ROS SCE-X 36:1
COLOR ZOOM CAMERA

OPERATION AND MAINTENANCE MANUAL

SERIAL NUMBER: _____

SALES ORDER: _____

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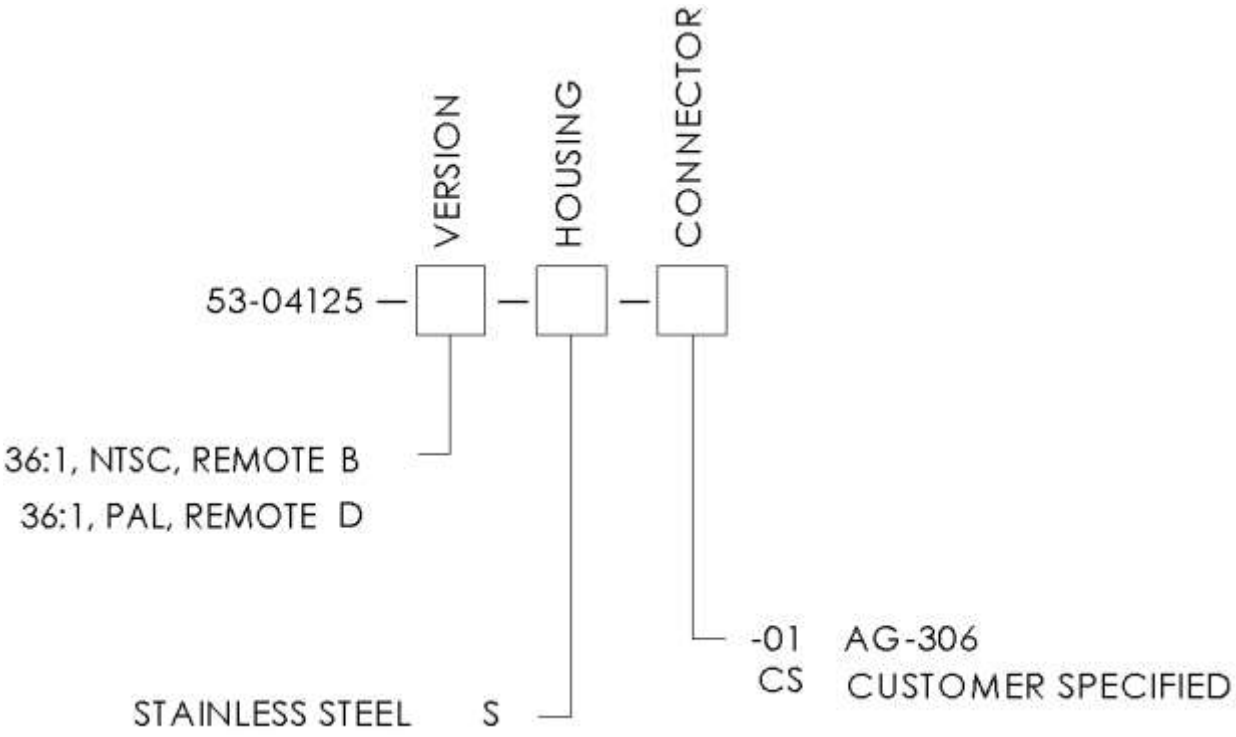
STANDARD ORDERING FORMAT FOR THE SCE-X-36 CAMERAS



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Remote Ocean Systems, Inc. (hereinafter called "**ROS**") warrants its products as stated below subject to the conditions specified.

ROS warrants its products, when operated under normal conditions, to be free from defects in material or workmanship for a period of one year from the date of purchase provided that inspection by **ROS** discloses that such defects developed under normal and proper use. **ROS** products repaired or replaced pursuant to this warranty shall be warranted for the unexpired portion of the warranty applying to the original product. The liability of **ROS** under this warranty shall exist subject to the following conditions:

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(b) **ROS** shall be released from all obligations under its warranty in the event repairs or modifications are made by persons not authorized by **ROS**.

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CHANGE RECORD

REV	DESCRIPTION	DATE
A	Initial Release	05FEB08,BAL

1 DESCRIPTION

The SCE-X, 36:1 is a high performance miniature Color Zoom camera intended for use in shallow water applications. The SCE-X, 36:1 is rated to 70 meters water depth. The camera has been designed from the outset with an eye towards simple, straightforward operation and maintenance. All major subassemblies: Rear Endcap, Universal Interface Board with Long Line amplifier, and Camera Module have been designed such that any part may be replaced in minutes utilizing only minimal hand tools. Soldering skills are required only for major repairs or modifications to the camera electronics. In addition to the standard configuration outlined here, ROS offers variations to the basic SCE-X, 36:1. These include:

* Alternate Connectors
* Control using Unipolar or Differential Voltages
* Remote Control from a Computer Terminal over RS-232 link

Due to the many options and variations possible, some areas of this manual may not apply to a specific camera or application. If your particular SCE-X, 36:1 camera is significantly different from the standard configuration, these details will be described in a manual addendum. When in doubt, please consult your local representative or ROS for assistance.

The ROS SCE-X, 36:1 camera is illustrated by the installation drawings in the appendix. The camera housing is constructed of stainless steel and is designed to be operated in natural but hostile environments. The front window is made of impact resistant optical grade acrylic and utilizes a single O-ring seal. The external connector on the standard camera is an Impulse Model AG-306.

The SCE-X, 36:1 camera utilizes a high resolution, EXview HAD (Hole Accumulation Diode) image sensor coupled to a miniature 36:1 zoom lens in order to provide high-resolution video under widely varying and adverse viewing conditions. Scene illumination and White Balance correction is completely automatic. Auto-Focus and Auto-Exposure operation is enabled upon power-up, but these may be overridden at any time with manual inputs if operating conditions warrant.

The basic SCE-X, 36:1 camera is capable of providing video outputs in composite (NTSC or PAL). All output video lines are buffered and fused to prevent accidental damage to the camera electronics in the event of improper connection. In addition, differential output mode may be selected for use with balanced shielded twisted pair cables.

All of the available modes of operation can be selected using compact switches located on a Mode Select Board. This board is fully accessible when the camera is removed from the pressure housing. No jumper installation or soldering is required to select the modes of operation.

The Universal Interface circuit board includes circuits that condition the input power, protecting the camera electronics from overload voltage or accidental application of power with reversed polarity. In addition, circuits on this board generate the camera control commands sent to the zoom camera module in order to achieve control of Focus position, Zoom position, and Exposure Settings.

A wiring diagram (Drawing No. 53-04126) outlining the basic interconnections within the SCE-X, 36:1 Camera is included in the Appendix of this manual.

2 SCE-X, 36:1 CAMERA SPECIFICATIONS

2.1 POWER

Operating voltage:	11 - 30 VDC, 350mA (max)

2.2 CAMERA PERFORMANCE DATA

Sensor:	1/4" EXview HAD CCD
Pixels:	380,000 (NTSC) 440,000 (PAL)
Resolution:	470 TVL minimum (NTSC) 460 TVL minimum (PAL)
Scene illumination:	1/60s mode: 1.4 lux typical
Signal to Noise Ratio:	>50 Db
Composite Video Output	VBS: 1.0 Vp-p (Sync Negative)
Long Cable Compensation:	Adjustable for cables of length 0 to 5,000 ft (0 to 1524m) of RG-59/U or equivalent balanced line cable
Zoom Range:	36:1 optical (3.4 to 122.4 mm focal length)
Digital Zoom:	12x (432x with optical zoom combined)
Field of View In Air:	69.2º Diagonal (full wide angle) 57.8ºH x 44.9ºV @ full wide angle 1.7 ºH x 1.2ºV @ full telephoto
Field of View In Water:	50.2º Diagonal (full wide angle) 42.3ºH x 33.2ºV @ full wide angle 1.3ºH x 0.9ºV @ full telephoto
Minimum Object Distance:	
In air	front of window @ full wide angle 1.5m @ full optical telephoto
In water	front of window @ full wide angle 2m @ full optical telephoto
Iris Range	Automatic, f/1.6 - f/4.5

2.3 DIMENSIONS

Length: (less connector)	5.47 inches (139 mm)
Diameter (max):	3.18 inches (81 mm)

2.4 WEIGHT (less connector)

Stainless	In Air	4.2 pounds (1.91 kg)
	In Water	2.4 pounds (1.09 kg)

2.5 MATERIALS

Housing:	Electropolished Stainless Steel
Viewing Port:	Polished Acrylic

2.6 ENVIRONMENTAL

Operating Temperature:	0ºC to +50ºC (32ºF to 122ºF)
Storage Temperature:	-20ºC to +60ºC
Depth Rating:	70 m (230 ft)

2.7 STANDARD SCE-X CONNECTORS

2.7.1 Impulse AG-306

Endbell Connector:	IMPULSE	AG-306
Inline Mating Connector:	IMPULSE	AG-206 with sleeve

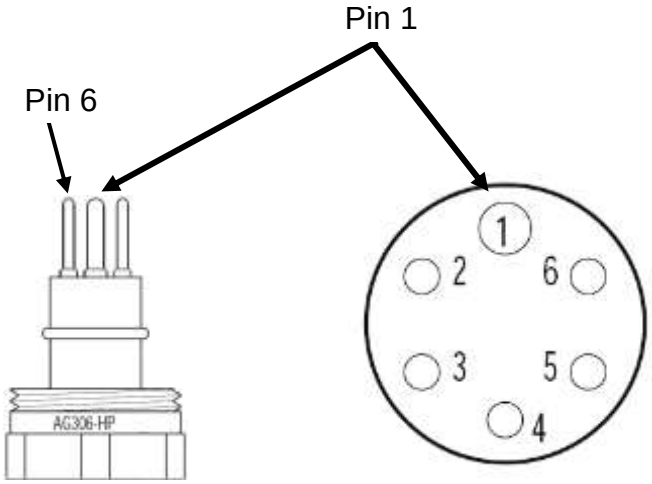


Figure 1: IMPULSE AG-306 Face View

2.8 CAMERA INTERCONNECTIONS

2.8.1 Basic Interconnections (Bipolar Control)

Typical connections for SCE-X 36:1 camera with bipolar control are:

CONNECTOR PIN	FUNCTION
1	Coax shield and power supply common
2	Composite Video Output
3	Camera power Input (+11 to +30 VDC)
4	Focus Control (+12V - Near, -12V - Far)
5	Zoom Control (+12V - Telephoto, -12V - Wide Angle)
6	Exposure Control (+12V - Increase, -12V - Decrease)

Three (3) additional pins are required if the camera is going to be used with Unipolar or Differential modes of operation.

2.8.2 Cameras with RS-232 Control (Option)

SCE-X, 36:1s can be furnished with interconnections for remote control from a computer terminal or any device that can send RS-232 messages. On these cameras all of the operating functions including focus, zoom and exposure can be controlled from the computer through two conductors, utilizing standard RS-232 serial data communication. A typical connection for a camera with RS-232 control is shown below:

CONNECTOR PIN	FUNCTION
1	Coax shield and power supply common
2	Composite Video Output
3	Camera power Input (+11 to +30 VDC)
4	TXD IN (RS-232)
5	RXD IN (RS-232)
6	Digital Ground

Notes: An RS-232 communications link is limited to a cable length typically less than 100 meters.

ROS can furnish basic software for enabling computer control through and RS-232 (or RS-485) communications link. The serial RS-232 code for camera commands can also be furnished by ROS for users that prefer to develop their own customized software.

2.8.3 Other Configurations

SCE-X, 36:1 Cameras can be furnished with other interconnections in order to meet customer's requirements.

Typically, the SCE-X, 36:1 cameras are controlled using bipolar signals (+/- 12V to 1 pin) as indicated under 2.8.1 above.

Cameras can also be configured for control with unipolar or differential input signals instead of bipolar. The following describes the modes of operation and signals required for each one including RS-232.

Bipolar (1 line) — Most common mode since it is efficient in terms of camera connector input pins and connecting wires required. For example a single pin receiving a voltage provides dual control by the polarity of the voltage. For example, +12V Focus Near, -12V Focus Far.

Unipolar (2 line) — This mode requires two camera input pins for each function but a single polarity for the input control voltage. For example, +12V applied to pin 4 for Focus Near, or +12V applied to pin 9 for Focus Far.

Differential (2 line) — This mode requires simultaneous application of a voltage source (both + and -) across two camera input pins. For example if the source (typically 12 VDC) is connected with + to pin 4 and – to pin 9 this causes Focus Near, and if polarity is reversed with – to pin 4 and + to pin 9 the Focus Far action is actuated.

RS-232 — This mode allows control of all lens functions on the basis of RS-232 control signals from a controller external to the camera. Additional data on RS-232 operation is included in section 2.8.2 above and 3.6 below.

2.9 CAMERA MODE SELECTION

The SCE-X, 36:1 Camera is designed to operate in a variety of operating modes that determine what input control signals are required and what output signals will be delivered. The selection of operating modes is normally made at the factory and may on occasion require changing at the customer facilities.

2.9.1 Mode Selection

If the user needs to make changes in the operating modes the camera includes an internal Mode Selection Board assembly with a group of small switches to

accomplish these changes. The internal electronics assembly must be temporarily removed from the housing and changes made. The Mode Selection Board is clearly accessible so that the switches can be operated easily.

There are two separate DIP switch assemblies on the board labeled S1 and S2. S1 has 8 and S2 has 6 individual switches. The ON position is indicated on each switch assembly.

A tabulation that follows shows the positions of switches in order to select specific modes of operation. S1-1 through S1-5 provides control of input control mode selection. S1-6 and S1-7 provide for video output mode selection and S2-2 through S2-4 provide microcontroller inputs.

0 = SWITCH OFF
X = SWITCH ON

MODE SELECTION	S1 1	S1 2	S1 3	S1 4	S1 5	S1 6	S1 7	S1 8		S2 1	S2 2	S2 3	S2 4	S2 5	S2 6
BIPOLAR INPUTS	X	X	O	X	X							O	X		
UNIPOLAR (OR DIFF) INPUTS	O	O	X	O	O							X	X		
"C" OUTPUT						O	X								
BALANCED VIDEO OUTPUT						X	O								
LLA OFF											X				
REMOTE LLA ENABLE											O				
RS-232 CONTROL	O	O	X	O	O							X	O		
SPARE MICRO INPUT 1															
SPARE MICRO INPUT 2															
SPARE MICRO INPUT 3															

INPUT MODE SELECT

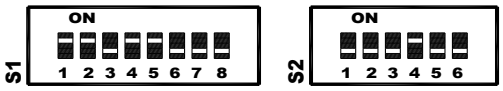
VIDEO OUTPUT SLELECT

MICRO DATA INPUTS

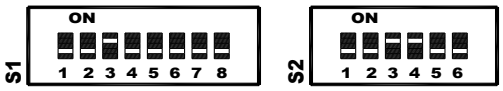
NOTE: LONG LINE AMPLIFIER (LLA), BALANCED OUTPUT, "C" OUTPUT CAN BE SELECTED ALONG WITH EITHER BIPOLAR, UNIPOLAR OR RS-232 CONTROL INPUTS.

The following illustrations show several typical combinations of mode selection with the corresponding switch positions:

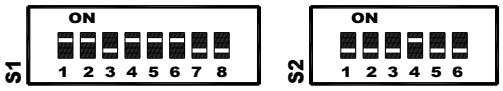
SELECTION: BIPOLAR INPUTS



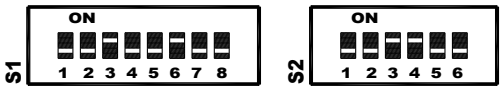
SELECTION: UNIPOLAR (OR DIFFERENTIAL) INPUTS



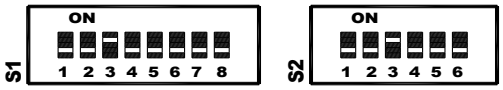
SELECTION: BIPOLAR INPUTS & BAL VID OUTPUT



SELECTION: UNIPOLAR (OR DIFFERENTIAL) INPUTS AND BALANCED VIDEO OUTPUT



SELECTION: RS-232 CONTROL



3 CAMERA OPERATION

3.1 GENERAL

Operation of the SCE-X, 36:1 Camera is straightforward, but there are some differences, which may not be familiar to personnel accustomed to operating older closed circuit TV system.

3.2 INSTALLATION

For ease of mounting, the SCEX, 36:1 camera has a mounting saddle, integral to its housing, with two 1/4-20 UNC tapped holes on 2.00 inch mounting centers. The camera must be mounted in a position that will protect against impacts with obstacles passing close to the camera.

The pins on the camera connector should be cleaned and dried then sprayed with a silicone-based lubricant. Grease should not be used on enclosed connectors because it will eventually become impacted in the mating connector, forcing the contacts apart and causing intermittent operation.

3.3 EXPOSURE CONTROL

The SCE-X, 36:1 camera provides operation over a wide range of scene illumination. To achieve this wide range the camera achieves Exposure Control through composite operation of the iris, video gain, and shutter modes. For most operations automatic exposure mode is used to optimize the camera for the existing illumination.

The camera's iris, gain, and shuttering functions are all controlled by an internal microprocessor. This automatic mode is normally selected when the camera is turned on. As illumination is increased from complete darkness, the AGC (automatic gain control) is the first function to operate from maximum to minimum gain. At the point of minimum gain the iris begins to function, closing as the illumination continues to increase. If the illumination continues to increase with the lens fully closed, the camera goes into a shuttering mode where the CCD is allowed to capture light over decreasing time intervals as the illumination increases.

In the event that manual Exposure Control is desired due to unusual viewing conditions such as severe reflections or flashing lights, the switch on the remote control unit can be toggled towards either the INCR or DECR position. This will place the camera in the manual mode and each toggle will result in a step change of the exposure. The operator normally continues to toggle this switch until an optimum display is seen on the television monitor.

To restore automatic Exposure Control simultaneously operate the Zoom towards WIDE and the Exposure switch towards DECR.

3.4 ZOOM CONTROL

The zoom lens operates whenever a Zoom switch on a remote control unit is operated towards either the Tele or Wide positions. The zoom function continues as long as the switch is depressed, until the lens zoom limit is reached. Tele operates towards increasing focal length settings providing reduced viewing angles with increased magnification of objects in the scene. Wide operation reduces focal length settings increasing viewing angles and allows viewing of greater areas of a scene.

When selecting different zoom lens settings the operator should be aware of the change in the Minimum Object Distance (MOD) changes as the viewing angle changes. At the full telephoto position in air, the MOD is approximately 60 inches (1.5 m). At the full Wide Angle position in air, the MOD is the front window.

3.5 FOCUS CONTROL

The SCE-X, 36:1 camera is normally energized and normally operated in Auto-Focus mode. This provides nearly ideal focusing when the camera is aimed at different scenes and tracks while the zoom control is actuated. In some instances where there are objects in a scene at different distances and there is a need for focusing on specific objects, operation in a Manual Focus Mode may be required. This is achieved by momentarily operating the Focus switch on the remote control unit.

To restore Automatic Focus Control simultaneously operate the Zoom towards WIDE and the Focus switch towards FAR.

Generally, most in-air users are able to stay in Auto-Focus mode all the time. The one set of conditions, which may force the operator to switch into Manual mode, is in trying to view a relatively close object that does not have much sharp detail. This occurs because the Auto-Focus system relies on increasing the sharpness of edges in the viewed image in order to optimize the focus.

If there are no edges to utilize for this process, the Auto-Focus will not be able to properly compensate and may even tend to "hunt" around the optimum focus point. Focus hunting may also be caused by low illumination. Again, if the camera is unable to properly sharpen edges due to insufficient video level, Auto-Focus operation will be less than optimum. Switching over to Manual mode and then focusing with the manual remote Focus control is the best option.

Underwater users have a special set of problems, which make Auto-Focus operation more difficult. Seawater normally contains particles in suspension and undissolved solids (animal, plant life, etc.) that reduce the detail of a viewed image. If the image does not have sharp detail, the Auto-Focus system will have a difficult time obtaining correct focus. Manual operation may then be the best choice.

3.6 IMAGE FLIP CONTROL

Another built in function is the electronic image flip. This function is very useful when the camera is mounted on a vehicle (carrier) that is capable of rolling over or a positioner that can tilt more than 90°. This function allows the user to electronically turn the image upside down when necessary.

To activate or deactivate this function EXPOSURE INC (+12Vdc) and FOCUS NEAR (+12Vdc) must be toggled simultaneously. As a way of visual acknowledgement whenever this function is activated or deactivated the camera will momentarily will text overlay the current function status (e.g. IMGFLP ON or IMGFLP OFF) depending of the state of the function and if the overlay has is activated.

3.7 NEGATIVE COLOR VIDEO CONTROL

Another built in function is the negative color video effect. This function is useful when an immediate change in contrast is needed. For example dark colors will be turned in white and simultaneously a light colors as well white illumination will turn dark. Allowing the user to see details in a shadowed area, like a crack.

To activate or deactivate this function EXP DEC (-12Vdc) and FOCUS FAR (-12Vdc) must be toggled simultaneously. As a way of visual acknowledgement whenever this function is activated or deactivated the camera will momentarily will text overlay the current function status (e.g. NEGVID ON or NEGVID OFF) depending of the state of the function and if the overlay has is activated.

3.8 COMPUTER CONTROL

ROS can furnish basic software for enabling computer control through an RS-232 communications link. The basic software displays a screen on the computer monitor with sliders, buttons and other symbols that allow the use of a mouse to provide even more functions than those listed above.

The serial code for camera commands can also be furnished by ROS for users who prefer to develop their own customized software.

Cameras can be furnished with connections allowing not only control but feedback of data from the camera to the computer to display date, time, focus distance and other data generated within the camera electronics module. Again, some users may prefer to develop their own software allowing customized and added sophistication.

3.9 LONG LINE AMPLIFICATION (LLA)

As delivered, the SCE-X, 36:1 camera is set up for normal composite video output over a relatively short length (<500-ft) of coaxial cable, typically RG-59/U.

NOTE: A variety of coaxial cables are available with the RG-59 designation. Many of these cables are intended for RF (radio frequency) applications such as the distribution of RF carriers in a commercial home cable TV network. These RF cables are not suitable for baseband video of the type generated by the SCE-X, 36:1 camera. The GOOD QUALITY RG-59 cables for this camera must be selected with good performance in video transmission. Please consult ROS if additional assistance in selecting optimum cables is desired.

For cases where the camera is going to be operated over extended lengths of coaxial or twisted pair cabling, long-line amplifier driver circuits are included within the camera. This circuitry can compensate for video loss.

NOTE: The Long Line Amplifier may be disabled by adjusting Mode Selection DIP switches. Refer to Section 2.9, Camera Mode Selection. This option requires temporarily removing the camera electronics from the housing to access the control.

3.9.1 Adjust LLA in Bipolar/Unipolar/Differential mode

Adjusting the LLA is a simple 3-step procedure:

Step 1: Enter the LLA adjust mode.
This is performed by simultaneously actuating Zoom Tele and Focus Near. Entering this mode, will display the current LLA setting on the television monitor screen in the following format:

LLA XX:100

Where XX is a number from 00 to 99, representing the current LLA setting as a percentage of its maximum value. At the minimum (for short cables) numbers corresponds to 00:100 and at the maximum (for long cables) numbers corresponds to 100:100.

100:100 will not be displayed it will actually display: LLA MAX

Having the LLA setting displayed on the television display as described above verifies that the camera is in the LLA setting mode.

Step 2: Adjust the LLA by increasing or decreasing the LLA setting.
Once the camera is in LLA setting mode, actuating Focus and/or Exposure has no effect on the camera. And actuating the Zoom control has no effect on the **Zoom**; it will instead increase or decrease the LLA setting. The overlay will display the new setting in real-time.

When the zoom control is actuated in Tele or Wide position, the LLA setting will increase or decrease as long as the control is maintained in that position or until the LLA reaches its minimum or maximum setting.

NOTE: The percentage of the maximum LLA value displayed on the video is just an indication to help the user in setting the amplification. Long Line Amplification is performed by some complex electronics with some non-linear components. As a result, the long line amplification feedback will not be a linear function of the cable compensation. In other words, if the correct long line amplification setting for a cable of 2000 ft is 25% (25:100), it is very unlikely that the corresponding long line amplification for a 4000 ft cable will be 50% (50:100).

Step 3: Exit the LLA adjust mode.
This is performed by simultaneously actuating **Zoom Tele** and **Focus Near**.
Note that entering and exiting the LLA adjust mode is performed with the same control combination.

Exiting the LLA adjust mode, will display on the screen the action just performed in the following format:

LLA EXIT

This message disappears shortly after it appears.

When the LLA adjust mode is exited, the video the new setting is saved in the flash memory of the microcontroller interface and the value is retained through power cycles.

NOTE: The LLA setting is saved only if the LLA adjust mode is exited as described above. If the user changes the LLA setting, then decides to turn off the camera before exiting the LLA adjust mode, the current LLA setting is not saved and the old LLA setting will be implemented on next power up.

3.9.2 Adjust LLA in RS-232 mode.

As described in the Computer Control section, the camera can be configured to be controlled via RS-232 commands. When the camera is operated in this configuration, some RS-232 commands can be sent in order to query and adjust the LLA setting. Please Contact ROS for more details.

3.10 OVERLAY CONTROL

The camera overlay can be turned off or displayed at different positions on the screen. This is performed by simultaneously actuating Zoom Tele and Focus Far. When the combination of switches is actuated, the overlay position changes to one of the four possibilities in the following sequence: UPPER LEFT, UPPER RIGHT, LOWER RIGHT, LOWER LEFT. Actuating the combination of switches one more time when in lower left position, will turn the camera overlay off. If actuated again when in OFF mode, the overlay appears in the upper left position, and the cycle starts over.

Each new setting is saved in the flash memory of the microcontroller interface and the overlay position is retained through power cycles.

Upon power up the camera overlay will display the current mode of operation (e.g. BIPOLAR). After all settings are displayed the camera overlay will go off.

NOTE: Even in the OFF mode, the overlay will automatically be activated when the user enters LLA adjust mode (in the upper left corner). As soon as the new LLA value has been set, the overlay will be turned off automatically.

4 THEORY OF OPERATION

4.1 UNIVERSAL INTERFACE BOARD ASSEMBLY

The schematic diagram of the Universal Interface Board Assembly (Drawing 51-11098) is included in the appendix to this manual. The schematic illustrates the Power Conditioning circuits as well as circuits required to decode Focus, Zoom and Exposure commands. This drawing also illustrates the elements that make up the Long Line Amplifier driver circuits.

Details of interconnections between the Universal Interface Board and the Mode Selector Board assemblies are shown on Wiring Diagram (Drawing 51-11106).

4.1.1 Reverse Polarity Protection

Power to the SCE-X, 36:1 camera is received through pin 3 with respect to pin 1 of universal interface connector J1. CR1 serves as a steering diode to prevent damage from accidentally reversed power connections to the camera.

4.1.2 Automatic Resettable Fuse Protection

RPS1 is a 500 mA “Polyswitch.” A Polyswitch behaves as a fuse that opens in case of a severe current overload but then unlike a fuse, closes automatically once circuit conditions return to normal.

4.1.3 Power Conditioning

Capacitor C9 provides filtering of the input power before it is presented to the main power input regulator device, XVR1. This regulator provides +10V through J3 pin 4 to the Camera Module. XVR1 is actually mounted external to the board on the aluminum base plate of the camera in order assure adequate heat dissipation when the camera is operated at higher input voltages.

The output of XVR1 is also used as an input to other power circuits:

a) Regulator VR1 - Provides +5V to the Zoom, Focus, Exposure control circuits as well as the microcontroller.
b) U4 - a DC-DC converter that generates negative output then regulated by VR2 to provide -6V to the video processing circuits.
c) VR3 - Provides +6V to the video processing circuits.

4.1.4 Standard Control Circuit Operation

The Zoom, Focus, and Exposure control circuits are actuated by dc voltage inputs from a remote control unit. These levels are applied to logic inverter circuits. When the bi-polar control mode is selected these circuits detect the polarity of the

incoming control signals. The outputs of the inverters are logic levels and are sent to a microcontroller. The microcontroller decodes the logic signals and sends RS-232 messages to the camera module to enable the selected control function. The microcontroller messages to the camera are conditioned by the MAX332 (U5) and then sent to the camera through J7 pins 5 and 6.

4.1.5 Video Signals

The camera module within the camera assembly generates one output video signal:

Composite Video (NTSC or PAL)

The composite video from the camera module enters the Universal interface through J7-1 (with respect to J7-2). Two pins are for the two-video signals, while the other three are connected to signal common.

4.1.6 Long Line Amplifier Circuit Operation

Drawing 51-11098 includes a schematic of the video amplifier driver stages. The video signals from the camera module are received through J3-6. The signals are applied to one side of capacitor C18 through the gain control R24 to an amplifier stage U6-A. The output of U6A is delivered through resistor R21, polyswitch RPS2, and connector J1-2 (with respect to J1-1) to the camera output connector and on to a remotely located television monitor.

There are camera systems that use a balanced twisted shielded pair for video transmission as opposed to common coaxial cable. For balanced transmission, two video signals are required: the normal video line and its invert. Stage U6B is used to provide this inverted output as described in the next paragraph.

The output of U6A is coupled through C21 and R30 to the input of stage U6B. This stage is configured as a unity gain inverter so that an inverted duplicate of the output video is available for systems requiring a balanced video output. This inverted video output is sent to the Mode Select Board and if selected will return to J1-8 where it is delivered to the transmission line and on to the remote receiving station.

When driving long cables (typically longer than 500 feet) the attenuation presented by the cable tends to reduce the video signal arriving at the receiving station. Therefore, it is necessary to provide additional amplification of the video signals. This is especially the case for the higher video frequencies. Capacitor C19 couples the higher frequencies of the camera video signals through the variable resistance within optical coupler OPT1, then resistor R25 to the input of stage U6A. The value of the resistance in OPT1 determines the amount of high frequency compensation coupled to U6A and thus the level of compensation.

The value of the resistance in OPT1 is in turn determined by the current passing through the LED within OPT1. And the level of this current is determined by an output from the microcontroller. Section 3.7 includes the instructions for setting the compensation using both the remote control unit's Zoom and Focus controls or through RS-232 communications.

4.1.7 Microcontroller

Drawing 51-11098 also shows the connections to and from the microcontroller (U2).

Programming of the microcontroller is normally performed at the factory. This programming is by temporary connections of equipment to connector J2.

As described earlier most of the logic inputs to the microcontroller are received from the inverters in device U1. The microcontroller responds to these inputs in achieving the desired camera functions.

The microcontroller sends and receives signals to the camera module through a level translator U5 and connector J7. These signals initiate zoom, focus, and other control functions.

Cameras furnished with optional control from external RS-232 signals, instead of the voltage levels typically used, normally include connections from the main camera connector to connector J4. These connections are buffered by circuits in device U5. These connections thus provide the microcontroller with direct input and output communication from the external RS-232 source.

5 TROUBLESHOOTING

5.1 GENERAL

In case of any sort of malfunction of the camera system, it is wise to resist the temptation to completely tear down the system and start replacing components indiscriminately. Many times a quick call to the ROS Technical Support Department will help in restoring operation with minimum effort. Most failures in the field turn out to be cabling problems, and the camera is typically the least likely cause.

If any (or all) camera functions are lost, many times the best course of action is to disconnect the cable connector from the back of the camera and check to see if the power and control voltages are present at the connector. Typical connector pinouts and voltage levels are given in section 2.8 of this manual. If your specific camera is fitted with a customer-specified connector, this wiring will be defined by a special drawing typically in the addendum to this manual.

Normally, all voltage levels present at this connector are referenced to Signal Common (normally Pin 1.) Camera power should be between +11 and +30VDC. The command

lines for ZOOM, FOCUS, and EXPOSURE MODE should all be approximately 0 VDC without any input from the front panel switches on the remote control unit. With the switches actuated, the level on the selected line should go to approximately +12 or - 12 VDC. The internal interface assembly will accept voltages from approximately +/-9 VDC to over +/-20 VDC.

If all video has been lost, use a standard DVM on the ohm scale to check the center conductor of the coax for continuity. This is normally Pin 2 on the standard connector, and exits the ROS controller on the middle pin of the BNC connector on the rear panel. Normal resistance should only be a few ohms unless the system cable is extremely long.

If all appears well at this point, the next step is to open up the camera housing and check the Universal Interface Board for proper operation.

5.2 CAMERA DISASSEMBLY

The SCE-X, 36:1 Camera Assembly is fairly easy to disassemble.

1) Remove the stainless steel snap ring retaining the rear endbell to the camera housing.
2) Remove the seal screw in the rear endbell.

Next Very Carefully:

3) Use a standard air chuck (preferably with a rubber tip) to slowly pressurize the housing until the camera slides out the back. Do not pressurize too quickly or the camera may tend to become airborne as it exits the housing.

4) Once the camera electronics assembly is out of the housing it should be placed on a non-conductive surface and secured to prevent accidental damage.

5.3 CAMERA OPERATIONAL CHECKS

On a camera with balanced video where a picture is not displayed on the receiving monitor, fuse F1 and F2 on the Mode Selection board assembly should be checked for continuity. These are 1/8A fuse elements that protect the camera module and output amplifiers from excessive loads or in the event of accidental shorts to camera power or control lines.

If either F1 or F2 is open it can be removed and replaced. Fuse F3 on the board is a spare fuse that can be used for replacement. Naturally, before powering up the camera again, the cause of the output overload should be identified and corrected.

5.4 CAMERA TROUBLESHOOTING

The Universal Interface Board (51-11101) has test points to assist in troubleshooting

circuits on the board. TP6 (Black near J6) is the common for all measurements. Readings should be as follows:

Test Point	Function	Voltage
TP1 (Red)	Regulated Power	9.8 -10.2 VDC (10 VDC nominal.)
TP2 (Red)	Regulated Power	4.7 - 5.3 VDC (5 VDC nominal)
TP3 (Yel)	Regulated Power	-5.7 – 6.3 VDC (-6 VDC nominal)
TP5 (Red)	Regulated Power	5.7 – 6.3 VDC (+6 VDC nominal)
J5:3	Unregulated Power	11 VDC < Input Voltage < 30 VDC

Variations in voltage from those tabulated above may be helpful in analyzing a fault. If camera operation is less than satisfactory at this point, ROS's Technical Services Department should be contacted for assistance.

6 MAINTENANCE

Maintenance of the camera is typically limited to cleaning, and maintenance of the O-ring seals on the window and rear end plate. The acrylic window should only be cleaned with a commercial lens cleaner or with a mild soap and water. Use only a soft cloth or lens tissue to avoid scratching the surfaces.

Anytime the housing is removed the O-rings should be carefully inspected for cuts, tears, or any other damage and replaced if necessary. The new O-ring should be given a light coating of silicone grease or other O-ring lubricant before re-assembly.

On the internal camera assembly, ensure that all electrical connectors are correctly fitted and all cabling is secured.

All threads should be carefully inspected for burrs or early signs of galling. Small areas of damaged threads may be polished to remove any offending material. The threads should then be completely cleaned and coated with a waterproof lubricant. When reassembling the camera, be aware of any grinding or dragging that might signify thread damage.

As the camera is being re-assembled just before the camera is sealed in the housing, blowing dry air or nitrogen into the housing is highly recommended, to avoid condensation on the inside surfaces, especially the front port. This is especially important if the camera is being sealed in a humid environment. Excess humidity in the housing will normally result in fogging of the window and may cause eventual damage to the camera electronics through corrosion.

APPENDIX

SCE-X 36:1 CAMERA DRAWINGS

53-04125	Top Assembly, SCE-X, 36:1
53-04128	Installation, SCE-X, 36:1
53-04126	Wiring Diagram, SCE-X 36:1
52-26634	Protocol, RS-232 Communication, UIB