MAXIMUS 7 OPERATOR'S AND MAINTENANCE MANUAL

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1 INTRODUCTION

The SpaceCam Maximus 7stabilized gimbal system is the latest development from the SpaceCam team. The Maximus is a 7 axis light weight, gyro stabilized mounting and steering system for high end film cameras. It provides 360 degree continuous steering in pan, tilt and roll axes with an architecture that totally avoids gimbal lock in all positions. Additionally, the base mounting position can be oriented in any attitude, top, bottom or cantilevered (matrix). The Maximus also allows full transition between these positions during shooting while still maintaining control and stability.

The degree of stability and control easily transcends competing systems for crane, camera car and boat applications.

As with any system it is highly recommended that technicians study and familiarize themselves with the set up and operating principals in order to obtain the best quality imagery.

1.1 Warnings

We designed the system to have a long life and be reliable (as long as it is not modified). The system power supply for example protects the system from trouble, over/under and reverse voltage and also supplies the current demand correctly.

Customers and operators should not alter any part of the unit or invent new ways of system setup. If they do

- Customers who bought a system lose their warranty and must pay for the repair.
- Customers who have a rental or demo unit should be responsible for the cost of repair or a replacement system.

1.2 Gimbal main operating modes

TABLE 1 - Gimbal operating modes	
MODE	**NOTE**
DISABLE	Gimbal servos are disabled
SPACECAM	This mode mimics the way the original SpaceCam System operated with the embellishment of being able to allow 360 degree continuous tilting and rolling of the camera platform. The camera's tilt axis is always aligned to the horizon. The camera can tilt up and down and the top and bottom of the image frame is always parallel to the horizon. The camera has full 360 degree of tilt freedom while still keeping the top and bottom of the image frame parallel to the horizon. When the camera is pointed straight down or straight up a sideways pan input on the joystick will result in the image rotating in the viewfinder. This effect transitions to a pure pan motion of the camera as it is tilted up to horizontal.
SPACECAM2	This mode is the same as SpaceCam mode with the additional feature that control polarity is maintained even when the camera is in an inverted position.
ZEDIR/PAN	This mode starting with the camera at zero degrees tilt has the horizon level in the frame. When the camera is tilted down a transition happens that allows the operator to pan the camera, in terms of image either left or right. This will begin at -30 and transition to full image pan authority at -60 degrees in the case of tilting the camera down. Upon tilting up the camera will transition to a level state in roll between -60 and -30 degrees. This will happen in time for the top of frame to be parallel with the horizon by the time it enters the image frame. This feature will also be applicable when pointing the camera above the horizon going to zenith. In all cases the horizon when in image frame will be level in terms of picture roll
HARD	In hard mode the gimbal will follow the mounting bracket in all directions (like welded). The joystick controls still work but there is no stabilization.

Select the desired gimbal mode with the F1 and F3 keys. Press F1 to disable the head and press F3 (repeat if needed) to select one of the 4 operating modes.

1.3 Gimbal sub operating modes

Pan Modes.

In the Yaw Velocity mode the yaw velocity of the platform is proportional to the pan joystick's displacement.

In the Yaw Follow mode the platform will follow the mounting bracket's yaw movements in addition to the joystick control. Press PAN. In follow mode the position limits don't work!

Tilt Modes.

In the Pitch Velocity mode the pitch velocity of the platform is proportional to the tilt joystick's displacement.

In the Pitch Follow mode the platform will follow the mounting bracket's pitch movements in addition to the joystick control. Press TILT. In follow mode the position limits don't work!

Roll Modes.

In the Roll Velocity mode the roll velocity of the platform is proportional to the roll joystick's displacement.

In the Roll Follow mode the platform will follow the mounting bracket's roll movements in addition to the joystick control. Press ROLL. In follow mode the position limits don't work!

In the Roll Position mode the roll position of the platform is proportional to the joystick's displacement. Press (SHIFT)ROLL. In roll position mode the position limits don't work!

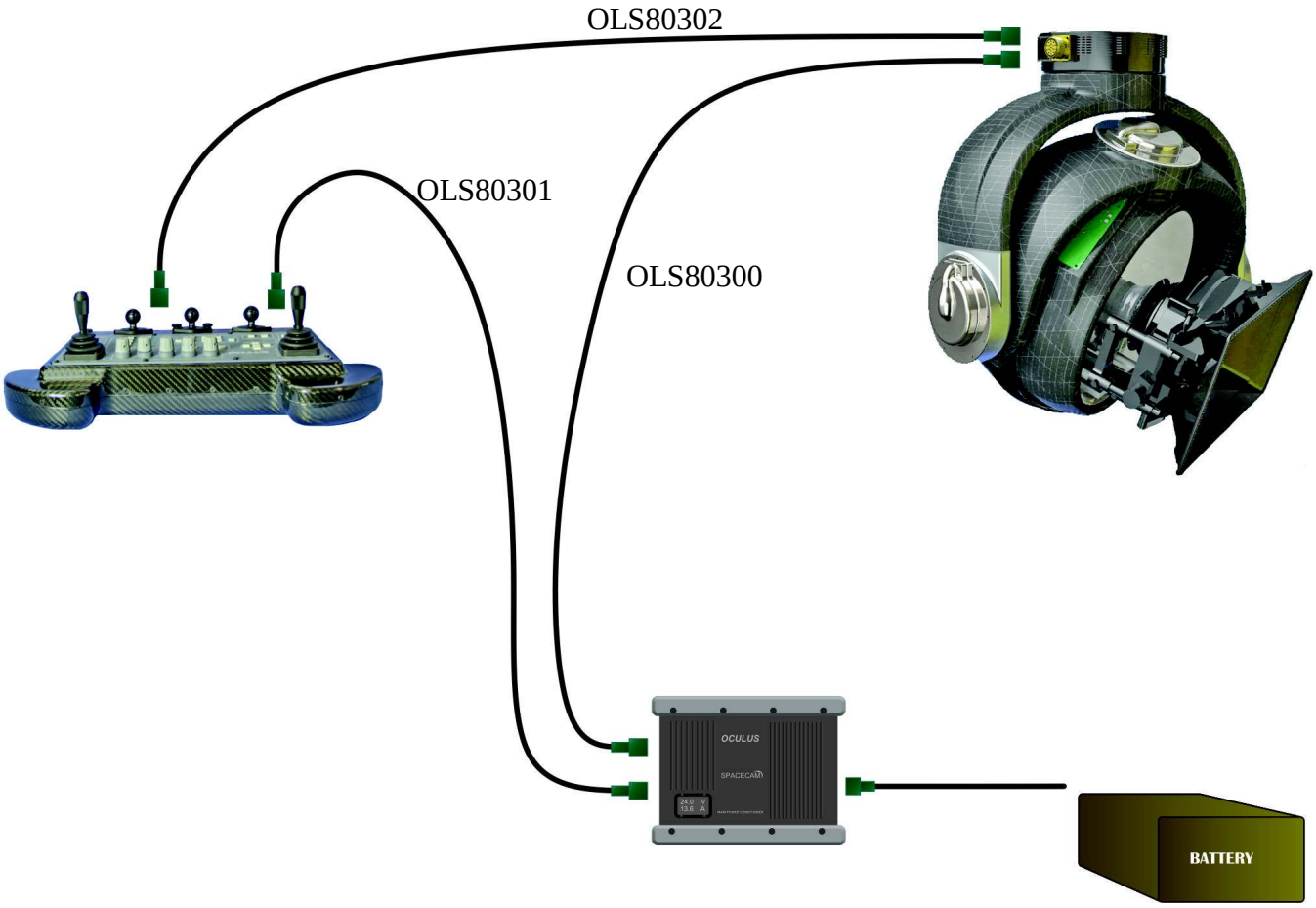
Select the desired roll joystick mode in the Options Menu.

Level Roll.

Press F2 any time to level the roll axis of the platform.

2 CONFIGURATIONS

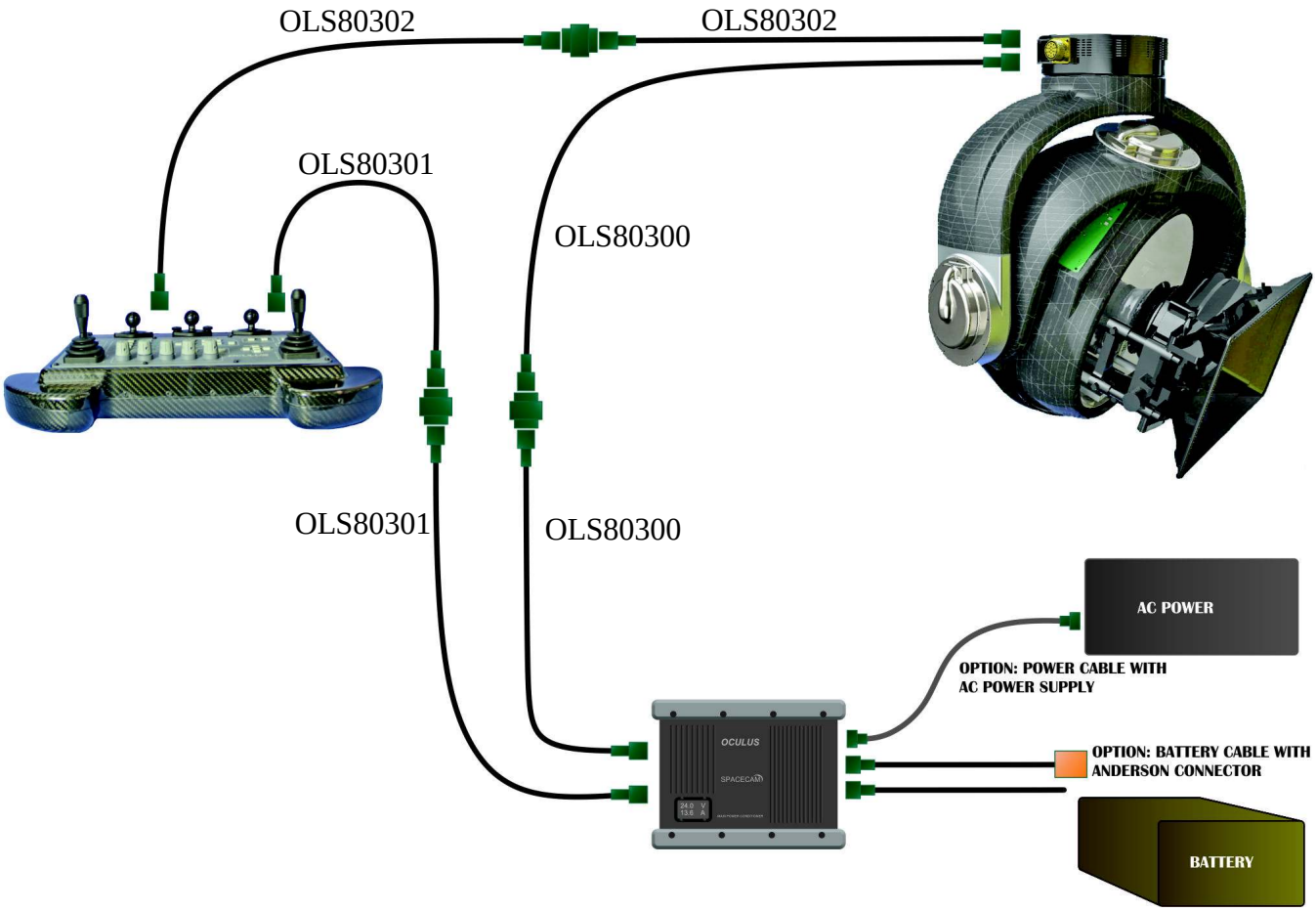
2.1 Minimum installation



Use the indicators on the System Power Supply to verify the correct polarity of the battery connection. If the REV LED is red, then the input power is reversed. The STBY LED indicates that the correct power is present at the power input connector. The STBY LED will not light up if the voltage is less than 18VDC or reversed.

If the system is powered up and turns off automatically due to a power glitch or low voltage, the power only can be turned on again manually with the ON switch on the console.

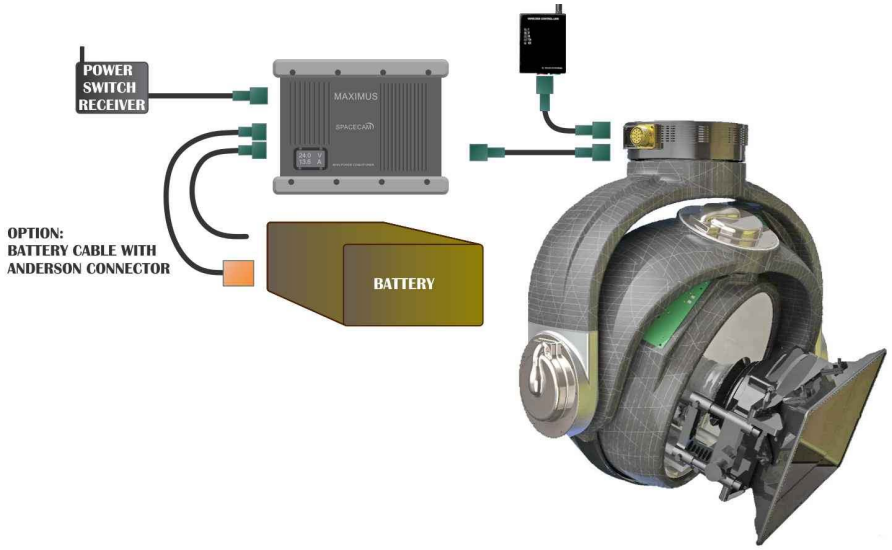
2.2 Installation with cable extensions

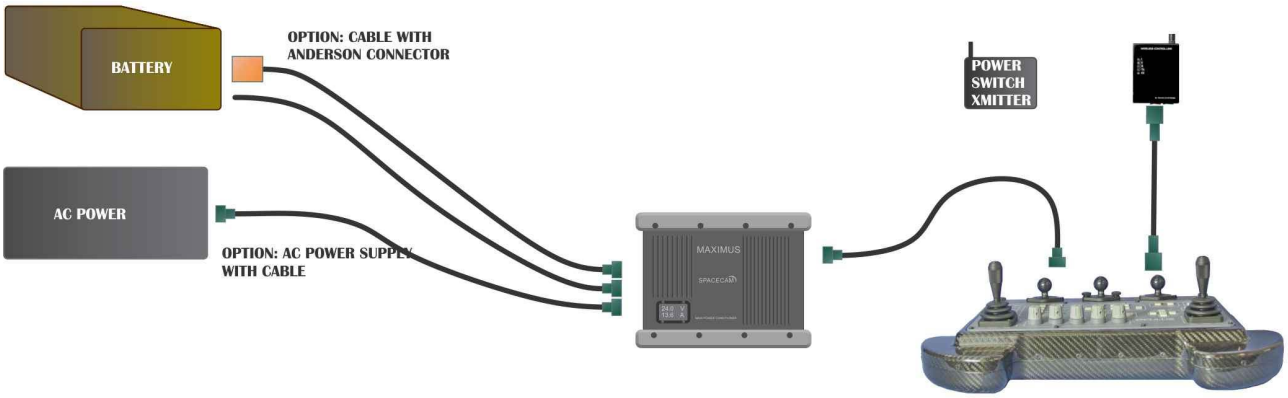


In case the distance between the main parts of the Maximus system is larger then the length of the standard cables the cables can be extended using coupler boxes and spare cables. The total length of an extended cable can not be longer than 150 feet. If longer distances required use the wireless configuration.

The System Power Supply can be connected to a battery with the standard cable that has bare wires on the battery end and the users must install their own battery connector. Maximus also has cables with Anderson connectors installed. There is also an AC Power Supply with cable that can be used if a battery is not available. The AC power supply runs on 100 ~ 260 VAC.

2.3 Wireless installation

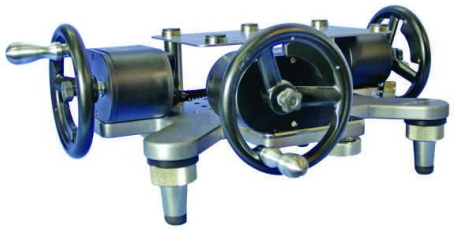




2.4 Wheel's installation

The pan and tilt wheels connect to the PBW connector on the back of the console and the roll wheel connects to the ROLL connector.

All three wheels can be mounted on the console stand or the roll can be mounted individually on it's own stand.



Pan, tilt and roll on console stand

Pan and tilt on console stand

and roll is on it's own stand

2.5 Analog controls installation

This connection is an upgrade!
Analog controls can connect to the ANA(LOG) connector on the back of the console. (Formal BLOOP). It is possible to control roll, zoom, focus and iris using these analog inputs. SpaceCam did not develop actual controllers for these analog inputs as of today. External wheel and pan-bar encoder freeze keys are also connected to this connector. (See Menu Option-2. 3.2.5)

See page 38 for definitions of the signals on the connector. Contact SpaceCam if you decide to use these functions.

Typical connections:

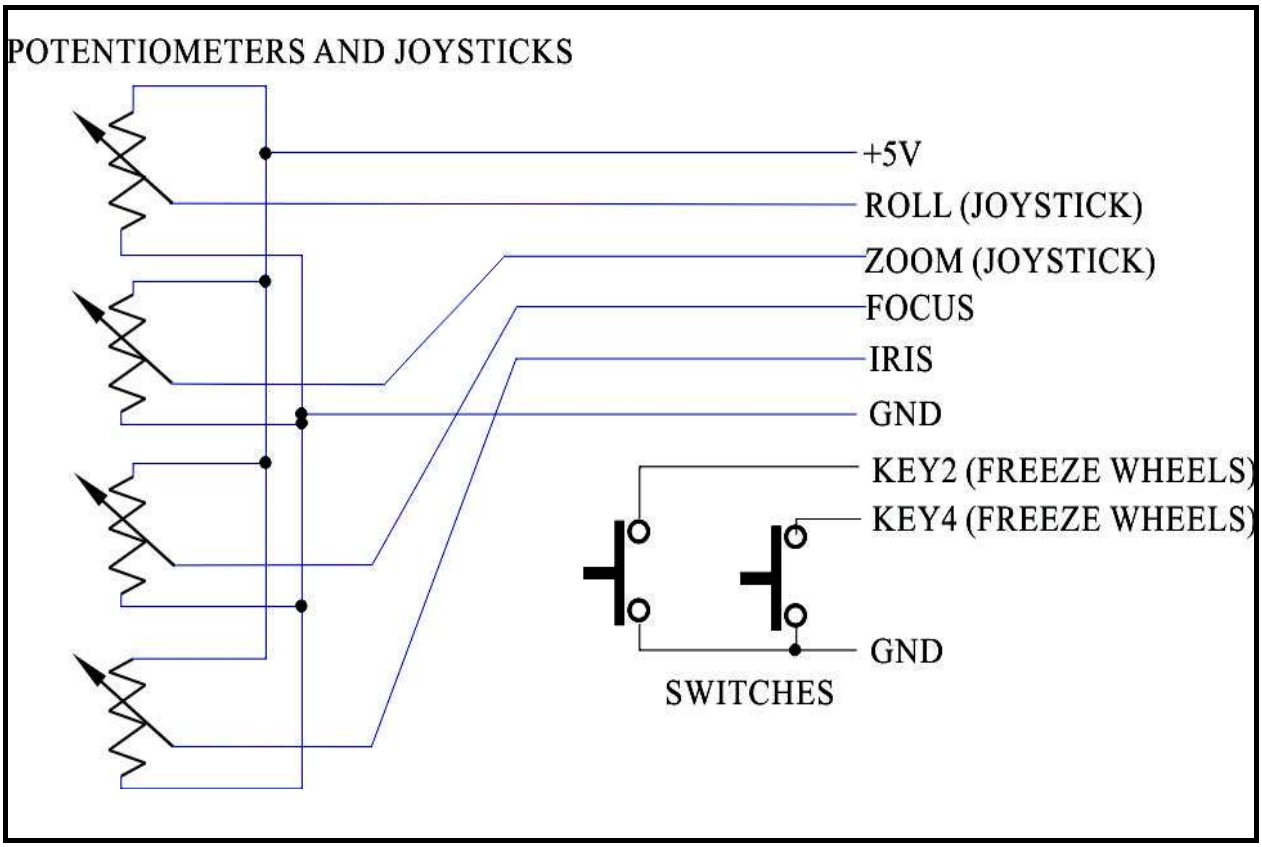


Figure 7 ANALOG CONTROLS SUGGESTED WIRING

Do not draw more than 50 mA from the +5V power. Good and safe choice for POTs would be between 2KΩ and 10KΩ. The joystick type inputs (Roll and Zoom) are nulled when the SHIFT(NULL) key is pressed. That is when the software will take the sampled value as center.

Make sure that the +5V pin is not shorted to GND! There is no short current protection on that pin.

3 OPERATION

3.1 Console key's functions

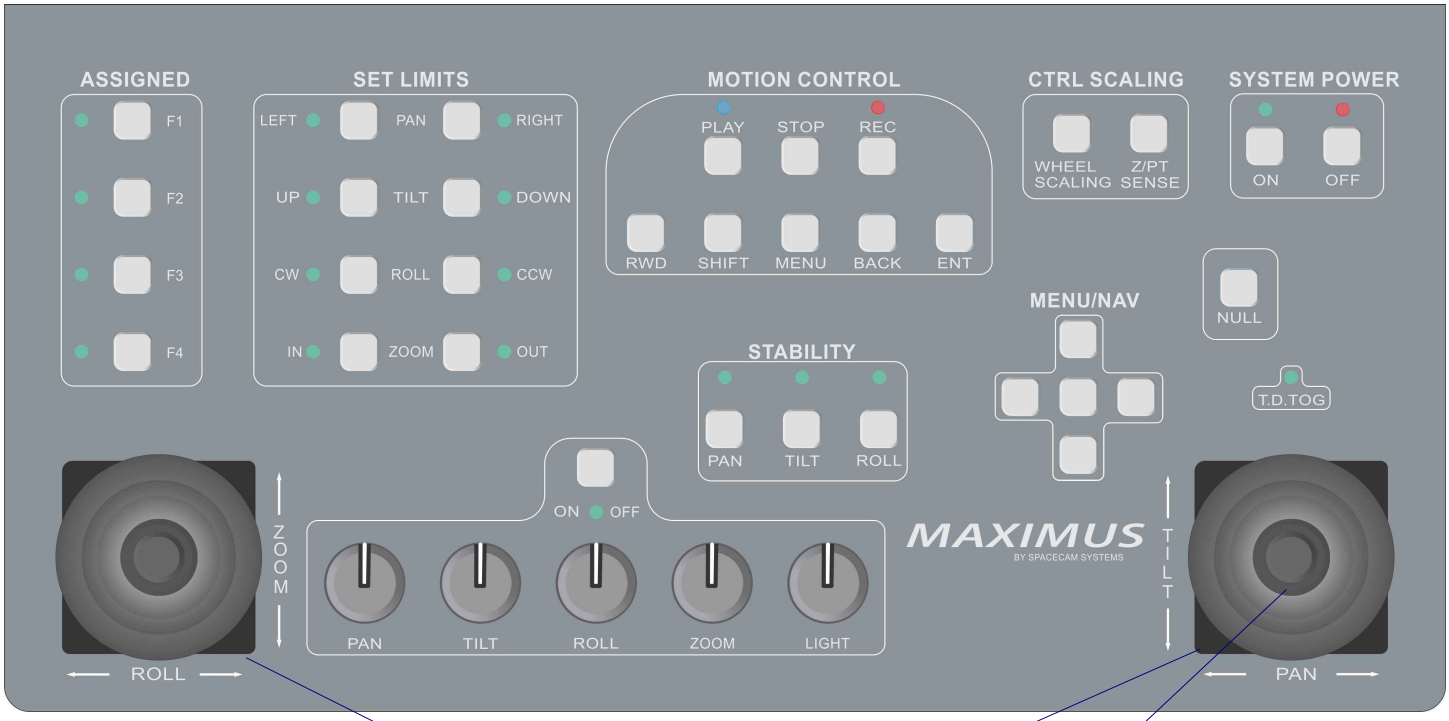


TABLE 2 - Console key's functions		
KEY	**FUNCTION**	**NOTES**
MOTION CONTROL GROUP		
PLAY	Play selected take.	If a take is selected
	Go to selected mark.	If a mark is selected
(STOP) PLAY	Delete all takes	If a take is selected
STOP	Stop record or play	
REC	Record selected take.	If a take is selected
	Record selected mark.	If a mark is selected
(STOP) REC	Delete current take	
RWD	Go to start of selected take.	If a take is selected

TABLE 2 - Console key's functions		
KEY	**FUNCTION**	**NOTES**
(SHIFT) RWD	Go to end of selected take.	If a take is selected
SHIFT	Modifier key.	
MENU	Calls the menu.	
	In menu returns to normal screen.	
BACK	Cancel current setup.	
	Move to the previous screen.	
ENT	Apply	
MENU/NAV GROUP		
UP, DOWN LEFT, RIGHT	Move to next or previous box.	
	Increment or decrement a value.	
(SHIFT) UP (SHIFT) DOWN	In some setup frames increments or decrements value 10 times faster.	
CENTER KEY	Same as ENT	
CTRL SCALING GROUP		
WHEEL SCALING	Disengage wheels as long as this key is held down.	(Freeze)
Z/PT SENSE	Set zoom pan/tilt scaling	Toggles Z/PT menu
ASSIGNED GROUP		
F1	Disable gimbal	
F2	Level roll	
F3	Select gimbal mode. Enable if currently disabled.	
F4	Display Master Gain	
hold F4	Display and modify Master Gain	Use up/down keys
SET LIMITS GROUP		

TABLE 2 - Console key's functions		
KEY	**FUNCTION**	**NOTES**
PAN-LEFT	Set pan left limit	The limits do not work in follow modes and Roll Position mode.
PAN-RIGHT	Set pan right limit	
TILT-UP	Set tilt up limit	
TILT-DOWN	Set tilt down limit	
ROLL-CW	Set roll clockwise limit	
ROLL-CCW	Set roll counterclockwise limit	
ZOOM-IN	Set zoom in limit	
ZOOM-OUT	Set zoom out limit	
STABILITY GROUP		
PAN	Pan normal or follow mode toggle.	Normal mode holds orientation of payload. Follow mode follows the mounting bracket.
TILT	Tilt hold orientation or follow mode toggle.	
ROLL	Roll hold orientation or follow mode toggle.	
(SHIFT) ROLL	Roll stick Velocity or Position control mode toggle.	
OTHER KEYS		
NULL	Cancel gyro drift.	
(SHIFT)NULL	Cancel joystick's drift.	
(STOP)NULL	Reset LCD screen.	
(SHIFT)T.D.TOG	Reverse tilt control direction. (Tilt Dir Toggle)	On top of right joystick.
Camera Record	Run and stop camera. [1]	On top of left joystick.
Z/PT ON/OFF	Zoom pan/tilt scaling setup.	
SCALES_ON	N/A	Above ROLL scale knob.
(SHIFT) SCALES_ON	Monitor lens controls and external switches.	

(1) Function not available.

3.2 Console operation

The ENT key and the center key of the navigation pad have the same functions:
ENTER, ACCEPT, YES.

3.2.1 Screen colors.

The screen is colored to distinguish individual groups of information. There are two colors that have special and important meanings.

RED	There is an condition preventing the gimbal from operation.
BROWN	There is a warning but the gimbal still could be operated.

3.2.2 Procedure to set a parameter.

Select: Move to desired field with the arrow keys.
Press ENT to set change mode.

Set: Set desired value with the arrow keys.
On some fields hold arrow key for continuous change.
On some fields press SHIFT concurrently to increase the step 10 fold.
Press ENT to enter the new value or BACK to return original value.

For example on the screen above the field the Take number is in focus (box around it).
To change the pan control device move the focus box with the arrow keys to the right to place it on pan's JOY(stick) field. Press ENTER, the box will blink. Select new control device for pan with the up/down arrow keys and press ENTER again.

3.2.3 Control device's select and setup:

The control devices move the 3 axes (pan, tilt and roll) in the desired direction.
There are four type of devices:

Console's built in joysticks.	JOY
Wheels.	WHL
External joystick.	JEX
Pan-bar.	BAR

The external joystick is very useful in vibrating environments, because it isolates the vibration from the control if held in the operator's hand.

To quicky set a control device in the main screen with the arrow keys move the focus to the desired

device. Press ENT to select it, when the block flashes around it select the required device with the arrow keys and press ENT to save it.

Each control has it's own setup (direction, smoothing and dead-band). Direction sets the control's direction relative to the axis direction. The tilt direction is often the preference of operator. So tilt direction can be changed easily pressing and holding the SHIFT key and pressing the button on the top of the right joystick. There is an LED to indicate the direction above the joystick. All other parameters can be changed in the menu.

To change control parameters, press MENU and select (¶ 3.2.2) "Controls".

Select the desired axis in the first line, then select the control device.

Direction. Set for each individual device on each axis.

Smoothing. Set for each individual device on each axis.

For joysticks recommending 10 or higher.
For wheels recommending 1 for fast response.
For pan-bar recommending minimum smoothing of about 10 otherwise you may see "stepping".

Dead-band. Set for each individual device on each axis.

For joysticks recommending more then 4 especially in linear joystick mode.
If experiencing drift from the stick, first NULL the stick by pressing and holding SHIFT then press NULL. If this does not work well increase dead-band.

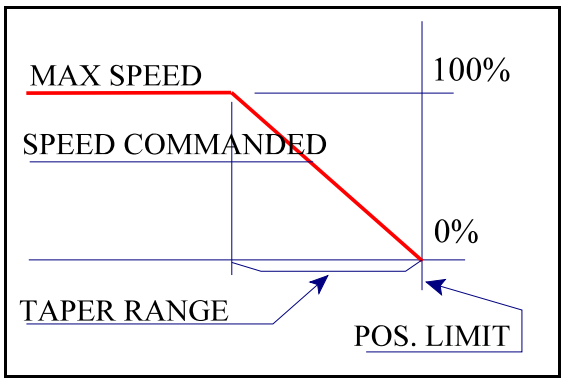
Wheels do not need dead-band or very little, recommending minimum.

Pan-bars do not need dead-band or very little, recommending minimum.

PosLimTaper. Set individually for each axis.

This parameter resides on the gimbal controller therefore can not be displayed or adjusted if the communication to the gimbal is broken.

The taper is the axis's maximum speed's roll down angle in degrees for the position limits. To avoid hard stops and malfunction of the position limit the velocity is proportionally lowered within this range from the stop position. The minimum taper value is 2, the maximum is 50 degrees. The actual command speed is always under the red speed limit. If the taper value is too low and the camera operator slams the axis into the position limit too fast the inertia may drive the axis through the limit and the function fails.



The last selected device will be the operating device for that axis after leaving the menu. That can be changed easily on the main screen.

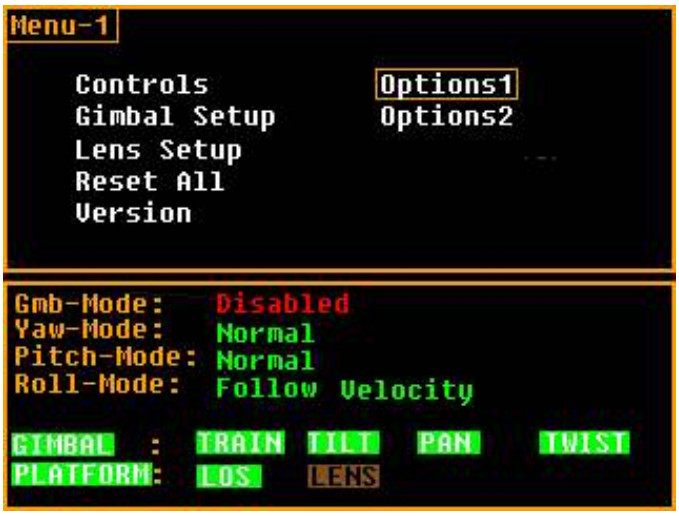
Exit from the setup menu by pressing MENU or BACK.

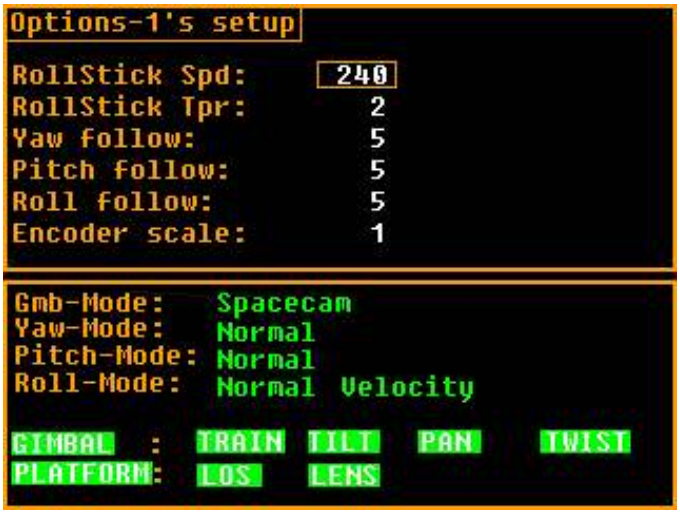
Select (¶ 3.2.2) control device from main screen:

In the main screen go to desired axis' control device with the arrow keys.
Set desired operating device.

3.2.4 Option-1's.

To change options, press MENU and select (¶ 3.2.2) "Options".





These parameters reside on the gimbal controller therefore can not be displayed or adjusted if the communication to the gimbal is broken.

RollStick Spd To change the maximum Speed of the roll in position mode.

RollStick Tpr To change the taper range of the roll in position mode. See explanation of taper range on page 19.

Yaw follow To change the yaw follow mode filter (follow dynamics), the larger the number the slower the response.

Pitch follow To change the pitch follow mode filter (follow dynamics), the larger the number the slower the response.

Roll follow To change the roll follow mode filter (follow dynamics), the larger the number the slower the response.

Encoder scale To change the pre-scale of the wheel and pan-bar encoders. Range is from 1 to 16. Use 1 or 2 for wheels and 16 for Cartoni pan-bar.

3.2.5 Option-2's.

To change options, press MENU and select (¶ 3.2.2) "Options".

Swap Joysticks To swap the front panel sticks left to right.

Swap Arm Control

If the analog control devices are used on a panbar the controls can be swapped left to right if placed correctly. This command is swapping the ANALOG CONTROL1 analog input with ANALOG CONTROL3 and ANALOG CONTROL2 with ANALOG CONTROL4. Those inputs are available on the ANA connector (in position of formal BLOOP) and used to control Roll, Zoom, Focus and Iris with analog devices (POT, Joystick). (page 38 for signals on the connector)

Stick property The sticks (pan, tilt and roll) have a linear (standard) and a curved operating mode. In standard mode the sticks are a lot more sensitive at the zero position. The curved mode is the default Spacecam mode.

Ext.Whl.Freeze The external keys connected to the ANA connector can be enabled or disabled here. The keys can be used to freeze the wheels or pan-bar.

Not all consoles have this connector it is an upgrade.
Not upgraded consoles must have this option disabled.

The following modes were made for tests, do not alter them!

Clink PRate Use 120!
Toggles the console to gimbal packet rate between 120 and 125 packets per second.

Clink Mode	Use "Standard" mode! Toggles between Standard and UniDir console-gimbal communication modes. In UniDir mode the console does not expect packets from the gimbal but still operates. If the status packet does not arrive from the gimbal a lot of functions won't work. No parameters should be changed in this mode, the position limit won't work. Etc...

3.2.6 Zoom auto Pan-Tilt sense control.

Not all functions will work with this window displayed, do not leave it on after finished setting up!
The "Z/PT SENSE" key toggles the window.

This function will desensitize the pan and tilt control when the zoom is at the long end. The zoom control must be setup and work for this function to operate properly.

Press the "Z/PT SENSE" key in the CTRL SCALING group on the front panel. The setup window will be displayed and the zoom can be operated to help find the required scaling factor.

Press the arrow keys to increase or decrease the scaling. 240 is the maximum and performs most effectively. 0 scaling is the minimum and has no effect. Press the left arrow to go to 80 and the right arrow to got 160. Press the SHIFT concurrently with the up/down arrow to step by 10-s.

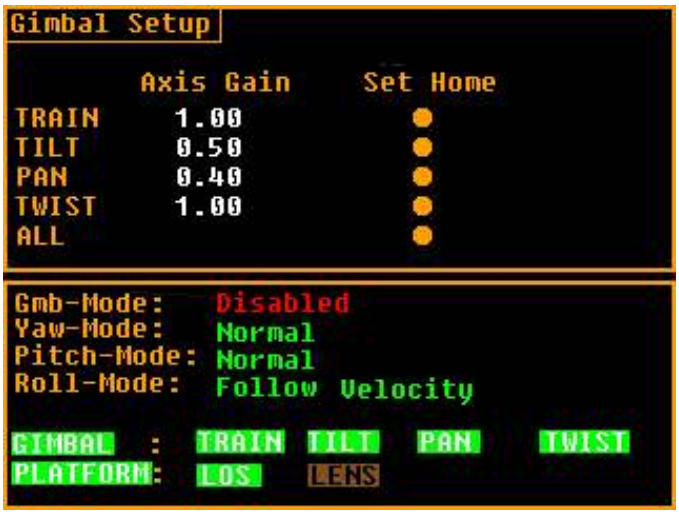
Press the RWD key to set the direction of the zoom control. The zoom position command ranges from 0 to 655. On most lenses 655 is the long end. Select Normal when 655 is the long end.

Press ENT or the Center Nav key to toggle enable-disable of the function. When the Z/PT is enabled a green "ZPT" is displayed in the axis status window's zoom row.

Press the "Z/PT SENSE" key to exit the setup window.

3.2.7 Gimbal Setup.

To change some gimbal parameters, press MENU and select (¶ 3.2.2) "Gimbal Setup".



Setting axes' Master Gains

The first column sets individual axes Master Gains. Select (¶ 3.2.2) one of the gains to change it. Press SHIFT concurrently to step by 0.1. The gain values are immediately saved in the active RAM and in the nonvolatile memory at each key press! There is no cancel function.

The system master gain is adjusted with the F4 key on the main screen, not on this setup screen.

Setting axes' Home Positions

The home position (P 4.4) is where the axis position shows ZERO. This can not be anywhere! Incorrect home position will cause major malfunction of the gimbal!

Preferred method is with the maintenance program from a PC.
To set home position for each axis, move the axis to the required position manually (gimbal disabled), move the focus to a button that belongs to the desired axis and press ENT.
Lower the system gain to test!

3.2.8 Wired lens control setups.

A LimeRock Lens Control Interface must be connected to the Saddle Interface on the camera platform. The LimeRock Lens Control Interface in turn will be connected to one of the following devices: Fujinon lens, Canon lens, LimeRock lens driver or Preston MDR lens driver.

At this time only the Fujinon and Canon broadcast lenses can be controlled through the Maximus system. Only the zoom can be controller from the console.

Analog POTs

Connected to the ANA connector.
Select Analog in Lens setup.
Select BAR for control device on zoom.

Preston analog option

If the Preston lens controller is used, the console's zoom joystick can control the zoom. Connect the console to Preston's zoom connector using the PRESTON ZOOM CTRL connector on the console.

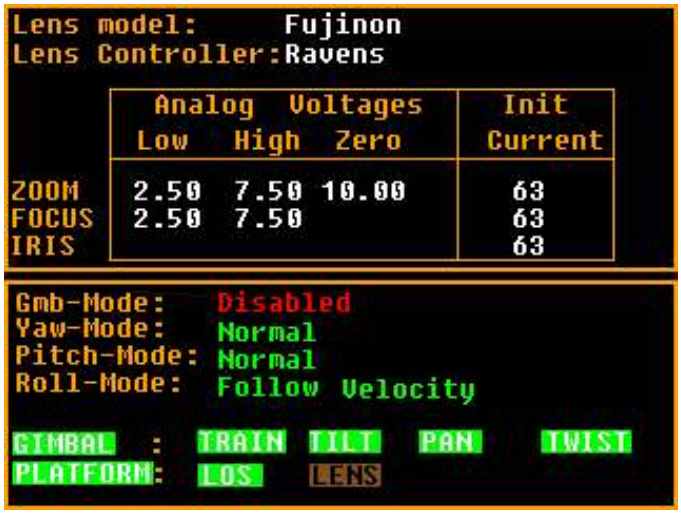
When powered up and connected press the Zoom S & R buttons concurrently on the Preston FIZ to register the console's zoom stick's center position.
Make sure the zoom stick is really in the center and the FIZ is set to be controlled be the analog input.

LimeRock option

:t to the LENS connector.
Ravens in Lens setup.
JEX for control device on zoom.

:t the Lens Control Kit from Spacecam.
the zoom needs to be controlled the console's zoom joystick may
l. Select JOY for the zoom control device.

Set the TOC to wired communication and the Fujinon or Canon lenses to servo mode.
To set lens options, press MENU and select (¶ 3.2.2) "Lens Setup".



Select lens model by moving the focus to the model box and pressing ENT as many times as needed.

Currently :

- The zoom and focus of the Fujinon's and Canon's broadcast lenses can be controlled. The actual lens positions are not fed back!
- The iris is controlled by the camera for Fujinon and Canon lenses.
- The Preston and LimeRock lens drivers have not been tested yet.

The analog voltages meant to be working with analog lenses. They set up the voltages for the LimeRock Lens Control Interface outputs. The maximum range is Low: 0.0V to High: 10.0V. It is the operators responsibility to make sure that Low is less than High and the voltages will not destroy the controlled lens drive.

The "Zero" is for velocity mode. Only the zoom has velocity mode. Set the Zero in the middle of the Low-High range and the analog command to the zoom will be velocity not position.

The "Init current" values are proportional to the initializing torque (commanded current) of the corresponding function (zoom, focus and iris). At power-up each axis will be moved one way and then the other to mark the end of the mechanical range. Set the current values for the lens that it can overcome friction but won't hit the end of range too hard.

Cmotion option

For wired setup use the **USER** interface on the console and saddle on the platform to connect the hand unit to the driver. We can make the connecting cables for you on request.

SpaceCam is working on integrating the Cmotion controller with the Maximus system.

3.2.9 Reset All.

To reset all **console parameters** to default, press MENU and select (¶ 3.2.2) "Reset All".

	PAN	TILT	ROLL	ZOOM
Direction Joystick	Forward	Forward	Forward	Forward
Direction Wheel	Backward	Forward	Backward	Forward
Direction External	Backward	Forward	Backward	Forward
Direction Pan-Bar	Forward	Forward	Backward	Forward
Smoothing Joystick	10	10	10	10
Smoothing Wheel	1	1	1	1
Smoothing External	10	10	10	10
Smoothing Pan-Bar	10	10	10	10
Dead-band Joystick	4	4	4	4
Dead-band Wheel	1	1	1	1
Dead-band External	4	4	4	4
Dead-band Pan-Bar	1	1	5	5

Swap joysticks	Normal	
Swap Arm Controls	Normal	
Stick property	Curved	
Clink Rate	120	
Clink Mode	Standard	
PanBar scale	1	
Take number	1	Only the take and mark numbers are set to 1, the existing data is not deleted.
Mark number	1	

Note that the gimbal parameters are not reset by this command.

3.2.10 Version.

In the menu screen click on this field to show the gimbal and console software version numbers.

3.2.11 Motion recording and playback.

Select a take number:	In main screen select Take. Set take number.
Record a move:	Take number must be in focus. Press REC.
Playback a move:	Take number must be in focus. Press PLAY.
Go to start of a take	Take number must be in focus. Press RWD.
Go to end of a take:	Take number must be in focus. Press and hold SHIFT. Press RWD.
Delete a take:	Take number must be in focus. Press and hold STOP. Press REC.
Delete all takes:	Take number must be in focus. Press and hold STOP. Press PLAY.

3.2.12 Mark recording and playback.

Set a mark number:	In main screen select Mark. Set mark.
Record a mark:	Mark number must be in focus. Press REC to memorize selected mark.
Go to a recorded mark:	Mark number must be in focus. Press PLAY to go to selected mark.

3.2.13 Stability and Master Gain.

To achieve best stability the gimbal must not have rattling and flexing parts. All devices and wires must be secured tightly and rigidly. The gimbal also must be balanced on all three axes.

The Master Gain is an overall scale for all the servo loop's gain. Most of the time it is sufficient to tune this parameter to match servo stability to the payload's inertia. For higher inertia the gain must be higher. At manufacturing the gimbals are setup with an average payload and all servo loops are refined for optimum stability at that time with the Master Gain set to 1.0. The Master Gain can be raise up to 5.0 or lower it to 0.2 for the servo loops. The parameter also can be observed in the General Parameter table (#Master Gain) using the Maintenance program (¶ 5.9).

To recall Master Gain:

The Master Gain of stabilization can be displayed on the screen by pressing F4.

To alter the Master Gain:

Press and hold F4 while changing the gain using the up/down arrow keys.

1.0 is the default setting for average payload inertia. Set the gain to 0.2 to 0.4 for operating without a payload. When setting up a new payload always start with a lower number and gradually increase the gain until the gimbal is responsive enough. Do not let it oscillate (audible sound). Making notes for new setups helps find the correct number quickly the next time.

It is possible to tune the individual axes. The procedure is dangerous and is outside the scope of this manual. Recommending SpaceCam trained technicians to do the procedure.

3.2.14 Disengage (freeze).

Press and hold WHEEL SCALING to temporarily disengage (freeze) the wheels or the Pan-Bar to move it to desired position without changing the camera orientation.

Also you can press and hold KEY2 or KEY4 if connected to the ANA(LOG) connector.

3.2.15 Gimbal drift.

To cancel gimbal drift release all controls, disable the servos (gimbal) and make sure the gimbal is motionless. Press the NULL and then the ENT keys and wait about eight seconds. The platform gyro drift will be canceled. The console screen will show that the task is active. Best to do this procedure when the LOS gyro is warm. (About 10 minutes powered on time).

Sometimes after a very violent move (oscillation, vibration) the gyro is overwhelmed, falls out of range and it is impossible to cancel drift for minutes. Do not try to cancel drift (this is not drift). Restart the system. Power down, wait a few seconds to make sure that the gyro forgets everything and power up.

.

If the environment does not allow the gimbal to be motionless (as waves move a boat) then do not press NULL !!! The gyro offsets can be set manually using the Maintenance program (¶ 5.9). Not recommended and very cumbersome procedure. The three gyro offsets (x, y, z) are under the General Parameters tab. First set all three to zero and see the result. If not acceptable then start changing them one by one, numbers most likely are under ±5.0e-3 (±0.005).

3.2.16 Joysticks drift.

Release all controls. Press (SHIFT)NULL. The joysticks current position will be fixed as 0.0 position. Check the results and repeat if needed.

3.3 Data transfer Console to PC.

The console can be connected to a personal computer via a USB interface. This connection then can be used to stream data to the PC.

3.3.1 Setting up the connection.

Need a A-B USB cable to connect the console to the PC.
The CP210x USB to UART Bridge Driver needs to be installed on the PC.
http://www.silabs.com/products/mcu/Pages/USBtoUARTBridgeVCPDrivers.aspx

Any PC terminal program to test the connection.
Tera Term: http://en.osdn.jp/projects/ttssh2/releases/

Set up communication to 115200 Baud, 8 data bits, no parity, 1 stop bit, No flow control.

3.3.2 Data format.

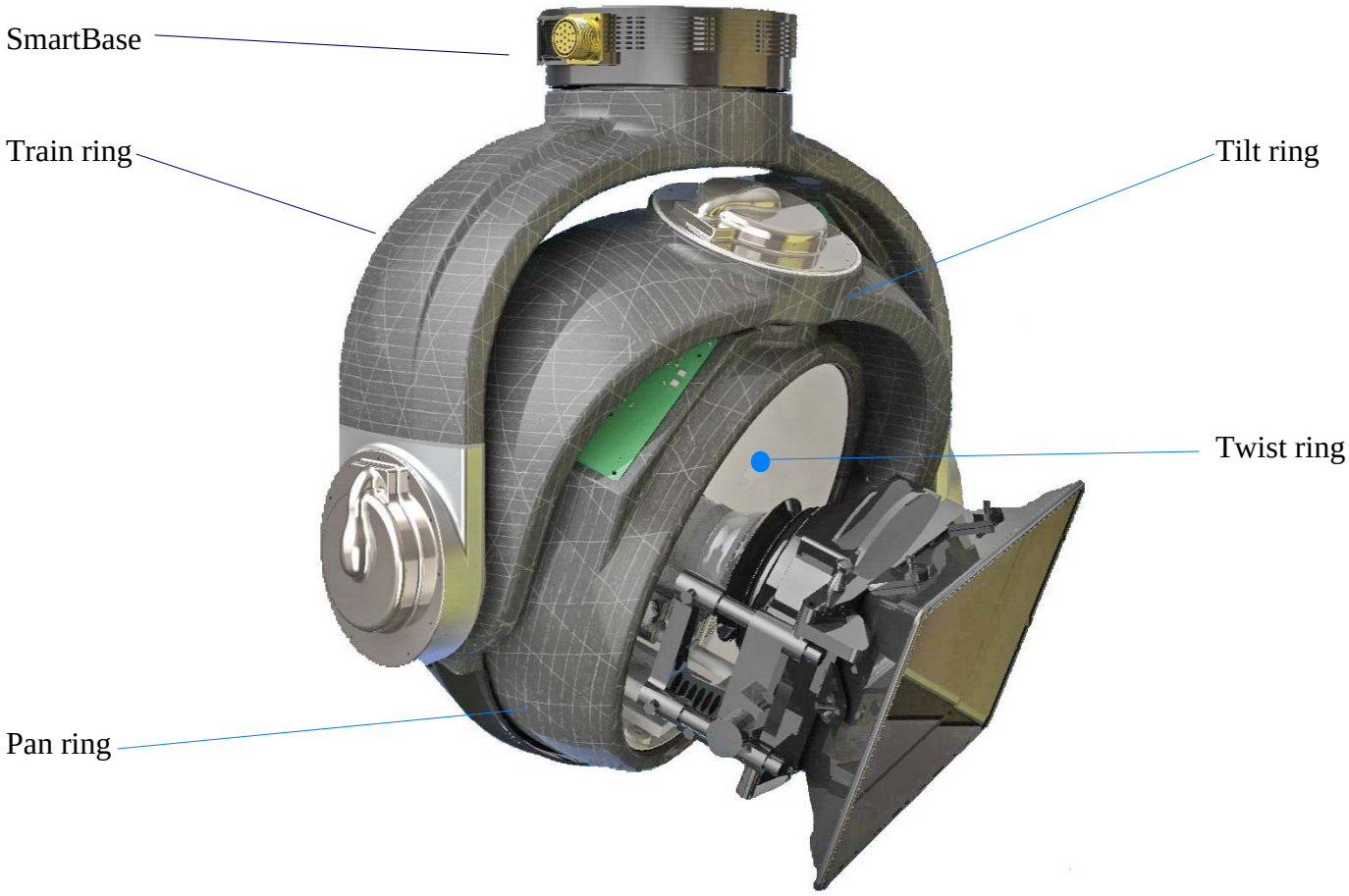
The data is sent in ASCII format. Each line represents one sample. There are 120 samples each second. A line starts with 'S' and ends with the hex code 0x0d.

At this time the data contains YAW, PITCH and ROLL positions in degrees.
The data fields are separated by ','. The streaming is continuous.

The yaw field only works correctly in topside mount.

4 THE GIMBAL

4.1 Gimbal main parts naming



4.2 Installing a camera.

The technician should always built up the camera and lens package utilizing a dovetail base plate that provides proper support to both the camera body and, in the case of zoom or longer focal length lenses, a strong support to the lens itself.

The camera "build" should avoid any floppy or weak attachment of auxiliary equipment such as lens drive modules or ultrasonic focus aids.

Wiring on the camera setup should be neat and clean with the minimum length of interconnecting cable being utilized.

Various options and accessories from SpaceCam allow for mounting choices of cameras, lenses and lens drive modules.

In all instances modules or other addition camera equipment mounted on the camera saddle should be rigid and secure.

After the basic camera body/lens configuration is built up on the dovetail plate, the assembly can then be inserted in the Maximus camera saddle receiver. During this operation insure that the tilt lock is engaged and care is taken not to allow the assembly to slip forward or rearward. It is recommended that a lock stop be employed in the underside of the dovetail base plate so the camera/lens assembly cannot slip forward and fall.

4.3 Balancing the payload.

1. With camera/lens assembly on saddle, disengage the tilt lock and slide the assembly forward or rearward until fore/aft balance is achieved. Tighten the three 10-32 set screws on the left side of the receiver plate to lock the assembly in place.
2. Place a collapsed cylinder jack unit on the camera top plate, (this should be an Maximus top plate or stepped handle). Set the jack unit with textured surface facing the texture surface of the top plate or stepped handle. Lift the cylinder jack upward until the four knobs on the top of the jack unit engage with the dimples either in the underside of the platform power supply unit or in the low profile brace plate located above the camera.
3. Holding the jack unit upward, rotate the knurled lower portion to the left thereby increasing the length of the jack until contact is made between the textured surface of the jack and the textured surface of the top plate or stepped handle.
4. Carefully continue to open the jack until a moderate resistance is encounter. This will be approximately 10 to 15 in/lbs of torque. Do not exceed this figure.
5. Attach any additional equipment to the camera or to the magnet side mount positions provided.
6. Install Twist Axis Umbilical Patch cable or Rotary Joint unit.
7. Disengage tilt lock and check balance fore/aft.
8. Disengage cylinder jack by rotating lower knurled section to right.
9. To make further fore/aft balance adjustments either loosen 3 x 10-32 set screw on left edge of receiver plate or disengage lever lock on camera base and lens support allowing camera package to be pushed forward or rearward to achieve fore/aft balance.
10. Lock all screws and locks and re-tighten cylinder jack.
11. Manually tilt camera platform down past 45 degrees.
12. If the camera platform moves then you must adjust the lateral balance by loosening the cylinder jack, loosening the lever locks on the front and rear of the camera saddle and sliding the camera package left or right until no movement is seen when camera is tilted down.
13. Lock lateral slide locking levers and re-tighten cylinder jack.
14. Now rotate camera package 90 degrees in the roll axis and manually tilt camera package down past 45 degrees. This is the test for top/bottom balance. If the camera rotates one way then that side of the package is heavier than the opposite.
15. If necessary add addition weight to the lightest side of the camera package. Try to distribute the extra weight equally fore/aft to save re-balancing in other axes.
16. When no movement is observed in all three sections of this procedure, the system is balanced.
17. Finally, you will check the tilt yoke balance. Place the camera level in roll axis and manually tilt the camera down. Remove your hands and observe if the tilt yoke wants to tilt up or down by itself. If it wants to tilt up then add magnetic weights to the top of the tilt yoke in the postitions provided until there is no movement.
18. The system is now balanced.

4.4 Axes' Home Positions Setup.

Hang the gimbal right side up. The alignments of the rings have nothing to do with horizontal or vertical orientations! They are strictly the relative positions of the rings to each other and the mounting bracket. Use the maintenance program main screen to check axes' positions. Double click the blue radio buttons to reset and store the positions as needed.

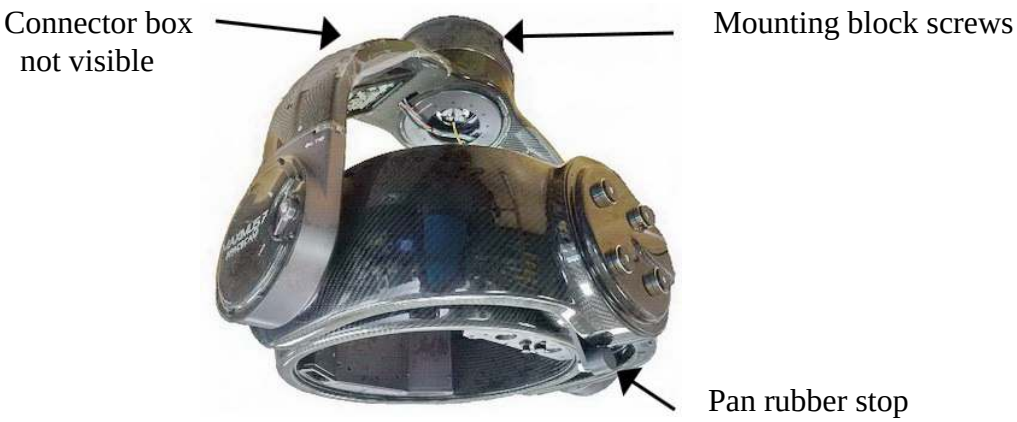
Move the tilt and pan rings to align with the train ring so that the pan rubber stop is on the top and the connector box of the SmartBase is on the opposite side. Align the train ring with the flat part on the SmartBase. This is home position for the train and the train position should read 0.00.

To set the correct tilt home position, start with above alignment and then rotate the tilt ring 90 degrees forward (pan rubber stop facing down). Tilt position should read 0.00.

Set the pan home position by aligning the pan ring with the tilt ring. Pan position should read 0.00.

Set the twist home position by moving the camera mounting saddle to the opposite side of the pan rubber stop. Try to align the ring exactly. Twist position should read 0.00.

The picture below show the home position for all rings.



4.5 LED Box.

The LED Box is an accessory that can be mounted anywhere on the mounting structure. Two LED arrays sends basic information of the status of the gimbal. The two LEDs indicate gimbal powered, disabled/enabled and error status. The LED Box connects to the gimbal control connector with a special cable. It only works if the system is upgraded for this function.

See page 49 for signal assignment.

5 SYSTEM CONNECTIONS, INDICATORS AND CONTROL.

5.1 Console Connectors

TABLE 3 - Console Connectors			
LABEL	**FUNCTION**	**SIGNAL ASSIGNMENT**	
		PIN	**SIGNAL**
JSTK 	External joystick connection. Lemo, 5 pos, size 1B. Mates with FGG.1B.305 Catalog Page 10 & 45 The 5V connection is directly connected to internal circuits and only can supply 50mA.	1	GND
		2	Digital input (active grounded)
		3	PAN (analog input < 5VDC)
		4	TILT (analog input < 5VDC)
		5	+5V
BLOOP (See next) 	Not used! The 5V connection is directly connected to internal circuits and only can supply 50mA. Lemo, 6 pos, size 1B. Mates with FGG.1B.306 Catalog Page 10 & 45	1	GND
		2	+5VDC
		3	ESTOP IN
		4	TRIG IN
		5	BLOOP OUT
		6	TRIG OUT

TABLE 3 - Console Connectors			
LABEL	**FUNCTION**	**SIGNAL ASSIGNMENT**	
		PIN	**SIGNAL**
ANA(LOG) (old BLOOP)  	Upgrade! The 5V connection is directly connected to internal circuits and only can supply 50mA. Hirose, 12 pos, size 10. Mates with HR10A-10P-12PC(73) Catalog Page 6 & 20 Connect buttons between signal (6, 12) and ground (7). Connect POTs betweem +5V (2) and ground (1). Wiper to signal (3, 4, 9,10) Use shielded wires (GND is shield) Short +5V to ground and the console is dead!	1	GND
		2	+5VDC
		3	POT1 (FOCUS POT)
		4	POT2 (ROLL JOYSTICK)
		5	KEY1 (Not programmed)
		6	KEY2 (FREEZE BUTTON)
		7	GND
		8	+5VDC
		9	POT3 (IRIS POT)
		10	POT4 (ZOOM POT)
		11	KEY3 (Not programmed)
		12	KEY4 (FREEZE BUTTON)
PBW  	Pan and tilt wheels or pan-bar connection. The 5V connection is to supply power to the encoders only ! Lemo, 8 pos, size 1B. Mates with FGG.1B.308 Catalog Page 10 & 45 The 24VDC is used for the optional adjustable wheel friction power.	1	GND
		2	+5V (out)
		3	ENC-PAN-A
		4	ENC-PAN-B
		5	ENC-TILT-A
		6	ENC-TILT-B
		7	24VDC (out)
		8	GND(24V)

TABLE 3 - Console Connectors			
LABEL	**FUNCTION**	**SIGNAL ASSIGNMENT**	
		PIN	**SIGNAL**
ROLL CON 	Roll wheel connection. The 5V connection is to supply power to the encoders only. Lemo, 8 pos, size 1B. Mates with FGG.1B.308 Catalog Page 10 & 45 The 24VDC is used for the optional adjustable wheel friction power.	1	GND (signal)
		2	+5V
		3	ENC-ROLL-A
		4	ENC-ROLL-B
		5	-
		6	-
		7	24VDC
		8	GND (power)
USB	PC connection for data download.	Standard USB pinout.	

TABLE 3 - Console Connectors			
LABEL	**FUNCTION**	**SIGNAL ASSIGNMENT**	
		PIN	**SIGNAL**
GIMBAL (CONTROL)  	Gimbal control connection. Improper wiring may cause intermittent or permanent errors in performance! Please use SpaceCam made cables. Bayonet, 18 pos. Mates with MS27473T14B18P	A	CONTROL_COM (isolated)
		B	CONTROL_CMD_N (isolated)
		C	CONTROL_STA_N (isolated)
		D	+24VDC (for radio only)
		E	-
		F	PWR_GND (for radio only)
		G	USER_SHIELD
		H	USER_B
		J	USER_D
		K	-
		L	-
		M	-
		N	CONTROL_CMD_P (isolated)
		P	CONTROL_STA_P (isolated)
		R	-
		S	USER_A
		T	USER_C
		U	-

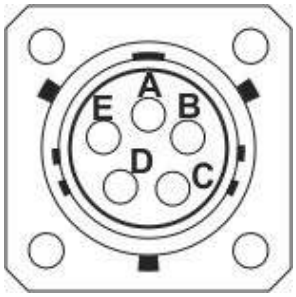
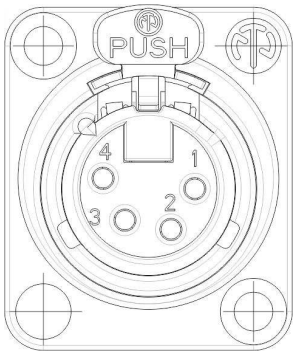
TABLE 3 - Console Connectors			
LABEL	**FUNCTION**	**SIGNAL ASSIGNMENT**	
		PIN	**SIGNAL**
POWER (IN) 	Console power connection to system power supply. Bayonet, 5 pos. Mates with MS27473E14B5S	A	GND
		B	24VDC (in)
		C	SWITCH OFF
		D	SWITCH ON
		E	13.1VDC (in)
12VDC 	Voltage: 13.1V DC Total current: 19A shared with all 13.1V on the System Power supply too! XLR, 4 pos: Qty 2 Mates with male XLR 4	1	GND
		2	-
		3	-
		4	13.1VDC (out)
PRESTON ZOOM 	Connects to Preston FI+Z/HU3 Zoom connector Downloads. Not for any other use! Lemo, 14 pos, size 1B. Mates with FGG.1B.314 Catalog Page 10 & 45 The pin assignment on the unit is different. Preston Manual Page 24	1	+12V (from Preston)
		2	GND
		6	Vref (6.2V from Preston)
		7	ZOOM OUT
		-	All other pins not used
		-	

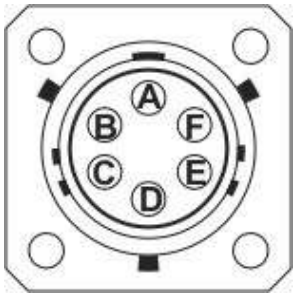
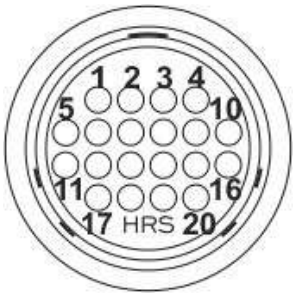
TABLE 3 - Console Connectors			
LABEL	**FUNCTION**	**SIGNAL ASSIGNMENT**	
		PIN	**SIGNAL**
USER 	User signals to camera platform. Bayonet, 6 pos. Mates with MS3116F10-6P Catalog Pages 18 (size 10), 19 (size 10), 10 (insert 10-6).	A	Common/Shield
		B	User-A
		C	User-B
		D	User-C
		E	User-D
		F	-
LENS 	Connection to LimeRock Lens Hand Controller (T.O.C.). Lemo, 8 pos, size 1B. Mates with FGG.1B.308 Catalog Page 10 & 45	1	COM
		2	RS232B-RX
		3	RS232B-TX
		4	VCC (5V)
		5	GND (POWER)
		6	RS232C-RX
		7	RS232C-TX
		8	+24VDC (POWER)

TABLE 3 - Console Connectors			
LABEL	**FUNCTION**	**SIGNAL ASSIGNMENT**	
		PIN	**SIGNAL**
LCD 	Console display connection. **Do not extend or alter this cable. The LCD and the console may suffer PERMANENT damage!** Hirose, 20 pos. Mates with HR10A-13P-20P(73) Catalog	1	GND
		2	+3.3V
		3	RESERVED (DO NOT USE)
		4	D/C-
		5	WR-
		6	RD-
		7	D0
		8	D1
		9	D2
		10	D3
		11	D4
		12	D5
		13	D6
		14	D7
		15	CS-
		16	RESET-
		17	VLED+
		18	RESERVED (DO NOT USE)
		19	RESERVED (DO NOT USE)
		20	VLED-

5.2 Platform Saddle Connectors

TABLE 4 - Platform Saddle Connectors			
LABEL	**FUNCTION**	**SIGNAL ASSIGNMENT**	
		PIN	**SIGNAL**
FIBER OUT	Converted from Video HD/SDI IN. System Fiber Optic Connection. Connecting to Twist ring FIBER IN.		
UMBILICAL  	Internal System Control Connections **Definitely not user accessible** Connecting to Twist ring UMBILICAL. Lemo 12 pos. Mate: FGG.2B.312.CLAD92Z Catalog Page 10 & 46	1	SLinkP
		2	SLinkN
		3	SLink_COM
		4	User-A
		5	User-B
		6	User-C
		7	User-D
		8	User-Common/Shield
		9	Video1_Signal
		10	Video1_common
		11	
		12	

TABLE 4 - Platform Saddle Connectors			
LABEL	**FUNCTION**	**SIGNAL ASSIGNMENT**	
		PIN	**SIGNAL**
VIDEO 1	Standard video input BNC	Center	Signal
		Shield	Video common
HD/SDI IN	HD SDI input BNC	Center	Signal
		Shield	Video common
USER  	May be used for RS-232, RS-422 and RS-485 or other LOW voltage signals. Not for higher than 48V POWER! Hirose 5 pos. Mate: HR10A-7P-5P(73) Catalog	1	Common/Shield
		2	User-A
		3	User-B
		4	User-C
		5	User-D
LENS  	Connection to LimeRock Lens Interface (Tilt5a) Hirose 12 pos. Mate: HR10A-10P-12P(74)	1	RS232-COM
		2	RS232-TX
		3	RS232-RX
		4	-
		5	-
		6	-
		7	-
		8	-
		9	-
		10	-
		11	GND
		12	+24VDC

TABLE 4 - Platform Saddle Connectors			
LABEL	**FUNCTION**	**SIGNAL ASSIGNMENT**	
		PIN	**SIGNAL**
CAMERA 	Camera Run/Stop Video sync from camera. TO BE DEFINED Hirose 10 pos. Mate: HR10A-10P-10P(74)	1	
		2	
		3	
		4	
		5	
		6	
		7	
		8	
		9	
		10	

5.3 Twist Ring Connectors

TABLE 5 - Twist Ring Connectors			
LABEL	**FUNCTION**	**SIGNAL ASSIGNMENT**	
		PIN	**SIGNAL**
FIBER IN	Converted from Video HD/SDI IN. System Fiber Optic Connection. Connecting to Saddle FIBER IN.		
UMBILICAL  	Internal System Control Connections **Definitely not user accessible** Connecting to Saddle UMBILICAL. Lemo 12 pos. Mate: FGG.2B.312.CLAD92Z Catalog Page 10 & 46	1	SLinkP
		2	SLinkN
		3	SLink_COM
		4	User-A
		5	User-B
		6	User-C
		7	User-D
		8	User-Common/Shield
		9	Video1_Signal
		10	Video1_common
		11	
		12	

5.4 Turret Connectors

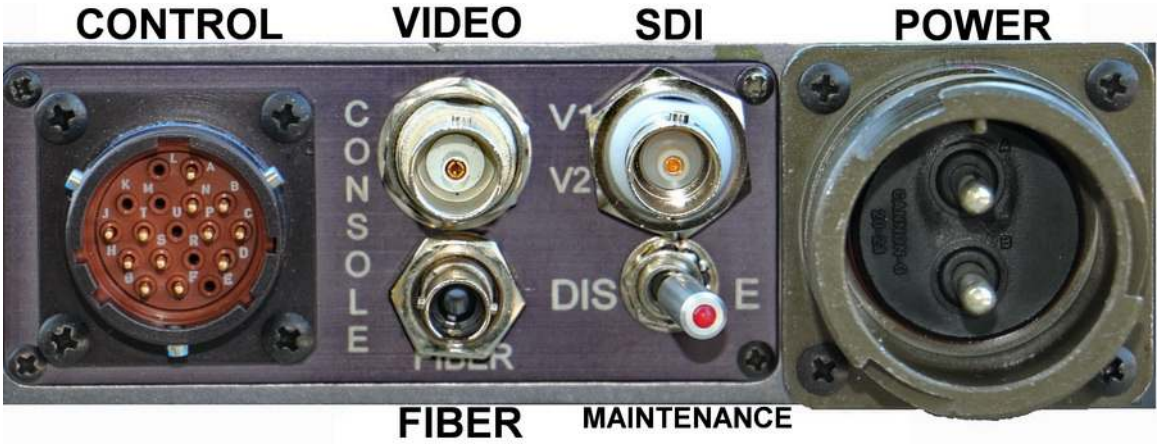


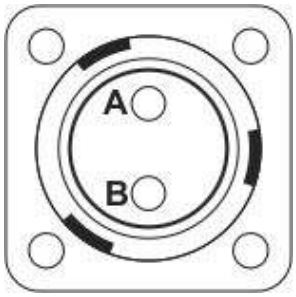
TABLE 6 - Turret Connectors			
LABEL	**FUNCTION**	**SIGNAL ASSIGNMENT**	
		PIN	**SIGNAL**
POWER 	Bayonet, 2 pos. Internal System Power Connections Improper wiring may cause intermittent errors in performance! Permanent damage to the system is also possible! IT IS NOT ONLY THE REVERS WIRING! Please use SpaceCam made cables. Mates with ITT CA3106E20-23SB	A	GND
		B	48VDC system power

TABLE 6 - Turret Connectors			
LABEL	**FUNCTION**	**SIGNAL ASSIGNMENT**	
		PIN	**SIGNAL**
CONSOLE  	Gimbal control connection. Improper wiring may cause intermittent or permanent errors in performance! Please use SpaceCam made cables. Bayonet, 18 pos. Mates with MS27473T14B18S The D_OUT signals can drive an LED box with two LEDs to signal status of gimbal in case of remote applications. The outputs can not drive LEDs directly! Ask SpaceCam for the LED box.	A	CONTROL_COM (isolated)
		N	CONTROL_CMD_P(isolated)
		B	CONTROL_CMD_N (isolated)
		P	CONTROL_STA_P (isolated)
		C	CONTROL_STA_N (isolated)
		F	GND_Radio
		D	+24V_Radio
		G	USER_SHIELD
		S	USER_A
		H	USER_B
		T	USER_C
		J	USER_D
		U	GND_D_OUT
		M	+5V_D_OUT
		L	D_OUT1
		K	D_OUT2
		E	-
		R	-
V 1	BNC. HD/SDI Video	Center	Signal
		Shield	Video common
V 2	BNC. Standard Video	Center	Signal

TABLE 6 - Turret Connectors			
LABEL	**FUNCTION**	**SIGNAL ASSIGNMENT**	
		PIN	**SIGNAL**
		Shield	Video common
BOOT PORT	USB mini B. USB port for PC connection	Standard USB pinout. (¶ 5.9)	

5.5 Indicators on the turret

TABLE 7 - Indicators on the turret	
LABEL	**FUNCTION**
Maintenance	LED on the maintenance switch. Light up in maintenance mode.
FLT	Fault LED. Gimbal will not enable when red.
OK	OK LED. Flashing green when DSP is running.

5.6 System Power Supply Connectors

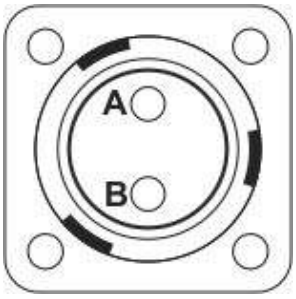
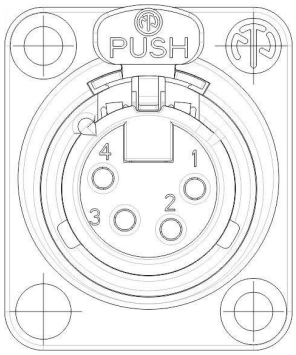
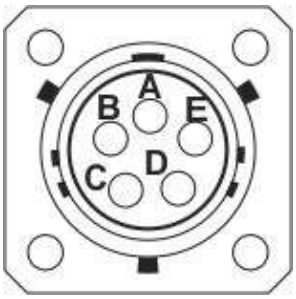
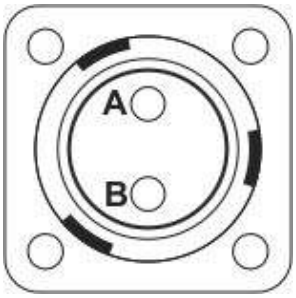
TABLE 8 - System Power Supply Connectors			
LABEL	**FUNCTION**	**SIGNAL ASSIGNMENT**	
		PIN	**SIGNAL**
21-36 VDC INPUT 	Power input from battery or AC power supply. Improper wiring may cause intermittent errors in performance! Permanent damage to the system is also possible! Please use SpaceCam made cables. Mates with ITT CA3106E20-23SB	A	GND
		B	POWER
12VDC 	XLR, 4 pos: Qty 3 Voltage: 13.1V DC Total current: 19A shared with the 13.1V connectors on the console ! Mates with male XLR 4	1	GND
		2	-
		3	-
		4	13.1VDC
CONSOLE POWER 	Bayonet, 5 pos. Power connection to console. Mates with MS27473E14B5P	A	GND
		B	24VDC (out)
		C	SWITCH OFF
		D	SWITCH ON
		E	13.1VDC (out)

TABLE 8 - System Power Supply Connectors			
LABEL	**FUNCTION**	**SIGNAL ASSIGNMENT**	
		PIN	**SIGNAL**
GIMBAL (POWER)  	Bayonet, 2 pos. Power connection to gimbal. Improper wiring may cause intermittent errors in performance! Permanent damage to the system is also possible! IT IS NOT ONLY THE REVERS WIRING! Please use SpaceCam made cables. Mates with ITT CA3106E20-23PB	A	GND
		B	48VDC

5.7 Platform Power Supply Connectors

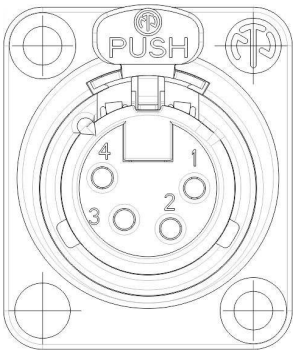
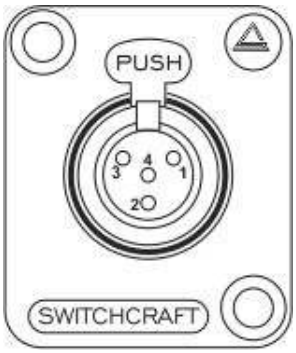
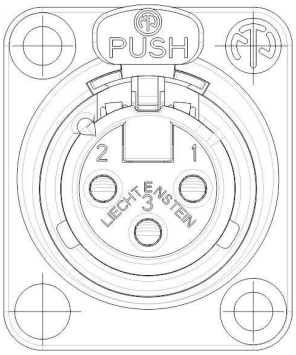
TABLE 9 - Platform Power Supply Connectors			
LABEL	**FUNCTION**	**SIGNAL ASSIGNMENT**	
		PIN	**SIGNAL**
12VDC 	XLR, 4 pos: Qty 2 Voltage: 13.1V DC Total current: 19A shared between all 13.1V connectors. Mates with male XLR 4	1	GND
		2	-
		3	-
		4	13.1VDC

TABLE 9 - Platform Power Supply Connectors			
LABEL	**FUNCTION**	**SIGNAL ASSIGNMENT**	
		PIN	**SIGNAL**
12VDC 	mini XLR, 4 pos: Qty 2 Voltage: 13.1V DC Total current: 19A shared between all 13.1V connectors. Mates with male mini XLR 4	1	GND
		2	-
		3	-
		4	13.1VDC
24VDC 	XLR, 3 pos: Qty 1 Voltage: 24.0V DC Total current: 10A. Mates with male XLR 3	1	GND
		2	24.0VDC
		3	-
48VDC IN 	Bayonet 3 pos. Used to extend power to box when not in standard position.. Please don't use as power source. Mates with ITT CA3106E10SL-3P	A	GND
		B	
		C	48VDC

5.8 The Maintenance switch and Tilt lock

The maintenance switch is on the gimbal turret. If switched on (the LED is red) the gimbal is disabled and the operator can not enable it from the console.

The tilt lock is located on one side of the tilt ring, mechanically locks the tilt in 22.5 degree steps. Wen the tilt is locked the gimbal is disabled.

5.9 Connecting a PC to the gimbal.

This is a important warning.

Any PC or laptop can be connected to the BOOT PORT on the turret with a standard USB cable that has a USB mini B plug. Several times someone pulled the USB cable by accident or negligence and the cable torn the mini connector off the PCB behind the turret wall. The damage is extensive and hard to repair, it is also your expense. To prevent this, keep the USB cable connected when absolutely necessary and only for the time needed. SpaceCam also offers a right angle 12" long USB mini B extension cable with a clamp. Plug this cable in the turret and restrain it with the clamp tightly. Then plug your USB cable into this extension cable. The USB connector on the Gimbal Controller PCB is now protected.

6 MAINTENANCE TOOL

The Maintenance Tool is a PC software that can be used to monitor and change some of the internal parameters of the Gimbal Controller's parameters. The Maintenance is to be used with caution, these parameters effect the response and stability behavior of the system. Incorrect parameters literally can disassemble your gimbal causing wild and powerful movements!

6.1 Installing the Maintenance Tool

Acquire the Maintenance Tool Setup program from spacecam. Copy it to a folder you will remember on your computer. When ready double click the program.

Read the License Agreement and accept it.
Select the shortcuts you want to create. (Definitely need the desktop shortcut.)
Click Install.
If this is the first time you install on this computer you may want to check :
"Install Gimbal's USB Driver"
Click Finish.

6.2 Uninstalling the Maintenance Tool

Delete directory c:\spacecam\maximus.
Delete the existing desktop icons.

6.3 The content of the Maintenance Tool's installation directory

The directory is "**c:\spacecam\maximus**".

MaximusMaintenance_vx.xx.exe	The executable of the Maintenance Tool
DSPFlash.bat	A batch file to boot-load (flash) the Gimbal Controller.
sfh_OMAP-L138.exe	TI licensed boot-loader used by DSPFlash.bat.
teraterm-4.89.exe	A terminal program installer, may be needed for the boot-loader procedure.
CDM v2.12.00 WHQL Certified.exe	Gimbal Controller's USB driver installer.

6.4 Maintenance Tool main screen

The main screen is a standard Window's screen. The version number of the software is on the top in the header. Under the header the connected port number is displayed with a small moving bar to indicate that the connection is active.

There are 5 tabs.
The Gimbal tab, that gives information on the current status of the gimbal and also can be used to do some debugging.
The Servo Parameters tab has all the servo loop parameters specific to individual axes.
The General Parameters tab shows parameters that do not belong to a specific axis.
The Err&Info tab displays error counters and other information of the system.
The Flash tab has tje tools to make quick software updates of the Gimbal Controller board.

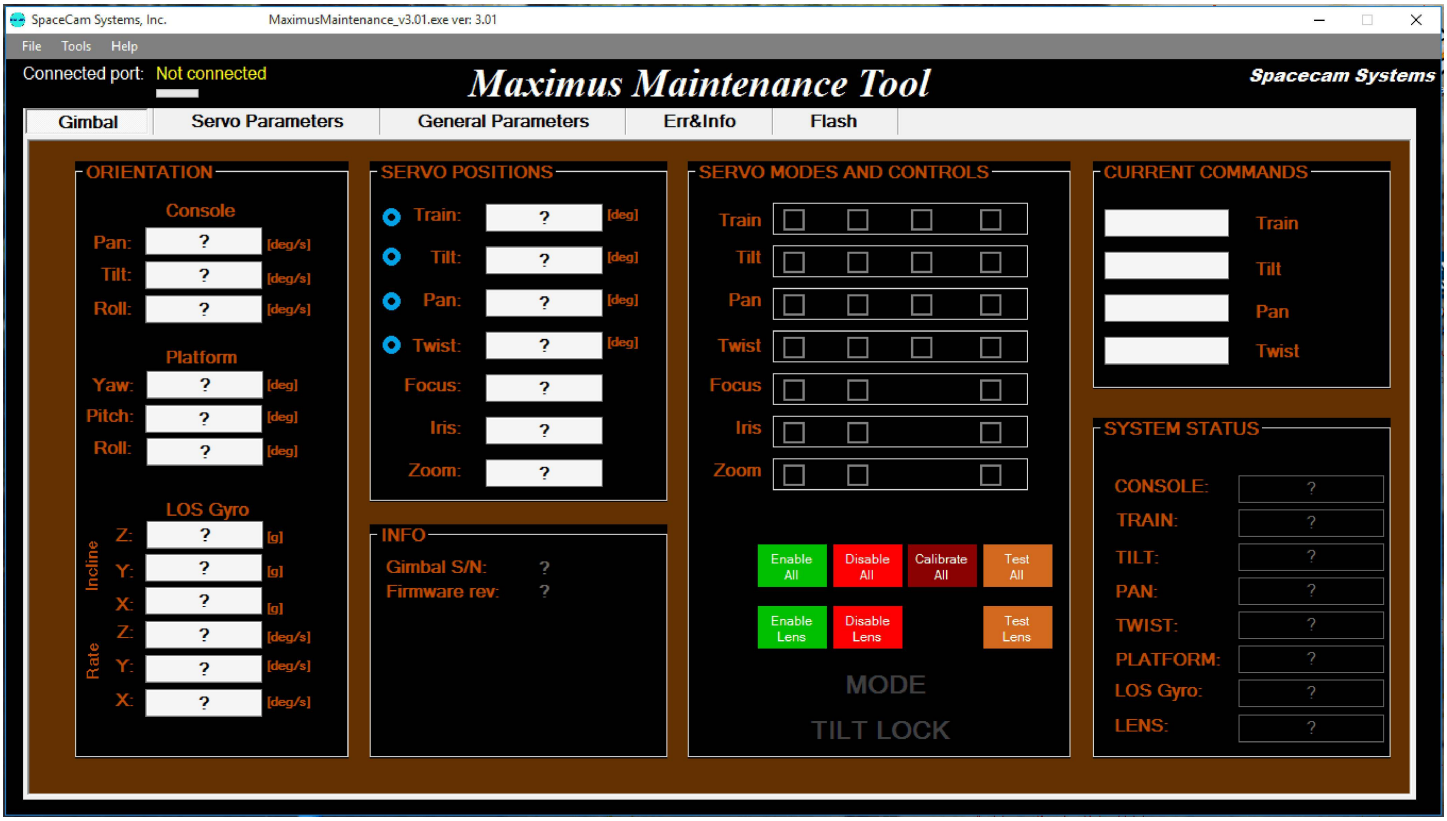
6.5 Saving the parameters

The relevant (user alterable) parameters can be saved in a file by clicking on the File roll-down menu on the top-left of the screen then clicking on the "Save All Parameters" menu item.

6.6 Printing the parameters

The relevant (user alterable) parameters can be printed by saving them in a file, then by clicking on the File roll-down menu on the top-left of the screen and then clicking on the "Print File" menu item. The PC must be connected to a printer or a network that has a printer.

6.7 Maintenance Tool, Gimbal tab



The left hand side group in the Gimbal tab is the ORIENTATION.

The Console sub-group shows the command from the joystick and can be used to check that the joystick works correctly. The range of the readings are approximately -2000 to +2000 [2000 is about 240 deg/sec].

The Platform sub-group shows the orientation of the platform in degrees. The Yaw is derived from the turret position, the Pitch and Roll from the gyro orientation.

The LOS Gyro sub-group shows the gyro's inclination [in G-s] and velocity [in deg/sec] in the x-y-z axes. Since the gyro is placed under the camera x would correspond to roll, y to pitch and z to yaw.

The SERVO POSITIONS group shows the mechanical angle of each axis in degrees. Also you can set a home position by moving the axis to the desired angle and double click the blue radio button to left of the label. (You can not set zero angle anywhere! The correct movement of the gimbal is related to these positions, if just one of them is incorrect the gimbal will behave uncontrollably and could cause damage to itself or personnel.

The SERVO MODES AND CONTROLS group shows enable, disable and test status of the axes and helps to perform some testing.

The first column is the enable column. All enabled axes marked by green squares. Click on a disable square to disable the desired axis. If you want to test torque disable all axes! (Click on "Disable All") Then click on the last column (Test) of the axis to be tested and then enter the desired current in AMPs in the field to the right. (CURRENT COMMANDS) Maximum 20 AMPs, that will brake arms! Restrain the axis before start, enter 1 or 2 AMPs only and gradually increase it if needed. The axis can be fixed by a torque meter to measure torque. Do not hold high currents for a long time (10-15 seconds) it will heat up drivers unnecessarily.

The SYSTEM STATUS group on the bottom right of the window shows the electronic module's connection status. Everything (except the LENS) must be green for correct operation.

6.8 Maintenance Tool, Servo Parameters tab

The big rectangular buttons to the right are commands to save or reload parameter tables.

LOAD:	Loads the current parameter table from the nonvolatile RAM.
STORE:	Stores the current parameter table into the nonvolatile RAM, use this to make your changes permanent.
LOAD DEFAULT:	Set this parameter table back to factory default. If you want it to be permanent click STORE too.
"Initialize All Parameters":	Set **all** parameter tables (general too) to factory default it will save them in the nonvolatile RAM also, don't have to click STORE. For safety do it twice. The zero positions of all axes must be checked after this command before enabling the gimbal!

In all servo tables the parameter "Axis MGain" is the master scaling of all the servo filters in that specific loop, use it to balance the loops. If these parameters are correctly balanced then the "Master gain" (a general parameter) that can be adjusted from the console with F4 key will work correctly.

Parameters that are not in green fields can not be changed. To change a parameter click on it's field and enter the new value in the "New value" box with the keyboard. Press the Enter key.

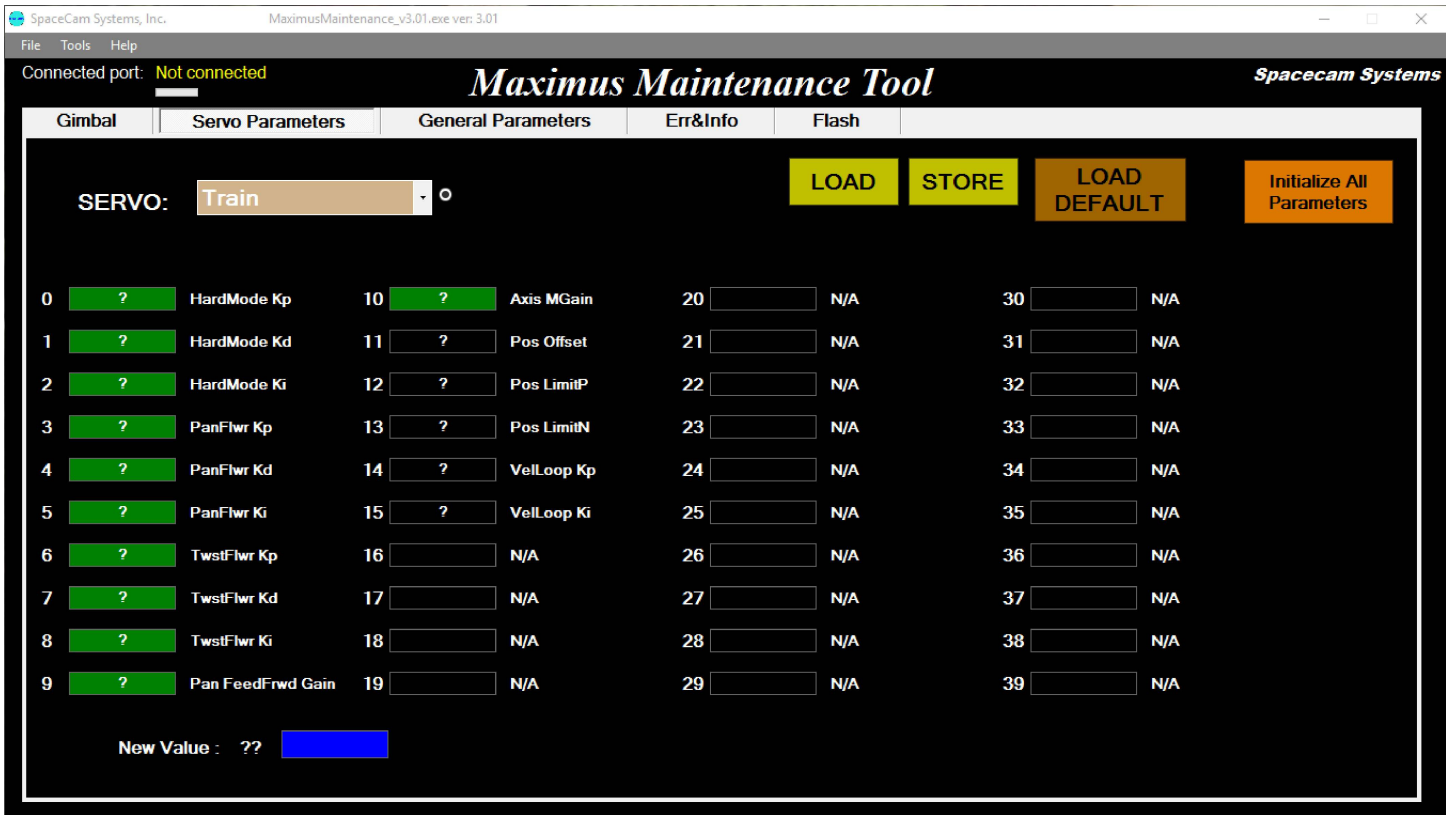
To select another axis parameter table select it using the drop-down list at the SERVO label. The lens tables do nothing this time.

6.8.1 The Train axis table

All modes of the train axis use PID type position loops:

The HardMode parameters are used with the hard mode and the PanFlwr and TwstFlwr parameters work with all other gimbal modes. Kp - gain, Kd - differentiation, Ki - integration. Since the pan and twist axes are followed by the train in a mixed matter it is important that the PanFlwr and TwstFlwr parameters are balanced.

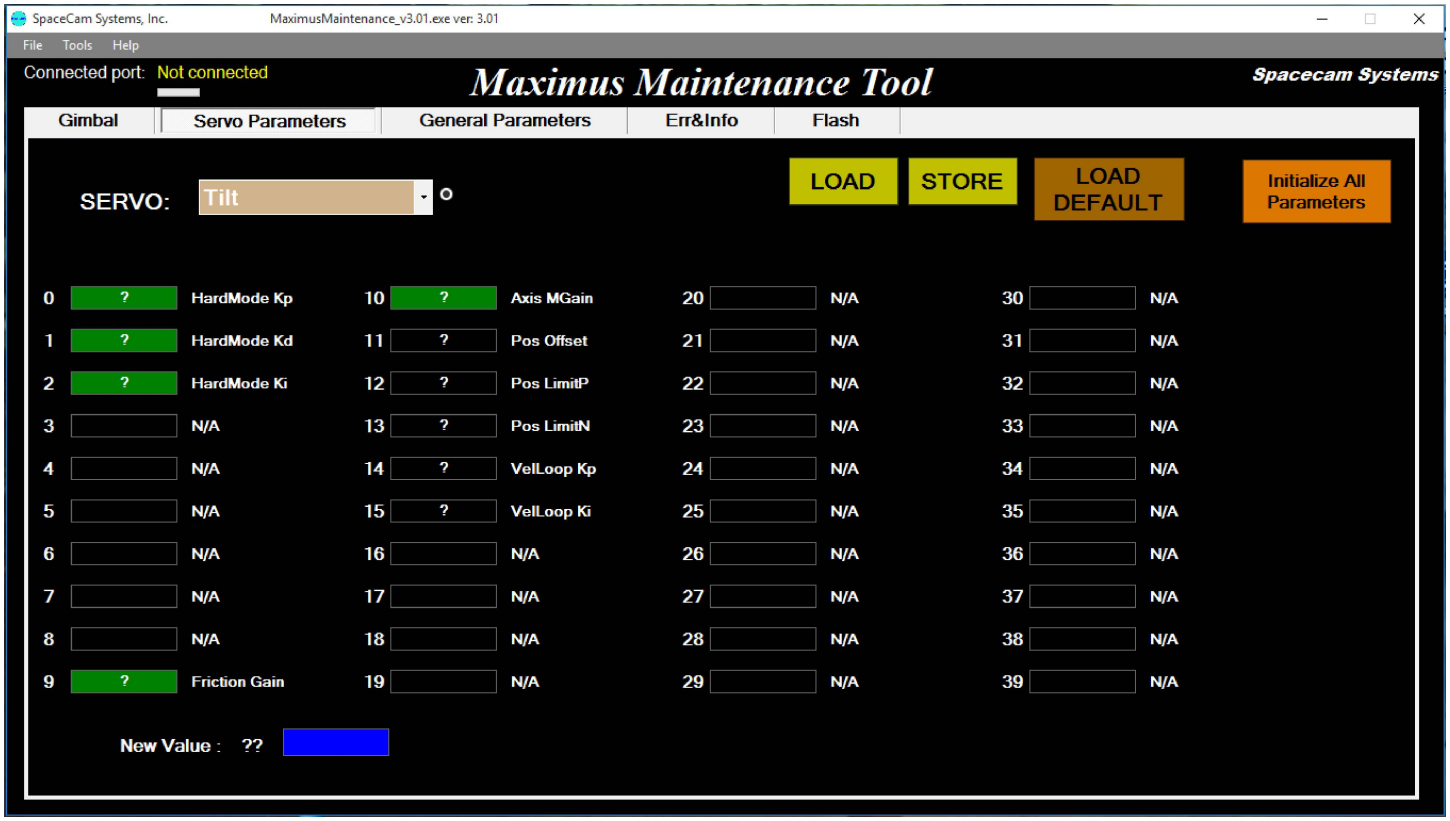
The Pan FeedFrwd Gain parameter is in testing. It supposed to help the train to react faster at high pan accelerations. It is an extra dangerous parameter because the code is not stable yet and can make the gimbal spin uncontrollable and very fast.



6.8.2 The Tilt axis table

Only the hard mode of the tilt axis is a type PID position loop: Kp - gain, Kd - differentiation, Ki - integration. All other modes use gyro loops and as the gimbal rotates the loops input references change! The "Axis Mgain" scales all loops for the axis.

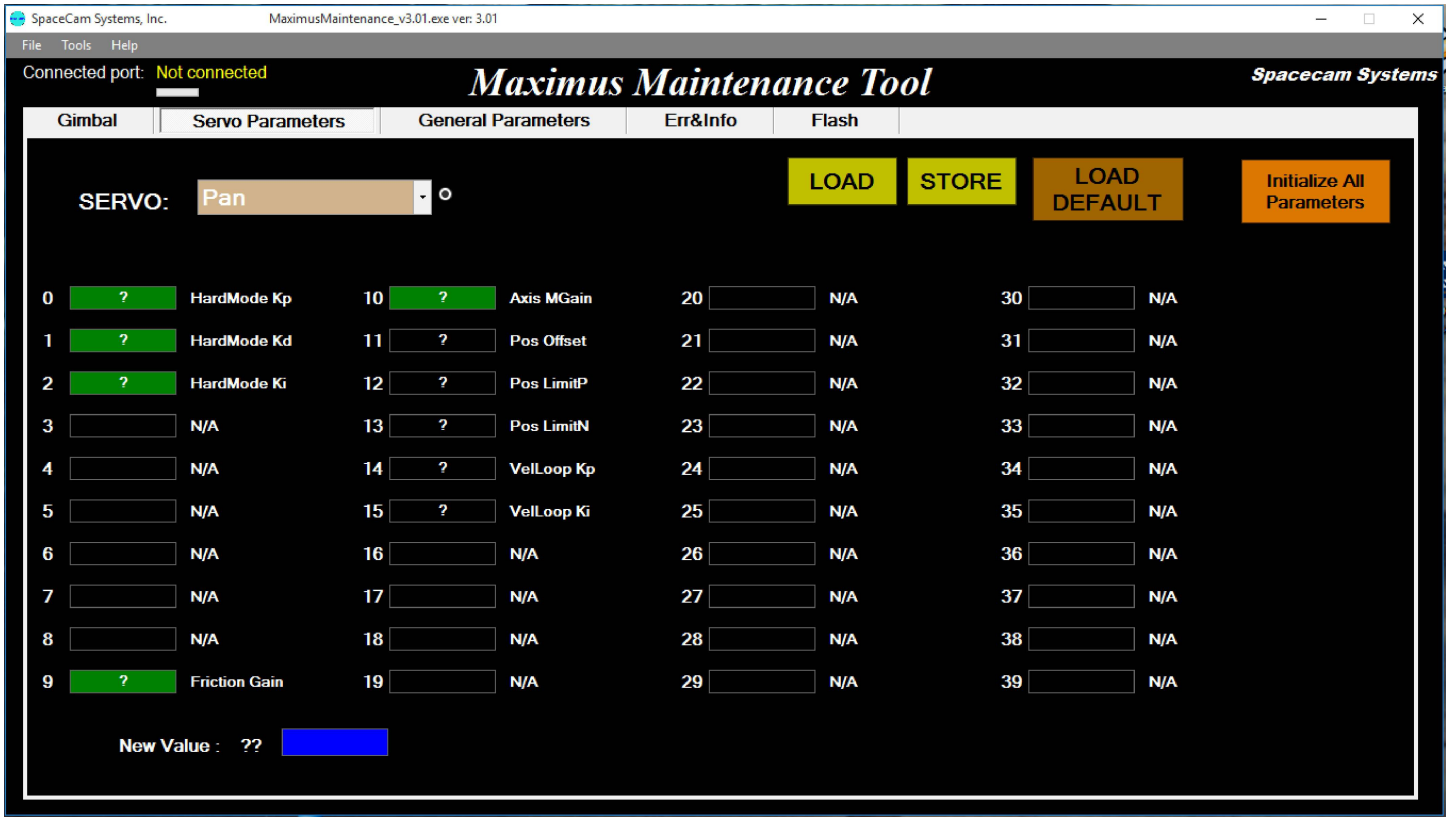
The Friction Gain is not used.



6.8.3 The Pan axis table

Only the hard mode of the pan axis is a type PID position loop: Kp - gain, Kd - differentiation, Ki - integration. All other modes use gyro loops and as the gimbal rotates the loops input references change! The "Axis Mgain" scales all loops for the axis.

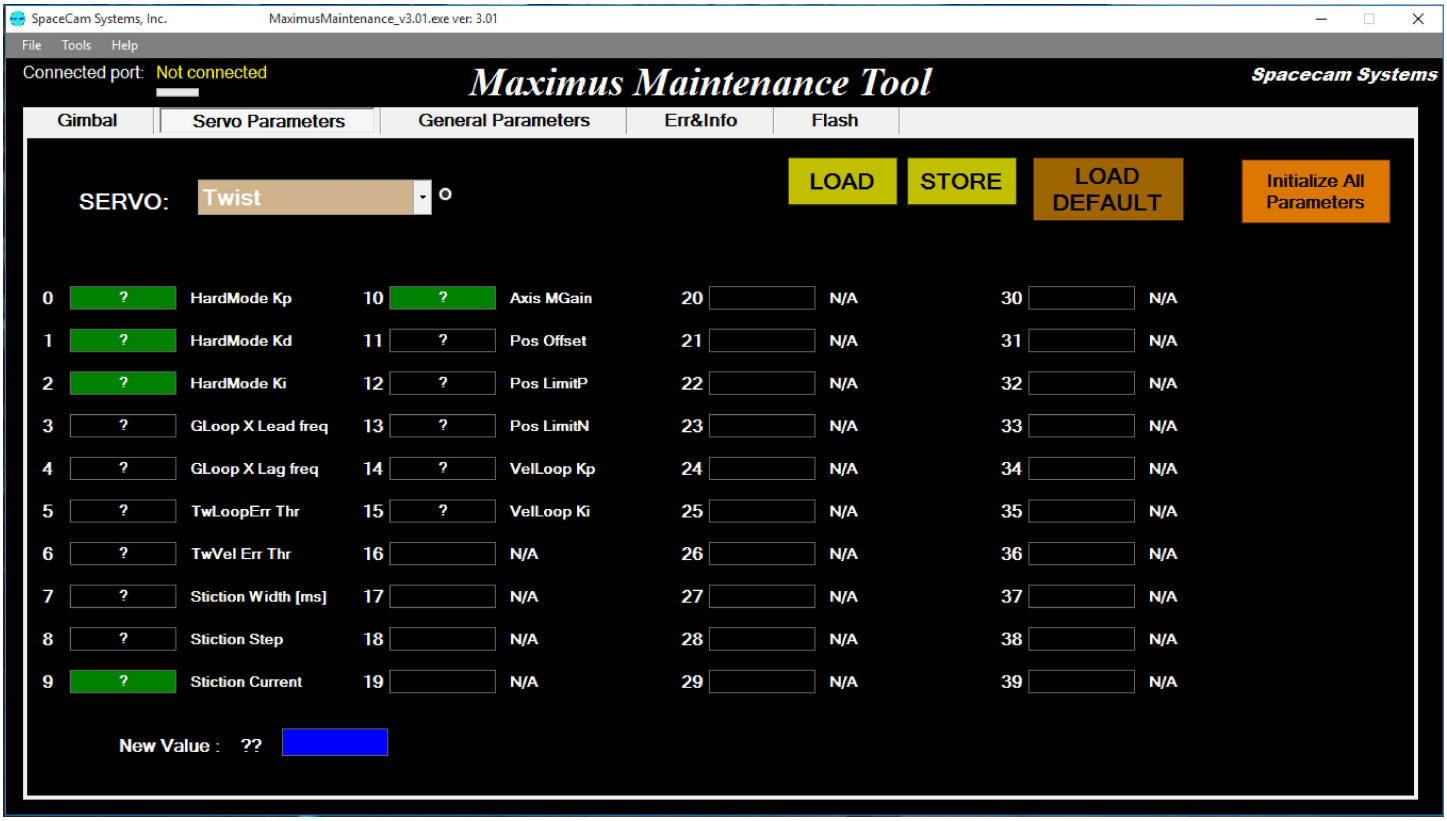
The Friction Gain is not used.



6.8.4 The Twist axis table

Only the hard mode of the twist axis is a type PID position loop: Kp - gain, Kd - differentiation, Ki - integration. All other modes use gyro loops and as the gimbal rotates the loops input references change! The "Axis Mgain" scales all loops for the axis.

The Stiction Current is the amplitude of a current pulse to start from stationary status. The value is critical, it can make the twist step either if it is too small or too large. **Please keep the default value**.



6.9 Maintenance Tool, General Parameters tab

The big rectangular buttons to the right are commands to store or load parameter tables. See paragraph "Maintenance Tool Servo Parameters tab" (¶ 6.8) for details.

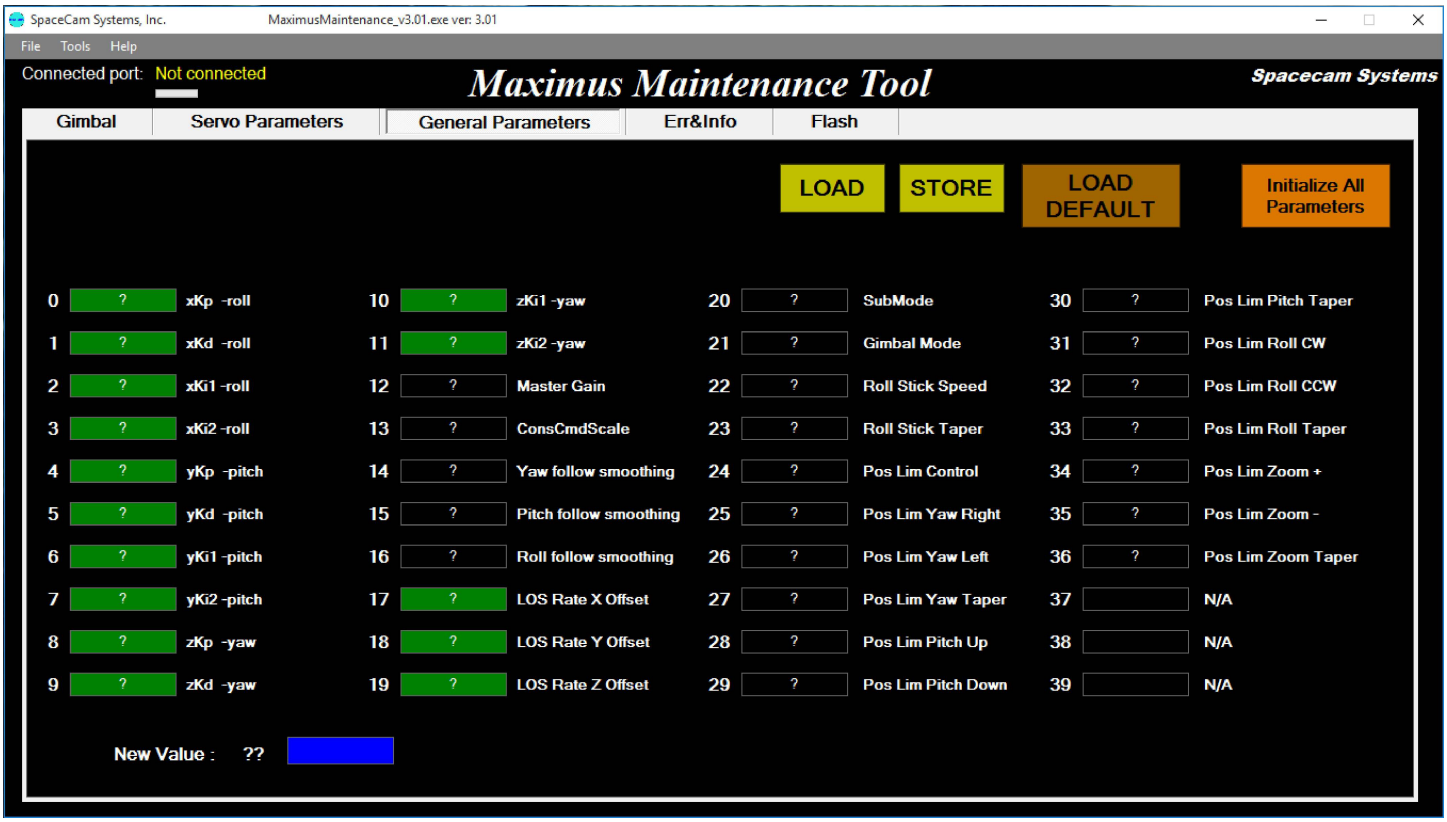
The "xK(p/d/i1/i2) roll", "yK(p/d/i1/i2) pitch" and "zK(p/d/i1/i2) yaw" parameters are gyro loop parameters (these are not typical position/velocity loops). These parameters must be in balance since as the gimbal turns and spins their functions change place. The 'p' parameters are proportional gain, the 'd's are only place holders they are not in the code, the 'i1' and 'i2' parameters are integrators.

The "Master Gain" is the overall system servo scaling and can be changed from the console with the F4 key.

The "(Yaw/Pitch/Roll) follow smoothing" parameters are the follow mode filters and set from the console's option's screen.

The "LOS Rate (X/Y/Z) Offset" parameters set from the console with the NULL button to cancel the gyro drift. These parameters can be set from this screen too but is is very difficult and only want to do it on a forever moving platform if you have a huhe drift. (Like a boat) In that case you may just want to set 0.0 on all three parameters.

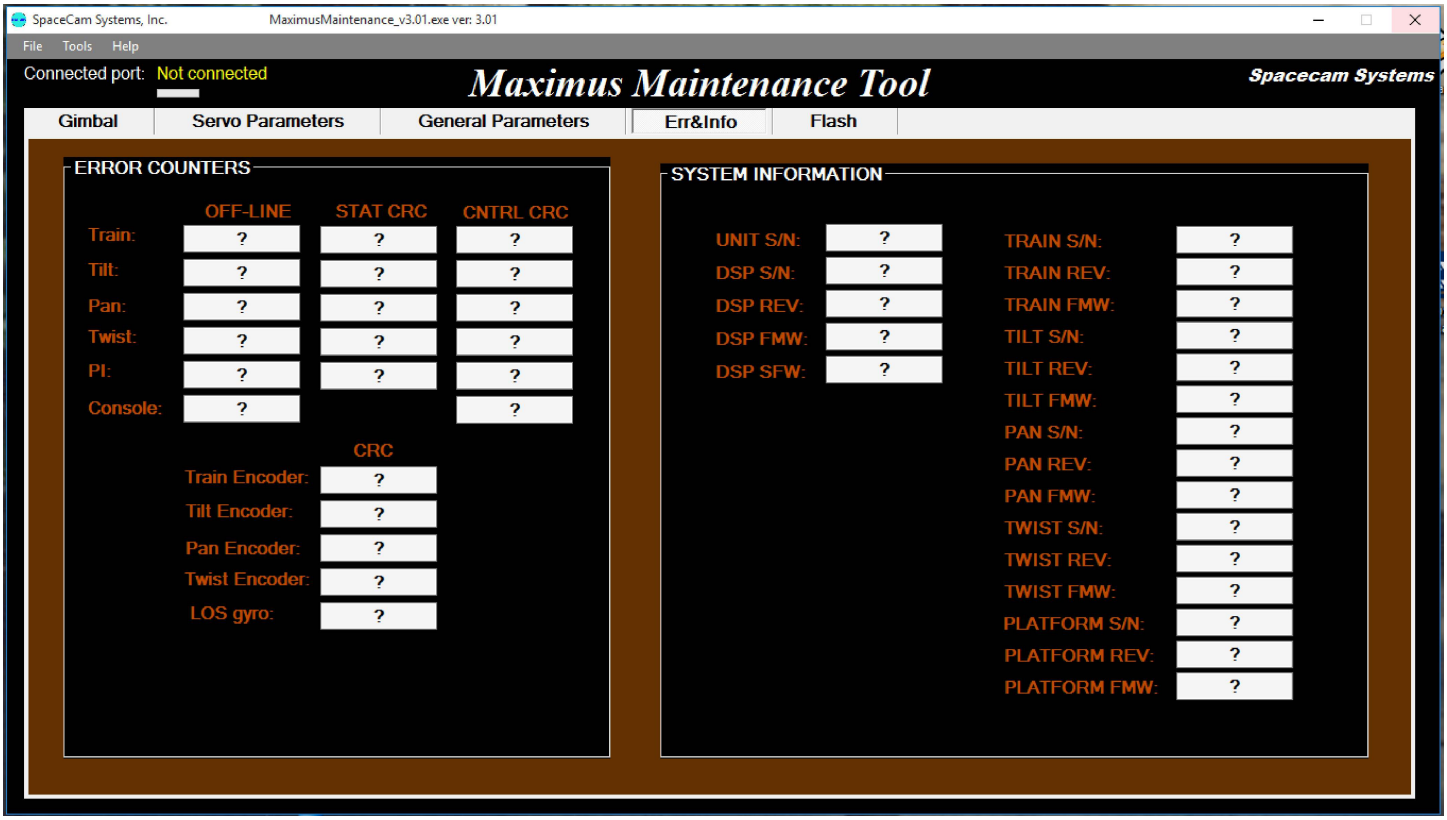
"Gimbal Mode", "SubMode" and all position limit parameters are set from the console.



6.10 Maintenance Tool Err&Info tab

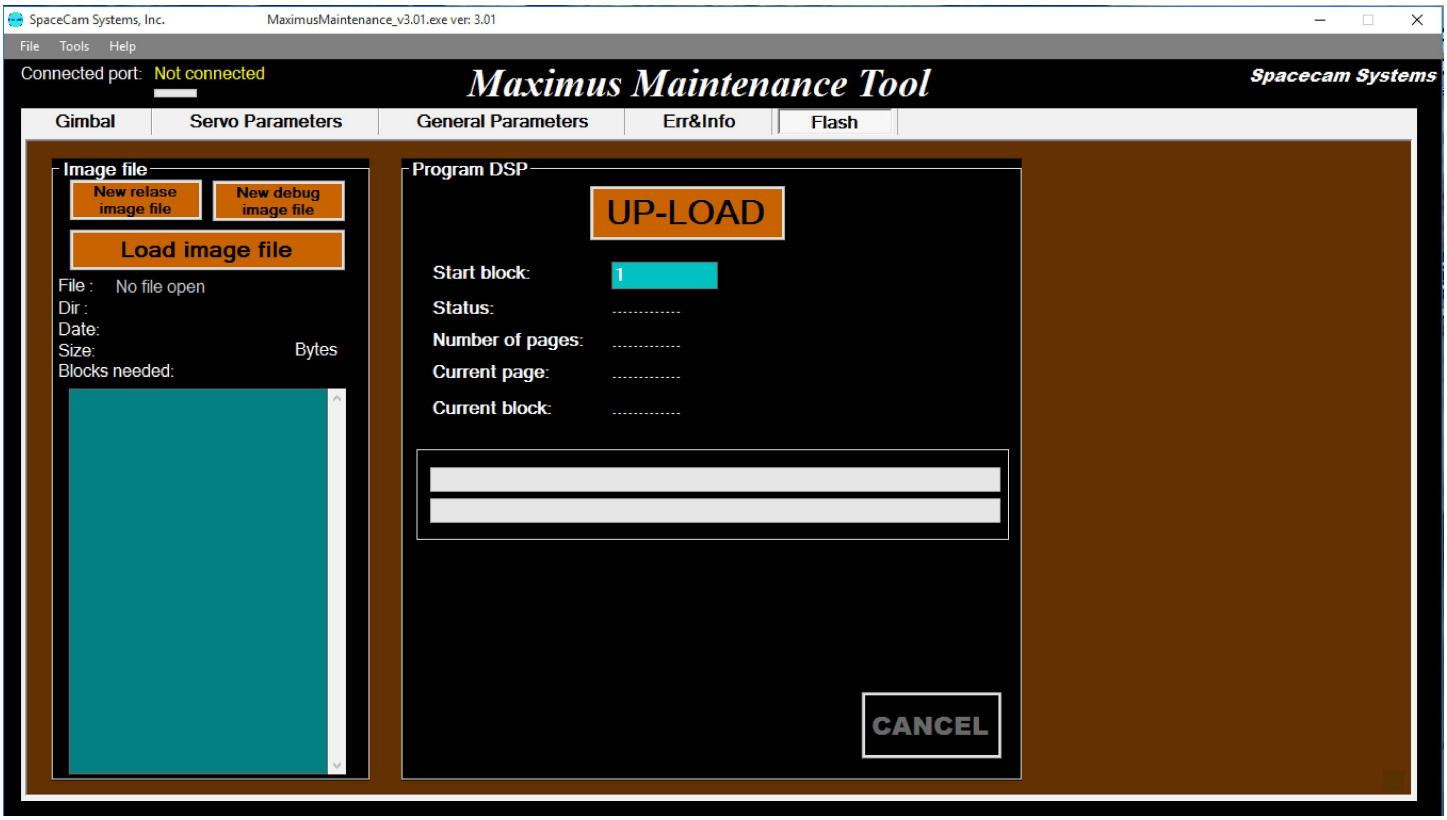
The absolute value of the error counters has no significance. If communications error are suspected to degrade performance the error occurrence **rate** is really the one to be analyzed. Off-line and CRC (+checksum) errors can be a sign of damage to the wiring. The communication line connecting the system control modules can not be disconnected from any module and expected to work error free. Not connecting the umbilical cable between the tilt and twist rings causes fatal errors on all modules.

The :SYSTEM INFORMATION" group is not operational but may be in the future.



6.11 Flashing the Gimbal Controller with the Maintenance Tool program

1. Acquire the new .ais file from Spacecam and copy it to directory c:\spacecam\maximus.
2. Connect your PC to the Gimbal using the procedure in ¶ 5.9.
3. Start the Maintenance Tool program when the gimbal power is on .
4. Click on the "Flash" tab.



5. Click on "Load image file" button.
6. Find and double click the .ais file you just saved.
7. The file attribute fields should fill up under the button.
8. Check that the gimbal is connected (on top left the Connected port's status bar is moving).
9. Click "UP-LOAD".
10. Wait until finished , make sure not to touch anything now (static).
11. Recycle power on the system.
12. Check that the gimbal is connected.
13. Click on the "Servo Parameters" tab.
14. Click on the "Initialize All Parameters" button at the right top.
15. Click it again just to make sure.
16. Click on the "Gimbal" tab.
17. **Definitely check the Train, Tilt, Pan and Twist zero positions. Reset if needed.**

18. Set master gain low (0.4 or less) on the console and enable gimbal. When the gimbal operates increase the gain gradually. Be very careful and alert.

If during flashing and error occurs (static discharge, power failure, communication error ...) The program will be corrupted and the DSP (Gimbal Controller) can not run anymore. Your not 100% doomed, read the next paragraph "BOOT LOADER" (¶ 7).

7 BOOT LOADER

7.1 Flashing the Gimbal Controller with the boot-loader

This procedure is only needed at initial programming or if the Gimbal Controller does not run due to damaged code in the FLASH memory.

1. Make sure the PC is connected to the gimbal and the gimbal power is off.
2. On the gimbal turret turn the boot-load switch to 1 with a small Philips screwdriver.
3. If you have a terminal program installed that you are familiar with find out which serial port the gimbal use (COM##).
4. If you don't, then install and use TeraTerm.
   - .1 Double click on the program teraterm-x.xx.exe in the c:\spacecam\maximus directory. Go through the installation, make sure you make a desktop shortcut icon.
   - .2 Turn the gimbal power on.
   - .3 Double click the "Tera Term" icon. If this is the first time that it will go to the new connection screen. Check the Serial radio button.
   - .4 Click OK to close the "New connection" window.
   - .5 In the main screen of TeraTerm click on Setup and Serial Port...
   - .6 Check the available Ports by clicking on the drop-down list arrow in the COM field.
   - .7 If there is only one port available then set the baud rate to 115200, 8bits, no parity, 1 stop.
   - .8. If there are more ports available then have to find witch one is the gimbal. (Close window, turn gimbal power off, open Serial Port Setup again, check ports, the one missing is the gimbal port. Close window, turn gimbal power on, open port setup, and set the parameters on the correct port.)
   - .9 Close setup window. Recycle gimbal power.
   - .10 The data screen should show BOOTME. This is sent from the gimbal and confirms connection and ready to boot.
   - .11 Exit TeraTerm.
5. You have to do the next step really concentrating:
6. In the c:\Spacecam\Maximus directory right click "DSPFlash.bat".
7. Select "Edit" in the drop-down context menu. The .bat file will open in Notepad.
8. In the first line set the correct COM**x** number of the serial port you just found previously and the version number of the POLS80100_v**x.xx**.ais file to the version number you have. Do not alter anything else. To make sure that it is a single line, if the first line wraps, open the Format menu and uncheck "Word Wrap".

   Example: sfh_OMAP-L138.exe -v -flash_noubl -targetType C6748_LCDK -flashType NAND -p COM**3** C:\spacecam\maximus\POLS80100_v**3.01**.ais

   Save and exit Notepad.

9. Make sure the gimbal power is off!

10. Double click "DSPFlash.bat".
11. Turn gimbal power on. Watch as the gimbal gets flashed.
12. Turn gimbal power off.
13. On the turret set the boot switch back to 0.
14. Turn gimbal power on.
15. Start the Maintenance Tool program.
16. Do steps 12 to 18 of paragraph "Flashing the Gimbal Controller with the Maintenance Tool program".¶ 6.11

8 MAINTENANCE

8.1 Tilt, Pan and Train Encoder Cleaning.

It is recommended that at 3 month intervals, or more often depending on operating environment, the encoder wheels on the tilt, pan and train axes be cleaned in order to insure proper operation. (The twist encoder is a sealed unit).

When dust and dirt are present on the edge surface of these encoder wheels an interruption in the axis position can occur and the head will go off-line in that particular axis. This will result in instability and interaxial "twitching" and disturbances.

In order to clean these wheels first remove the carbon fiber motor covers on each axis. You will then notice a polished stainless steel wheel and an aluminum box-like "reader" head with a glass cover facing the edge of the polished wheel. Micro laser engraving is on the edge of this wheel. In order to clean the encoder do the following:

1. Remove carbon fiber cover on tilt, pan and train axis.
2. Unplug motor connector if necessary to give better access.
3. Use soft tissue, clean soft cotton cloth or a Q tip to apply alcohol or acetone to surface on edge of wheel.
4. Use dry tissue or soft cotton cloth to dry wheel edge.
5. Rotate axis in order to access 360 degrees of the tilt and train wheel. The pan axis encoder only rotates plus/minus 30 degrees.
6. Take thin cotton cloth and run very gently between glass cover plate on reader and wheel edge.
7. TAKE CARE NOT TO DISTURB POSITION OF READER OR WHEEL DURING THIS CLEANING.
8. Turn system on but do not "enable".
9. Rotate pan and then the train axis slowly through 360 degrees while observing status boxes on display. They should remain green throughout rotation.
10. Rotate pan axis from one extreme to other. Display box should remain green throughout except for left and right extremity when the box will turn brown. This is normal. It is the magnetic limit switch working.
11. Reinstall covers.
12. Test assembled system.

9 PARTS LIST

Partial parts list for reference only			
#	**Name**	**Part number**	**Notes**
1	Gimbal assembly	OCC-MA-03	
2	Console assembly	OCC-SA-718	
3	Wheel assembly	WCV-SA-400	
4	System power supply	OCC-SA-713	
5	Platform power supply	OCC-SA-716	
6	AC power supply	OCC-SA-714	
7	Gimbal power cable	MXW80300	
8	Console power cable	MXW80301	
9	Control cable	MXW80302	
10a	System power cable	MXW80303	Connection to battery(bare battery end)
10b		MXW80313	Connection to battery with Anderson connector
10c		MXW80316	Connection to AC power supply

10 SPECIFICATIONS

Power requirement		
		UNIT
Battery voltage minimum	20	V DC
Battery voltage maximum	34	V DC
Battery current minimum at 20VDC	50	AMP DC
Battery current minimum at 28VDC	36	AMP DC
AC voltage minimum	100	V AC
AC voltage maximum	240	V AC
AC current minimum at 100VAC	12	AMP AC
AC current minimum at 220VAC	6	AMP AC

Mechanical			
			UNIT
Gimbal weight (unloaded)	64		lb
Gimbal dimensions (L, W, H)	23.5, 8.0, 28.5		inch
Gimbal maximum payload width (centered)	12		inch
Gimbal maximum payload height (centered)	9		
Gimbal maximum payload length (centered)		20	inch
	with 6" train“ ring extensions	32	
Gimbal maximum payload weight	70 +		lb
Gimbal pan, tilt and roll freedom of movement	continuous rotation		deg
Console weight	6.5		lb

Payload power supplies		
		UNIT
13.1VDC	19	AMP
24VDC	10	AMP

Performance			
			UNIT
Stabilization	yaw, pitch, roll		
Number of axes	7		
Maximum axis speed (all axes)	240		deg/sec
Maximum axis drift (all axes, average system, reference only)	20		deg/hour
Wireless operation maximum distanced	omni antenna	1.5	mile
	directional antenna	10	
Operating temperature	-4 to +120		°F
	-20 to +50		°C