



SULIS Z70 Deep-sea 4K Zoom Camera User Manual

Revision 1.14

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Revision History

Revision	Author	Release date	Notes
1.0	NN, AG	August 8, 2016	Initial release
1.1	NN, AG	November 1, 2016	Updated NAS section
1.11	AG	June 20, 2017	Updated white balance information
1.12	AG	August 11, 2017	Updated control box information
1.13	AG	September 12, 2017	Updated NAS section
1.14	AG	May 19, 2018	Updated CB1 section, added Servicing and Storage info

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Disclaimer

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The information in this manual is believed to be accurate and reliable. SULIS assumes no responsibility for its use.

Warranty

SULIS warrants that its products sold under contract will be free from defect in material and workmanship for a period of one year from the date of shipment from the factory, if they have been properly used. Equipment will be investigated and inspected to ensure it was used under normal operating conditions. This warranty will be limited to the repair or replacement of parts and the necessary labour and services required to repair the goods. All shipping and associated costs for transporting the equipment to and from SULIS's facility are to be covered by the Customer.

Repairs and/or modifications may be made by SULIS employees only, otherwise the warranty shall be void, unless such repairs are made with the prior written consent of SULIS. In the event of a product failure, and the customer fails to take prompt reasonable action to prevent further damage to the product, SULIS will not be held responsible for any further damage.

SULIS does not accept any liability concerning any consequential or incidental damage of any sort that occurs as the result of the operation, repair, and/or maintenance of its products.

Customer Support

Technical support for the Z70 is available from SULIS's head office:

SULIS Subsea Corporation
17 Dundee Avenue, Unit 4
Mount Pearl, NL A1N 4R6
Canada
(709) 745-5080

support@sulissubsea.com
www.sulissubsea.com

Should it be necessary to return the camera to the factory, please first contact SULIS.

General Information

In this manual the user can find all necessary information to safely set up and operate the Z70 system. Please note that the user should not try to alter or repair the system; all repairs should be done by authorized service personnel. There should be no reason to ever open the housing of your Z70; it has been thoroughly pressure-tested prior to leaving the factory to confirm the integrity of the complete assembly.

Operation on deck

The Z70 is not meant to be operated out of the water for long periods of time. Unless downloading imagery from the camera (which involves commands that shut down video output), the user should limit on-deck operation to 1 hour or less. In environments greater than 25 C ambient temperature, on-deck operation should be limited to 30 minutes or less.

Model information and features

- Deep-ocean camera with live 4K video transmission and 12X optical zoom
- Unparalleled optics designed specifically for aquatic environments
- Fully-corrected 100-degree ultra wide-angle field of view (diagonal)
- Large 1-inch sensor for increased light sensitivity
- 20-megapixel stills capture
- Broadcast quality controls
- Internal recording w/ optional Ethernet downloading
- Available for 6000 m depth and 3000 m depth

Z70 specification

Electrical

Image sensor:	1-inch format (CMOS)
Video resolution:	4K (HDMI 2160p30/24) , HD (HDMI 1080p60/30/24)
Photo resolution:	20 Megapixels

Serial comm. specification:	Two-wire (isolated) or three-wire RS485 (half duplex)
Strobe trigger:	Isolated 5V, 60mA maximum; active level configurable
System Power:	24 VDC nominal (10.5 V to 36 V), 12W (typical)

Mechanical

Housing dimensions:	155mm (D), 350mm (L) (excluding hood)
Depth rating:	3000 m (anodized aluminum) 6000 m (grade 5 titanium)
Weight:	~10Kg dry (6000 m model) ~5.5Kg wet (6000 m model)

Optical

Zoom range:	12X (optical)
Field of view:	100 degrees (diagonal, full-wide) 11 degree (diagonal, full-tele)

Environmental

Operating temperature:	0 C to 30 C
Maximum in-air operating time:	1 hrs (<25 C ambient), 0.5 hrs (<30 C ambient)
Storage temperature:	-20 C to 60 C

Pre & Post Dive Inspection

Before deployment, check to make sure that all connectors are secure and undamaged. Check front window (dome) to ensure there is no damage from previous dives.

Rinse your Z70 in fresh water after use in saltwater.

After each deployment, check to make sure the camera is operational and has not been damaged/flooded.

Topside Monitoring & Recording

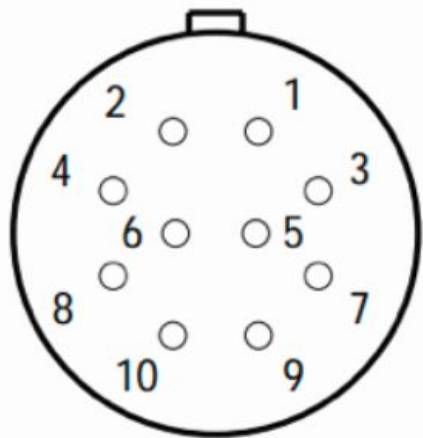
The Z70 can be configured to provide live 4K video via an uncompressed HDMI signal sent over a fibre optic link. For 4K monitoring and recording, when the signal reaches topside, it is converted from optical back to electrical using the supplied receiver box.

NOTE: When connecting the fibre link to the Z70 receiver box, be sure to first measure the optical power output. If necessary, add attenuation to ensure the input power to the receiver does not exceed -10 dB.

Electrical Connector Configurations

Titan MKS-310-BCR w/ Ethernet downloading

All power connections and electrical signals, including Ethernet, are on a single 10-pin Teledyne Titan bulkhead. **Face view (male):**



- 1- +24V input
- 2- RS-485 A (+)
- 3- COM (24V return)
- 4- RS-485 B (-)
- 5- Flash trigger +
- 6- Flash trigger -
- 7- Ethernet Tx +
- 8- Ethernet Rx +
- 9- Ethernet Tx -
- 10- Ethernet Rx -

SubConn MCBH4M, MCBH6F w/ USB downloading

Power and RS-485 are on a 4-pin SubConn MCBH4M. **Face view (male):**



- 1- Power - DC Common
- 2- Power - +24V DC
- 3- RS-485 - Data +
- 4- RS-485 - Data -

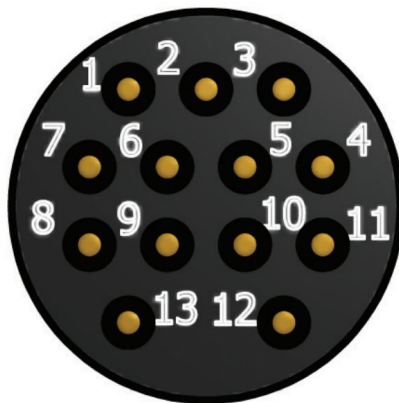
USB downloading and strobe trigger are on a 6-pin SubConn MCBH6F. **Face view (male):**



- 1- USB - GND
- 2- USB - Data-
- 3- USB - Data+
- 4- USB - 5V
- 5- Strobe Trigger +
- 6- Strobe Trigger -

SubConn DBH13M w/ Ethernet downloading

All power connections and electrical signals, including Ethernet, are on a single 13-pin SubConn Power Ethernet bulkhead. **Face view (male):**



- 1- Power - DC Common
- 2- NC
- 3- RS-232 GND
- 4- RS-232 Rx (RS-485 -)
- 5- RS-232 Tx (RS-485 +)
- 6- Trigger +
- 7- Trigger -
- 8- Ethernet Tx +
- 9- Ethernet Tx -
- 10- Ethernet Rx +
- 11- Ethernet Rx -
- 12- Power - +24V DC
- 13- Shield

Servicing

It is recommended to service your Z70 system on a yearly basis. This is performed at SULIS's factory and includes disassembly and full inspection, and replacement of all seals.

Storage

The Z70 may be stored at the temperature range indicated the Z70 specification. After several months or more of storage, the date/time may need to be reset on the system, which will occur upon first power-up; instead of the camera feed showing, there will be a series of on-screen menus that must be navigated (using the menu navigation controls) before the feed is restored.

Camera control

Z70 control is based on a proprietary serial communication protocol. The protocol is ASCII-based, so the user can send commands using a standard serial terminal, if desired. SULIS also offers two user-friendly control operations, a GUI-based computer program, and a physical control box. The following control procedures can be achieved with any control scheme.

Modes of Operation

The Z70 supports two modes of operation: **Video** and **Photo**.

When in video mode, the camera provides a live 4K feed at 24 or 30 frames per second (or 1080p at 24, 30, or 60 fps), with hybrid 20-megapixel stills capability. The stills do not interrupt the camera feed, and are not flash-synchronized. Stills can be captured approximately every 12-15 seconds, up to 3 at a time.

When in photo mode, the camera switches to a live HD feed at 60 frames per second, along with flash-synchronized 20-megapixel stills. When commanding stills, the feed pauses briefly to display the captured still. Stills can be captured approximately every 1-2 seconds.

Zoom and Focus commands

The Z70 is capable of variable-speed focus and zoom, with the ability to accept rapid-fire serial commands; if the commands are sent faster than what the camera mechanics can handle, the camera will simply return 'BUSY'. The Z70 is also capable of auto-focus.

Focus near/far

When the Z70's focus control is set to manual, focusing near and far can be achieved with eight variable-speed focus commands for each direction (far/near). The GUI supports a subset of these speeds, while the control box provides a speed-sensitive rotary dial dedicated to focus control (the faster you twist the dial, the faster you will change focus).

Zoom in/out

There are four zoom speeds for each direction (in/out). The GUI supports a subset of these speeds, while the control box provides a 3-axis joystick for pan/tilt/zoom; zoom control is achieved via a twisting motion of the joystick (the more you twist the joystick, the faster the camera will zoom).

Save default zoom and focus

If desired, the user can issue a command to set default settings for focus and zoom on power-up. To preserve other camera settings, this command will only be accepted upon start-up. The user should set zoom and focus immediately, and then execute the command. The live feed will be interrupted temporarily to save the settings, which can take up to 60 seconds.

Control of Iris, Shutter, and ISO

The Z70 supports full manual control of iris, shutter and gain (ISO). Automatic control of iris and gain are also supported.

Automatic or manual control of these settings are achieved via serial commands. The Z70 can also be interrogated for current ISO and shutter settings. The GUI provides these controls along with status display for ISO/shutter settings. The control box provides a speed-sensitive rotary-dial for control of each setting (selectable via the touchscreen), and provides a similar status display.

Please note that the iris and shutter settings are the same across operational modes (i.e. both video and photo), while the ISO settings are specific to each mode.

On-Screen Control

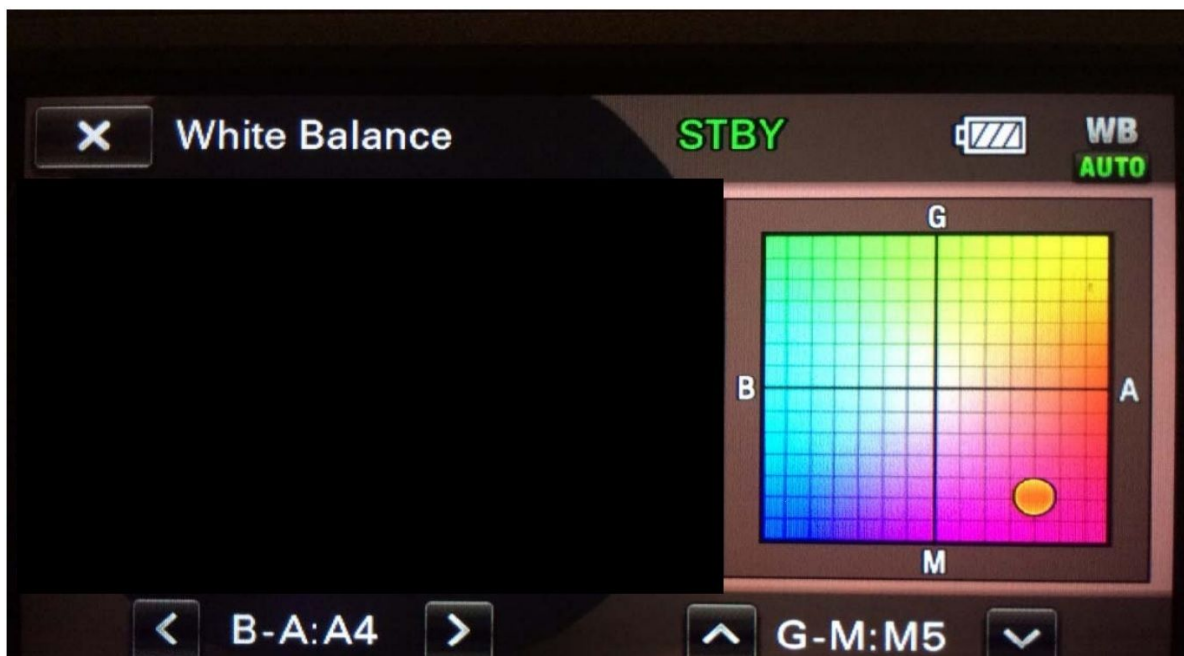
The Z70's camera module has a range of on-screen settings that can be navigated through serial control of an on-screen cursor. This includes a menu command (bringing up the main menu), as well commands to select an option, and move the cursor up, down, left, or right. Both the GUI and control box provide these controls for easy navigation.

The majority of menu options can be left alone, with key on-screen controls brought up through available of serial commands.

White Balance adjustment

The Z70's white balance can be modified through several serial commands. This includes various modes such as auto white balance (default operation), on-screen white balance adjustment, and one-touch white balance (particularly useful when imaging a white target, such as a slate or chart). Both the GUI and control box provide these commands.

If the auto-WB or one-touch-WB functions produce overly greenish or reddish hues in the captured imagery, the balance can be adjusted on the fly by navigating to the "option" button on the right of the on-screen white balance configuration. This will bring up a "tint" tool (shown below), that will help you fine-tune the balance and correct any perceived imbalance.



To assign the “tint” that you desire for the image, use the arrows along the bottom of the screen to navigate the yellow dot. For example, if you would like to correct a greenish hue, you should move the dot **away** from the green colour, toward magenta. When you find an acceptable balance, you can save the settings as default (as explained in the next section).

White Balance saving

If desired, the user can save their white balance settings as the default for start-up. To ensure other settings are preserved, this command can only be executed during start-up, where the user may first execute a series of focus and/or zoom commands to properly frame the white balance target (if desired). Complete execution of the command will take 30 - 60 seconds.

NOTE: When attempting to execute any white balance commands, the user must ensure they first exit out of any on-screen menus.

Cinematone

This command brings up an on-screen menu to enable or disable Cinematone (enabled by default), which automatically adjusts image quality to be more “film-like”, in terms of contrast and colour.

NOTE: When attempting to execute the Cinematone command, the user must ensure they first exit out of any on-screen menus.

AEShift

This command brings up the AEShift menu, which can be used to adjust the exposure level of the auto-exposure algorithm, in terms of EV.

NOTE: This command will not execute if the camera is in full-manual mode. When attempting to execute the AEShift command, the user must ensure they first exit out of any on-screen menus.

Video recording

Internal 4K video recording is possible on the Z70, however it is not possible to simultaneously record in 4K and output a live feed (live feed is automatically disabled when recording starts). Simultaneous display/record is possible in HD.

There are commands for starting and stopping recording, as well as checking status. The recording status is displayed graphically on the GUI and control box display.

Taking Still Images

Still image behaviour is explained in the previous section "[Modes of Operation](#)". The user can command for a still to be taken, as well as check status on whether the camera is still saving previously taken stills. This status is displayed graphically on the GUI and control box display.

For Photo mode, the strobe trigger can be set to active-high or active-low.

Video/Still Data Transfer

Depending on the configuration, the Z70 can support Ethernet downloading or on-deck USB data transfer. Both are commanded using the same set of serial commands, CDLOn & CDLOff.

To avoid running out of in-camera memory during a dive, the best practice is to delete image/video files from the camera after they are successfully downloaded.

Before sending the command to start the download process, the user should exit any on-screen menus.

Ethernet Downloading

NOTE: If you need to make room on the camera's memory card, it must be done through this interface. Do NOT format the card via the camera's on-screen menu, as it may cause the internal NAS unit to malfunction, requiring it to be reset at SULIS's factory.

With an in-camera NAS unit, the user can access the image data over their local network. When NAS is on, the live feed is interrupted. By turning off the NAS, the live feed automatically restarts.

The internal NAS unit is a [Ushare Mini NAS Adaptor](#). It is configured to query the network's DHCP server for a network address. Once it is assigned an IP, the Z70's imagery will be available over the network via a Samba shared drive, named 'Z70-DATA'. Under that directory, you will find still images in 'DCIM', and video clips in 'Private → M4ROOT → Clips'. If you are asked for a username/password, use guest/guest.

If you have trouble accessing the folders, or would like to configure the device with a static IP, you can access its configuration server in any web browser. The default username/password is admin/admin.

NOTE: If re-configuring the IP settings of the NAS, please take great care. If the settings are incorrect and prevent network access, the Z70 will need to be sent back to the factory to have the NAS reset.

If you have any trouble determining the camera's IP address, you can download the [Search NAS Utility](#) software from the manufacturer's website (a Java runtime environment is required to use this software).

Below you will find the main configuration page on the HTTP server:



The user should maintain the Z70's internal storage by simply deleting files over the NAS. However, in the unlikely event that you need to format the SD card, the shared directory configuration will need to be restored.

First, take at least one still image, and record a short video clip, to populate the file storage locations on the camera. Then, under the NAS configuration, navigate to 'File Server'. Check that the Samba Server is enabled, and under the account list, select the desired account, usually Guest, and choose to modify.

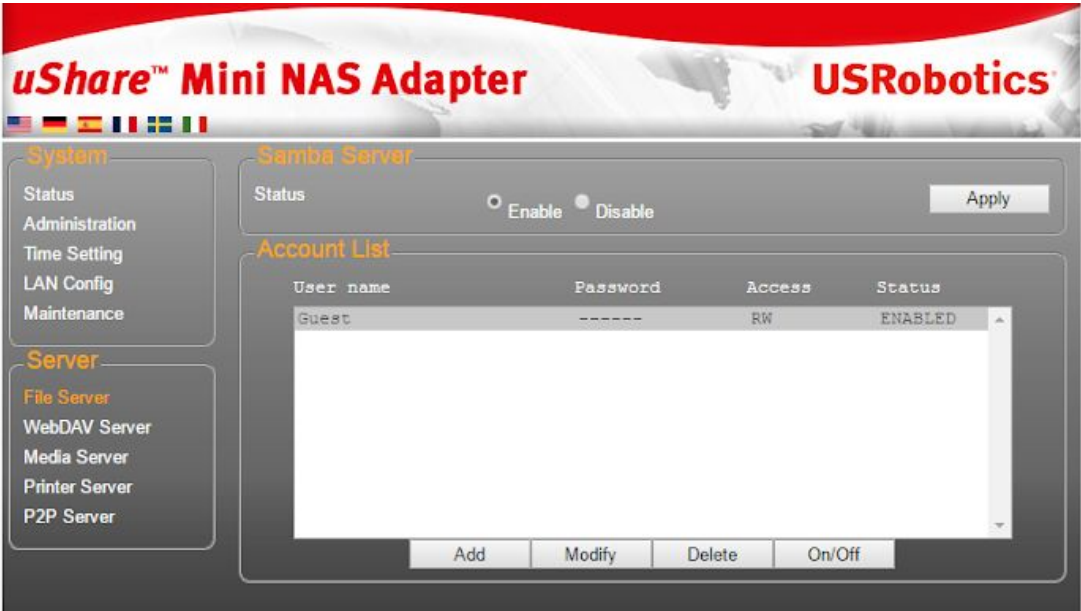


Figure 4. File Server menu

Directories can be added to or deleted from the shared list. The DCIM folder contains the captured still images, and all videos are saved on the Private folder. If those two folders are not shared, add them to the sharing list.



On-deck USB Downloading

On-deck downloading can be achieved by connecting a portable computer (e.g. laptop) to the Z70 via the supplied download cable. The camera should be first commanded to prepare for transfer (i.e. 'CDLON'), so it turns off video output to minimize heat generation while on deck.

When connecting to the host computer, two drives will be visible. On the drive named Removable Disk (not PMHOME), you can find stills under DCIM folder and videos on Private → M4ROOT → Clips folder. The time zone of timestamps are GMT without any daylight saving.

When user finishes downloading data, the drives should be safely ejected from the host computer, followed by disconnecting the download cable. If the user wants to restore the live feed, USB downloading should be turned off by sending the proper serial command.

NOTE: It is recommended to power the camera from a reliable 24V DC supply when it is on deck; camera should not be powered down during the download process.

NOTE: At the time of accidental shutdown of host computer, it is recommended to disconnect the USB cable and turn off USB downloading, and restart the download process when the computer is on again.

Firmware field upgrade

NOTE: Please make sure that you have a reliable serial connection; serial communication or power must not be interrupted at the time of programming the camera's flash memory.

NOTE: The firmware upgrade should be done upon powering up the system. It is recommended to power cycle the system after finishing the update.

GUI Download

Please download the GUI form Chip45 website. The proper bootloader is already programmed on the microcontroller:

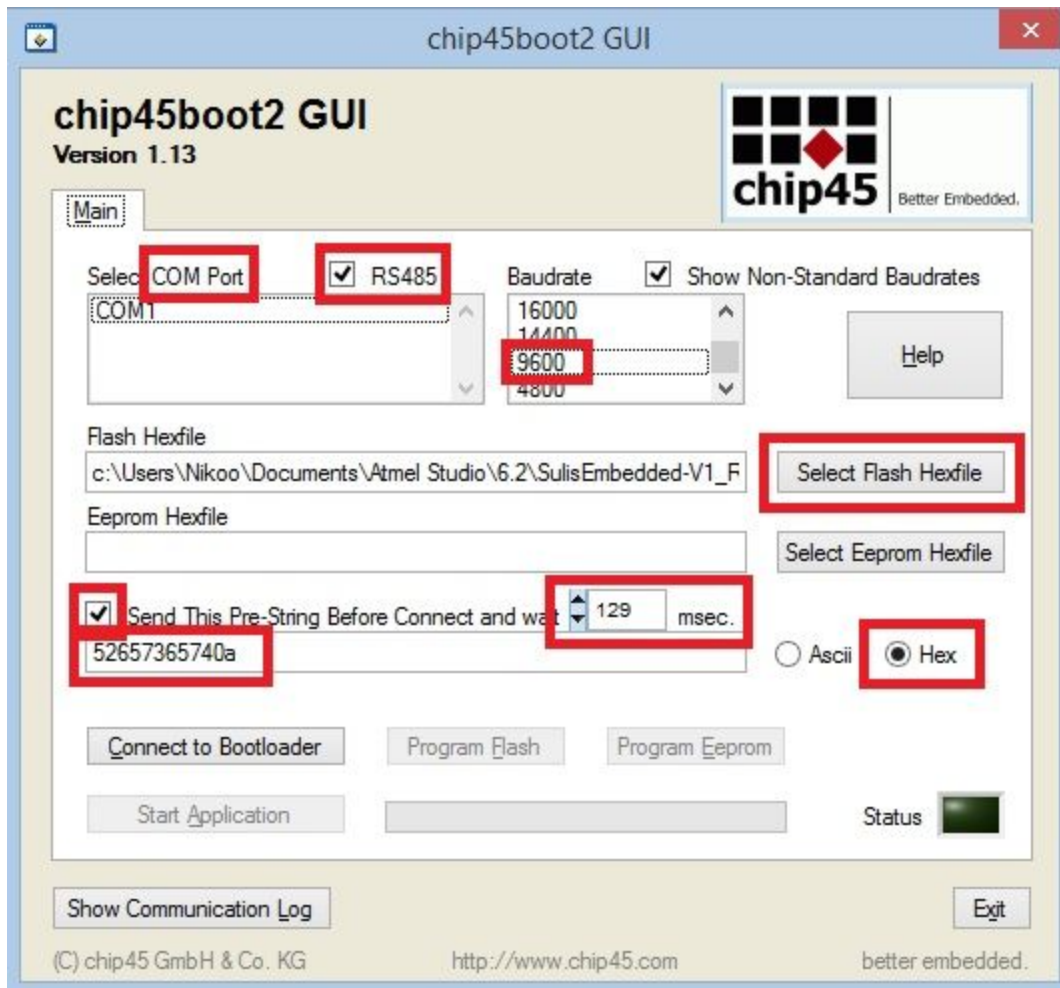
https://www.chip45.com/avr_bootloader_atmega_xmega_chip45boot2.php

Under the "chip45boot2 GUI PC/Windows Program" section, download chip45boot2 GUI V1.13.

GUI Setting

On the following image, all the dialogues that should be set are marked in red.

RS485 should be chosen as the communication channel. The proper COM port should be selected. The baud rate should be set at 9600, and new firmware hex should be selected.



Firmware Update

Before connecting to the bootloader a pre-string should be sent, please select the check box for sending pre-string, and the Hex format. The Hex string is 52657365740a, and a 129 ms delay is required.

After setting all the fields as explained, you can select connect to bootloader; at the time of a successful connection the status indicator will be light green. Then Program Flash should be selected and the bar by the status indicator will show the progress of programming, at this time the status indicator will be yellow. When programming is done the status will get back to light green, and you should disconnect the bootloader, and then power cycle the camera.

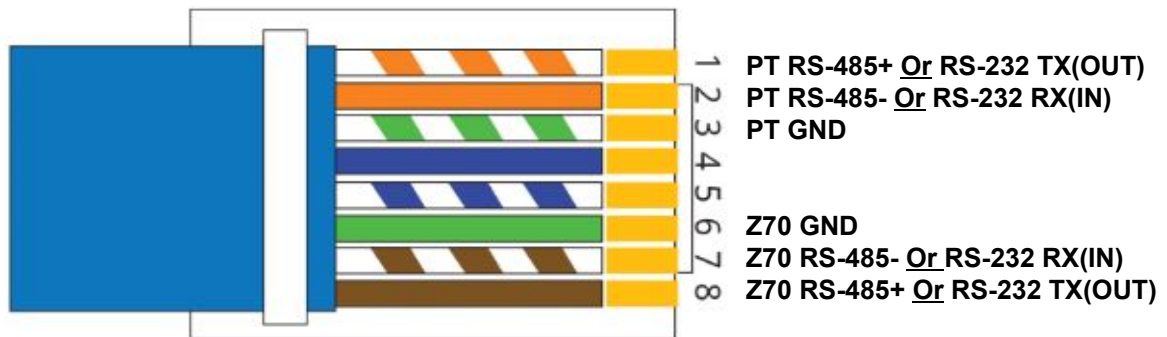
Z70 Camera Control Unit

The Z70 CCU (SULIS CB1) is the most effective and intuitive way of controlling the SULIS Z70. It features:

- Three-axis joystick for variable-speed zoom and pan/tilt motion control. Supported pan/tilt positioners include Remote Ocean Systems PT25, and the SIDUS SS100 series.
- Two speed-sensitive dials for fine camera control; one is dedicated to focus, with the other being multi-function for iris, shutter speed, and ISO.
- Momentary button for stills capture, with LED status illumination
- Large touchscreen for control of all features, status display, and full configuration.

The CCU can be turned on and off with the power button on the back. It runs an embedded version of Linux, and has protection built in to prevent the OS from being corrupted in the event of a power failure or hard power-off.

The following is the pin-out for the RJ45 jack used for serial communications:

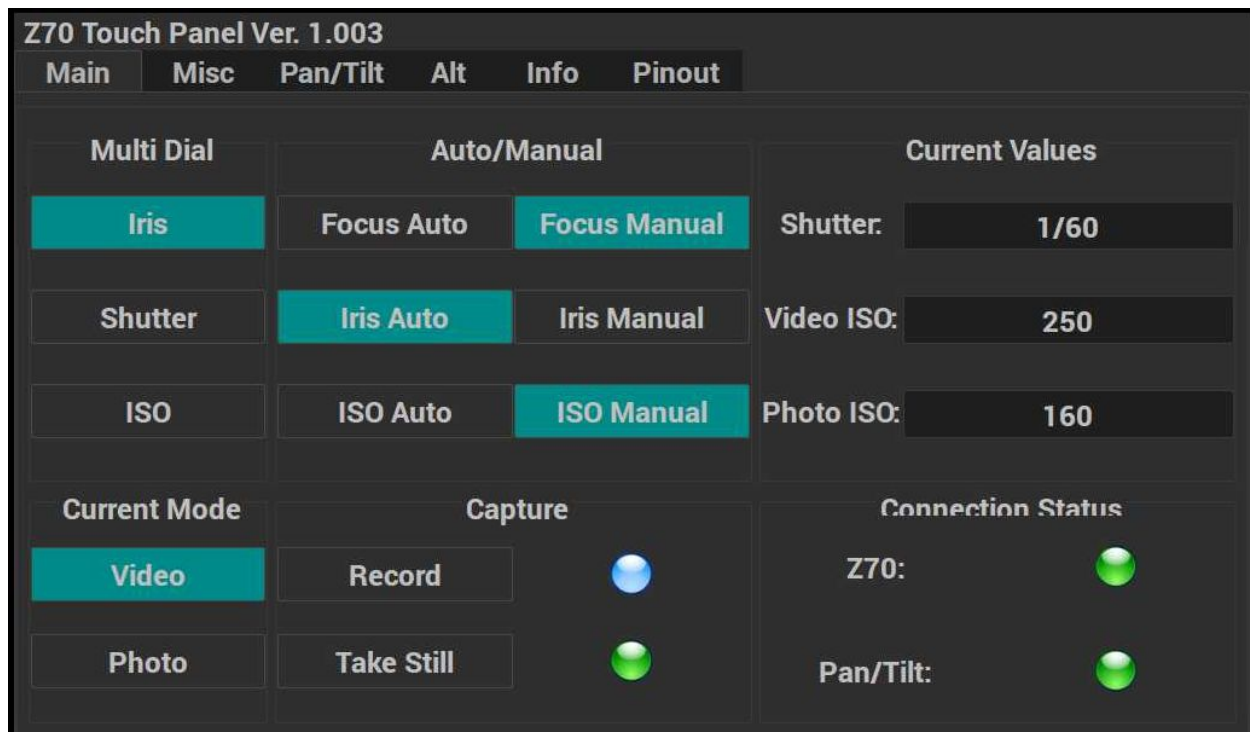


NOTE: The serial interfaces for both the Z70 and pan/tilt positioner will be configured at the time of manufacture, depending on the configuration of your equipment.

CCU Control Views

The touchscreen display is composed of three control views, detailed as follows.

Main Control View

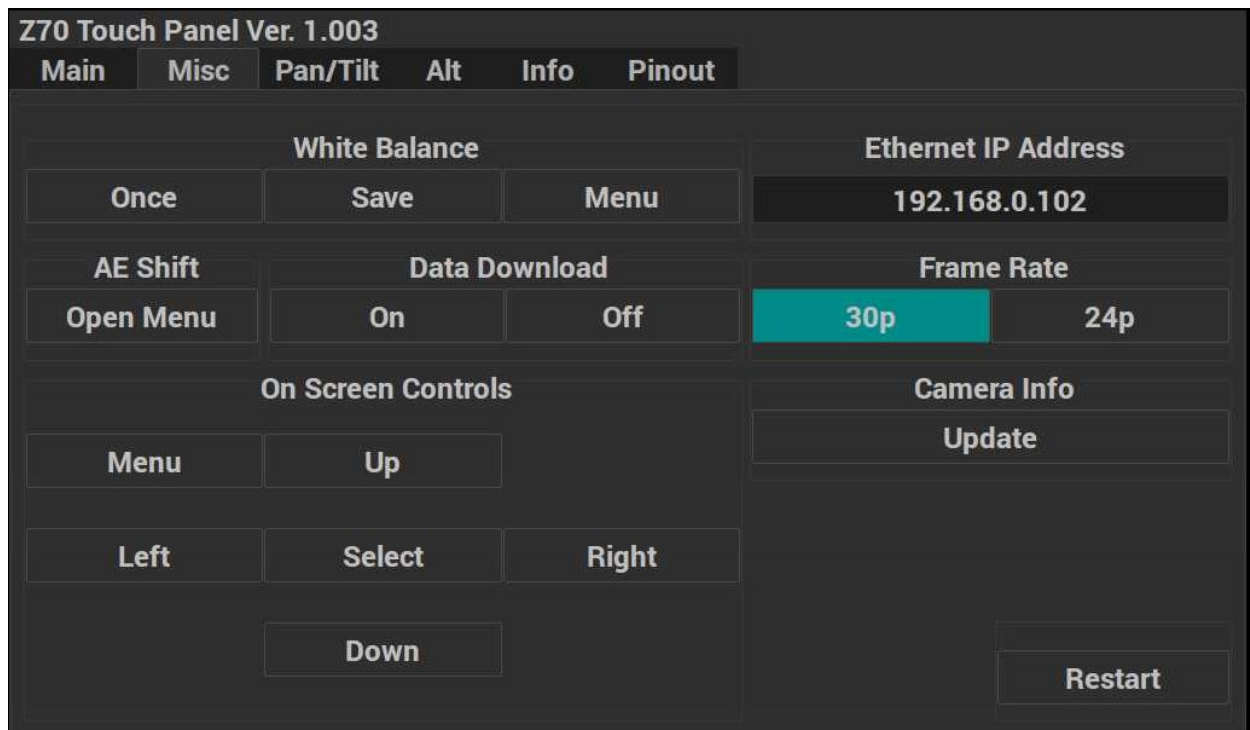


The control selection for the multi dial is found here, along with auto/manual switching for various camera settings, video/photo mode selection, video and still capture buttons, and various status displays:

- If the Z70 and/or support pan/tilt positioners are connected and communicating, they will show green status lights. Otherwise, a red light with white cross will be shown.
- When recording video internally, the record light changes from blue to red, indicating recording is in progress.
- When taking a still, either via the physical button, or the touchscreen control, the green light changes to red to indicate that stills are saving, and no more can be taken. If additional stills can be taken while previous ones are saving, the light will turn yellow. This status lighting is reflected on both the momentary button, and the touchscreen display.

NOTE: Some camera controls will not respond while stills are saving (i.e. the status light is yellow or red).

Misc Control View



The misc. control view provides functions for:

- Frame rate selection
- White balance controls
- Auto-exposure control (AE Shift)
- On-screen menu display/navigation
- IP address display (if the box is connected to a network)
- USB/Ethernet download control
- Program restart button.

Pan/Tilt Control View (ROS PT25)

Z70 Touch Panel Ver. 1.003

Main Misc **Pan/Tilt** Alt Info Pinout

Current Position

Pan: 45

Tilt: -27

Invert Axis

Pan

Tilt

Acceleration Profile

Slow Medium Fast

Pan Soft Stops

Lower

Set -90 Reset

Upper

Set 90 Reset

Tilt Soft Stops

Lower

Set -60 Reset

Upper

Set 60 Reset

The control box supports the Remote Ocean Systems PT25 Pan/Tilt positioner. Its control view provides:

- Orientation information. The camera is pointing forward when at 0/0 for pan/tilt, with the units in degrees (e.g. 45 degrees means it's pointing 45 degrees to the right, -27 degrees means its pointing down 27 degrees).
- Controls for inverting the pan/tilt axes if desired (particularly useful if you mount the assembly upside-down).
- Three different acceleration profiles.
- Functions for setting the soft stops, which are software-defined limits of the panning and tilting range. These can be set to avoid any physical contact between the Z70 and other nearby instruments during pan/tilt operation.

Pan/Tilt Control View (Sidus SS100-series)

Z70 Touch Panel Ver. 1.003

Main Misc **Pan/Tilt** Alt Info Pinout

Current Position

Pan: 45

Tilt: -27

Invert Axis

Pan

Tilt

Active Braking

Enable Disable

Pan Soft Stops

Lower

Set -90 Reset

Upper

Set 90 Reset

Tilt Soft Stops

Lower

Set -60 Reset

Upper

Set 60 Reset

The control box supports the Sidus SS100 series of Pan/Tilt positioners. Its control view provides:

- Orientation information. The camera is pointing forward when at 0/0 for pan/tilt, with the units in degrees (e.g. 45 degrees means it's pointing 45 degrees to the right, -27 degrees means its pointing down 27 degrees).
- Controls for inverting the pan/tilt axes if desired (particularly useful if you mount the assembly upside-down).
- Braking functionality
- Functions for setting the soft stops, which are software-defined limits of the panning and tilting range. These can be set to avoid any physical contact between the Z70 and other nearby instruments during pan/tilt operation.

Alternative Control View



System Information View

Z70 Touch Panel Ver. 1.003

MainMiscPan/TiltAltInfoPinout

Manufacture Date 24/05/2017	Product Info Version: 1.01.05.UE	Temperature °C Operat.: 0 to 40
Warranty End: 24/05/2019	Serial Num: 17Z20	Storage: -20 to 60
Boards Interface: 1.04	Video Output Fibre/HDMI (1290 nm)	
Power: 1.02	Storage GB: 512	Data Download Ethernet/IP (H.265)
Firmware 1.05	Internal Rec: 4K/H.265	Depth (m): 6000

Pinout View

Z70 Touch Panel Ver. 1.003

Main

Misc

Pan/Tilt

Alt

Info

Pinout

Type

SubConn DBH13M



Pin Labels

1	Ground DC
2	N/C
3	N/C
4	RS485 B/-
5	RS485 A/+
6	Flash Trigger +
7	Flash Trigger -
8	Ethernet Tx +
9	Ethernet Tx -
10	Ethernet Rx +
11	Ethernet Rx -
12	24 Volts DC
13	N/C