NEWTON S

SYSTEM OPERATION MANUAL

1.2.2

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CONTENTS

1 Introduction

This manual describes the handling and operation of the Newton S remote controlled, stabilized, head together with the Dominion controller.

1.1   OVERVIEW

Newton S is a fully electronically stabilized three-axis remote camera head with 360 degree free pan made for broadcast and film production from wires, rails, crane, vehicles and other moving platforms. The full system comprises Newton S, the Dominion controller connected via a wireless or wired link, lens control dongles, mechanical mounting accessories and a power supply solution. In addition to this the user supplies the moving platform, any passive stabilization required and the camera.

1.2   WARNINGS AND NOTICES

> ⚠️ **WARNING**
> Before connecting or turning on the Newton S remote head or Dominion controller, read this manual and any warnings provided carefully.

> ⚠️ **WARNING**
> Do not power or charge the Newton S remote head or Dominion controller with anything but external prower supplies delivered by and/or approved by Intuitive Aerial for use with the respecitve product. Doing so can permanently damage or destroy the product.
> Newton S accepts extenral power between 12 and 28 Volt. Powering it with a supply outside this range will permanently damage it.

> ⚠️ **WARNING**
> When using attached batteries to power the Newton S, make sure they are fully charged before starting operations.

> ⚠️ **WARNING**
> Make sure the camera and any other equipment is properly mounted and secured before turning on the Newton S.

WARNING

The Newton S and the Dominion controller are rain protected but is not water proof, so do not expose them to direct spraying or submersion into water.

WARNING

Performing any disassembly, modification or service not explicitly described in this manual will void any warranties for the system.

! NOTICE !

When utilizing the wireless connection between the Newton S and the Dominion, always extend antennas veritcally and make sure there is a free line of sight between the units to get the best possible range and most stable connection.

2 Physical Layout

2.1 NEWTON S
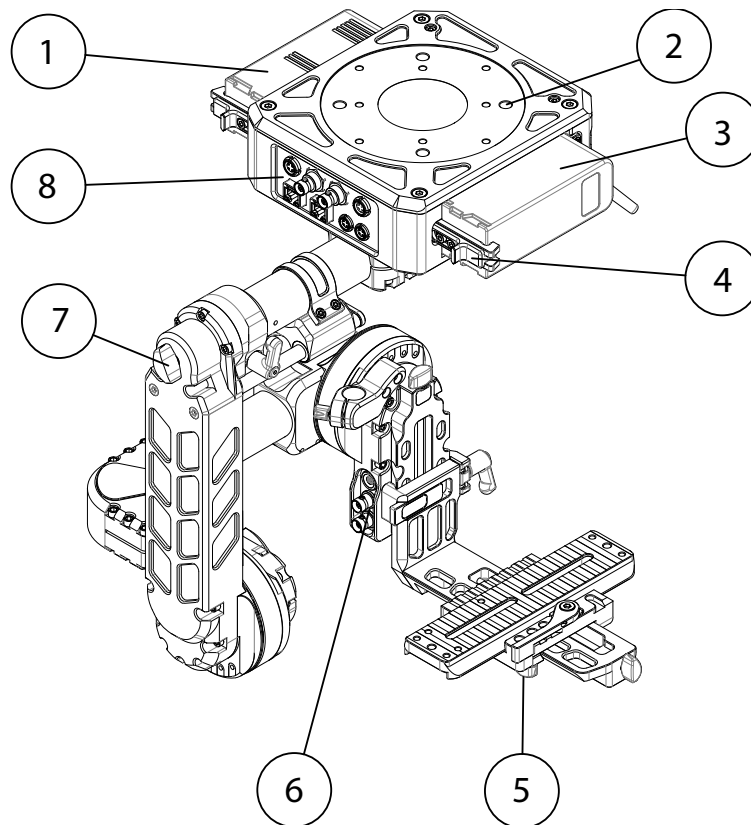
Figure 2.1: Newton S overview 1

Table 2.1: Overview Descriptions

Item	Description
1,3	Battery
2	Attachment points
4	Battery clamp
5	Side-to-side lock clamp
6	Cradle connectors
7	Pan balance adjustment screw
8	Pan-box connectors
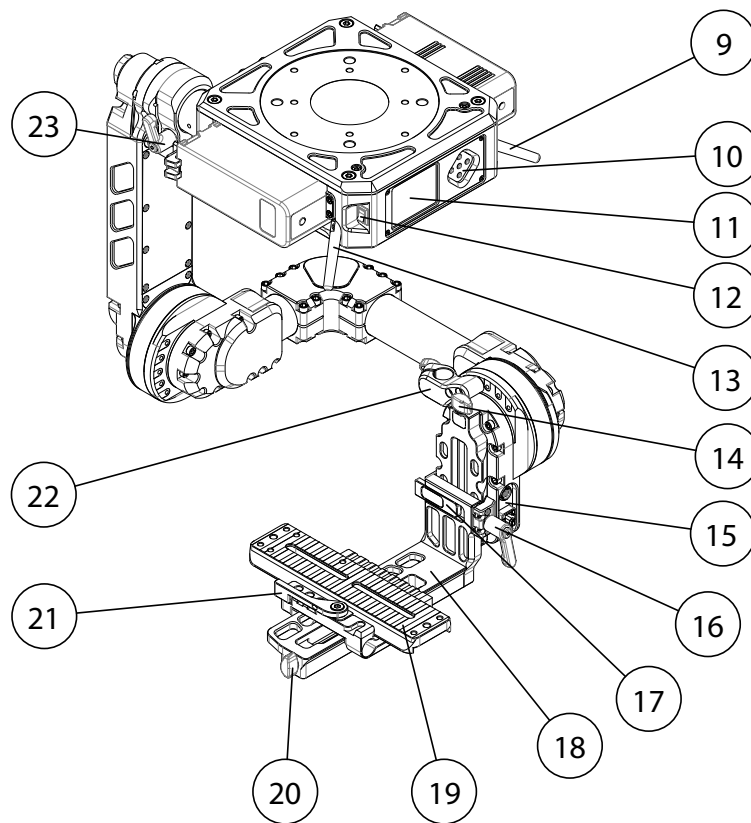
Figure 2.2: Newton S overview 2

Table 2.2: Overview Descriptions

Item	Description
9,13	Antennas
10	UI buttons
11	Display
12	Power switch
14	Vertical adjustment screw
15	Cradle connectors
16	Vertical lock clamp
17	Cradle release clamp
18	Cradle
19	Camera dovetail
20	Horizontal adjustment screw
21	Front-back lock clamp
22	Top-mount attachment
23	Pan balance lock clamp
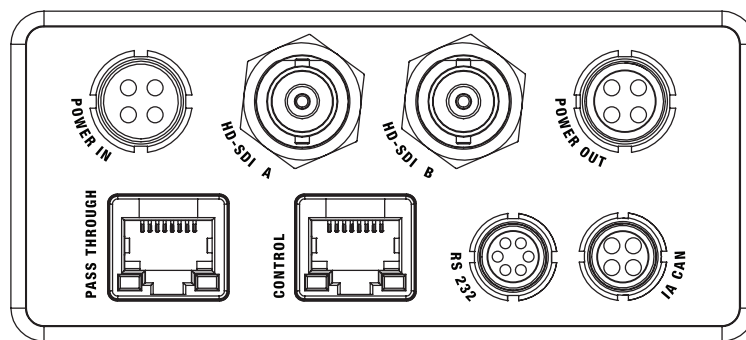
Figure 2.3: Newton S Pan-box connectors
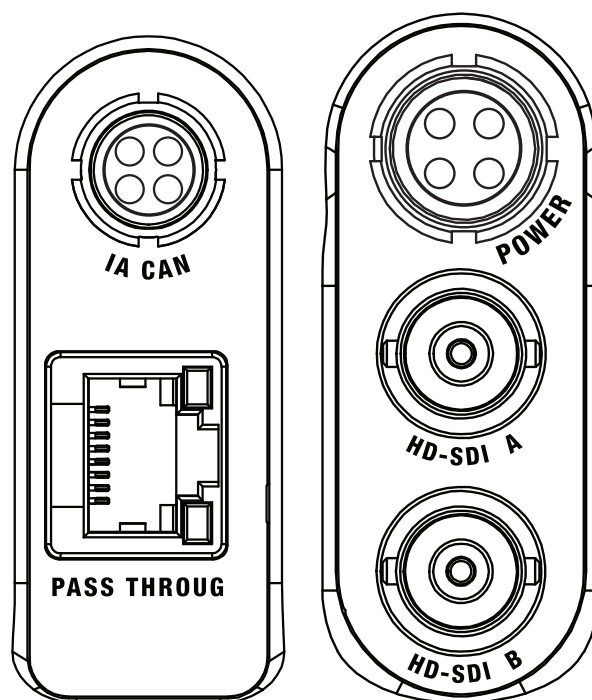
Figure 2.4: Newton S cradle connectors

2.2   DOMINION
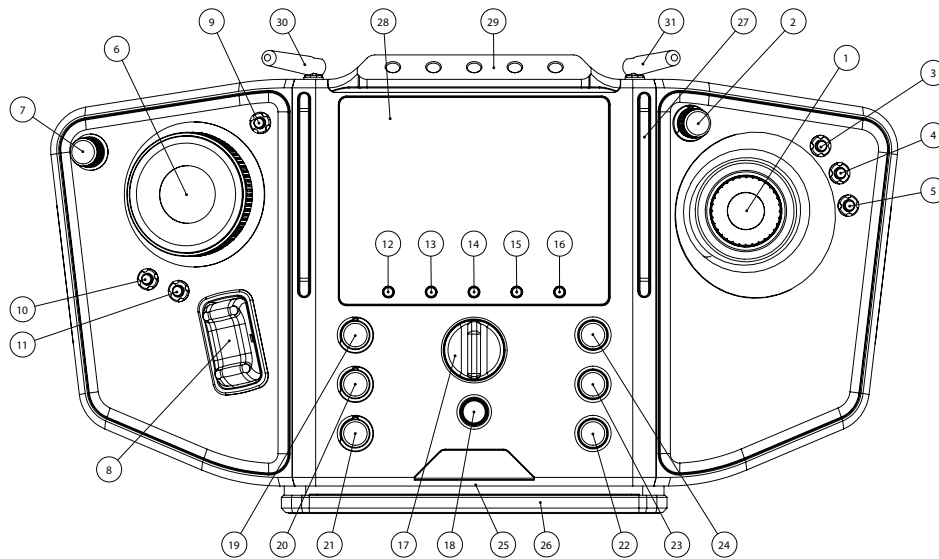
Figure 2.5: Dominion top view

Table 2.3: Top View Descriptions

Item	Description
1	Joystick
2	Mappable wheel (default unmapped)
3-5	Invert axis
6	Focus wheel
7	Iris wheel
8	Zoom rocker
9-11	Mappable buttons (default unmapped)
12-16	Menu buttons
17	Mode switch
18	Record switch
19-21	Speed for tilt, pan, roll
22	Pan trim compensation
23	Ease in/out
24	Mappable wheel (default unmapped)
25	SD card slot
26	Extendable support
27	Neck-strap rails
28	Display
29	NATO accessory rail
30,31	Antennas

3 Setup

3.1 UNBOXING AND ATTACHING

The Newton S and the Dominion controller are delivered packed into hard-cases with shape fitting foam. In the Newton S hard-case, the top layer has space for cables and accessories while the Newton S itself is placed in the second layer. It is recommended to use the hard case for storage and transport to reduce the risk of damage to the head or controller.

Unbox the Newton S by pulling it straight up and place it on a stable surface such as a table, or directly attach it to the platform it will be used with, such as the rail or wire dolly. Make sure it is properly and securely attached so it cannot fall over. The generic mount can be used for mounting a camera to the head and has two parts, the camera cradle (point 18) and the camera dovetail (point 19). When delivered, the generic mount is not attached to the remote head. If using the generic mount, attach the camera cradle by engaging the cradle release clamp and then sliding the cradle straight down until attached. Release the clamp and verify that the clamp cannot be moved.

The Dominion controller is also unboxed in the same way by pulling it straight up out of the foam.

3.2 ATTACHING CAMERA

The camera can be attached either by using the included generic mount or by using a Newton camera cage, which is sold separately. Using the cage provides a more stiff mounting of the camera, attachment points for accessories and reduces the se tup time when removing and reattaching the same camera package. For instructions on how to assemble and attach the camera cage, see the documentation included with the cage.

To attach a camera using the generic mount, use the following procedure:
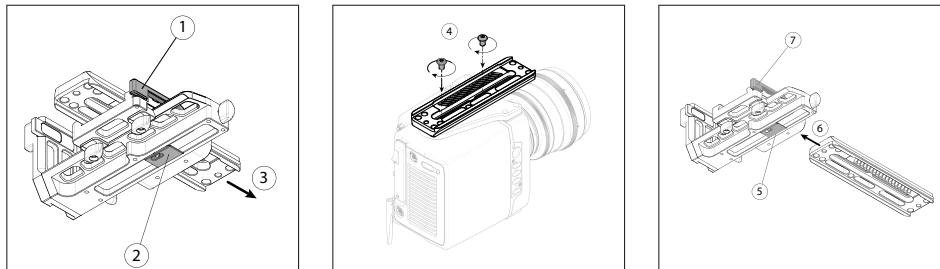
Figure 3.1: Attaching camera

1. Remove the dovetail from the cradle

    1.1 Release the front-back lock clamp (point 21)

    1.2 Pull down the adjustment pin

2. Attach the camera to the dovetail with two or more screws

3. Reattach the dovetail to the cradle

    3.1 Pull down the adjustment pin

    3.2 Slide the dovetail into the base, position it at approximate front-back balance.

    3.3 Lock the front-back lock clamp (point 21)

If using a long lens it is recommended to mount a forward lens support on rods; 15mm rods for lens support or lens drive motors can be attached to the dovetail base. After attaching the camera, attach any auxiliary devices such as lens drive systems, lens control dongles and cabling. Make sure everything is tightly attached and cannot move or vibrate. Strap together all cables tightly with cable straps or Velcro.

> ## ! NOTICE !
> It is highly recommended to always use a top mount on the camera, or a full cage solution that gives the same function. The extra rigidity such a solution gives is very important for optimal stabilization.

3.3 CAMERA POWER AND SIGNALS

3.4 BALANCING

In order to use the Newton S the head must be properly balanced. First and foremost the balance must be done so that the motor can stabilize the payload, too much offset in one axis can make it impossible to steer and stabilize that axis. The more carefully balanced the head is, the better the stabilization will work, especially in highly dynamic environments.

3.4.1 BALANCING WITH GENERIC MOUNT

Before you start the process of balancing the Newton you need to make sure that everything that's needed is mounted to the head as the addition of accessories will affect the balance. Remember to loosen any top mounts and similar before trying to balance the camera and to re-tighten them when done.
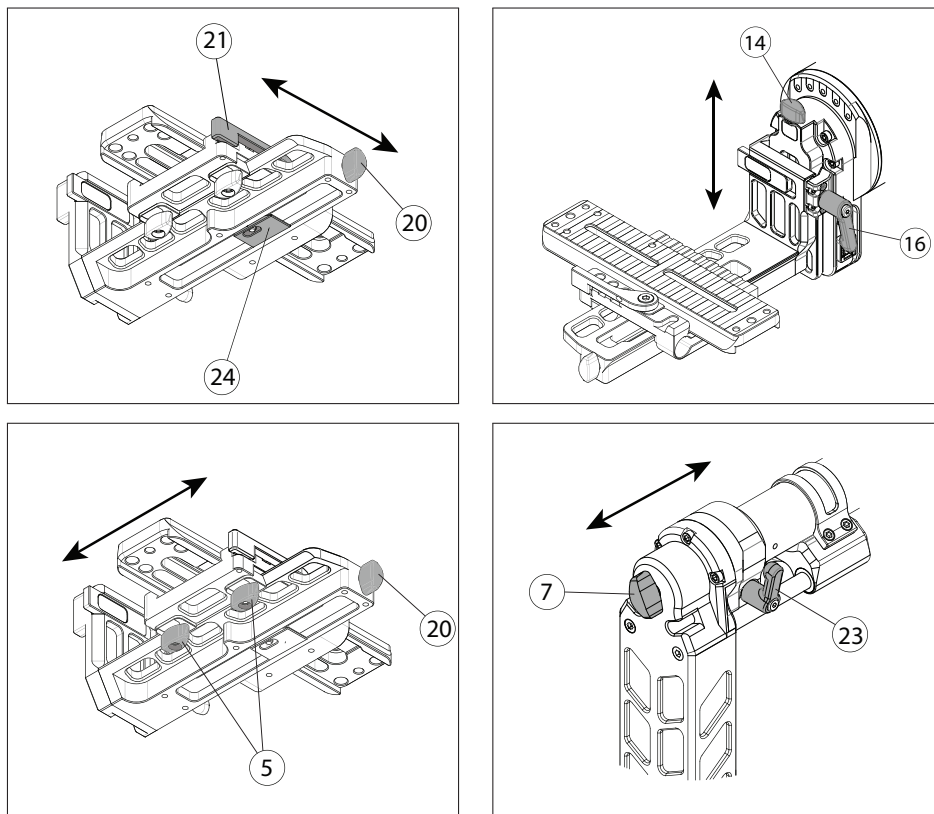
Figure 3.2: Balancing

Front-back balance

The first step is to adjust the front-back balance. Start by releasing the front-back lock clamp (point 21) and then push the adjustment pin button and move the camera package to the fixed position where the balance is the best. Release the pin and then use the adjustment knob (point 20) on the side of the cradle to do the last fine adjustments.

Some camera/lens setups that are long and front-heavy may need counterweights or a special camera cage in order to be properly balanced.

Vertical Balance

Rotate the tilt axis 90° forward or backwards. Release the lock (point 16) and adjust the vertical slider (point 14) until good balance is achieved. To test the front-back and vertical balance, rotate the camera around the tilt axis to different angles and check if it stays in same angle. If not, make further adjustments of balance.

Roll Balance

The roll balance is adjusted with the same knob (point 20) that was used for doing fine adjustments in tilt. Make sure the front-back lock (point 21) is closed and loosen up the horizontal slider side-to-side lock (point 5).

Pan Balance

The pan balance can be adjusted by turning the knob (point 7) on the back of the spine. Start by loosening the pan lock (point 23). By tipping the base of the head slightly to its side it should not move

if the head is balanced. If the back of the head moves to the opposite side it is back heavy and the knob should be turned clockwise. If it moves to the other side the head is front heavy and the knob should be turned counter clockwise.

3.4.2 BALANCING WITH CAGE

Vertical and Pan Balance

Vertical and pan balancing when using a Cage is identical to when using generic mount, so see the section above about pan balance.

Front-back and Roll Balance

Both the front-back and the roll balance needs to be simultaneously tuned when using the cage, as both are affected by placement and orientation of the counter-weights. Start by adjusting the rough front-back balance by moving the counter-weights and the cage clamps until you reach a position with the desired balance. Keep the roll axis stable and rotate the tilt axis to different positions to verify correct balance.

As a second step, rotate the counter-weights to adjust the balance in the roll axis. If you need to rotate a lot, it could be needed to afterwards re-adjust the weights front-back to keep tilt axis balance.

3.5 POWER

3.5.1 POWERING NEWTON S

The Newton S is turned on by switching the power switch (point 12) to 1.

3.5.2 POWERING DOMINION

The Dominion has two ways of receiving power. It can either be powered by an external input (point 38) or by the internal Li-Ion battery. The Dominion will automatically charge the internal battery as soon as there is external power in, no matter if it is turned on or not.

Before first use it is recommended to fully charge the internal battery. That way any accidental disconnection of external power will not result in the Dominion turning off or disconnecting from the remote head. First time it is recommended to let the Dominion charge for at least six hours before use.

To turn on the Dominion press the power button (point 39). The same button is used to turn the Dominion off.

3.6 COMMUNICATIONS

The Newton S and the Dominion controller has two different possible communication channels, either the built in 2.4GHz radio modem or an Ethernet link that in turn can be transported over cable, fiber or radio.

To use the internal radio modem, make sure correct antennas are mounted and if possible utilize an external antenna on the Newton S mounted in a location that gives free line-of-sight between the antenna and the Dominion. Make sure the radio modem is enabled on both Newton S and Dominion and that the units are paired as seen in section 5.4.1.

To utilize the ethernet link for communication, establish ethernet connectivity between the Newton S and the Dominion either via a direct cable[1], or using any suitable ethernet infrastructure such as switches, fiber-converters and fiber cable, or ethernet-over-radio[2] or WLAN links. Once the physical connectivity is established use the settings in section 5.4.2 to establish a connection between the units.

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[1]If having more than 25 meters between the unit, Intuitive Aerial recommends either a repeater or a fiber link to ensure signal integrity

[2]Intuitive Aerial has a number of tested links with instructions on how to use them. Contact the support hotline or your sales contact for more information

The ethernet traffic between Newton S and Dominion can be shared with other traffic such as camera control, however make sure this does not negatively impact the control latency before operating the Newton S in a live production.

3.7 TUNING

When setting up the Newton S, after attaching the camera and carefully balancing it, the remote head needs to be tuned for the specific setup to get good stabilization and avoid vibrations. The tuning depends on the mass distribution of the whole camera and lens package (including any other devices attached to it) so while general guidelines and rough values can be provided for a specific setup, a full tuning is still required after each assembly of the system.

Tuning is done through the user interface on the Dominion controller, in the settings menu, **RMT SETTINGS** tab. For each axis there are three principal tuning parameters and one auxiliary parameter, namely:

P Controls how strongly a disturbance or steering input is compensated. The main tuning parameter

I Compensates for residual errors on longer movements

D Dampens reaction to quick external disturbances

Pos Gain Controls how quickly the head returns to correct position after a larger deviation. Normally no need to tune this

The recommended procedure for tuning the Newton S is as follows:

1. Make sure the remote head and camera is balanced and that nothing is loose or rattles

2. Set the P, I, and D for all axes to a low value. A good starting point is (4, 0.05, 0) for tilt, (3.5, 0.05, 0) for roll and (8, 0.05, 0) for pan. Let Pos Gain be at default value of 6

3. Doing one axis at a time, in the order tilt, roll, pan, tune

    3.1 Increase P until a high frequency oscillation begins, then back down to 80% of the value. Use the controller and move the axis from endpoint to endpoint, if oscillations begin at any angle reduce the P value further

    3.2 Increase I until a low frequency oscillation begins, then back down to 80% of the value. Again check if there is any angle that is more prone to oscillation and if so reduce the I further

    3.3 Check that the head responds well to external disturbances by pressing lightly on the axis. If the remote head is prone to oscillation when returning to the starting position, increasing D to about 5-10 should dampen it

4. After all axes are tuned, return and check so that there is no angle more prone to oscillation. If so, repeat the entire process for all three axes

For further information and guidance on tuning, see the Intuitive Aerial website where you can find videos and other help to tune the system.

4 Operation

4.1 USER INTERFACE AND CONTROLS

> **! NOTICE !**
> This manual describes controls and interfaces when using the default mappings. Most buttons and rotary dials on the Dominion can be remapped by the user, if this has been done the exact references in this manual will not be correct.

4.1.1 DOMINION

The graphical user interface is the main way to interact with and get feedback from the Dominion. User feedback is given on the display (point 28) and input is given using the buttons under it (point 12-16). The exact functionality of the buttons are context dependent and displayed at the bottom of the display.

The main page, shown after startup, provides feedback on all major functions. It is divided into two major parts; the left hand part of the screen displays feedback for lens and camera control (collectively referred to as FIZC) while the right hand part provides feedback for the remote head, the Dominion itself and the communication link.
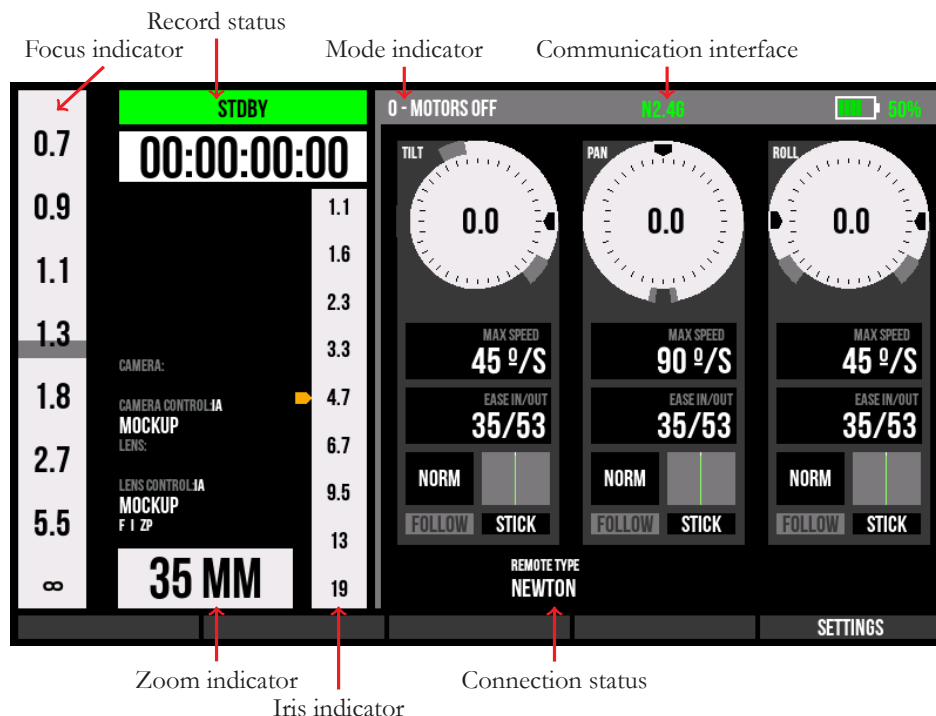

Figure 4.1: Dominion Main Page

The left side contains feedback and information about remote lens and camera control. The main parts shown at left, bottom and right side is focus, zoom and iris information respectively. The middle contains more detailed information including:

1. Recording status

2. Recording time and media status

3. Camera and lens control information

The right side, which contains information about the remote head and the communication link has a number of larger pieces of information[1], from top-to-bottom, left-to-right:

1. Current control mode

2. Currently active communication link

3. Dominion battery status

4. Per-axis information

    a) Current angle and set limits
    b) Maximum speed (at full joystick movement)
    c) Ease in/out amount
    d) Normal or inversed mode
    e) Graph of applied torque

5. Remote head battery status

6. Remote head type

4.1.2 NEWTON S2

The graphical user interface is the way to interact with and get feedback from the Newton locally. User feedback is given on the display (point 10) and input is given using the buttons next to it (point 10). The exact functionality of the buttons are context dependent.

The main page, shown after startup, provides feedback on all major functions.

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[1]Some information might only be displayed when connected

Mode indication   Communication interface

Supply voltage   Battery voltages
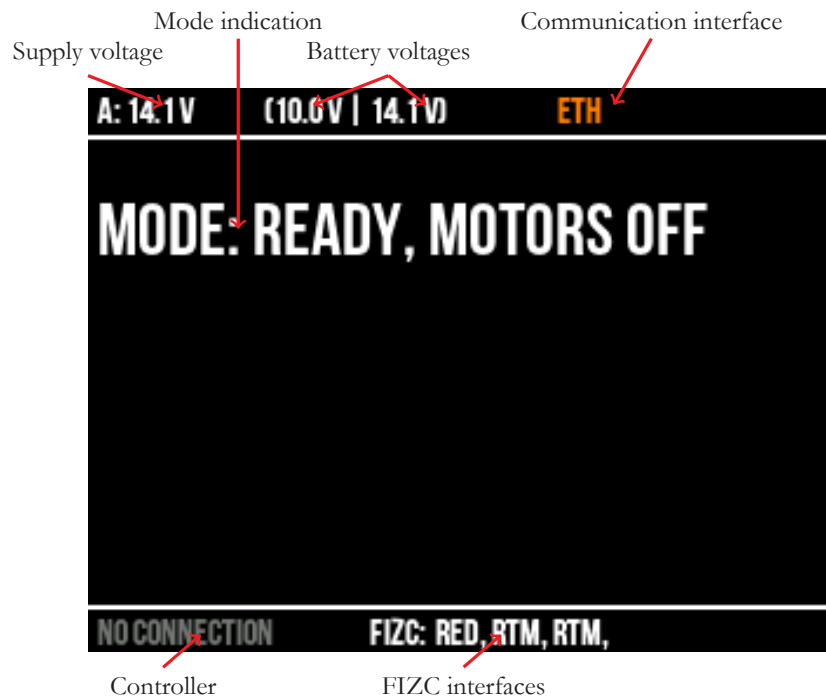

Controller   FIZC interfaces

Figure 4.2: Newton S2 Main Page

The top row shows:

1. Supply voltage (either battery or external)

2. Battery voltage for battery 1 and 2

3. Currently active communication link

Under this is a mode indicator. On startup this will show which calibration step is currently executing, and after that what mode has been activated from the remote control. Together with the mode indication is also an indication of any errors detected. If any error is shown, look at the troubleshooting guide in chapter 7.

The bottom row of the screen shows currently connected controller (the Dominion) and which camera/lens (FIZC) interface dongles are currently connected and identified.

4.2   OPERATING THE HEAD

The Dominion controller is used for all normal operation controls of Newton S.

The main control for the remote head is provided by the joystick. The coupling between the three axes of the joystick and the axes of the remote head depends on which control mode is selected, using the mode switch (point 17).

0 - Motors off   All motors are off and the head is inactive

1 - Active - Roll Position   The head is active. Joystick left-right controls pan, up-down controls tilt and rotating the joystick controls the roll of the remote head. A given rotation directly match a given roll angle

2 - Active - Roll Fixed   The head is active. Joystick left-right controls pan and up-down controls tilt. Roll of the remote head is locked to its current position

3 - Active - Roll Velocity The head is active. Joystick left-right controls pan, up-down controls tilt and rotating the joystick controls the roll of the remote head. A given rotation controls roll speed

4 - Active - Camera Frame Same as **Active - Roll Velocity** with the exception that all controls are relative to the camera/image, not the remote head

5 - Invalid

6 - Motors locked The head is locked. Depending on the setting `MOTOR LOCK MODE` this will either be *Home* which means straight forward or *Current* which is the current position when the mode is entered

In the settings menu, tab **CONTROL**, dead-band and exponential mapping can be set for each joystick axis. In addition to the joystick there is a number of other controls that affects the movement of the remote head. These are as follows:

Speed dials (point 19-21) sets the max speed (at full joystick deflection) for each of the tilt, pan and roll axes

Ease in/out (point 23) controls how much filtering is applied when changing velocity. A higher value will result in a smoother operation, but also requires more planning ahead for example when stopping a pan

Motors locked button Holding this button will cause the remote head to enter the Motors Locked state until the button is released. This is done in order to minimize random walk. When this button is held down, it is not possible to control the remote head using the joystick. This feature can be assigned to a button through the Remap Inputs setting described in the advanced section 5.5.1

4.3   LENS CONTROL

Given a compatible lens or camera, and the correct interface dongle, the Dominion can control the following settings:

RECORD Start/stop camera record. Controlled by the big record button (point 18)

FOCUS Adjust lens focus. Controlled by the large focus wheel (point 6)

IRIS Adjust lens iris/aperture. Controlled by the smaller iris wheel (point 7)

ZOOM Adjust lens zoom. Controlled by rocker (point 8). The zoom rocker have adjustable dead-band and exponential function that can be adjusted in the settings menu, tab **LENS**.

Note that not all lens/camera interfaces supports all controls. To get exact information which lenses/cameras supported by an interface dongle and which controls it supports, see the documentation for that specific dongle.

4.4   ADVANCED

4.4.1   ZOOM DESENSITISE

The Dominion contains a function called zoom desensitise that allows more precise control of the remote head when using different zoom levels. Zoom desensitise reduces the effective speed of all control movements based on the current zoom level in a way so that when fully zoomed out (wide angle) the max speed will be the speed set by the speed dials and when zoomed in (tele). The speed is

reduced by a factor, settable by the operator. To enable zoom desensitise and set the reduction factor use the settings `ZOOM DESENS` and `ZOOM DESENS MAX` on the **CONTROL** settings tab.

The max zoom desensitation value can also be mapped onto one of the rotary dials on the Dominion using the input remapping settings as described in section 5.5.1.

4.4.2 PAN FOLLOW

Pan follow is an advanced feature whereby the camera will follow the rotations of the pan box, with settable strength. This feature is for example useful when using the Newton S on a car or other vehicle where you want the camera to in general follow the movements of the vehicle itself as it turns.

To activate the pan follow mode, set the setting `PAN FOLLOW` on the **RMT SETTINGS** to EN-ABLED and use the `PAN FOLLOW STRENGTH` to control how tightly the camera follows the movement of the Newton S.

It is not advisable to activate the pan follow mode unless it is explicitly needed.

4.4.3 MOTION RECORD

> ⚠️ **WARNING**
> Motion Record is at this time an experimental feature, more of a proof-of-concept than a fully completed featured. As such the intention is to allow for users to try it out and provide feedback, but Intuitive Aerial does not provide any gurantees about functionality or future development of the feature.

Motion record is a feature whereby the movements of the Newton S can be recorded, stored and then played back. In this alpha version there are a number of built-in limitations of the feature

- Only the movements of the camera are recorded. No recording is done of the lens control.

- When playing back the recording, no user control of the movement can be done, so the user cannot modify the recording on-the-fly.

- The recording is limited to 10 tracks of recording. On Newton S the length of each track is limited to approximatly 5 minutes.

That said, motion record alpha can be useful for repeating the same move over and over.

To activate the motion record feature, go to the setting tab **ADVANCED** and set `MOTION RECORD` to ENABLED. This will modify the GUI main page to display information about current track as well as buttons to activate motion record/playback. Once enabled, recording a track is a three step process

1. Using *MREC DECR TRACK* and *MREC INCR TRACK* to select the track to use

2. Press *MREC ARM REC* to arm recording. Arming recording clears the track and prepares for immediate recording. Arming can take up to a few seconds to completed

3. Press *MREC START REC* to start the recording. All movements will be recorded and saved inside the Newton S

Playing back an already recorded track follows a similar procedure, but use *MREC ARM PLAY* and *MREC START PLAY*. One important feature to remember is that the pan angle recorded is relative to the start position while tilt/roll is absolute angle. This means that before playing back a recording you must aim the Newton S in the correct pan orientation. This however also allows you to correct for any smaller differences/drifts in pan between recording and playback time.

5 Settings

5.1 CONTROLS

The **CONTROL** settings tab contains settings related to remote head control/steering. For every axis there is a setting for the max speed, ease in/out, inverting the axis, dead-band and exponential.

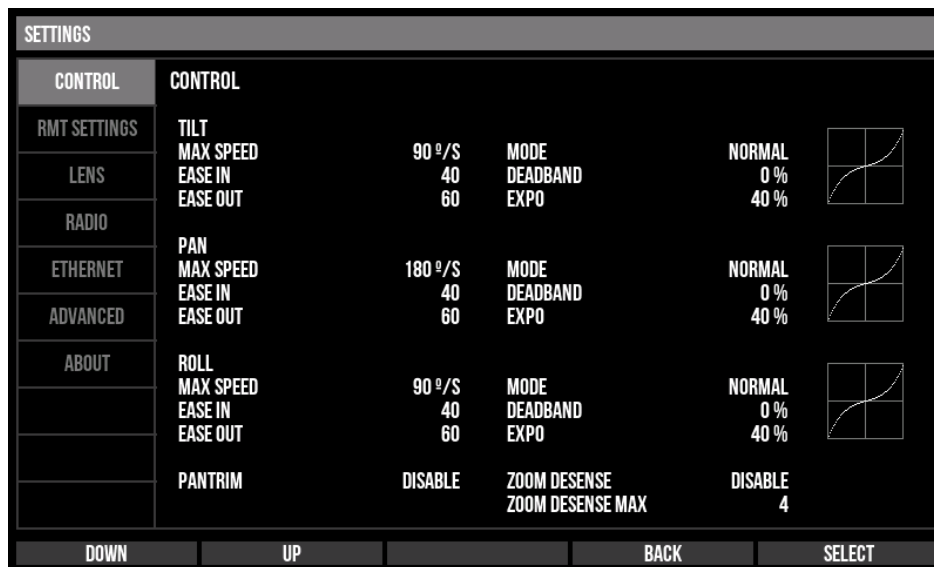The **CONTROL** tab also allows enabling or disabling the manual pan axis trim.

Figure 5.1: Dominion Settings - Control tab

Table 5.1: Dominion Settings - Control tab

Setting	Range	Description
MAX SPEED	$45°/s – 360°/s$	Maximum speed for axis
EASE IN/OUT	$20 – 500$	Maximum ease in/out for axis
MODE	NORMAL INVERTED	Axis invert
DEADBAND	$0\% – 100\%$	Axis dead-band in percent
EXPO	$-100\% – 100\%$	Axis exponential in percent
PANTRIM	ENABLE DISABLE	Activate manual compensation of drift in pan axis. Amount of trim can be adjusted
ZOOM DESENSE	ENABLE DISABLE	Activate zoom-based desensitation
ZOOM DESENSE MAX	1 - 100	Set the max zoom-based desensitiation

5.2 HEAD CONFIGURATION

The **RMT SETTINGS** tab allows for tuning of parameters on the remote head.

The top part sets the control system tuning. For each axis, tilt, roll and pan, there are four parameters to set. These values can be modified individually just as any other setting, or as a group of three (P, I and D together) for a given axis. When modifying a group the values are changed by using the three encoders on the right side, point 22-24. In group change mode the up/down buttons switch between the axes.

```
!  NOTICE   !
After updating any settings on RMT SETTINGS you need to explicitly
save them to the head by selecting SAVE REMOTE. Otherwise the settings
will be lost once the Newton S is power cycled.
```


Figure 5.2: Dominion Settings - Remote settings tab

Table 5.2: Dominion Settings - Remote Settings

Setting	Range	Description
<Axis> P	0.25 – 25	See section 3.7
<Axis> I	0 – 5	
<Axis> D	0 – 20	
<Axis> POS GAIN	2 – 10	Normally no need to change, keep at default of 6
MOTOR LOCK MODE	HOME POS CURRENT POS	Controls the motors locked mode
CONTROL FILTER	0.5 – 10	Controls smoothing of the control input.
TILT MIN ANGLE	$-145° – 0°$	Adjust the min/max angle limit of the axis
TILT MAX ANGLE	$0° – 145°$	
ROLL MIN ANGLE	$-60° – 0°$	
ROLL MAX ANGLE	$0° – 60°$	
PAN FOLLOW	ENABLED DISABLED	
PAN FOLLOW STRENGTH	0 – 90	Controls how tightly the camera is following the base of the Newton
AUTO PAN DRIFT COMP	OFF ADAPTIVE	

```
!  NOTICE  !
If the connection between the Dominion and the remote head is severely
degraded, some settings might not be displayed within a reasonable time. In
such cases it will be shown with "–" instead of the real value. Selecting the
setting will try to read the setting again and might resolve the issue.
```

5.2.1 MOTOR LOCK MODE

The `MOTORS LOCKED` mode can be configured to work in one of two ways. When `MOTOR LOCK MODE` setting is set to HOME POS the head will return to home position, that is pointing straight forward at a level setting for tilt/roll. When set to CURRENT POS the head will lock the motors at the current position, as long as that is a valid control position, or do a minimal rotation to reach a valid position and then lock there.

5.2.2 MAX/MIN ANGLES

These settings allow updating of the software limits for control. The angles given for min/max angle is IMU/world angles, not angles of the joints of the head.

5.2.3 PAN FOLLOW MODE

When follow mode is active the camera follows the base of the Newton. This can be useful for instance when Newton is mounted on a car, ' the camera will follow the rotation of the car. Follow mode can also be used to remove pan bias drift when the base of the Newton is not rotating, for instance when mounted on a straight rail system. The `PAN FOLLOW STRENGTH` option controls how tightly the camera follows the base.

5.2.4 AUTOMATIC PAN DRIFT COMPENSATION

Automatically correct for pan bias drift when the base of the Newton is stationary. In most cases it is recommended to use the system with this setting set to ADAPTIVE.

5.3 LENS CONTROL

The **LENS** tab contains settings for focus-iris-zoom (FIZ) control and feedback. Note that the units and limits only affects the user feedback in the display, the control is still the entire range provided by the FIZ system.
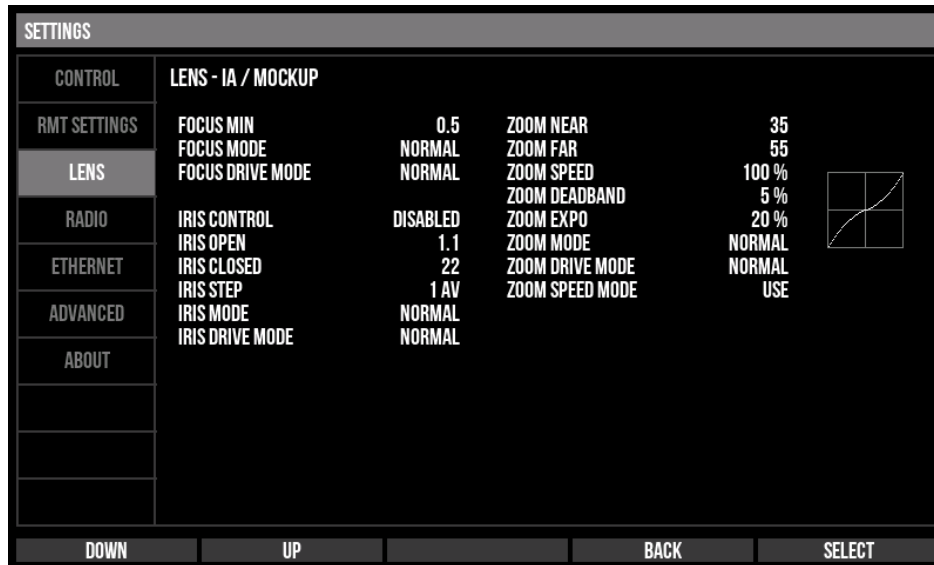

Figure 5.3: Dominion Settings - Lens tab

Table 5.3: Dominion Settings - Lens tab

Setting	Range	Description
FOCUS MIN		Minimum focus value shown in GUI
FOCUS MODE	NORMAL INVERT	Invert mode of focus wheel
FOCUS DRIVE MODE	NORMAL INVERT	Invert mode of focus motor
IRIS CONTROL	ENABLED DISABLED	Enable or disable IRIS control
IRIS OPEN	1.0 – IRIS CLOSED	Open IRIS value shown in GUI
IRIS CLOSED	IRIS OPEN – 64	Closed IRIS value shown in GUI
IRIS STEP	0.5	Step size of values shown in GUI
IRIS MODE	NORMAL INVERT	Invert mode of iris wheel
IRIS DRIVE MODE	NORMAL INVERT	Invert mode of iris motor
ZOOM NEAR	10 – ZOOM FAR	Zoom near value shown in GUI
ZOOM FAR	ZOOM NEAR – 1000	Zoom far value shown in GUI
ZOOM SPEED	10 – 200%	Zoom speed
ZOOM MODE	NORMAL INVERT	Invert mode of zoom
ZOOM DEADBAND	0 – 100%	Zoom control dead-band
ZOOM EXPO	0 – 100%	Zoom control exponential
ZOOM MODE	NORMAL INVERT	Invert mode of zoom wheel
ZOOM DRIVE MODE	NORMAL INVERT	Invert mode of zoom motor
ZOOM SPEED MODE	USE DISABLE	Use speed-based zoom control if available

5.4 COMMUNICATIONS

5.4.1 RADIO

Configuration of the radio modems is done in the **RADIO** settings tab. To use a radio modem the modem must be enabled. To save the configuration, select `SAVE CONFIG`.

When the Dominion is used together with a Newton S for the first time the radios must be paired. The pairing procedure works the following way:

1. Turn off the remote head

2. Move the selector to the `DO PAIRING` option using the *DOWN* and *UP* buttons and press `SELECT`. The message "RADIO PAIRING IN PROGRESS" will be displayed

3. Turn on the remote head

4. The pairing procedure can take up to 60 seconds. When the pairing is completed the message "RADIO PAIRING SUCCESSFUL" will be displayed. To abort the procedure, press *CANCEL*
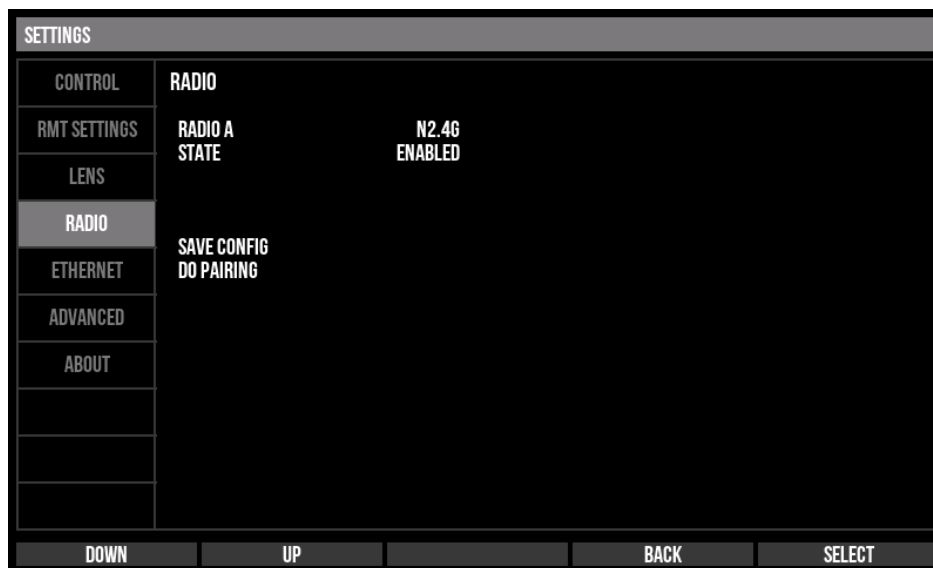
Figure 5.4: Dominion Settings - Radio tab

5.4.2 ETHERNET

Under the **ETHERNET** settings tab the Ethernet connection is configured, such as the IP address and net-mask of the Dominion as well as the IP address of the remote head. The Dominion and the remote head must be on the same IP subnet. Note that the Dominion and Newton S are configured to be compatible with each other as default.

If the setting AUTOCONNECT is set to ENABLE the Dominion will try to connect as soon as a valid physical link is established. It will also automatically reconnect should the connection break for any reason. When AUTOCONNECT is set to DISABLED, the Ethernet connection must be manually initiated by selecting CONNECT.

> ⚠️ **WARNING**
> If AUTOCONNECT is set to ENABLE in a use-case where radio is the prefered transport and an ethernet connection is not expected to be available, it can lead to stutter in control and loss of connection.
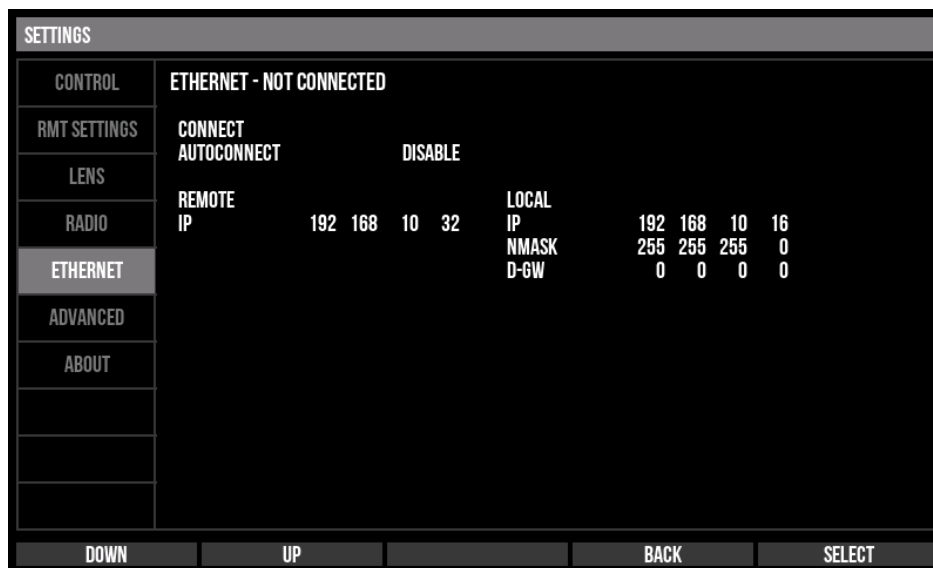> If using radio, set AUTOCONNECT to DISABLED.

Figure 5.5: Dominion Settings - Ethernet tab

5.5   ADVANCED

The advanced tab contains advanced settings for the Domionion.

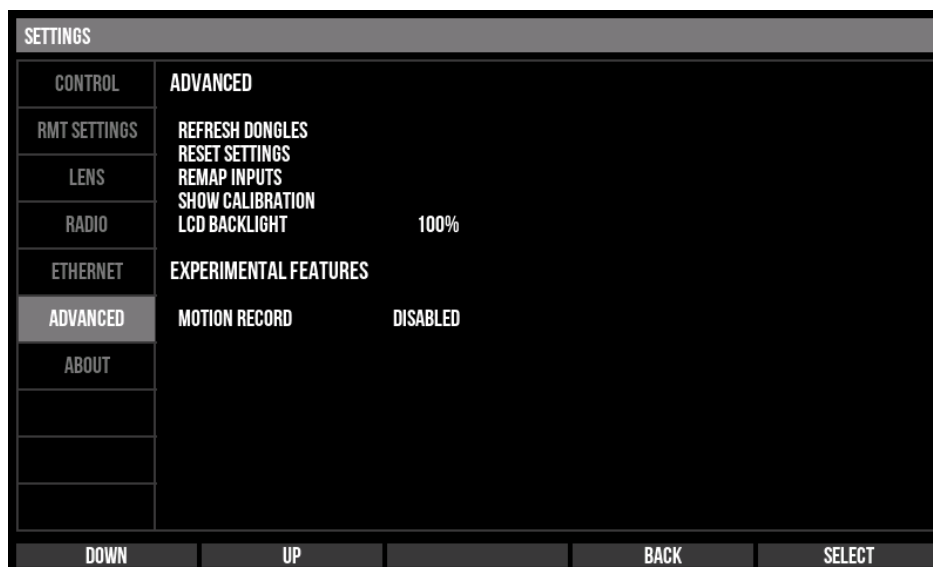Figure 5.6: Dominion Settings - Advanced tab

Table 5.4: Dominion Settings - Advanced tab

Setting	Range	Description
REFRESH DONGLES	-	Refresh status of accessory dongles connected to Dominion.
RESET SETTINGS	-	Reset all settings of the Dominion to factory defaults.
REMAP INPUTS	-	Enter the input remapping menu.
SHOW CALIBRATION	-	Show the current control input and calibration
LCD BACKLIGHT	10 - 100	Brightness of LCD backlight in percent.
MOTION RECORD	ENABLED DISABLED	Enable the experimental motion record feature. See section 4.4.3.

5.5.1 CONTROL REMAPPING

Most inputs of the Dominion can remapped to different functionality. To reach the remapping page, navigate to the **ADVANCED** settings tab, and then select REMAP INPUTS.

Use *PREV* and *NEXT* to navigate between each input or move any physical input slightly and its automatically selected, indicated by a red marker on the Dominion layout sketch. A list appears to the right where all available functionality that can be mapped to the selected input is shown. Press *CHANGE* and navigate through the menu with *DOWN* and *UP*. To finalize the remapping press *SELECT* or abort by pressing *BACK*.
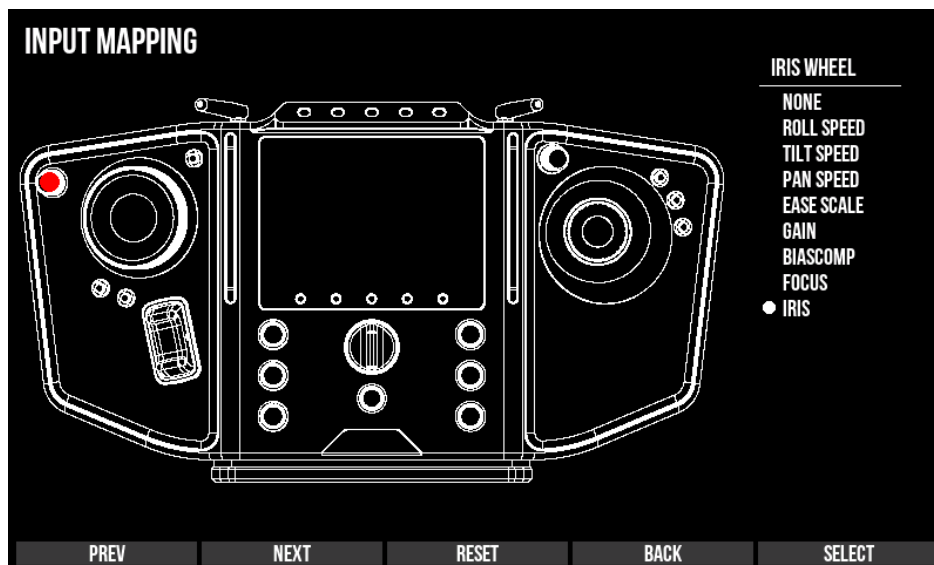

Figure 5.7: Dominion Settings - Remap input

5.5.2 ABOUT TAB

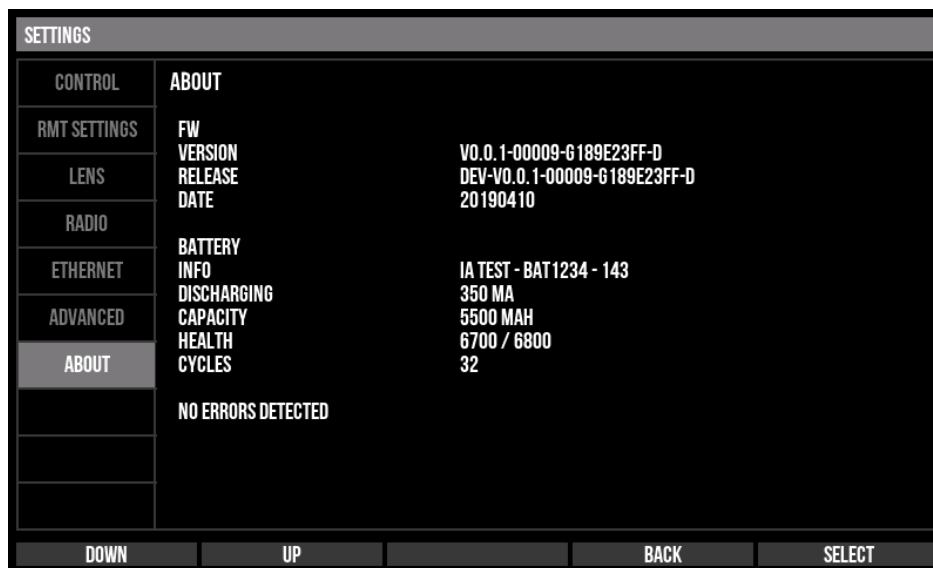The About tab contains firmware version and battery information.

Figure 5.8: Dominion Settings - About tab

5.6 NEWTON S LOCAL SETTINGS

The settings menu contains settings that can be set locally on the Newton head. To access the settings menu, press the *SELECT* button (center button) at the main screen.

The settings menu is divided into a number of tabs grouping settings together in logical groups. To navigate the menu use *UP/DOWN* button to move between fields and *LEFT/RIGHT* to change its value. *SELECT* activates functions.

To exit the settings menu and return to the main menu, move the selection to the tab bar and press *SELECT*.

5.6.1 RADIO

Configuration of the radio modems is done in the **RADIO** settings menu. To use a radio modem the modem must be enabled and active modem must be set to the modem that is going to be used. To save the configuration, select `SAVE CONFIG`.
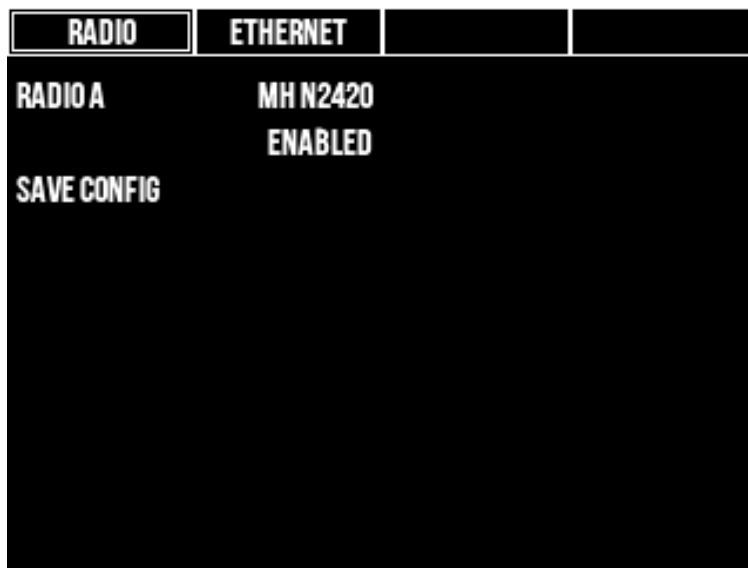
Figure 5.9: Settings - Radio tab

5.6.2   ETHERNET

Under the **ETHERNET** settings page the Ethernet connection is configured, such as the IP address and netmask of the Newton. The Newton and the Dominion must be on the same IP subnet. Note that the Dominion and Newton are configured to be compatible with each other as default.
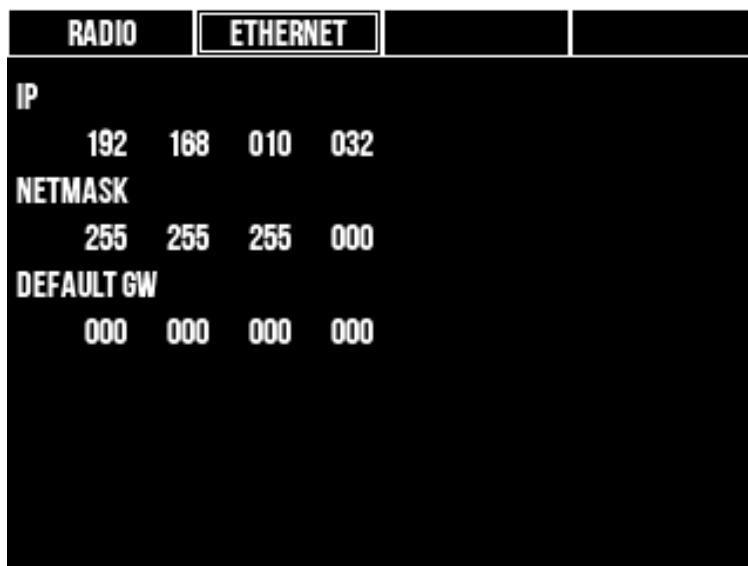

Figure 5.10: Settings - Ethernet tab

6 Maintenance

The Newton S, the Dominion and its accessories are highly technical and very precise equipment with high requirements on exactness and internal tolerances. In addition it contains weather sealing. For this reason it is not recommended to ever disassemble or try to perform maintenance on any internal parts.

6.1 CLEANING AND CARING

Clean the Newton S and Dominion externally using a soft, and if needed slightly damp, cloth. If it is very dirty, use a mild detergent such as washing up soap.

⚠️
WARNING
Do not use any cleaning agents containing alcohols, acids or other corrosive chemicals. Using such cleaning agents might damage the surface treatment and/or the display surface.

6.2 FIRMWARE UPDATE

Firmware updates are distributed by Intuitive Aerial through its homepage together with the required updater application for Windows and OSX.

Before updating please read the attached release notes for any specific information pertaining to that release. When upgrading the Newton S, make sure to also update the Dominion and FIZC dongles to a matching version.

To upgrade the Intuitive Aerial device, follow the procedure below:

1. Connect the USB/CAN dongle to the CAN port on the device

2. Start the upgrade application, named "firmware_gui.exe" on Windows or "firmware_gui.app" on OSX.

3. Follow the instructions in the wizard. When asked for firmware file, select the correct firmware file for the device in question

4. When finished, restart the device

6.3 CALIBRATION

When delivered the Newton S and the Dominion are factory calibrated and when performing service for other reasons the calibration will be verified to make sure it is still within tolerances. Outside of this there is no reason for recalibration.

Users are warned to never perform any calibration procedures without directly instructed to do so by Intuitive Aerial support staff.

7 Troubleshooting

7.1 ERROR CODES

Both Newton S and Dominion contains internal systems for internal diagnostics and fault reporting. Upon discovery of an internal error it will display an error code (Newton S displays it on the main screen, Dominion in the **ABOUT** settings tab). If you encounter a problem and get an error code, contact the Intuitive Aerial support line for help with decoding the code and information about how to resolve it.

7.2 BASIC TROUBLESHOOTING

Problem	Possible Cause(s)	Solution(s)
Newton does not start up	Batteries are empty	Exchange to fully charged batteries
	No external power connected	Connect external power supply to Newton
Dominion does not start up	Battery is empty	Connect power adapter to charge
	Improper firmware loaded	Reload latest supplied firmware according to instructions
Dominion does not establish radio connection with remote head	Antennas are not extended	Extend antennas
	Antennas are damaged	Contact IA support for replacement
	Dominion and remote head are not paired	Perform pairing procedure, see section 5.4.1
There is a constant drift in pan, tilt or roll	Input calibration is not properly done	Immediate solution: Use deadband setting to compensate. Contact support for instructions on how to redo calibration
	There is a very small drift present in pan due to gyro bias	Activate the pan drift compensation on **RMT SETTING**
Camera/lens interface dongle is not recognized by Dominion	Dongle has incompatible firmware	Update dongle firmware to same version as Dominion
	Communication link is not established between Newton and Dominion	See entry above

A Technical Specification

A.1   NEWTON S

A.1.1   MECHANICAL

Table A.1: Newton S - Mechanical

Parameter	Min	Typ	Max
Length[1]		35 cm	
Width[1]		30 cm	
Height[1]		35 cm	
Weight[1]		7.0 kg	

[1] Without camera

Table A.2: Newton S - Power supply

Parameter	Min	Typ	Max
Power input			
Input voltage	12 V	24 V	26 V
Input current			16 A
Pan-box power out			
Output voltage[1]	12 V	24 V	26 V
Output current			3.3 A
Cradle power out			
Output voltage	14.5V	15 V	15.5 V
Output current[2]			6.5 A
Output power[2]			105 W

[1] Unregulated input/battery voltage
[2] Depends on input/battery voltage

Table A.3: Newton S2 - Newton Battery

Parameter	Min	Typ	Max
Voltage	12 V	14.4 V	16 V
Current			20 A
Capacity		89 Wh	

Table A.4: Shipping/hard-case

Parameter	Min	Typ	Max
Length		62 cm	
Width		55 cm	
Height		29 cm	
Weight[1]		19 kg	

[1] Including two batteries and charger
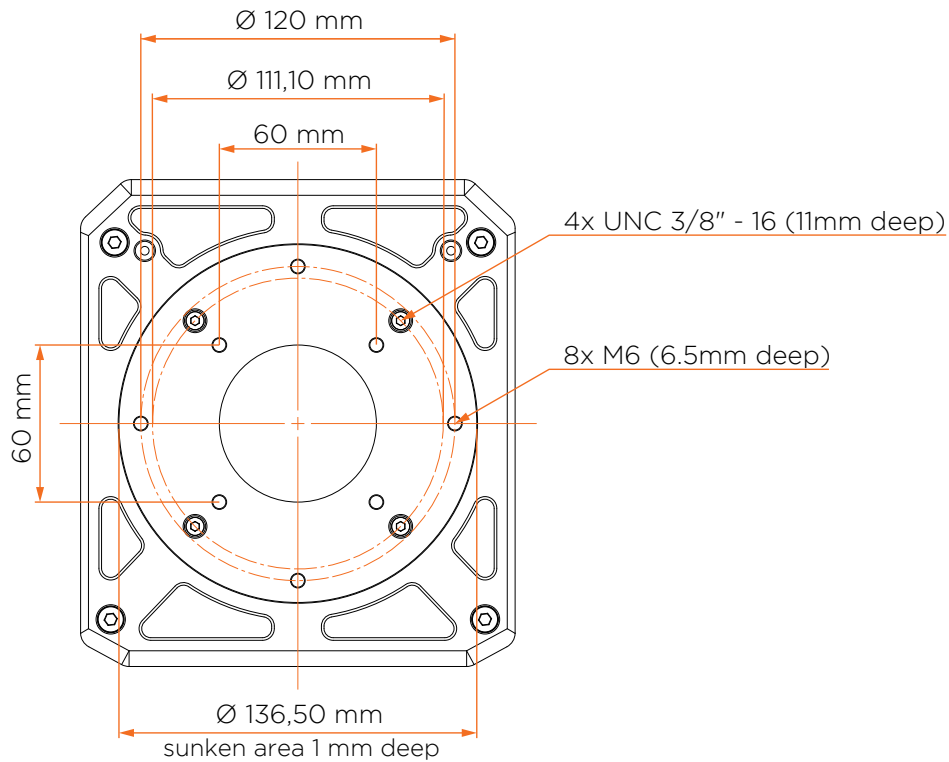
A.1.2 DRAWINGS AND DIMENSIONS

Figure A.1: Mounting hole pattern

A.1.3 CONNECTORS

The 3G-SDI, HD-SDI and the 8P8C/RJ45 passthrough connector provides a one-to-one connection between the pan-box and cradle.

The IA-CAN connector is proprietary to Intuitive Aerial equipment.

Pan-box Power In

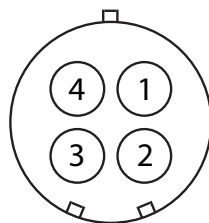**Mating connector:** LEMO EGJ.2B.304
Acceptable voltage: 12V – 36V

Figure A.2: Power in

Table A.5: Power in, pins

Pin number	Description
1,2	Positive (+)
3,4	Negative (-)

Pan-box Power Out

Mating connector: LEMO EGG.1B.304
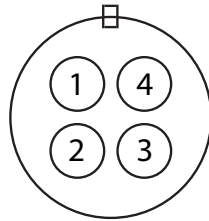**Output voltage:** 15V
Max current: 2A

Table A.6: Power out, pins

Pin number	Description
1,2	Negative (-)
3,4	Positive (+)

Figure A.3: Power out

Cradle Power Out

Mating connector: LEMO EGG.1B.304
Output voltage: Regulated 15V
Max current: up to 10A

Table A.7: Power out, pins
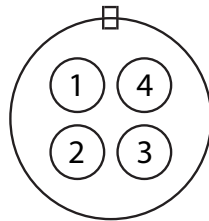
Pin number	Description
1,2	Negative (-)
3,4	Positive (+)

Figure A.4: Power out

A.1.4   NEWTON S2 FIBER CONNECTORS

The Newton S2 Fiber variant has a few differences in terms of connectors. Instead of a 3G-SDI connector it has a single-mode fiber (ST/UPC Single-mode 9/125 μm), and the Ethernet passthrough is limited to 5 pins (1,2,3,5,6)[1].

A.1.5   SHIPPING/HARD-CASE

Table A.8: Newton S2 - Shipping/hard-case

Parameter	Min	Typ	Max
Length		62 cm	
Width		55 cm	
Height		29 cm	
Weight[1]		20 kg	

[1] Including two batteries and charger

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[1]100Mbit Ethernet utilize 1,2,3,6

intuitive aerial™

A.2 DOMINION

A.2.1 MECHANICAL

Table A.9: Dominion - Mechanical

Parameter	Min	Typ	Max
Width		40 cm	
Depth		21 cm	
Height		6 cm[1]	
Weight		3.2 kg	

[1] 14 cm with joystick

A.2.2 POWER SUPPLY

Table A.10: Dominion - Power Supply

Parameter	Min	Typ	Max
Power input			
Input voltage	12 V	18 V	25 V
Input current			6 A
Power out			
Output voltage[1]	12 V	18 V	25 V
Output current			2.5 A
Battery			
Voltage	9.6 V	14.4 V	16.8 V
Capacity		98 Wh	
Charge current			3 A
Charge time		3 h	

[1] Unregulated input/battery voltage

A.2.3 CONNECTORS

The IA-CAN connector is proprietary to Intuitive Aerial equipment.

Power in

Dominion connector: LEMO EGJ.1B.304
Mating connectors: LEMO FGJ.1B.304 / FHJ.1B.304
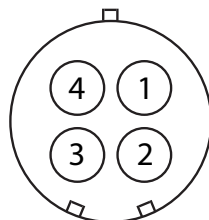**Acceptable voltage:** 12V – 26V

Figure A.5: Power in

Table A.11: Dominion - Power in, pins

Pin number	Description
1,2	Positive (+)
3,4	Negative (-)

Power out

Dominion connector: LEMO EGG.1B.304
Mating connectors: LEMO FGG.1B.304 / FHG.1B.304
Output voltage: Unregulated input / battery voltage
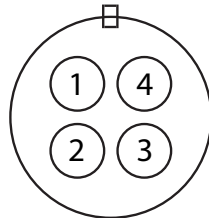**Max current:** 2.5A (combined)

Table A.12: Dominion - Power out, pins

Pin number	Description
1,2	Negative (-)
3,4	Positive (+)

Figure A.6: Power out

A.2.4 SHIPPING/HARD-CASE

Table A.13: Dominion - Shipping/hard-case

Parameter	Min	Typ	Max
Length		45 cm	
Width		30 cm	
Height		30 cm	
Weight[1]		7.6 kg	

[1] Including external power supply

A.3   COMMON

A.3.1   COMMUNICATION INTERFACES

Table A.14: Common - Communication Interfaces

Parameter	Min	Typ	Max
Ethernet			
Connector		RJ45 (8c8p)	
Interface		100 Mbit/s	
Data-rate			200 kbit/s
2.4GHz Radio			
Radio type		FHSS	
Frequency	2401.6 MHz		2477.6 MHz
Transmit Power			20 dBm[1]

[1] dBm e.i.r.p as measured according to ETSI EN 300 328 V2.1.1

B Revisions

Rev	Date	Changes
1	2019-04-10	Version 1.2.0. First version with a combined Newton and Dominion manual
2	2019-07-03	Version 1.2.1. Added specification for communication interfaces
3	2019-08-13	Version 1.2.2.