



RobotEye REV25-ST

3-Axis High Performance Stabilized Vision System User Manual

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Revision Table

Date	Notes
27/05/2015	Initial Release

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1 Introduction

**IMPORTANT**

READ CAREFULLY BEFORE USE
KEEP FOR FUTURE REFERENCE

The REV25-ST User Manual is provided as a guide to the connection, configuration and safe use of the Ocular Robotics REV25-ST VISION - STABILIZED System. For development of custom software applications for use with the REV25-ST system see the RobotEye Network Interface Manual, RobotEye API Reference Manual, or contact Ocular Robotics.

Chapter 2 Basics, describes the initial setup and basic use of the REV25-ST including information on cleaning, maintenance and safety. Chapters 3 General Description presents a system description in terms of the system's Mechanical and Electrical properties and its communication and power interfaces.



CAUTION - USE OF CONTROLS OR ADJUSTMENTS OR PERFORMANCE OF PROCEDURES OTHER THAN THOSE SPECIFIED HEREIN MAY RESULT IN SIGNIFICANT RISK OF INJURY. IT WILL ALSO VOID YOUR WARRANTY

2 Basics



IMPORTANT – Before connecting the power to this system or attempting to operate it in any way, read and follow all instructions regarding safe operation of this system contained in section 2.5.

2.1 System Components

2.1.1 REV25-ST VISION - STABILIZED Unit

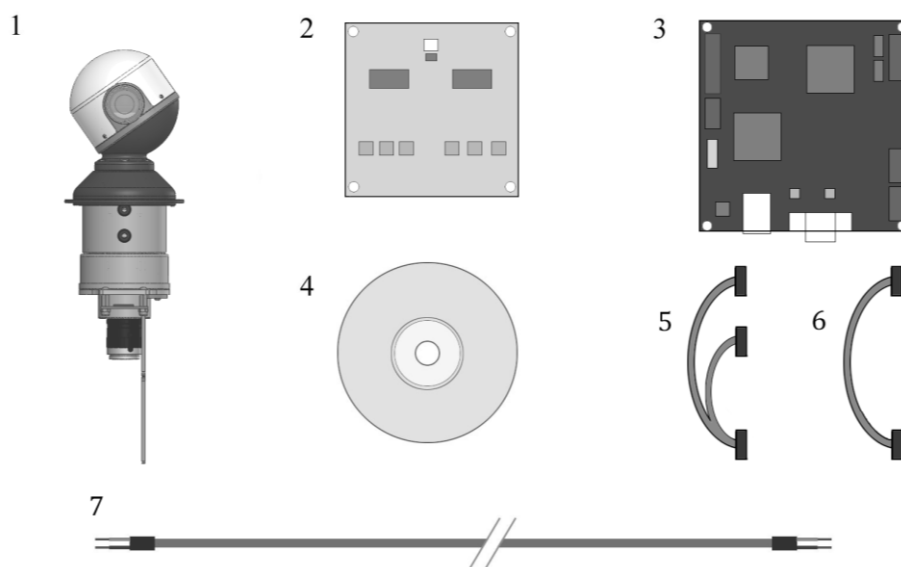


Figure 2.1 – REV25-ST Vision Unit Packing List

The Ocular Robotics RobotEye REV25-ST VISION - STABILIZED unit is supplied standard with the following components, each of which can be seen in Figure 2.1:

1. The RobotEye REV25-ST VISION - STABILIZED unit.
2. Motor Power Amplifier Board.
3. 2-Axis Motion Controller Board.
4. Installation & documentation disk.
5. Cable Harness.
6. AHRS to Controller Board Cable Harness
7. REV25-ST VISION - STABILIZED unit power cable

2.1.2 REV25-ST VISION - STABILIZED System

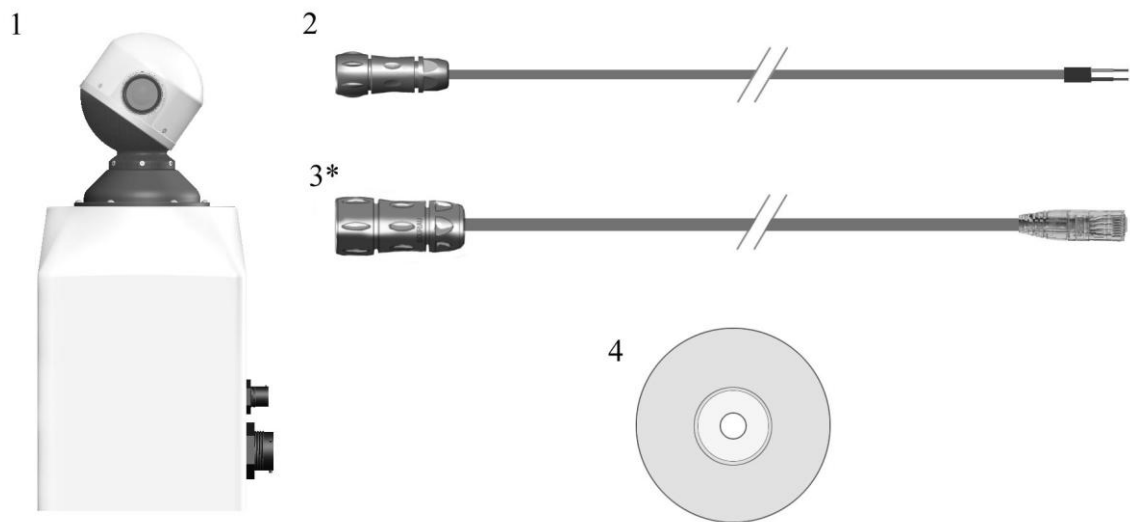


Figure 2.2 – REV25-ST VISION - STABILIZED System Packing List

The Ocular Robotics RobotEye REV25-ST VISION - STABILIZED System is an REV25-ST VISION - STABILIZED Unit mounted in an IP65* enclosure with power connector and dual Ethernet connectors for RobotEye control and camera communication with the following components, each of which can be seen in Figure 2.2:

1. The RobotEye REV25-ST VISION - STABILIZED System.
2. REV25-ST VISION - STABILIZED system power cable.
3. IP68 LAN cable (*optional).
4. Installation & documentation disk.

* To maintain the IP65 enclosure rating after installing or accessing the camera the base plate must be replaced and base plate screws correctly tensioned

2.2 What You Need

In order to operate the REV25-ST VISION - STABILIZED unit and system, you will need:

1. Power supply – A 24 volt DC 10 Amp power supply with a continuous current capacity of 10 Amps.
2. A suitable C-mount camera – Ocular Robotics can supply and mount a range of Allied Vision Technologies GigE cameras.
3. Ethernet cable – A standard Ethernet cable (Cat5e or Cat6) is needed for control and communication with the REV25-ST system.
4. Camera communications cable – All cameras supplied by Ocular Robotics have a GigE communications interface.
5. A computer with a Windows or Linux operating system with one free 100 Megabit Ethernet port.

2.3 Handling and Transportation

Avoid handling the RobotEye using the scanning head. This may result in mechanical damage and misalignment of the sensor.

When transporting, make sure the RobotEye head will not be subject to large external loads and stresses.

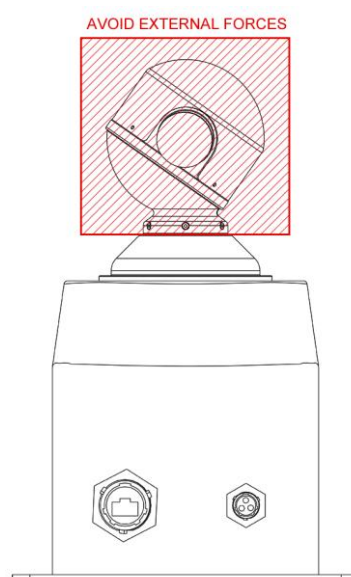


Figure 2.3 – REV25-ST Handling Zones

2.4 Initial Setup



NOTE – The robot eye head must be handled with extra care during transport and installation. External loads exerted on the head may result in damage.

2.4.1 REV25-ST VISION - STABILIZED Unit

Follow the steps below to set the REV25-ST unit up for use on a computer with a Windows or Linux operating system. The library version number and system IP address shipped with your system should be noted on the supplied *Certificate*.

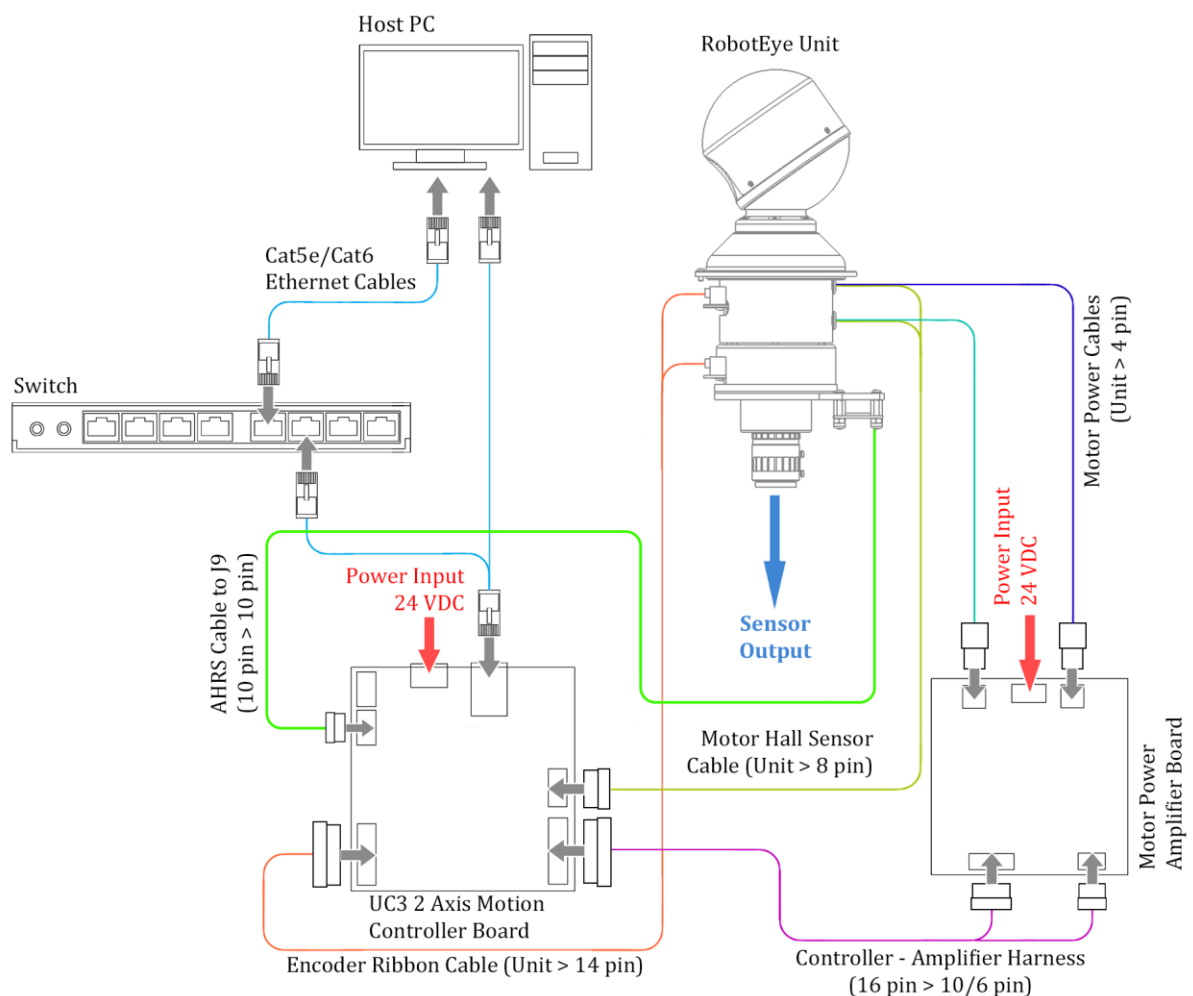


Figure 2.4 Wiring and connections for the REV25-ST Unit

1. Connect Cable Harness (16 pin to 10/6 pin cable) between controller and amplifier board.

2. Connect unit Encoder Sensor cable (14 pin connector) to black 2 Axis Motion Controller board.



NOTE – Make sure the orientation of the connectors is correct. Incorrect orientations may result in damage to the system.

3. Connect motor Hall Sensor cable (8 pin connector) from the unit to the black 2 Axis Motion Controller board.
4. Connect Attitude and Heading Reference System (AHRS) cable (white 10 pin connector) to the ARHS board. Connect the cable (black 10 pin connector) to J9 header on the 2 Axis Motion Controller board



WARNING - DO NOT CROSS CONNECT ARHS TO THE DIGITAL I/O (J12) ON THE CONTROLLER BOARD. Doing so will cause irreparable damage to circuits and/or equipment..

5. Connect motor power cables (4 pin white connectors) to the Motor Power Amplifier board. Match the colour coding of the connectors to ensure correct operation, incorrect connection of the motor power cables will result in uncontrolled motion of the system on power up.
6. Connect both the 2 Axis Motion Controller board and Motor Power Amplifier board to a 24 VDC power supply. Information on the polarity of the power connectors are detailed in Section 3.2.



WARNING - Make sure the power supply is not powered before connecting the cables.

7. Connect one end of the Ethernet cable to the network port on the PC or switch. Connect the other end to the Ethernet port on the 2 Axis Motion Controller board.
8. Connect the chosen camera to the C-mount thread on the end of the REV25-ST unit. A universal camera mount to suit all Allied Vision Technologies cameras recommended for use with the REV25-ST VISION - STABILIZED product is supplied with the REV25-ST VISION - STABILIZED Unit. If a different camera is chosen and it can't be used with the mount provided then alternative mounting arrangements should be provided. **DO NOT** allow the camera to be unsupported on the camera lens.

- a) The camera lens should be rotated on the filter thread where it attaches to the REV25-ST by the minimum amount required to align the body of the camera to one of the two possible camera mount positions shown in Figure 3.11.
 - b) Remove two socket head screws in the base of the REV25-ST body in the chosen position for the attachment of the camera mount (**DO NOT** have any more than two screws removed from the base of the REV25-ST at any time). Place the camera mount in position and replace the socket screws but do not tighten until the mount is attached to the camera.
 - c) Use fasteners appropriate for your camera to fasten the camera to the mount and then tighten the socket screws attaching the mount to the base of the REV25-ST (Note – The screws used to attach the camera to the mount will need to be loosened to focus the camera).
9. Attach power and communications cables as appropriate for your camera.

2.4.2 REV25-ST VISION - STABILIZED System

Follow the steps below to set the REV25-ST system up for use on a computer with a Windows or Linux operating system. The library version number and system IP address shipped with your system should be noted on the supplied *Certificate*.

1. Connect one end of the Ethernet cable to the network port on the PC or Switch. Connect the other end to the REV25-ST Control Ethernet port (right-side Ethernet connector). Refer to Figure 2.5.
2. Connect another Ethernet cable to the REV25-ST Camera Ethernet port (left-side Ethernet connector) and a PC or Switch.

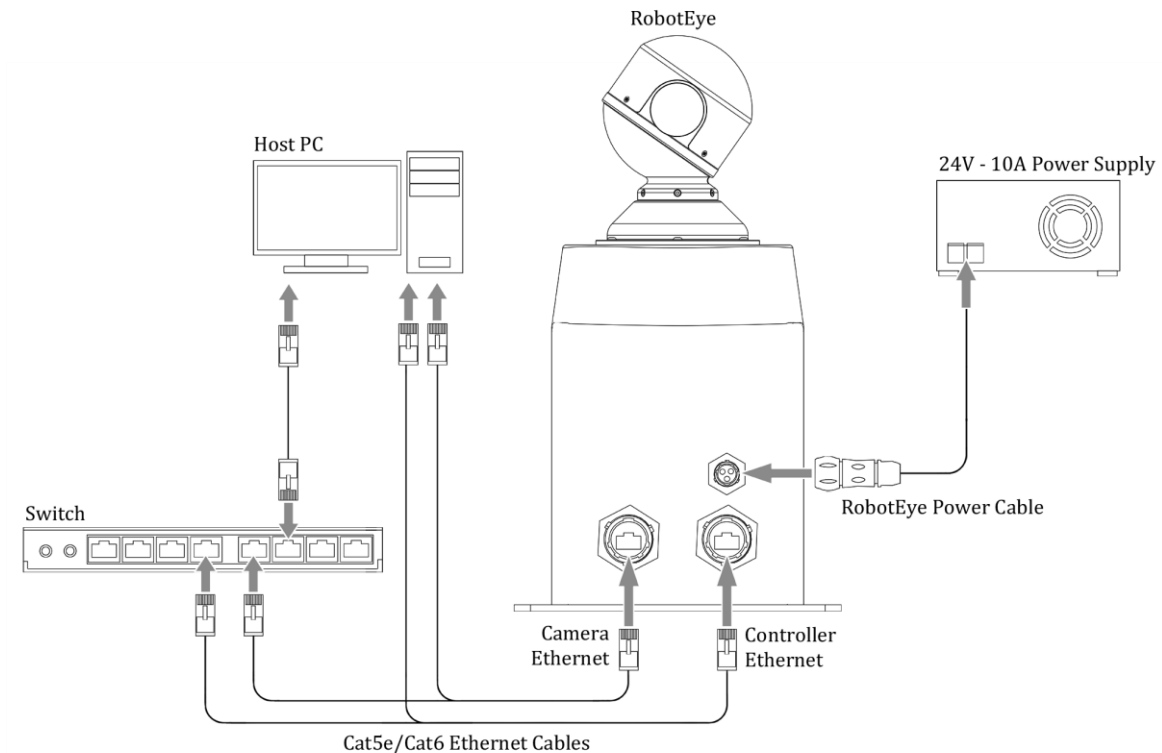


Figure 2.5 Wiring and connections for the REV25-ST System

3. Make sure the 24 volt power supply is switched OFF. Connect the supplied power cable to the 24 volt power supply. On the unterminated end of the cable you will find two wires one black and one with a red sheath on it. The black wire should be connected to the negative terminal on the power supply. The cable with the red sheath should be connected to the positive terminal on the power supply. The green and yellow cable should be connected to a ground reference.



WARNING - Make sure the power supply is not powered before connecting the cables.

4. Connect the power supply cable to the corresponding plug on the REV25-ST system. Ensure the correct orientation by aligning the polarisation keys on the panel connector and the plug. If forced in the incorrect orientation, damage to the system is likely to result. Refer to Section 3.2.2 - Power for further details.
5. If your REV25-ST VISION - STABILIZED System was ordered complete with an Allied Vision Technologies camera then your system should be ready to use. For adjusting the Focus and Aperture of your camera see Section 3.5.3 - Camera Focus and Aperture. Otherwise follow steps a) to i) to install your chosen camera.

- a) Open the system enclosure by removing the eight countersunk socket screws from the base.
- b) Connect the chosen GigE camera to the C-mount thread on the end of the REV25-ST unit. A universal camera mount to suit all Allied Vision Technologies cameras recommended for use with the REV25-ST VISION - STABILIZED product is supplied with the REV25-ST VISION - STABILIZED System. If a different camera is chosen and it can't be used with the mount provided then alternative mounting arrangements should be provided. **DO NOT** allow the camera to be unsupported on the camera lens.
- c) The camera lens should be rotated on the filter thread where it attaches to the REV25-ST by the minimum amount required to align the body of the camera to one of the two possible camera mount positions shown in Figure 3.11.
- d) Remove two socket head screws in the base of the REV25-ST body in the chosen position for the attachment of the camera mount (**DO NOT** have any more than two screws removed from the base of the REV25-ST at any time). Place the camera mount in position and replace the socket screws but do not tighten until the mount is attached to the camera.
- e) Use fasteners appropriate for your camera to fasten the camera to the mount and then tighten the socket screws attaching the mount to the base of the REV25-ST.



NOTE – The screws fastening the camera to the universal camera mount must be loosened before adjusting the focus.

- f) Attach the internal Ethernet cable from the enclosure camera Ethernet connector to your GigE camera
 - g) The two pin connector shown in Figure 3.3 makes 24 VDC available for camera power connection; a suitable converter from 24V to your camera's required voltage will need to be provided.
 - h) Follow the procedure in Section 3.5.3 to adjust the focus and aperture of the camera.
 - i) Replace the base using the eight countersunk socket screws and tension correctly to maintain the integrity of the seal.
6. Attach power and communications cables as appropriate for your camera.

2.5 Safety

The RobotEye REV25-ST VISION - STABILIZED System is a high speed device. All instructions regarding safe operation of this system should be strictly followed.



Protection Class 3. The device operates with a separated extra low voltage (SELV) of 24 Volts DC.



The device may only be operated as intended and in faultless condition. Safety and warning signs must not be removed.



The REV25-ST VISION - STABILIZED System is in accordance with Ingress Protection 65 (IP65). The device is protected against dust and jet water.



The REV25-ST VISION - STABILIZED Unit by itself is in accordance with Ingress Protection 0 (IP00). The device is **NOT** protected against dust and jet water.

All instructions regarding safe operation of this system should be strictly followed.

- The user is responsible for the safe operation and maintenance of this system at all times.
- The REV25-ST is NOT intended for use by inexperienced personnel.
- Installers of the sensor are responsible for ensuring their safe use in accordance with all applicable regulations in the state, country or territory of use.
- The device's rotating head is not designed to accommodate for any alterations or additions. High speed projectiles may result.
- The device must be securely mounted during operation to prevent unstable motions.
- Ensure that the Robot Eye head will not contact anything while operating in its full range of movement.
- **Do not try to hold or touch the Robot Eye head while operating.**
- **Do not attempt to disassemble the sensor.** Improper disassembly will destroy the optical alignment of the sensor and necessitate factory repairs. Tampering with any enclosure will void warranty coverage.
- The manufacturer will not accept liability for any resulting damages caused by the non-observance of this manual or any unauthorised modification to the system.

2.6 Operation

Special precautions for when operating the device.

- **DO NOT** attempt to touch or impede the Robot Eye head during operation.
- Avoid strands of fabric or long exposed hair from being in the vicinity of the Robot Eye head during operation. Significant injury and/or mechanical damage may result.
- The REV25-ST's RobotEye head must be protected from direct impact.

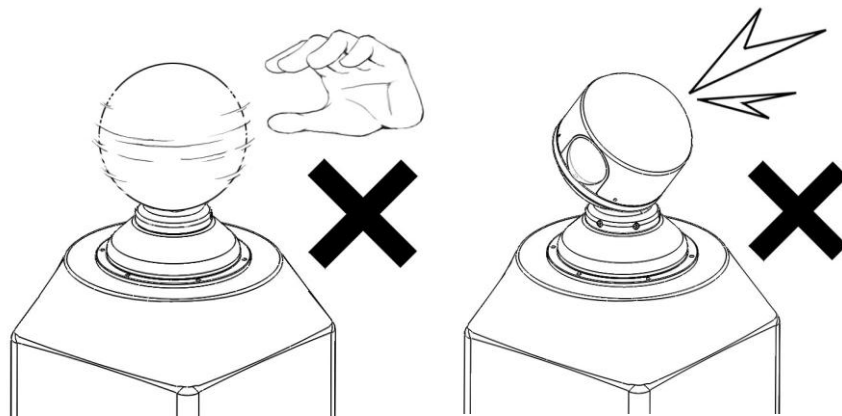


Figure 2.6 Do not touch RE Head while in operation. Avoid impacts.

General considerations for when operating the device.

- The REV25-ST should not be put into operation when the aperture is fogged or dirty. The aperture should not be touched with bare hands. Refer to Section 2.7 for cleaning the device.
- The device must be protected against overheating. Persistent overheating of the device will lead to reduced lifetime of the camera.
- Additional protection is recommended when operating the device under extreme or adverse environmental conditions. Rapid changes in temperature may lead to humidity entering the device.

2.7 Cleaning and Maintenance



CAUTION – Power must be disconnected from the REV25-ST system before any cleaning or maintenance is carried out.

User performable cleaning and maintenance of the RobotEye REV25-ST VISION - STABILIZED System is limited to cleaning of the exterior housing and the aperture window. For ANY other maintenance or repair the unit should be returned to the factory. Unauthorised opening of the system enclosure will void warranty. Use the following guidelines for cleaning of the system enclosure and aperture window.

- It is **VERY** important not to abrade or scratch the system window during cleaning or at any other time as it has the potential to significantly degrade system performance.
- Use a soft non-abrasive cloth to clean the window, make sure there are no foreign abrasive particles on the window before performing cleaning, as this may damage the window.
- **DO NOT** use solvents. If a cloth alone is not sufficient, water or Isopropyl Alcohol may be used.
- The rest of the REV25-ST VISION - STABILIZED System housing can be cleaned with a soft damp cloth.

2.7.1 Replacement Parts

Replacement parts can be ordered directly through Ocular Robotics.

- 1) *RobotEye REV25-ST System power cable.*
- 2) *IP68/IP69K Data cable (REV25-ST System).*
 - a) An optional 5m or 10m IP68 Cable can be purchased from Ocular Robotics
- 3) *5mmx20mm 16A Slow Blow Fuse.*
 - a) The fuse is located in the Fuseholder located above the left Ethernet connector.

3 General Description

The RobotEye REV25-ST VISION - STABILIZED System is a three-axis high performance VISION - STABILIZED system with unprecedented motion bandwidth. The REV25-ST System is ideally suited for use on ground vehicles, surface craft, aircraft and other dynamic platforms.

The REV25-ST's embedded RobotEye technology allows applications such as inertial stabilisation, object tracking, telepresence/teleoperation, environment mapping, rapid disparate point data acquisition and persistent surveillance to be easily achieved.

3.1 Electrical

The REV25-ST VISION - STABILIZED System requires a 24 Volt DC power supply that has a continuous current capacity of 10 amps. The output voltage of the 24 VDC power supply used with the REV25-ST System should not vary by more than $\pm 15\%$ from the nominal 24V under any circumstances otherwise damage to the REV25-ST System may result.

3.2 Power

3.2.1 REV25-ST VISION - STABILIZED Unit

Power is supplied to the REV25-ST Unit via connectors as shown in Figure 3.1. Both the 2 Axis Motion Controller board and Power Amplifier board need to be directly powered by the 24 VDC supply.

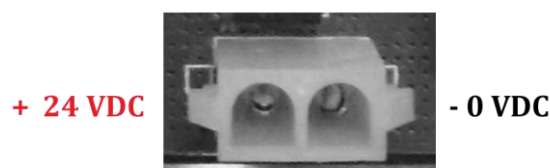


Figure 3.1 – Power connector on the controller and amplifier boards

3.2.2 REV25-ST VISION - STABILIZED System

Power is delivered to the REV25-ST System with the supplied 5 metre power cable. The unterminated end of the power cable has two wires, one black and one with a red sheath on it. The black wire should be connected to the negative terminal on the power

supply. The cable with the red sheath should be connected to the positive terminal on the power supply.

During connection of the power supply cable to the corresponding plug on the REV25-ST system, ensure the correct orientation by aligning the polarisation keys on the panel connector and the plug. If forced in the incorrect orientation, damage to the system is likely to result.

A 16A rated slow blow fuse is housed in the fuseholder to prevent potential damage to internal electrical components from power surges.



Figure 3.2 – Fuseholder on the REV25-ST Enclosure

Power to the camera inside the enclosure is provided via a two-way connector. The red wire provides 24 VDC with respect to the black wire at 0 V. A suitable voltage converter is required if the camera operates at a different voltage.

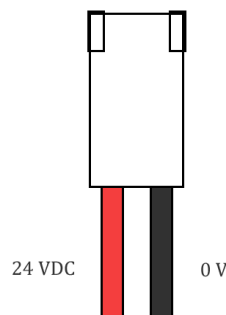


Figure 3.3 – Power connector for the camera

3.3 Mechanical

3.3.1 REV25-ST VISION - STABILIZED Unit

The REV25-ST VISION - STABILIZED Unit has no environmental protection rating by itself however as the RobotEye Head has a rating of IP65, it can adopt up to and including this rating when housed in an appropriate enclosure. The REV25-ST can operate in ambient temperatures of up to 70°C (The maximum operating temperature of installed cameras may however be lower than this) making it suitable for use in a wide range of industrial environments.

The bounding dimensions and positions of mounting holes for the REV25-ST Unit are shown in Figure 3.4

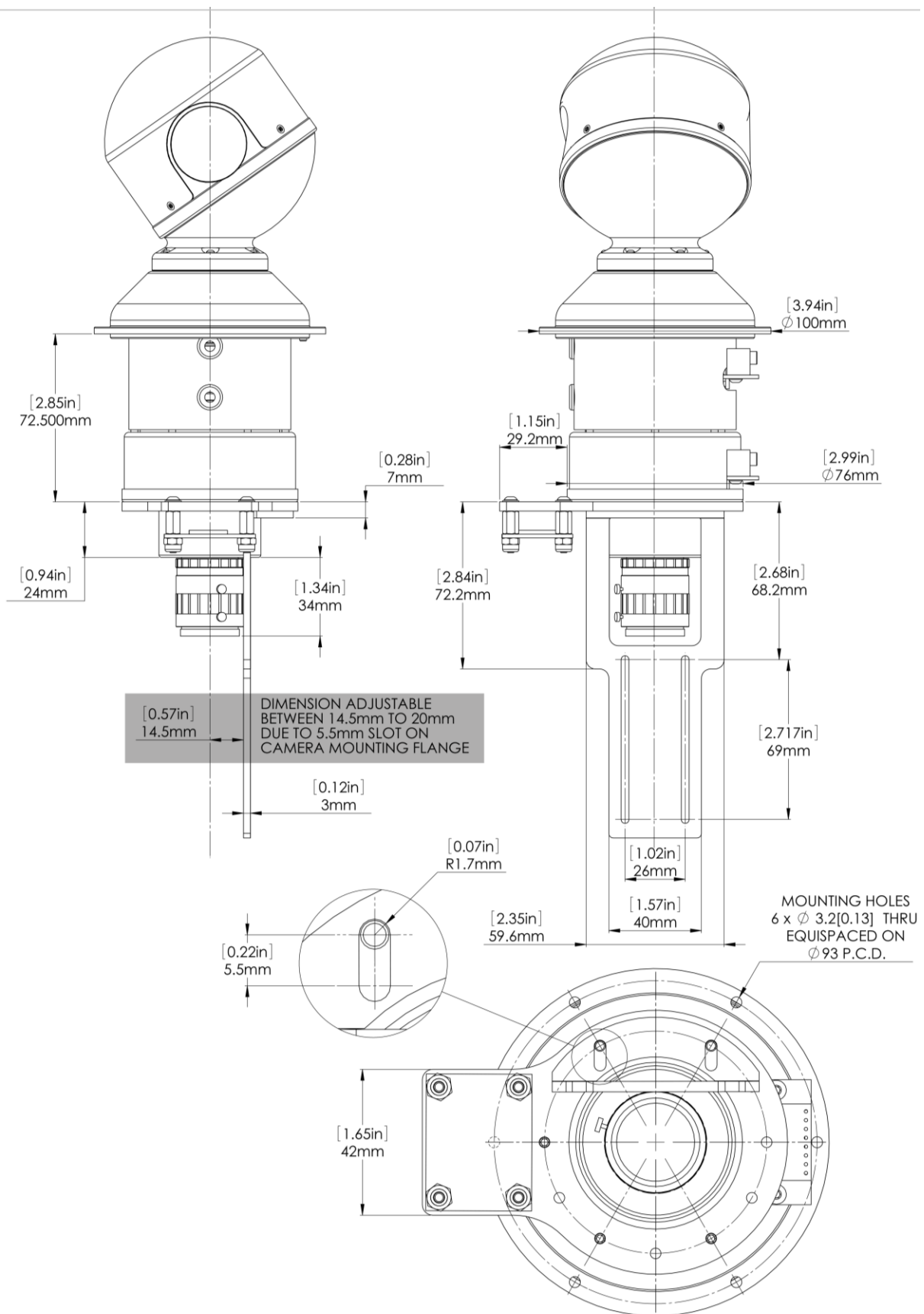
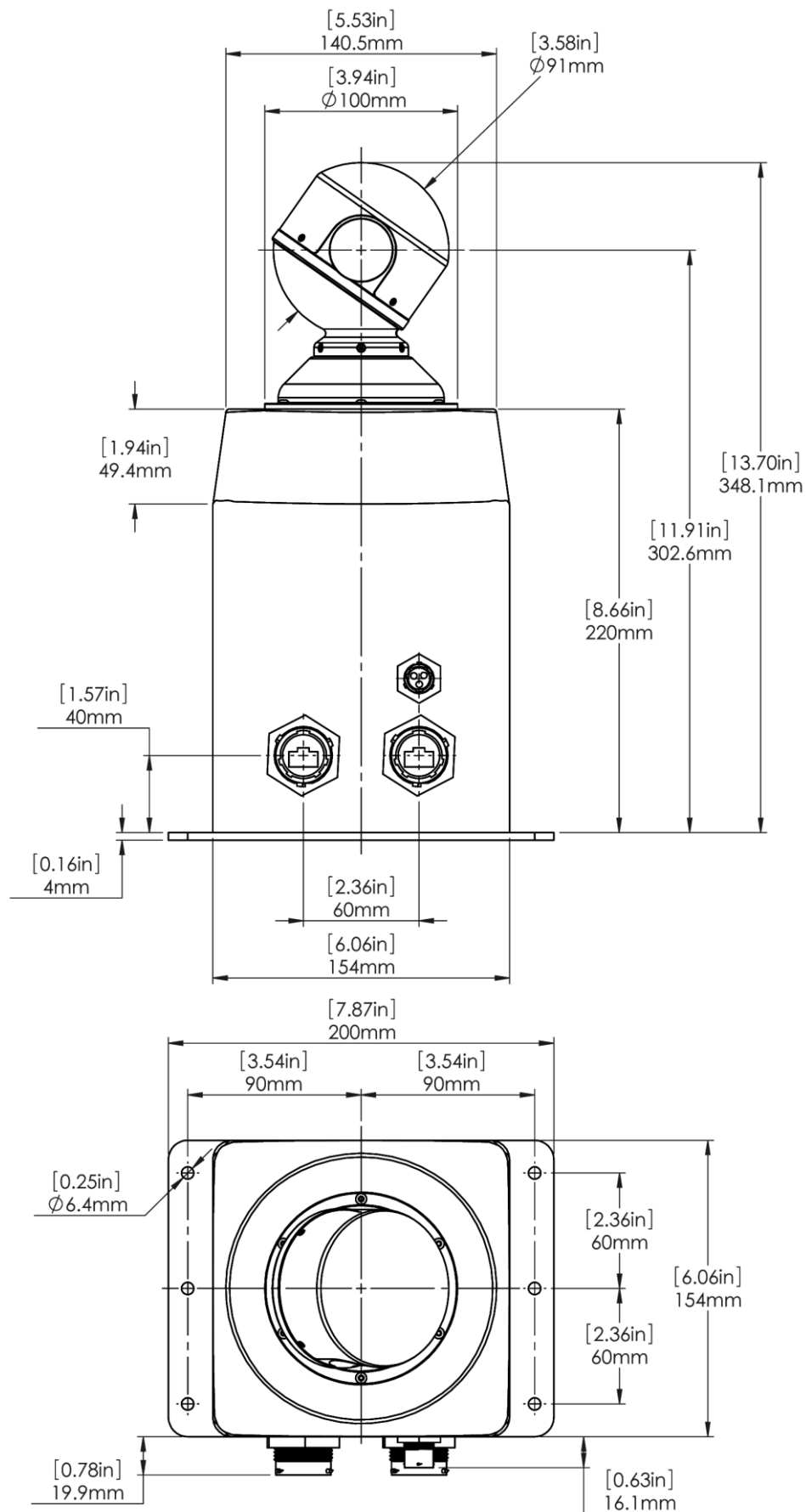


Figure 3.4 – REV25-ST Unit Mechanical Dimensions

3.3.2 REV25-ST VISION - STABILIZED System

The REV25-ST VISION - STABILIZED System has an environmental protection rating of IP65 and can operate in ambient temperatures of up to 70°C (The maximum operating temperature of installed cameras may however be lower than this) making it suitable for use in a wide range of industrial environments. The REV25-ST VISION - STABILIZED enclosure has IP65 rating (when used with the cable socket and panel plug connectors mated).

The bounding dimensions and positions of mounting holes for the REV25-ST System are shown Figure 3.5.

**Figure 3.5 – REV25-ST System Mechanical Dimensions**

3.4 Ethernet

3.4.1 REV25-ST VISION - STABILIZED Unit

The REV25-ST VISION - STABILIZED Unit interfaces with a computer via a standard Ethernet cable. The REV25-ST Control supports a 100 Megabit connection.

The Ethernet connection is located on the black 2 Axis Motor Controller Board.

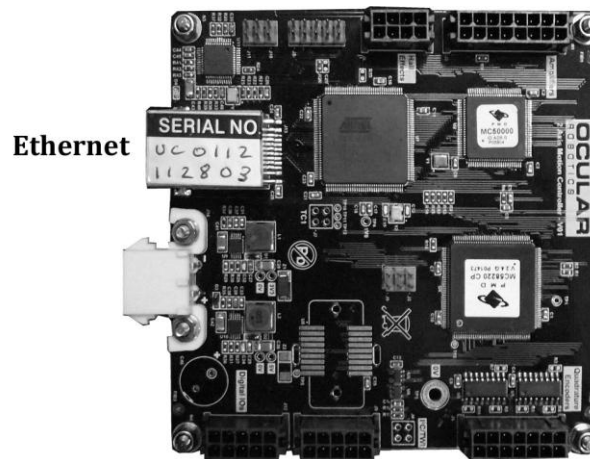


Figure 3.6 – RJ45 Ethernet Connection located under the Serial No. label.

3.4.2 REV25-ST VISION - STABILIZED System

The REV25-ST VISION - STABILIZED System interfaces with a computer via a standard Ethernet cable. The REV25-ST Control supports a 100 Megabit connection.

The REV25-ST VISION - STABILIZED System has two Ethernet connections located on the side of the enclosure. The left Ethernet connector is for interfacing with the nominated imaging camera. The right Ethernet connector is for controlling the REV25-ST VISION - STABILIZED System.

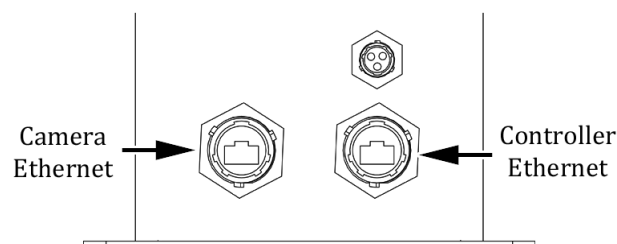


Figure 3.7 – RJ45 Ethernet Connections on the REV25-ST System Enclosure

3.4.3 Network Topology

In most situations use of a Cat5e Ethernet cable will be sufficient for operation of the REV25-ST VISION - STABILIZED Unit/System, however it is recommended that a Cat6 cable be used over long distances.

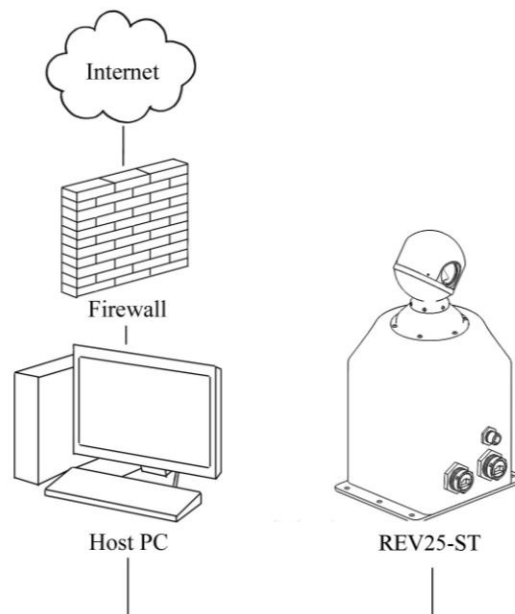


Figure 3.8 – Network Schematic for Single Host PC to Single REV25-ST

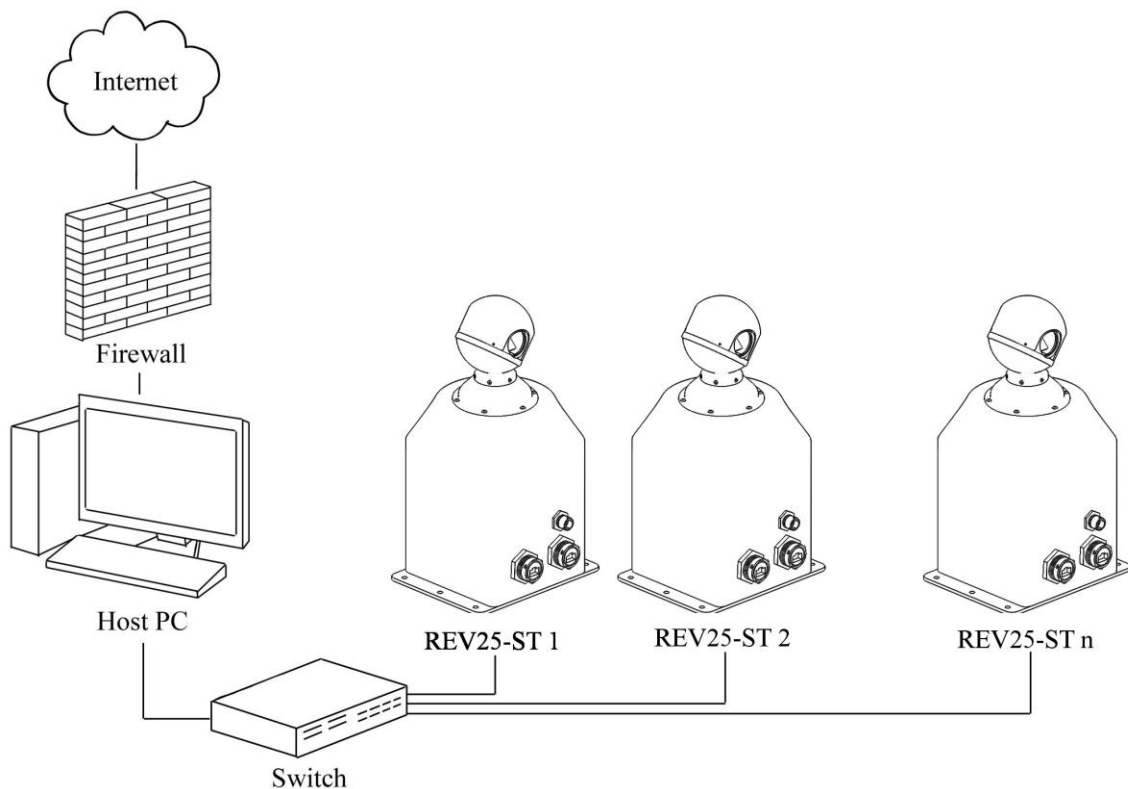


Figure 3.9 – Network Schematic for Single Host PC to Multiple REV25-STs

3.5 Optical

3.5.1 Field of View

The optical diagonal field of view for standard 4:3 aspect ratio CCD's are listed in Table 1, with corresponding representations illustrated in Figure 3.10.

Table 1 – Approximate Diagonal Fields of Views for standard CCD's

CCD Size	Diagonal FOV
1/4"	15°
1/3"	22°
1/2"	29°
2/3"	40°

Due to the nature of the optical path within the RobotEye, the 4:3 viewing rectangle will rotate within the grey aperture circle depending on the RobotEye aperture's azimuthal position. The white circular mask inside the 4:3 viewing rectangle is a representation of the effective field of view when a non-rotating video feed/image is desired.



NOTE – De-rotation of the video/image needs to be handled via software.

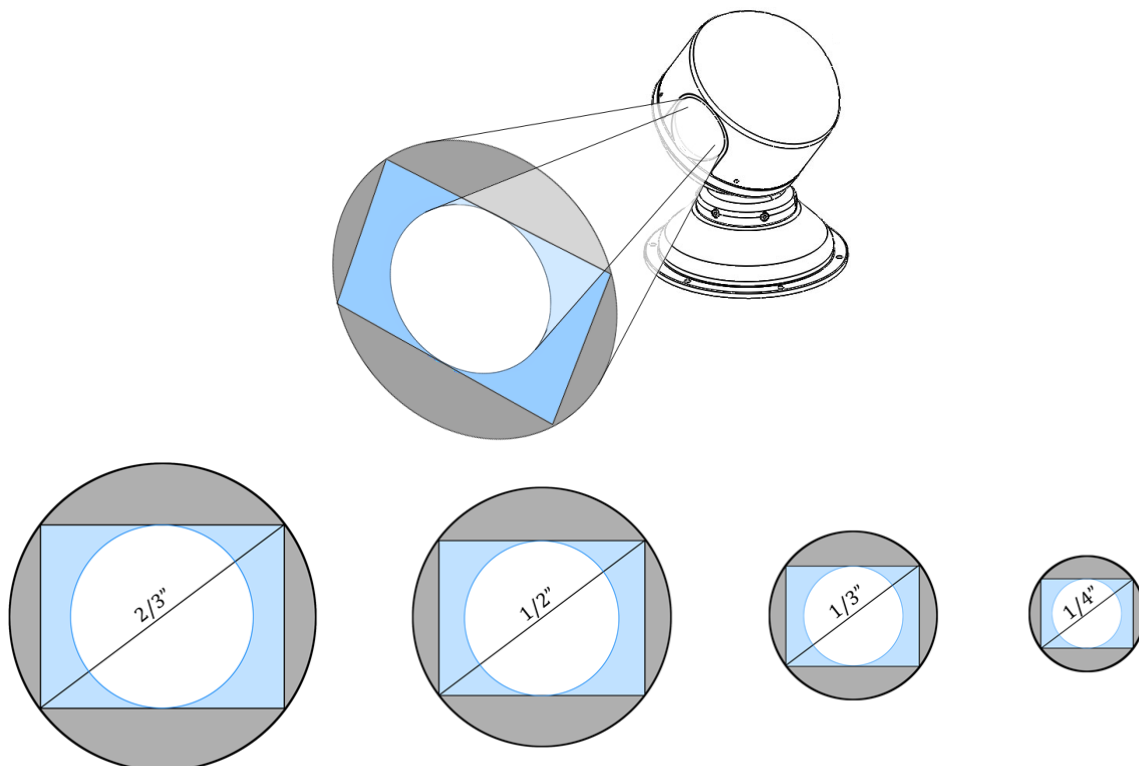


Figure 3.10 – Field of View Representations for various CCD sizes (Not to Scale)

3.5.2 Camera Mounting

The universal camera mount provided with the REV25-ST is designed to suit all Allied Vision Technologies cameras recommended for use with the REV25-ST VISION - STABILIZED Unit. If a different camera is chosen and it can't be used with the camera mount provided then alternative mounting arrangements should be provided.



DO NOT allow the camera to be unsupported on the camera lens. Unsupported cameras may result in mechanical damage.

The universal camera mount can be placed in two different orientations on the mounting plate located at the bottom of the RobotEye unit as shown in Figure 3.4. The recommended mounting orientations are illustrated in Figure 3.11 below. Note that the RobotEye head in Figure 3.11 is facing the default *home position* (0 elevation, 0 azimuth) and that the resulting camera view will be rotated 90° with respect to horizontal for each orientation.

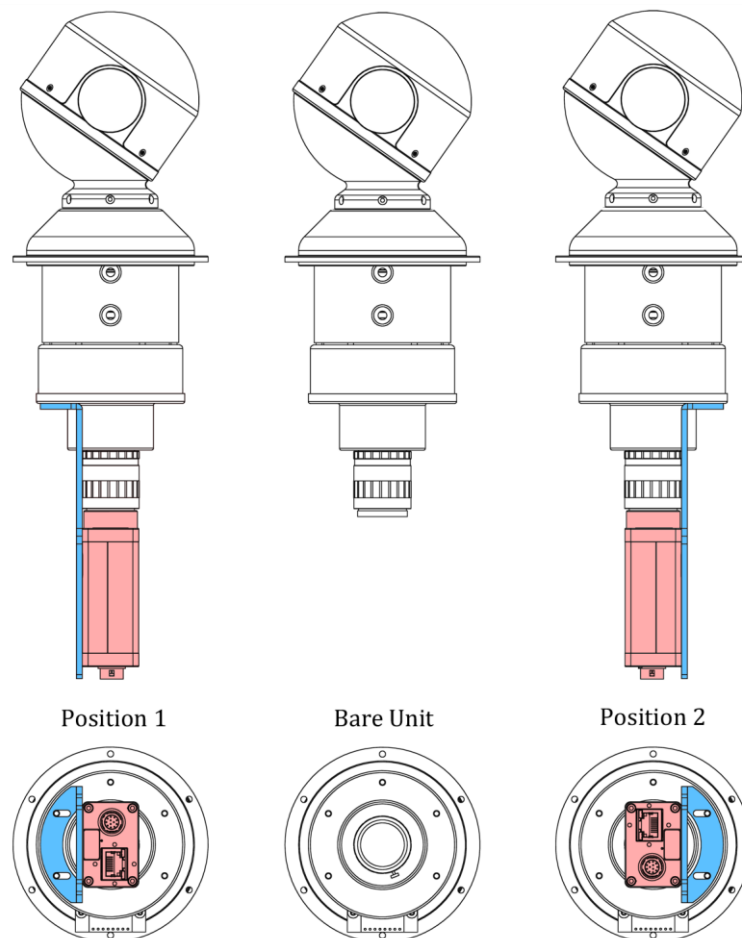


Figure 3.11 – Recommended Camera Mounting Orientations (Forward View)

3.5.3 Camera Focus and Aperture

A lens is attached to the bottom of the REV25-ST unit. The focal length is 50mm with an iris range of F2.3 to F22. The camera focus and aperture can be adjusted by rotating the rings on the lens as shown in Figure 3.12. Release the locking knobs to freely rotate the rings.



NOTE – The screws fastening the camera to the universal camera mount must be loosened before adjusting the focus.

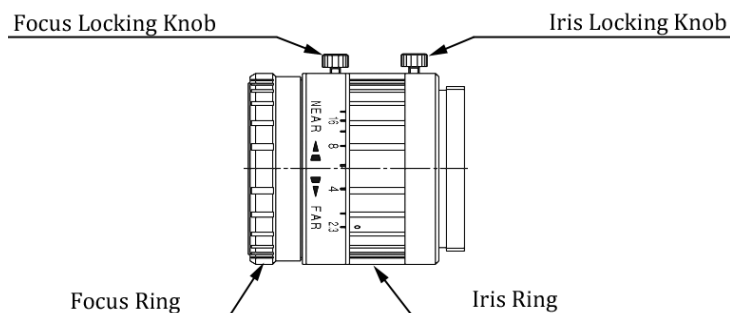


Figure 3.12 – C-mount Lens

3.5.4 Modulation Transfer Function

The REV25-ST VISION - STABILIZED optical system Modulation Transfer Function is provided below for reference.

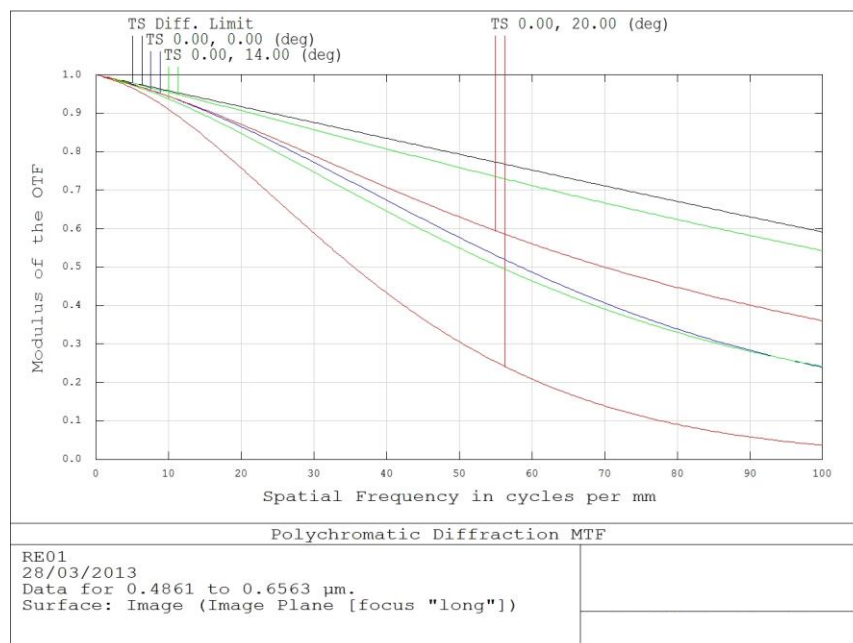



Figure 3.13 – Plot of the Modulation Transfer Function

4 Specifications

Mechanical	
Maximum Aperture Rate	10,000°/s*
Maximum Aperture Acceleration	100,000°/s ²
Azimuth Axis Resolution	0.010°
Elevation Axis Resolution	0.010°
Azimuth Range	360° Continuous
Elevation Range	70° (±35°)
Accuracy	0.05°
Weight (Unit/System)	1.6kg/3.4 kg

Electrical	
Communication (minimum 100 Megabit)	Ethernet
Supply Voltage	24 VDC
Power Consumption — Typical (average)	<40 W
— Maximum (peak)	200 W

Optical	
Maximum optical field of view (diagonal)^	40°
Optical port	C-Mount

Environmental	
Operating Temperature Range^^	-20°C - +50°C
IP Class Rating (REV25-ST System Only)	65
 <i>Note: IP Rating valid only when both supplied power & optionally supplied Ethernet cable connectors are fitted.</i>	

Inertial**	
Stabilisation Update Frequency	800 Hz
Maximum Angular Rate	±2000°/s
Static Accuracy (pitch/roll)	0.5°
Static Accuracy (heading)	2.0°
Angular Resolution	< 0.05°
Repeatability**	< 0.2°
Operating Temperature Range	-40°C - +85°C
<p>*At the maximum acceleration rate of 100,000°/s² more than a full rotation is required to reach 10,000°/s aperture slew rate.</p> <p>** Extended temperature calibration IMU option available for calibrated operation across -40°C to 85°C range</p>	<p>^ See details under Imaging Options in following pages</p> <p>^^ Does not include temperature rating of the camera used with the system</p>