. Replace any damaged cables or cable sleeves promptly. Do not operate the pedestal if any conductors are exposed!

  Inspect all points where cables connect to the pedestal, the head, or the payload. Make sure that the connectors are mated properly.

  Check that all cables are properly dressed, so that strain on connectors is eliminated as much as possible, and that the cables have adequate slack to allow for the full range of robotic motion.

- **Check the mounting bolts**

  Periodically check that the bolts holding the payload together are tight. Also check the bolts that fasten the payload to the camera cradle, the bolts that fasten the camera cradle to the head, and the bolts that fasten the head to the lift column. Checking the mounting bolts is especially important in the first few weeks after installing the payload.

- **Check the clearance of the cable guards**

  Cable guards are installed on each of the three caster wheels. They ensure that when the pedestal moves across the studio floor, it pushes cables aside rather than running over them.

  The cable guards should be set to the lowest height possible that does not result in the guards themselves contacting the studio floor.

  To check cable guards height, move the pedestal to all areas of the studio while observing the clearance between the cable guards and the floor.

  Generally, the height of the cable guards do not require adjustment after initial setup. However, if adjustments are necessary, use a 3/32" hex key to adjust the height of the cable guards.

- **Inspect wheels for dirt and debris**

  As wheels roll across the studio floor, they accumulate dirt and debris, which can impair smooth motion.

  Visually inspect the wheels to detect the presence of foreign material.

If the wheels require cleaning, follow the directions in the section, "**Cleaning the Cable Guards and Wheels**" on page 4–25.

Cleaning the Cable Guards and Wheels

As the pedestal is moved across the studio floor, the cable guards and wheels may accumulate dirt and debris. Cleaning the guards and wheels periodically helps maintain the smooth motion and positional accuracy of the pedestal.

NOTE: For optimal performance, it's important to keep the pedestal wheels clean. Sweep and mop the studio floor regularly. Avoid moving the pedestal across a dirty floor. Also, periodically replace worn spike marks with new spike tape, and remove all old tape residue from studio floors.

The easiest way to clean the wheels is to wipe down the exposed portion of each wheel and then move the pedestal manually to expose a different portion of the wheel's surface.

Before you begin:

- Gather the following materials:
  - 3/32" hex key (also known as a hexagonal wrench, or Allen key)
  - Protective gloves
  - Mild liquid detergent

    DO NOT use harsh chemical cleaners such as ammonia. Harsh chemicals can damage the wheels.
  - A clean bucket, a rag, and access to warm water.

    DO NOT use steel wool or other abrasive tools that can damage the wheels.
- Move the pedestal to a clean area of the studio floor and ensure that there is ample working space all around the pedestal.
- Ensure that the payload is balanced and that the anti-tip feet are lowered to prevent the possibility of tipping.
- Disengage the wheel locks on each of the pedestal's wheels.
- Set the ON/OFF switch on the pedestal base to the OFF (O) position.

To clean the cable guards:

1. Use a 3/32" hex key to loosen the screws that fasten cable guards to the wheel unit. Each cable guard has two screws. Loosen the screws just enough to allow the cable guard to move (see **Figure 1**).

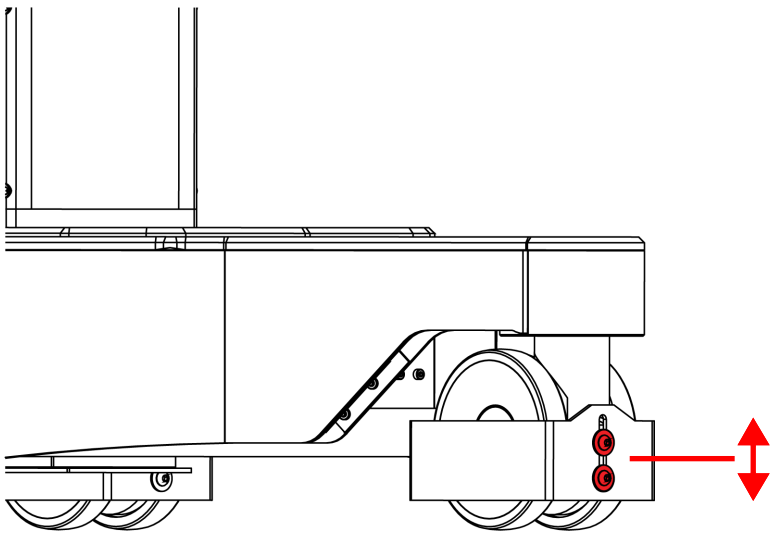


Figure 1 *Adjusting the height of the cable guards*

2. Raise the cable guard to the highest position, and then tighten the screws just enough to hold the pieces in position. Do not over-tighten.

3. Put on protective gloves, and then clean all three cable guards by wiping the bottom edge of each of the cable guards using a cloth, warm water, and mild detergent, such as dish detergent.

   IMPORTANT: Wear protective gloves. Debris on the wheels may be sharp. Glass shards from broken bulbs may be embedded in the wheels.

4. Lower the guards to their original position by using a 3/32" hex key to loosen the screws that fasten the cable guards.

   The cable guards prevent the pedestal from running over cables. The guards should be set as low as possible, but must not bottom out as the pedestal moves across the studio floor.

5. Tighten the screws to secure the guards. Do not over-tighten.

To clean the wheels:

1. Put on protective gloves, and then clean portion of the wheel that is exposed above the cable guard using a cloth, warm water, and mild detergent (see **Figure 2**).

   IMPORTANT: DO NOT use harsh cleaning agents on the wheels. Harsh chemicals or solvents such as acetone can seriously and permanently damage wheel material. Use only a mild detergent, such as dish detergent.

   IMPORTANT: Wear protective gloves. Debris on the wheels may be sharp. Glass shards from broken bulbs may be embedded in the wheels.

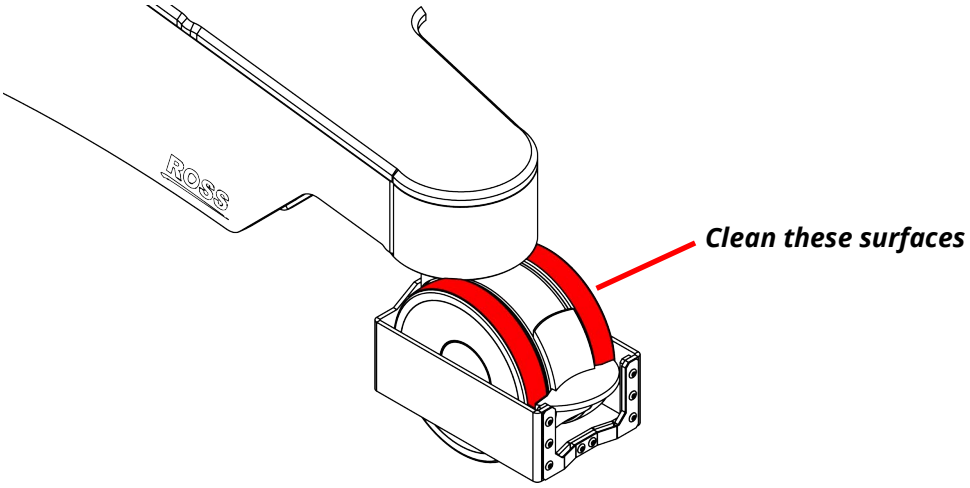


Figure 2 *Clean the exposed portion of the wheel's surface*

2. Manually move the pedestal base forward or backward to expose another portion of the wheel's surface and wipe the wheel's surface using a cloth, warm water, and mild detergent.
3. Repeat **Step 2** until all of the wheel's surface has been cleaned.
4. Repeat the cleaning process on the other two wheels.

Balancing the Payload on a VR600 or X350 Head

For best performance, and to reduce wear on the head's drive train, you must ensure that the payload's center of gravity is aligned with the tilt axis.

Balance the payload when installing a new VR100 or VR600 head, and whenever you replace, add, or reposition any payload components. Balance the payload horizontally first, and then vertically.

The head and camera cradle are designed to make balancing easy. **Figure 3** and the following lists identify the payload balancing adjustment features:

Horizontal adjustment components

- Depending on the camera model, two or more screws (with washers) to secure the camera to the camera cradle.

- Three horizontal slots on the camera cradle allow for horizontal fine-tuning.

IMPORTANT: Always use two (or more) screws in a single slot to fasten the camera to the cradle.

Vertical adjustment components

- Four screws (with washers) that join the cradle to the head allow for vertical adjustment (up / down)
- A series of threaded holes allow the screws to be repositioned for major vertical adjustments.
- Two vertical slots on the camera cradle allow for vertical fine-tuning.

IMPORTANT: Always use four screws to fasten the camera cradle to the head (two per slot).

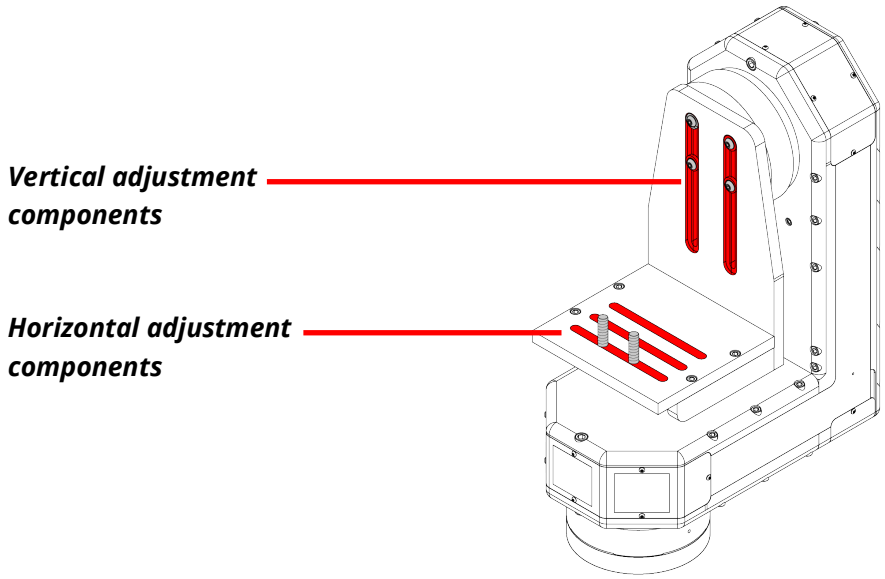


Figure 3 *Payload Balancing Adjustment Components*

To balance the payload horizontally:

1. Ensure that there's no power entering the head by disconnecting the Head-to-Ped cable from the head's connection panel.
2. Manually tilt the payload so that it is horizontal, and then release it.
3. If the payload does not tilt, it is horizontally balanced. Skip the remaining steps, and proceed to the next procedure.
4. Use the horizontal adjustment components (**Figure 3**) to move the payload away from the direction it tilted, and then test again.
5. Continue adjusting and testing until the payload is horizontally balanced.

   Tip: After you balance the payload horizontally, use a grease pencil or marker to mark the position of the payload on the camera cradle.

To balance the payload vertically:

1. Manually tilt the payload approximately 40º (but not as far as it can go), and then release it.
2. If the payload does not move, it is vertically balanced. Skip the remaining steps in this procedure.
3. Based on the direction the head tilts, note whether it needs to be raised or lowered:
   - › If the payload tilts back towards horizontal, it is mounted too low, and must be raised.
   - › If the payload continues tilting away from horizontal, it is mounted too high, and must be lowered.
4. Use the vertical adjustment components (**Figure 3**) to raise or lower the payload as required, and then test again.

   Tip: If you cannot easily access the vertical adjustment screws, you may need to temporarily remove the payload from the camera cradle. Be sure to return it to its original horizontal position.

5. Continue adjusting and testing until the payload is vertically balanced.

   Tip: After you balance the payload vertically, use a grease pencil or marker to mark the position of the cradle mount screws on the cradle.

Balancing the Payload on a X350 Head

For best performance, and to reduce wear on the head's drive train, you must ensure that the payload's center of gravity is aligned with the tilt axis. You must balance the payload horizontally, and then vertically.l

This section describes how to balance the payload. Perform the procedures in this section when installing a new X350 head, and whenever you replace, add, or reposition any payload components.

The head and camera cradle are designed to make balancing easy. **Figure 4** illustrates the following payload balancing adjustment features:

- Three screws along the bottom edge of the camera cradle fasten the cradle pieces together, and allow for horizontal adjustment (forwards / backwards):
  - › A series of threaded holes allow the screws to be repositioned for major horizontal adjustments.

    Tip: When repositioning the screws, be careful to avoid losing washers.
  - › Slots allow for horizontal fine-tuning.

  IMPORTANT: Be sure to tighten the three screws that fasten together the camera cradle pieces. These screws are shipped partially-loose.
- Four screws that join the camera cradle to the head allow for vertical adjustment (up / down):
  - › A series of threaded holes allow the screws to be repositioned for major vertical adjustments.

    Tip: When repositioning the screws, be careful to avoid losing washers.
  - › Vertical slots on the camera cradle allow for vertical fine-tuning.

  IMPORTANT: Always use four screws to fasten the camera cradle to the head (two per slot).

IMPORTANT: An overweight or improperly balanced payload can cause permanent damage to the head.

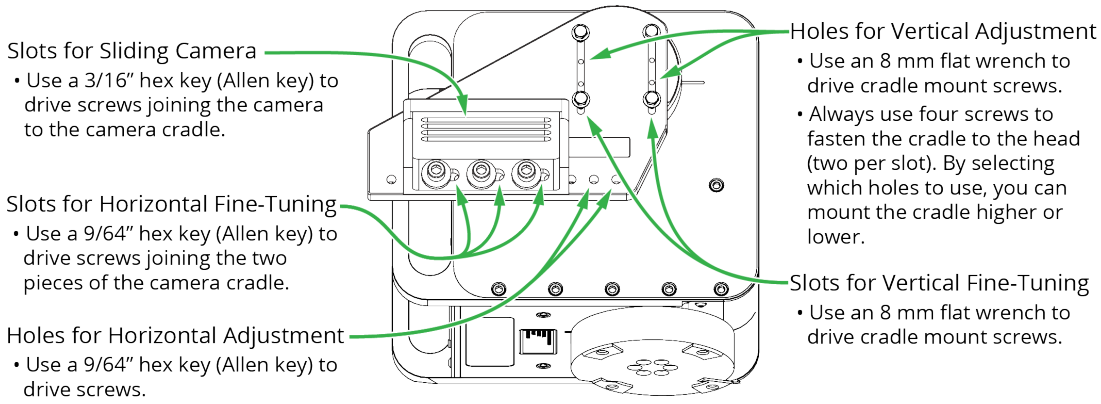


Figure 4 *- Payload Balancing Adjustment Features*

To balance the payload horizontally:

1. Ensure that power to the head is disconnected.
2. Manually tilt the payload so that it is horizontal, and then release it.
3. If the payload does not tilt, it is horizontally balanced. Skip the remaining steps, and proceed to the next procedure.
4. Use the horizontal adjustment features (**Figure 4**) to move the payload away from the direction it tilted, and then test again.
5. Continue adjusting and testing until the payload is horizontally balanced.

To balance the payload vertically:

1. Manually tilt the payload approximately 40º (but not as far as it can go), and then release it.
2. If the payload does not move, it is vertically balanced. Skip the remaining steps in this procedure.
3. Based on the direction the head tilts, note whether it needs to be raised or lowered:
   - If the payload tilts back towards horizontal, it is mounted too low, and must be raised.
   - If the payload continues tilting away from horizontal, it is mounted too high, and must be lowered.
4. Use the vertical adjustment features (**Figure 4**) to raise or lower the payload as required, and then test again.

   Tip: If you cannot easily access the vertical adjustment screws, you may need to temporarily remove the payload from the camera cradle. Be sure to return it to its original horizontal position.
5. Continue adjusting and testing until the payload is vertically balanced.

Tip: After you balance the payload vertically, use a grease pencil or marker to mark the position of the cradle mount screws on the cradle.

Removing the VR600 Head

To remove the head:

1. Move the pedestal to an open area so you have easy access to all sides.
2. Use the control system or the manual lift control switch to lower the lift column all the way to allow easy access to the payload.
3. Remove the payload, and then turn the pedestal **OFF (O)**.
4. Do the following to remove the head:
   a. Disconnect all cables from the head.
   b. Have someone hold the head steady to prevent it from falling.
   c. Use a 4 mm hex key to remove the three screws in the mounting coupler that fastens the head to the lift column (**Figure 5**).

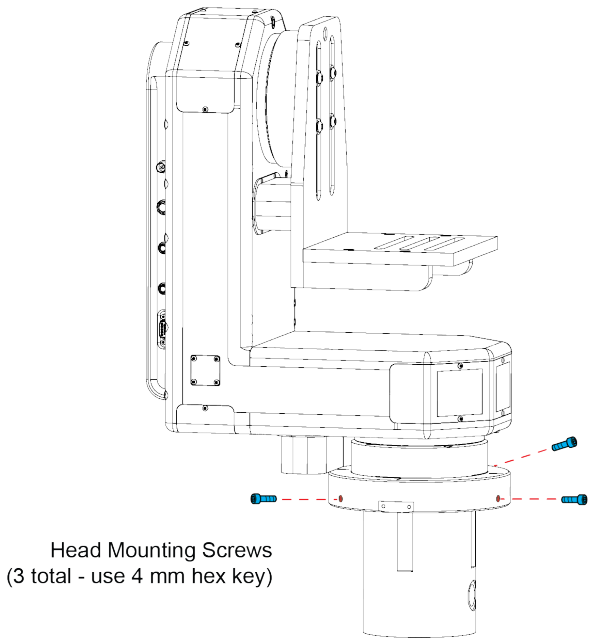


Figure 5 *- Removing the VR600 Head from the Lift Column*

   d. Remove the head and place it gently on a sturdy surface.

Removing the X350 Head

To remove the head:

1. Move the pedestal to an open area so you have easy access to all sides.
2. Use the control system or the manual lift control switch to lower the lift column all the way to allow easy access to the payload.
3. Remove the payload, and then turn the pedestal **OFF (O)**.
4. Do the following to remove the head:
   a. Disconnect all cables from the head.
   b. Have someone hold the head steady to prevent it from falling.
   c. Use a 3/16” hex key to remove the four screws that fasten the head to the lift column.

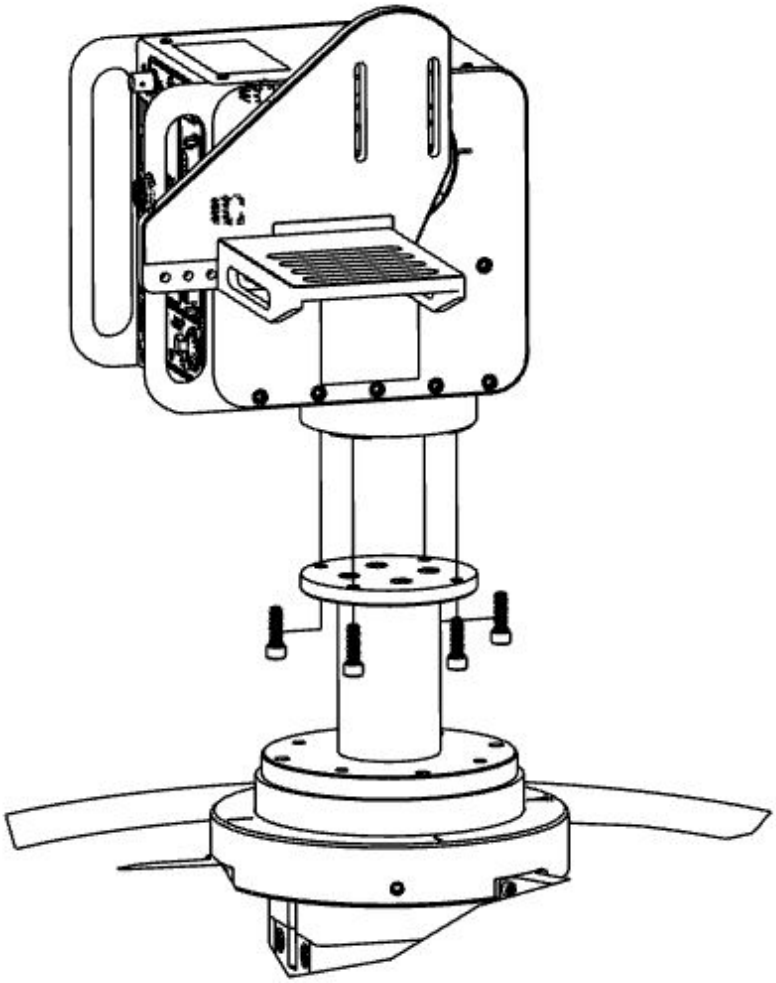


Figure 6 *- Removing the X350 Head from the Lift Column*

5. Remove the head and place it gently on a sturdy surface.

Replacing the FRU

The **Field Replaceable Unit (FRU)** contains all the control electronics. All network and power connections for the pedestal, lift, and head are through the FRU's connection panel (**Figure 7**).

If the FRU malfunctions, you can easily replace it with a different one. This section describes how to remove and replace the FRU.

Removing and replacing the FRU takes approximately 20 minutes.

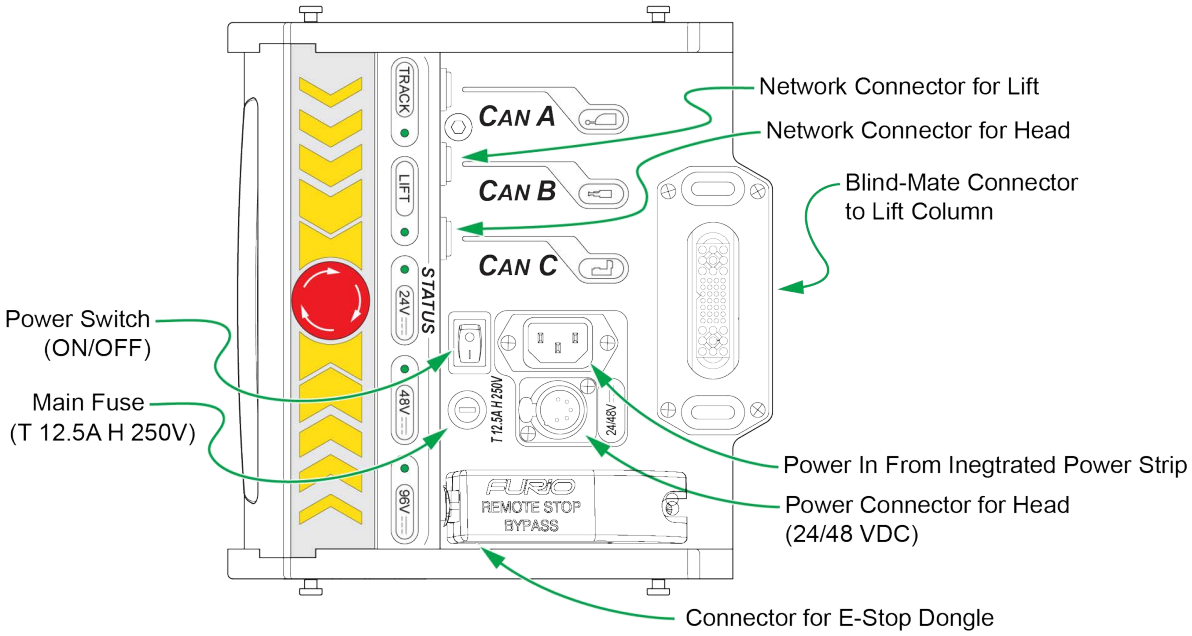


***Figure 7** - BlackBird S2/SE FRU Connection Panel*

Before you begin:

1. Read all steps and ensure that you understand them.

   If you have any questions, contact Ross Video Technical Support.
2. Have the following tools and materials available:
   - 3 mm hex key (also known as an Allen key or hexagonal key wrench)
   - Replacement FRU, with appropriate configuration files installed. For more information, contact Technical Support.
3. Move the pedestal to an location that allows ample space to work.

To remove and replace the Main FRU:

1. Turn off the pedestal, and then disconnect the FRU's Power In cable (**Figure 7**).
2. Disconnect all other cables from the FRU.

   Tip: Ensure that each cable is labeled, so they're easy to reconnect later.
3. Disengage the lift lock connector (**Figure 8**).

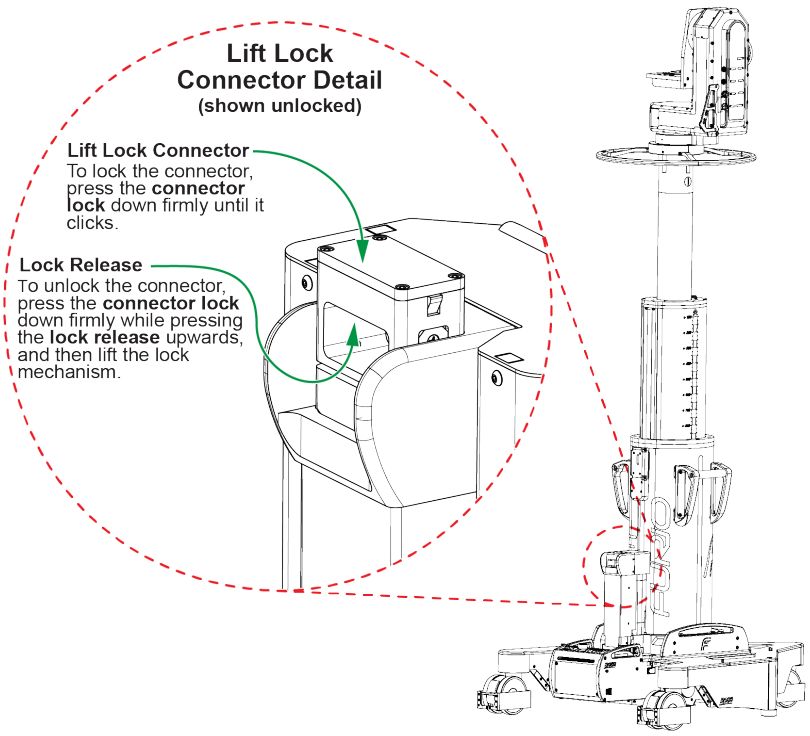


Figure 8 *- Lift Lock Connector Detail*

4. Use a 3 mm hex key to remove the four screws that secure the FRU to the pedestal.

Figure 9 shows the four mounting screws (colored blue in the drawing for illustrative purposes).

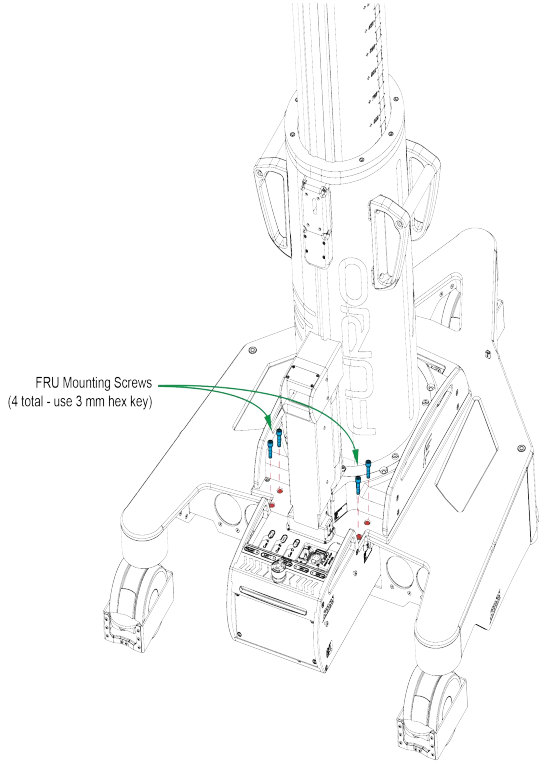


Figure 9 *- Four Mounting Screws that Secure the FRU*

5. Grasp the handles on the FRU, and then slowly slide it out from the body of the pedestal.

   Tip: The FRU has two runners that ride on guide ledges within the body of the pedestal. Be prepared to catch the FRU as it disengages from the body of the pedestal.

   IMPORTANT: Store the removed FRU in a safe location, away from moisture and extreme temperatures.

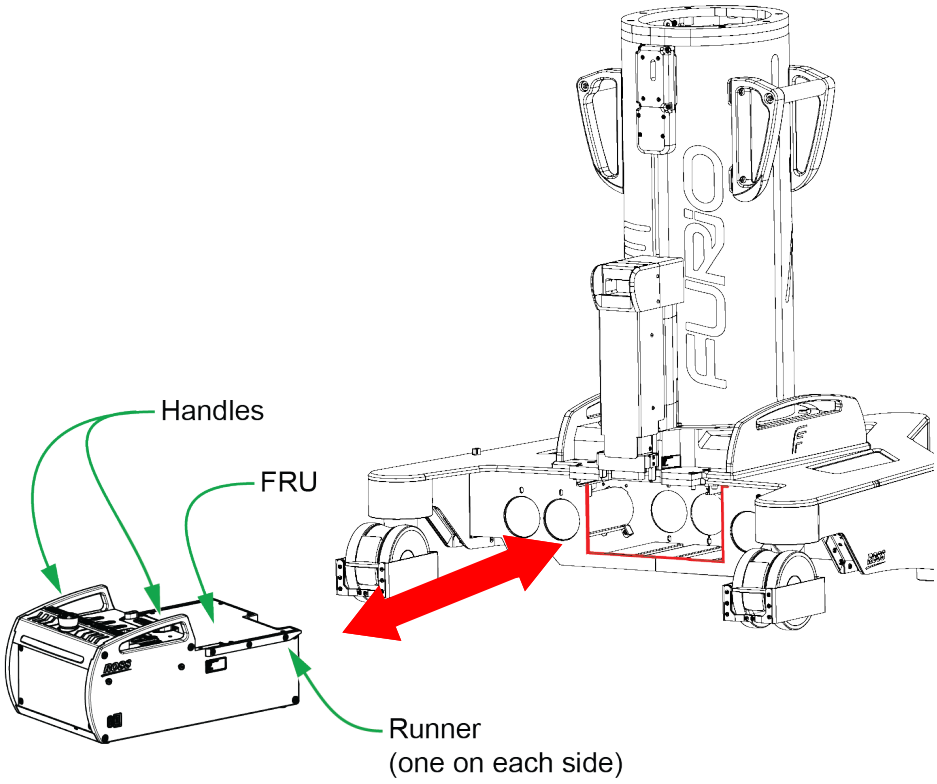


Figure 10 *- Removing the FRU from the BlackBird S2/SE Pedestal*

6. Align the runners of the new FRU with the guide ledges within the body of the pedestal, and then slowly slide the FRU into place. Continue until the FRU is fully inserted.

   Tip: When the FRU is fully inserted, the four mounting holes on the top of the pedestal base align perfectly with the mounting holes on the FRU.

7. Insert and tighten the four mounting screws you removed in step **4** on page 4-32, using a 3 mm hex key.
8. Engage the lift lock connector (see **Figure 8** on **page 32**).
9. Reconnect all cables to the FRU.

   IMPORTANT: Ensure that all cables are reconnected to their original positions.

10. Turn on the FRU and then test the pedestal's operation.

Technical Specifications

This section contains technical specifications for BlackBird S-series pedestals, fitted with either the VR100, VR600, or X350 head. It includes the following sub-sections:

BlackBird S2/SE Specifications Table

The following tables lists technical specifications for the BlackBird S2 and SE pedestals.

Property	BlackBird S2	BlackBird SE
General Properties		
Lift Column Type	• Furio Two-Stage	• Furio Three-Stage
Robotic Head	• VR600, X350	• VR600, X350
Pan/Tilt Repeatability	• <0.02 degrees	• <0.02 degrees
Maximum Payload Capacity	• VR600: 125 lbs (57 kg) • X350: 15 lbs (6.8 kg)	• VR600: 125 lbs (57 kg) • X350: 15 lbs (6.8 kg)
Maximum Speed		
Pan (degrees/sec)	• VR600: 0.001 - 90 degrees/sec • X350: 0.001 - 60 degrees/sec	• VR600: 0.001 - 90 degrees/sec • X350: 0.001 - 60 degrees/sec
Tilt (degrees/sec)	• VR600: 0.001 - 90 degrees/sec • X350: 0.001 - 60 degrees/sec	• VR600: 0.001 - 90 degrees/sec • X350: 0.001 - 60 degrees/sec
Lift	• 5” (127 mm) per second	• 6” (150 mm) per second
Height		
Pedestal and Lift Without Head	• min 37” (939 mm) • max 56.2” (1428 mm)	• min 37.2” (945 mm) • max 72.2” (1833 mm)

Pedestal and Lift With Head (without camera cradle)	• VR600:
	  • min: 55.4" (1406 mm)
	  • max: 74.4" (1889 mm)
	• X350:
	  • min: 49.8" (1265 mm)
	  • max: 68.8" (1748 mm)
		• VR600:
		  • min: 55.4" (1407 mm)
		  • max: 90.3" (2294 mm)
		• X350:
		  • min: 49.8" (1266 mm)
		  • max: 84.8" (2153 mm)

Head Only (without camera cradle)	• VR600: 17.7” (449 mm) • X350: 7.4” (188 mm)	• VR600: 17.7” (449 mm) • X350: 7.4” (188 mm)

Distance from Floor to Tilt Axis	• VR600:
	  • min: 51.75” (1314 mm)
	  • max: 70.99” (1887 mm)
	• X350:
	  • min: 47.90” (1216 mm)
	  • max: 67.14” (1705 mm)
		• VR600:
		  • min: 52.07” (1322 mm)
		  • max: 86.99” (2209 mm)
		• X350:
		  • min: 48.22” (1224 mm)
		  • max: 83.14” (2111 mm)

Distance from Floor to Cradle (the surface to which payload is mounted) Payload must be balanced around the tilt axis. Balancing the load determines the cradle position in relation to the tilt axis.		
With Lift Column and Head at Min Height	• VR600: 45.5” (1154 mm) • X350: 44.7” (1135 mm)	• VR600:45.5” (1154 mm) • X350: 44.7” (1135 mm)
With Lift Column and Head at Max Height	• VR600: 68.7” (1745 mm) • X350: 65.9” (1675 mm)	• VR600: 84.6” (2149 mm) • X350: 81.9” (2080 mm)
Length and Width of Pedestal Base	• length 42.5” (1081 mm) • width 32.0” (813 mm)	• length 42.5” (1081 mm) • width 32.0” (813 mm)

Property	BlackBird S2	BlackBird SE

Weight (Base + Lift + Head)	• VR600: 292.7 lbs (132.8 kg)
	• X350: 249.3 lbs (113.1 kg)
		• VR600:
		  • 367.5 lbs (166.7 kg) [with weights]
		  • 299.3 lbs (135.8 kg) [without weights]
		• X350:
		  • 324 lbs (147 kg) [with weights]
		  • 255.9 lbs (116.1 kg) [without weights]

Range of Motion		
Pan Axis	• VR600:+/- 178 degrees • X350:+/- 178 degrees	• VR600: +/- 178 degrees • X350:+/- 178 degrees
Tilt Axis	• VR600: +/- 90 degrees • X350: +/- 90 degrees	• VR600: +/- 90 degrees • X350: +/- 90 degrees
Lift Axis (vertical stroke)	• 19” (4830 mm)	• 34.3” (8710 mm)

Physical Dimensions of the BlackBird S2

The following images show a side view of the BlackBird S2 pedestal with its two-stage lift column in both its lowest position and its highest and fitted. A separate image is provided for each of the available heads: VR100, VR300, and X350. Measurements are shown in inches, followed by [millimeters].

- **Figure 1** - Dimensions of the BlackBird S2 Pedestal with a VR600 Head
- **Figure 2** - Dimensions of the BlackBird S2 Pedestal with a X350 Head

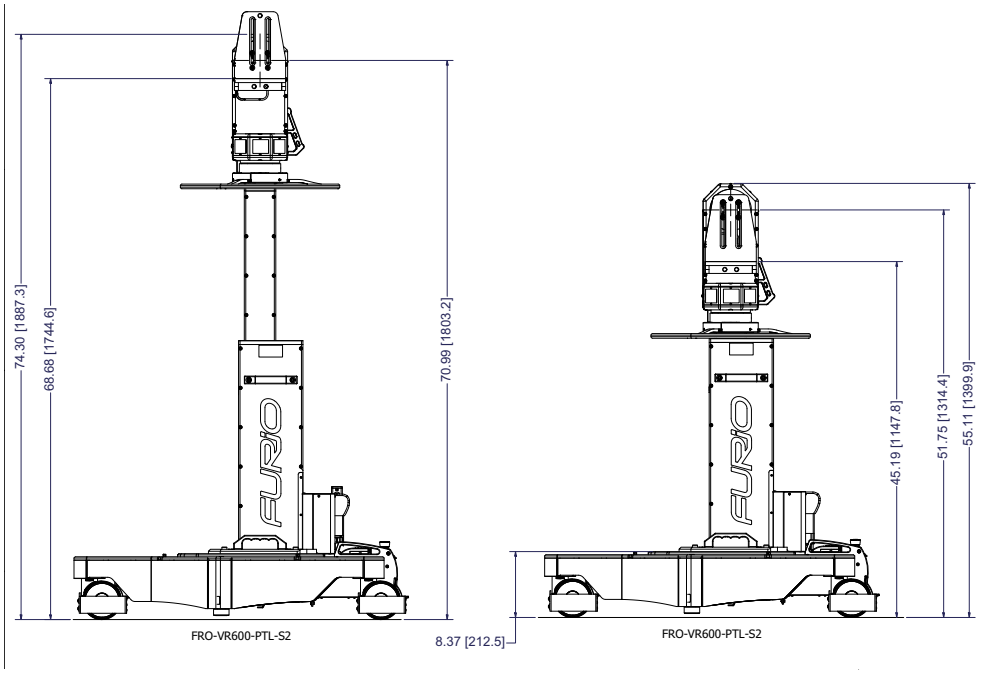


***Figure 1** - Dimensions of the BlackBird S2 Pedestal with a VR600 Head (side view)*

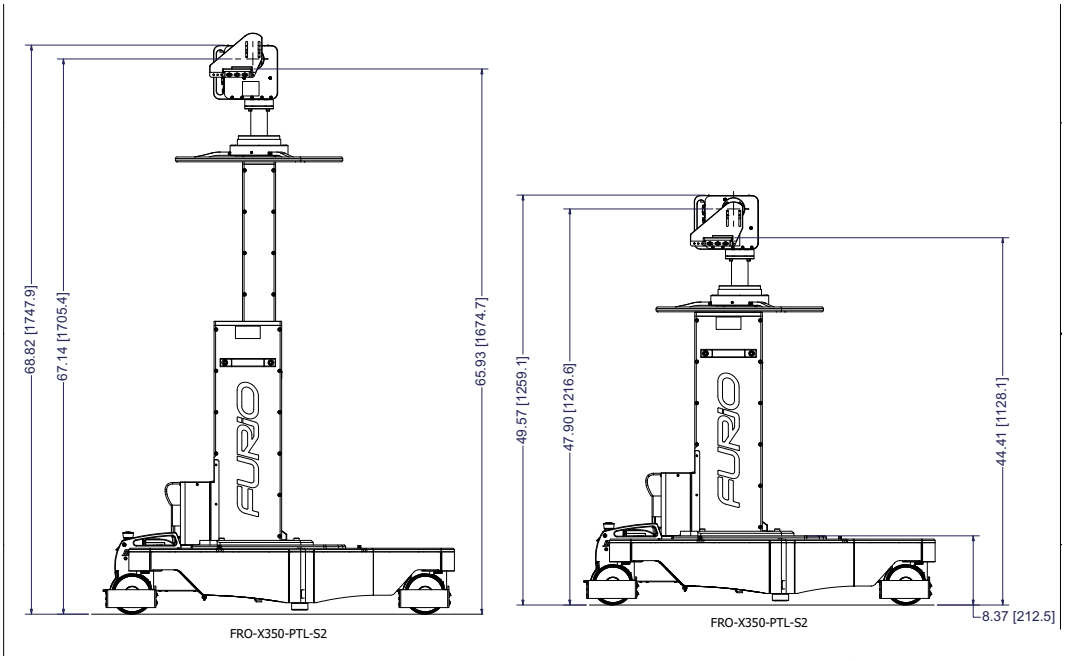


Figure 2 *- Dimensions of the BlackBird S2 Pedestal with an X350 Head (side view)*

Physical Dimensions of the BlackBird SE

The following images show a side view of the BlackBird SE pedestal with its three-stage lift column in both its lowest position and its highest and fitted. A separate image is provided for each of the available heads: VR100, VR300, and X350. Measurements are shown in inches, followed by [millimeters].

- **Figure 3** - Dimensions of the BlackBird SE Pedestal with a VR600 Head
- **Figure 4** - Dimensions of the BlackBird SE Pedestal with a X350 Head

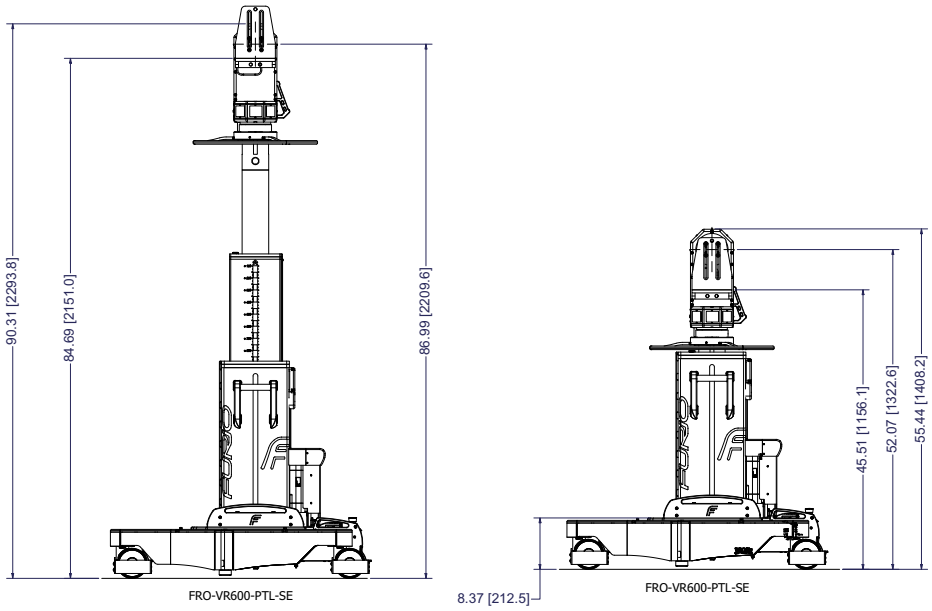


Figure 3 *- Dimensions of the BlackBird SE Pedestal with a VR600 Head (side view)*

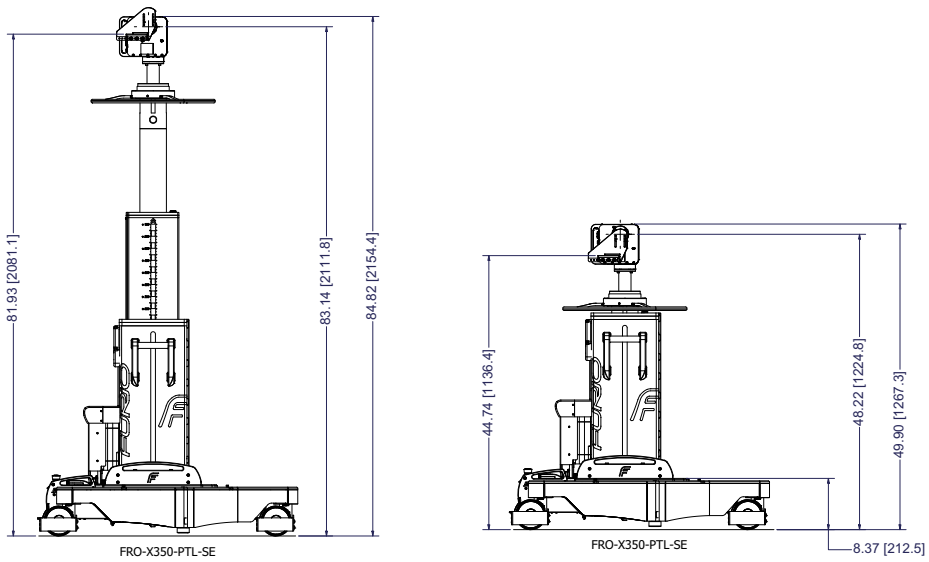


Figure 4 *- Dimensions of the BlackBird SE Pedestal with an X350 Head (side view)*

Physical Dimensions of the BlackBird S2/SE Base

Figure 5 shows the physical dimensions of the BlackBird S2/SE pedestal. Measurements are shown in inches, followed by [millimeters].

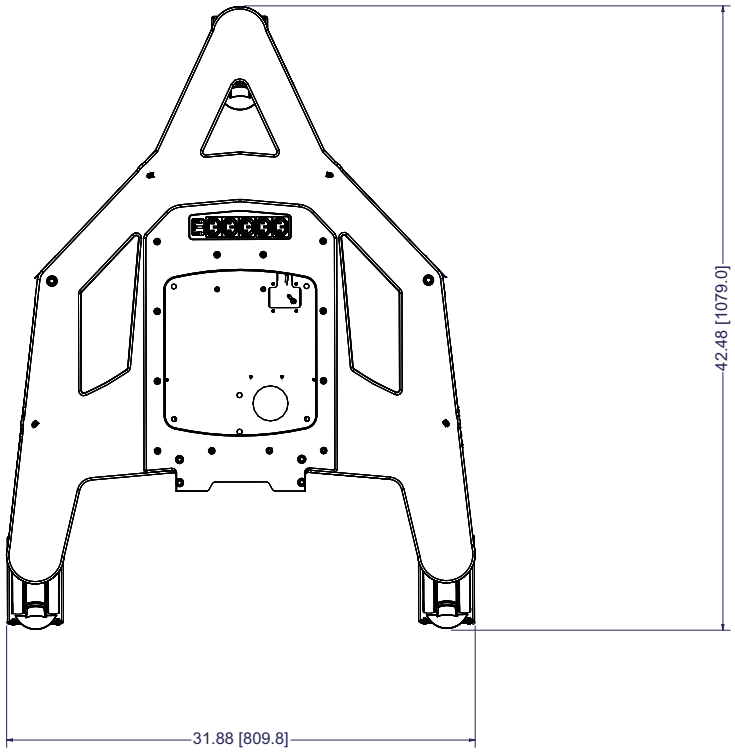


Figure 5 *- Dimensions of the BlackBird S2/SE Pedestal Base (top view)*

Electrical and Environmental Specifications

The Furio Camera Motion Systems series includes three systems—Furio Floor-Mount, Furio BlackBird, and Furio SkyDolly—designed to carry and control camera and teleprompter payloads, offering precise pan, tilt, zoom, and path-following capabilities for dynamic shots in various environments like film production, live events, and TV studios. All systems share common components, with the primary difference being the dolly's mechanical design.

	Furio Floor-Mount Rail System	**Furio SkyDolly Ceiling-Mounted Rail System**	**Furio BlackBird Elevation System**
Full system view	 For more information on Furio SkyDolly Systems, refer to the ***Technical Manual for Studio (5100DR-043-04)***.	 For more information on Furio SkyDolly Systems, refer to the ***Technical Manual for Furio SkyDolly (5100DR-074-03)***.	
Remote controlled movements (by an operator)	1) **X axes** through traction motor on the Dolly 2) **Z axes** through a motor on the Lift 3) **Pan & Tilt** through the Head where the payload is mounted.		1) **Z axes** through a motor on the Lift 2) **Pan & Tilt** through the Head where the payload is mounted.
Manual controlled movements (by an operator)	**None**		**XY Axes**
Differences	Floor-Mounted Rail motorized dolly	Ceiling-Mounted Rail motorized dolly	Non-motorized floor dolly

	Furio Floor-Mount Rail System	Furio SkyDolly Ceiling-Mounted Rail System	Furio BlackBird Elevation System
Product ratings	**Electrical Input rating:** 12.5A, 100-240Vac, 50/60Hz **Electrical Output rating (Power bar):** 5A max, 100-240Vac, 50/60Hz **Mechanical rating:** • X350: 5.3Kg Max Payload • VR600: 25Kg Max Payload **System Speed Rating:** • **S2 Lift:** 127mm/sec • **SE Lift:** 152mm/sec • **X350 Pan & Tilt:** 0.001 - 45 deg /sec. • **VR600 Pan & Tilt:** 0.001 -90 deg /sec. **Environmental ratings:** 0ºC to +40ºC, 0% to 90% RH (non-condensing)		
Input Ports	**Dollies:** 1x Main AC input, 1x Remote E-Stop **X350 Head:** 1x 48Vdc input power, 2x Ethernet Ports, 1x Sync In Port, 1x CAN Control Port **VR600 Head:** 1x 48Vdc input power, 1x Ethernet Ports, 1x Sync In Port, 2x CAN Control Port		
Output Ports	**Dollies:** 5x AC Main power bar, 1x Can (wiredraw), **X350 Head:** 1x 12Vdc output, 1x Serial Port, , 1x Sync Out Port, 2x Lens control ports **VR600 Head:** 1x Serial Port, , 3x Lens/Cam control ports		