

NEWTON S2

SYSTEM OPERATION MANUAL

1.5.0

NEWTON NORDIC AB
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NEWTON°

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1 Introduction

This manual describes the handling and operation of the Newton S2 remote controlled, stabilized, head together with the Newton C1 or C2 controller.

1.1 OVERVIEW

Newton S2 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 S2, the Newton Controller C1 or C2 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.

This manual covers both the Newton S2 3G and Newton S2 Fiber products.

1.2 WARNINGS AND NOTICES



WARNING

Before connecting or turning on the Newton S2 remote head or Newton Controller, read this manual and any warnings provided carefully.



WARNING

Do not power or charge the Newton S2 remote head or Newton Controller with anything but external power supplies delivered by and/or approved by Newton Nordic for use with the respective product. Doing so can permanently damage or destroy the product.
Newton S2 accepts external power between 12 and 36 Volt. Powering it with a supply outside this range will permanently damage it.



WARNING

When using attached batteries to power the Newton S2, 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 S2.

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WARNING

The Newton S2 and the Newton 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 S2 and the Newton C1 or C2, always extend antennas vertically and make sure there is a free line of sight between the units to get the best possible range and most stable connection.

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2 Physical Layout

2.1 NEWTON S2

2.1.1 NEWTON S2 3G

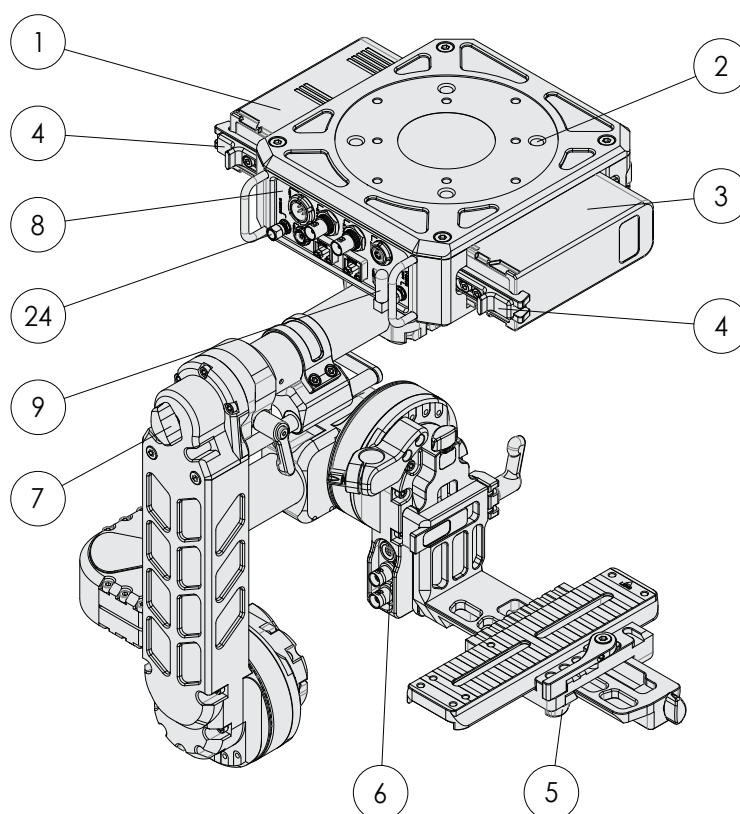


Figure 2.1: Newton S2 Overview 1

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
9	Primary antenna connector
24	Secondary antenna connector (currently unused)

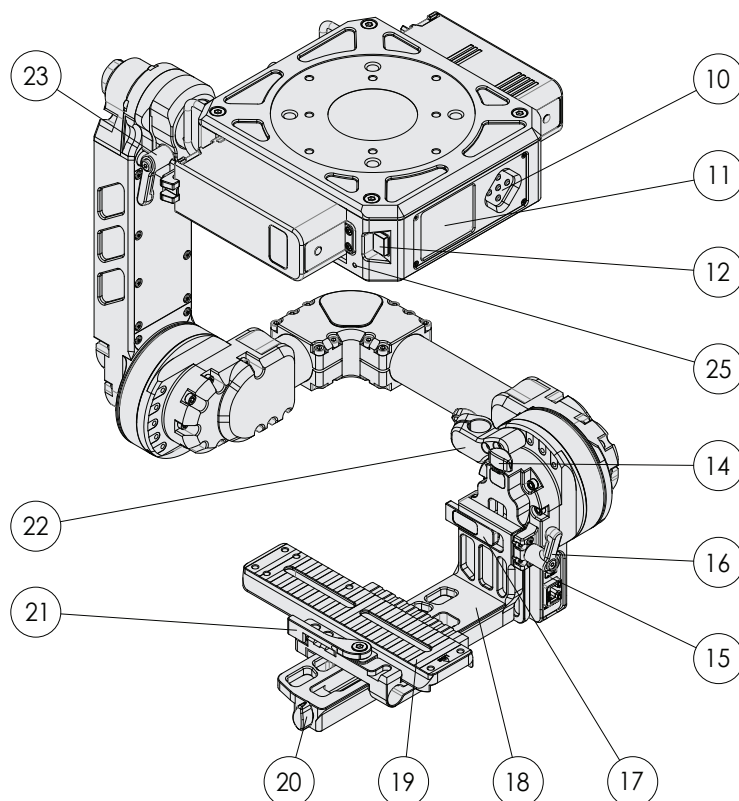


Figure 2.2: Newton S2 Overview 2

Table 2.2: Overview Descriptions

Item	Description
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
25	Status diode

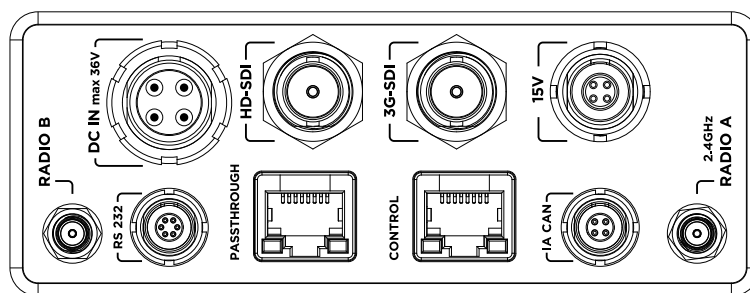


Figure 2.3: Newton S2 Pan-box Connectors

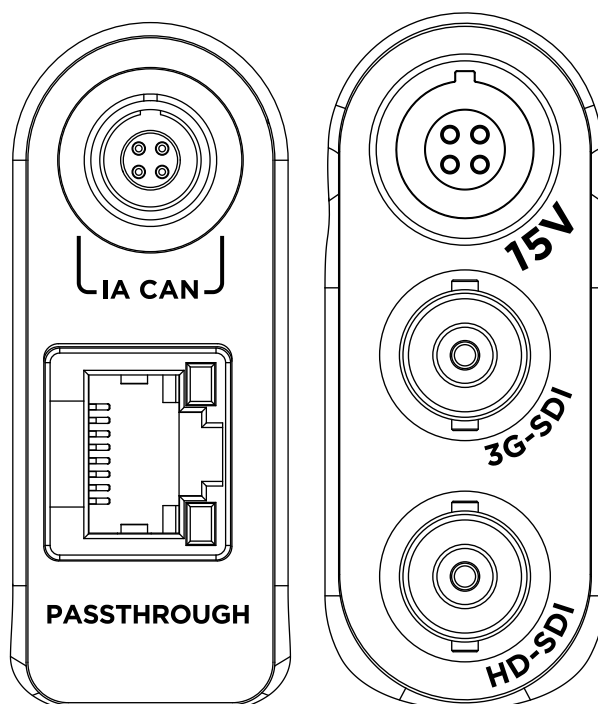


Figure 2.4: Newton S2 Cradle Connectors

2.1.2 NEWTON S2 FIBER

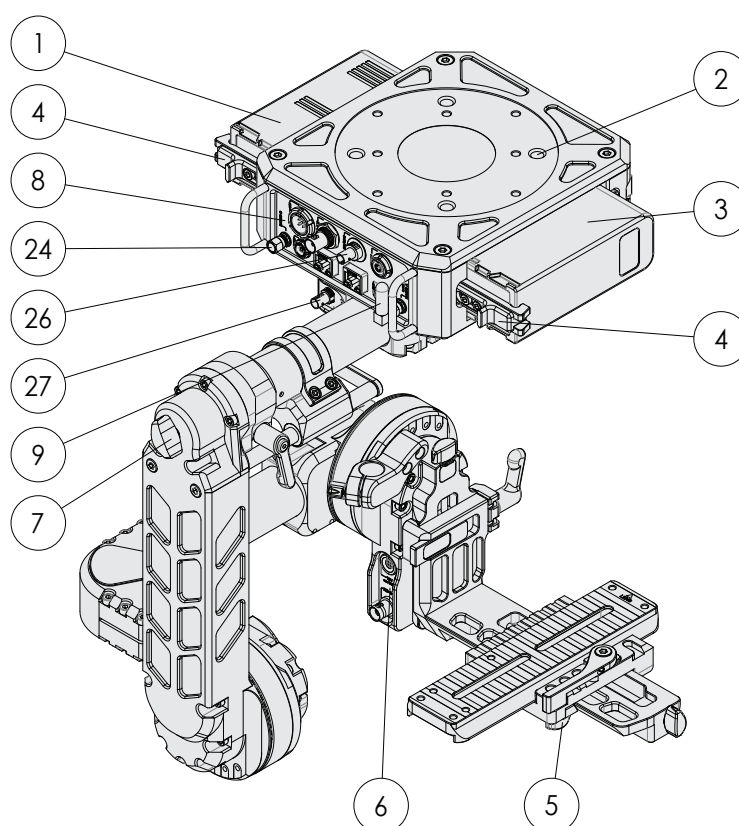


Figure 2.5: Newton S2 Fiber Overview 1

Table 2.3: 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
9	Primary antenna connector
24	Secondary antenna connector (currently unused)
26	Pan-box fiber connector
27	Camera fiber connector

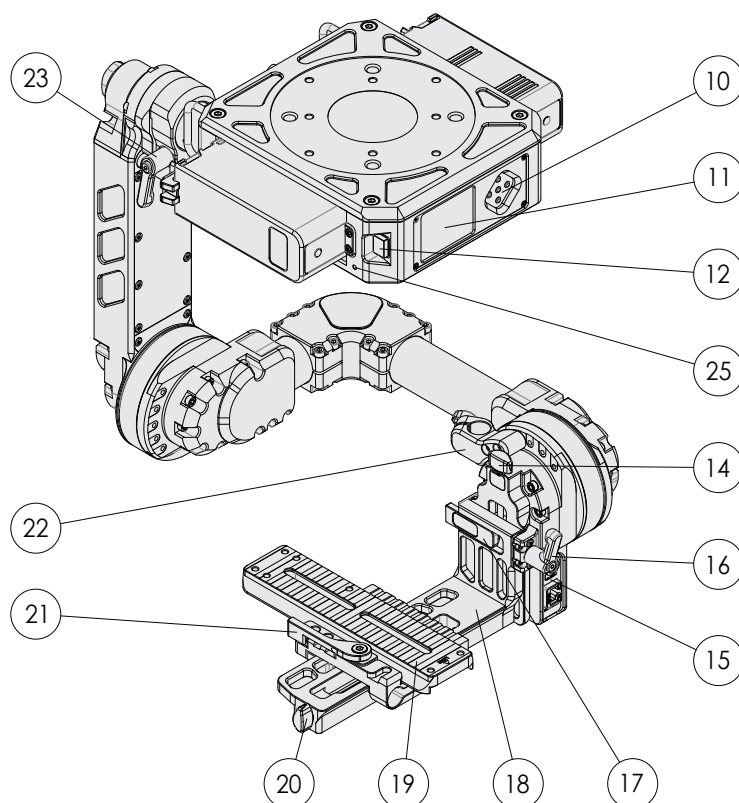


Figure 2.6: Newton S2 Fiber Overview 2

Table 2.4: Overview Descriptions

Item	Description
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
25	Status diode

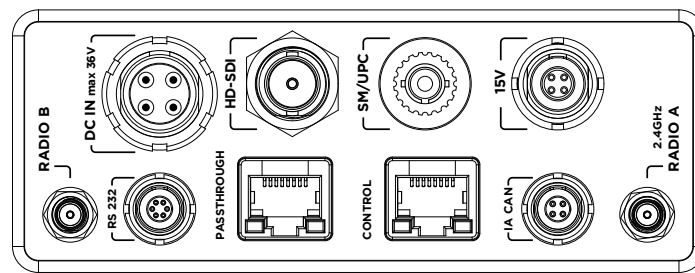


Figure 2.7: Newton S2 Fiber Pan-box Connectors

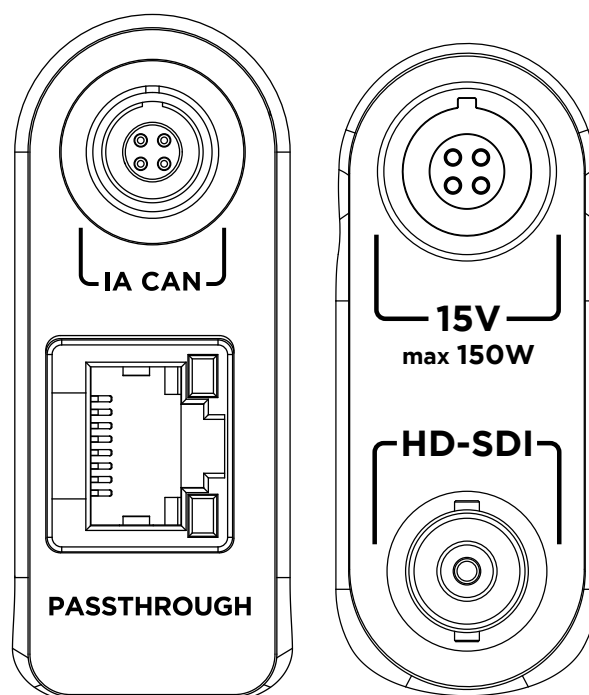


Figure 2.8: Newton S2 Fiber Cradle Connectors

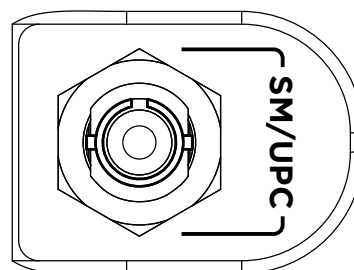


Figure 2.9: Newton S2 Fiber Camera Fiber Connector

2.2 NEWTON C1 AND C2

There are currently two versions of the controller for the Newton system, designated Newton C1, the first generation controller, and C2, the second generation controller. Furthermore the C2 controller exists in two configurations, either as the C1 with a zoom rocker and a big focus wheel on the left hand side or with two joysticks.

2.2.1 NEWTON C1 AND C2 ZOOM ROCKER CONFIGURATION

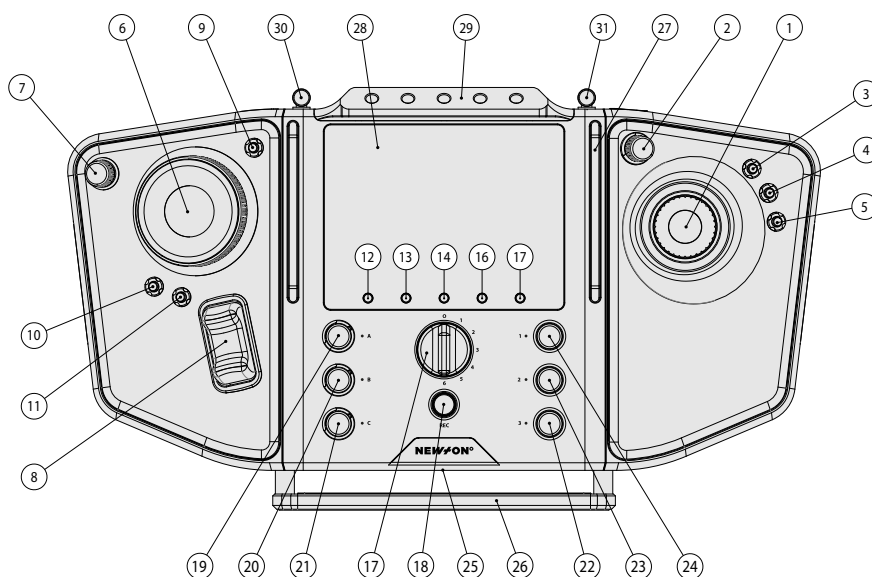


Figure 2.10: Newton C1/C2 with zoom rocker top view

Table 2.5: 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	Lens preset 3
10	Lens preset 1
11	Lens preset 2
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

2.2.2 NEWTON C2 DUAL JOYSTICK CONFIGURATION

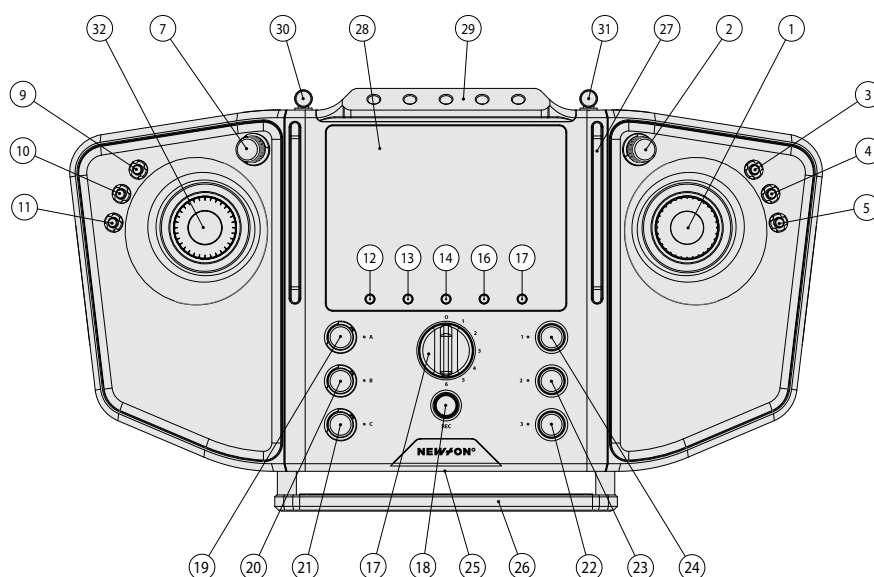


Figure 2.11: Newton C2 with dual joystick top view

Table 2.6: Top View Descriptions

Item	Description
1	Joystick
2	Mappable wheel (default unmapped)
3-5	Invert axis
7	Mappable wheel (default unmapped)
9	Lens preset 1
10	Lens preset 2
11	Lens preset 3
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
32	Secondary joystick

3 Setup

3.1 UNBOXING AND ATTACHING

The Newton S2 and the Newton C1/C2 controller are delivered packed into hard-cases with shape fitting foam. In the Newton S2 hard-case, the top layer has space for cables and accessories while the Newton S2 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 S2 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 Newton C1/C2 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 set up 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:

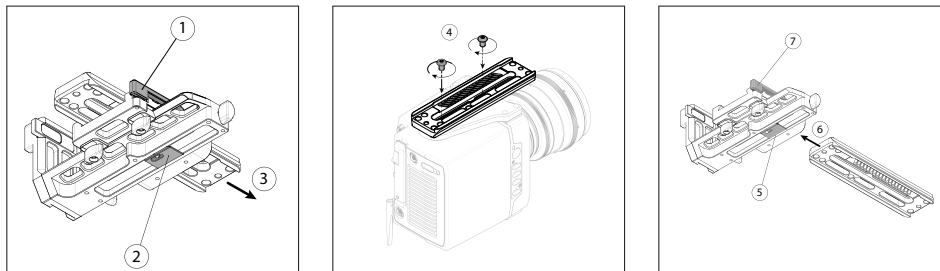


Figure 3.1: Attaching camera

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 S2 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.

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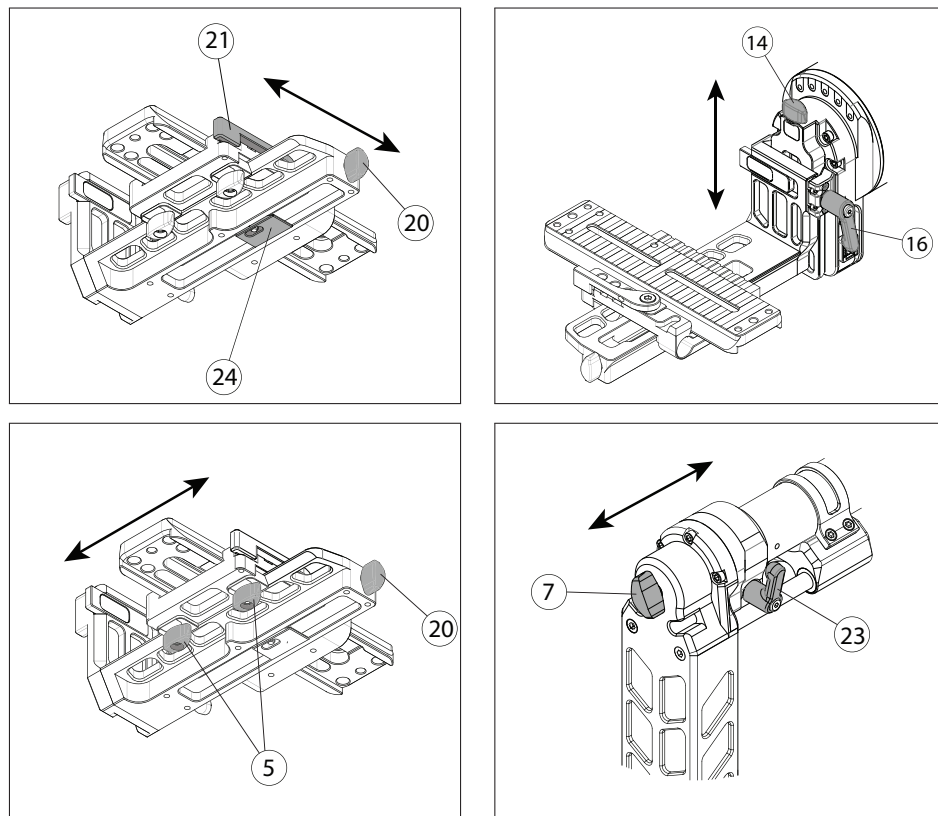


Figure 3.2: Balancing

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 S2

Newton is powered through connections on the pan box, either using the internal battery bays or through the DC input connector. When using external DC power the Newton must be supplied with between 12 and 36 volt, recommended 24-36 volt for maximum performance.

To protect both the internal circuitry, connectors and also the power supply while maximizing performance Newton S2 implements a dynamic power limiting scheme. Depending on how the unit is powered the maximum power available for camera and motors will be adjusted.

Table 3.1: Power limit modes

Input Power	Power Mode	Camera Power	Motor Power
DC, >22 V	Full power	150 W	Enhanced
DC, <22 V	Standard	60 W	Standard
Battery	Battery	60 W	Standard

! NOTICE !

When using Newton S2 in full power mode it can consume in excess of 400 W. Make sure the power supply you use can meet this requirement.

The Newton S2 is turned on by switching the power switch (point 12) to 1.

3.5.2 POWERING NEWTON CONTROLLER

The Newton Controller 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 Newton Controller 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 Newton Controller turning off or disconnecting

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from the remote head. First time it is recommended to let the Newton Controller charge for at least six hours before use.

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

3.6 COMMUNICATIONS

The Newton S2 and the Newton Controller has three different possible communication channels, either the built in 2.4GHz radio modem or an Ethernet link or RS232 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 S2 mounted in a location that gives free line-of-sight between the antenna and the Newton Controller. Make sure the radio modem is enabled on both Newton S2 and Newton Controller and that the units are paired as seen in section 5.5.1.

To utilize the ethernet link for communication, establish ethernet connectivity between the Newton S2 and the Newton Controller either via a direct cable¹, or using any suitable ethernet infrastructure such as switches, fiber-converters and fiber cable, or ethernet-over-radio² or WLAN links. Once the physical connectivity is established use the settings in section 5.5.2 to establish a connection between the units.

The ethernet traffic between Newton S2 and Newton Controller 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 S2 in a live production.

To use the RS232 link, connect an RS232 cable³ between the Newton S2 and the Newton Controller and then enable RS232 in the settings on both units. The RS232 link can also be used together with RS32 radio modems or other types of links with full duplex RS32 support.

The three communication channels has a priority order of:

- Ethernet
- RS232
- Radio

This means that if you wish to utilize RS232 you must ensure there is no active Ethernet connection between the units, and if RS232 is enabled then the built in radio will not be used.

3.7 TUNING

When setting up the Newton S2, 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 Newton 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

¹ If having more than 25 meters between the unit, Newton Nordic recommends either a repeater or a fiber link to ensure signal integrity

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

³ For RS232 a maximum of 10 meter cable is recommended

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 S2 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 Newton Nordic 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 Newton Controller can be remapped by the user, if this has been done the exact references in this manual will not be correct.

4.1.1 NEWTON CONTROLLER

The graphical user interface is the main way to interact with and get feedback from the Newton Controller. 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 Newton Controller itself and the communication link.

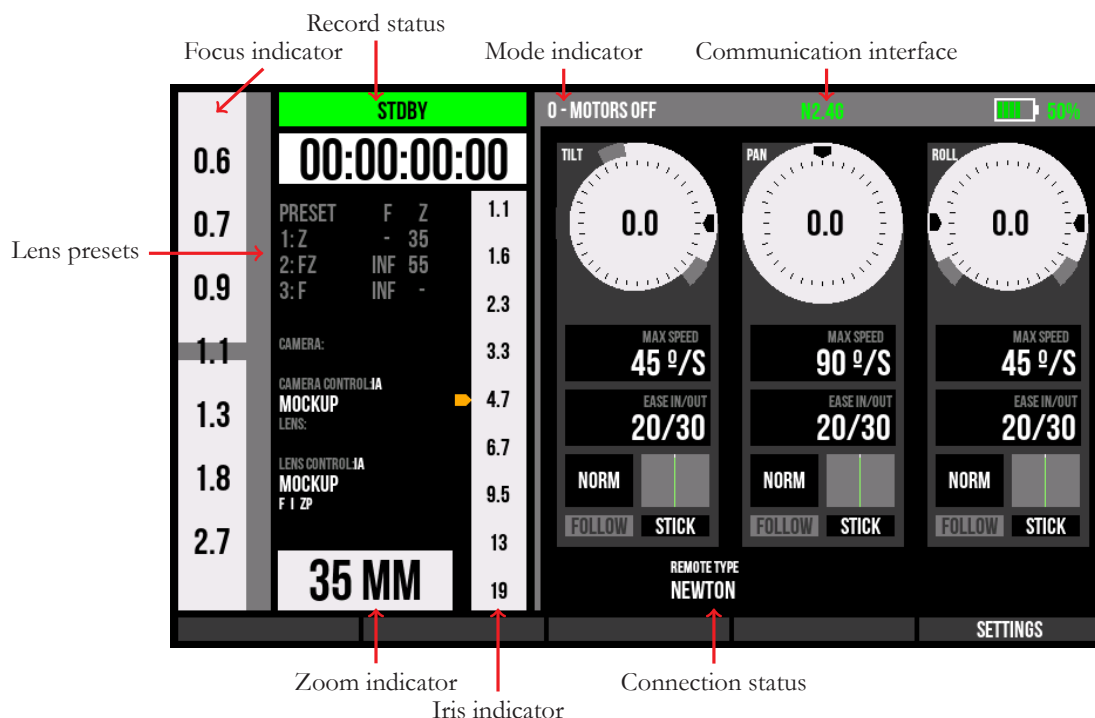


Figure 4.1: Newton Controller Main Page

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 information¹, from top-to-bottom, left-to-right:

1. Current control mode
2. Currently active communication link
3. Newton Controller 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.

¹Some information might only be displayed when connected

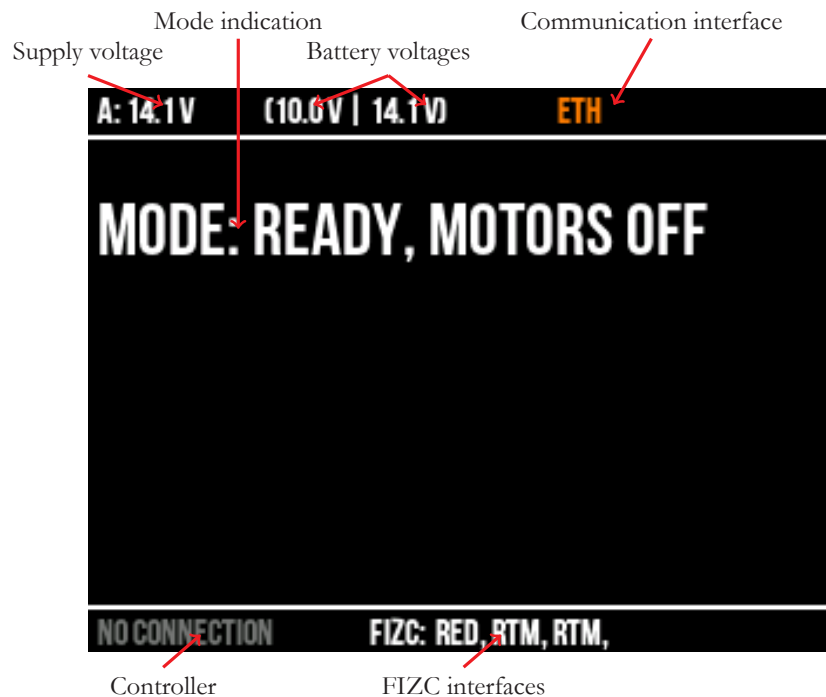


Figure 4.2: Newton S2 Main Page

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 C1 or C2 controller) and which camera/lens (FIZC) interface dongles are currently connected and identified.

4.2 OPERATING THE HEAD

The Newton Controller is used for all normal operation controls of Newton S2.

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

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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 5.6.1

4.3 LENS CONTROL

Given a compatible lens or camera, and the correct interface dongle, the Newton Controller 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.

4.3.1 LENS PRESETS

There are three lens presets which can be individually configured to control any combination of zoom and focus. By holding the preset button for approximately 3 seconds, the preset will be set to the current zoom and/or focus, depending on the settings described in section 5.3.

Once the preset has been set, a single press of the corresponding preset button will make the lens go to the preset zoom and focus positions.

4.4 ADVANCED

4.4.1 ZOOM DESENSITISE

The Newton Controller 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 desensitisation value can also be mapped onto one of the rotary dials on the Newton Controller using the input remapping settings as described in section 5.6.1.

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 S2 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 **ENABLED** and use the **PAN FOLLOW STRENGTH** to control how tightly the camera follows the movement of the Newton S2.

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 Newton Nordic does not provide any guarantees about functionality or future development of the feature.

Motion record is a feature whereby the movements of the Newton S2 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 S2 the length of each track is limited to approximately 30 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

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3. Press *MREC START REC* to start the recording. All movements will be recorded and saved inside the Newton S2

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 S2 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

The settings page of the GUI in the Newton Controller is used to configure settings both on the Controller itself and on any attached Newton Heads.

To save the settings to the built in flash memory you must close the settings and return to the main page.

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.

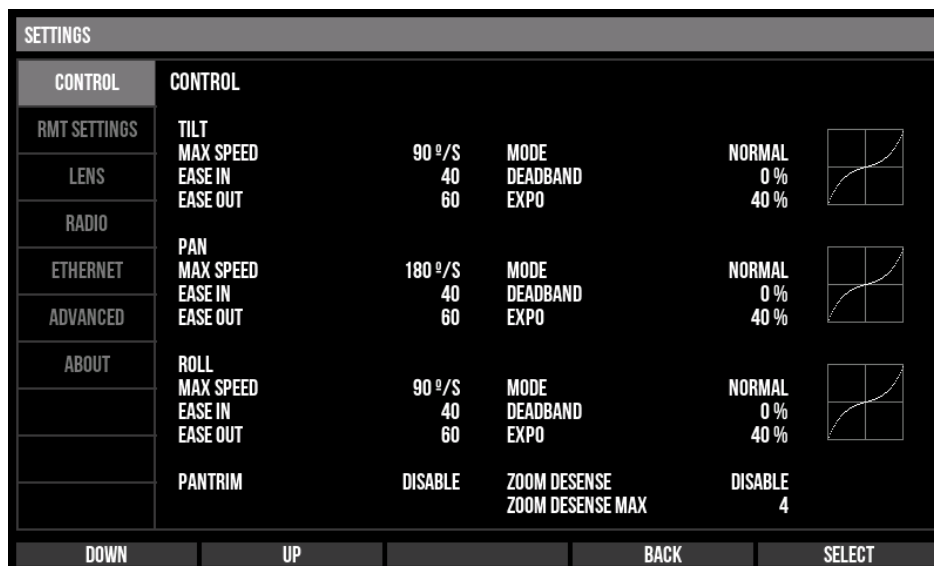


Figure 5.1: Newton Controller Settings - Control tab

Table 5.1: Newton Controller 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 desensitization
ZOOM DESENSE MAX	1 - 100	Set the max zoom-based desensitization

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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 S2 is power cycled.

SETTINGS				
CONTROL	RMT SETTINGS - NEWTON HEAD			
RMT SETTINGS	SAVE REMOTE			
LENS	TUNE P	TILT	PAN	ROLL
	TUNE I	--	--	--
RADIO	TUNE D	--	--	--
	POS GAIN	--	--	--
ETHERNET				
ADVANCED	MOTOR LOCK MODE	--	AUTO PAN DRIFT COMP	--
	CONTROL FILTER	--	VARIABLE DRIFT COMP	--
ABOUT	TILT MIN ANGLE	--		
	TILT MAX ANGLE	--		
	ROLL MIN ANGLE	--		
	ROLL MAX ANGLE	--		
	PAN FOLLOW	--		
	PAN FOLLOW STRENGTH	--		
DOWN	UP		BACK	SELECT

Figure 5.2: Newton Controller Settings - Remote settings tab

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Table 5.2: Newton Controller 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	
VARIABLE DRIFT COMP	OFF ADAPTIVE	

! NOTICE !

If the connection between the Newton Controller 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

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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.

5.2.5 VARIABLE DRIFT COMPENSATION

Reduces small movements when the system is stationary. This is a new and experimental feature so by default it is set to OFF. To try it, switch 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.

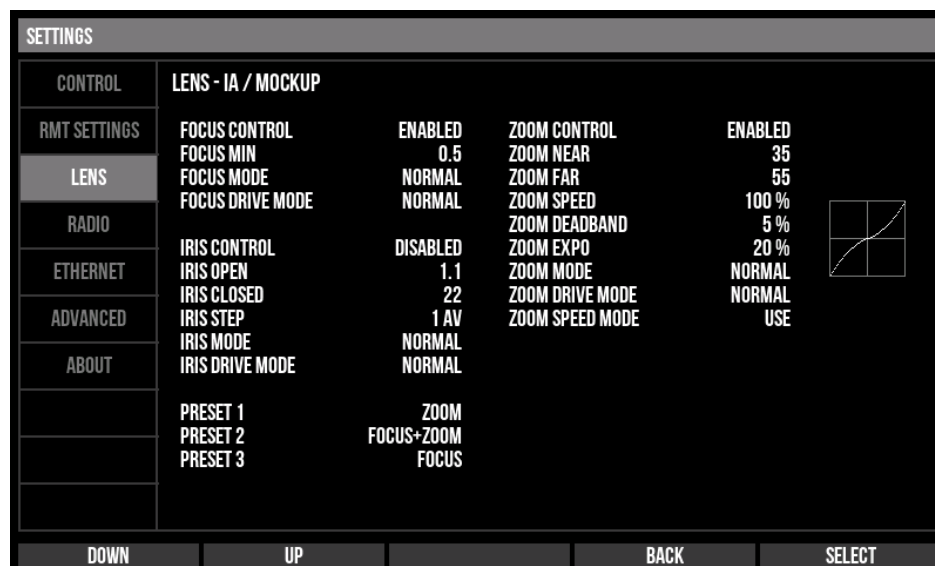


Figure 5.3: Newton Controller Settings - Lens tab

Table 5.3: Newton Controller 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
PRESET 1	FOCUS+ZOOM FOCUS ZOOM	Set preset mode
PRESET 2	FOCUS+ZOOM FOCUS ZOOM	Set preset mode
PRESET 3	FOCUS+ZOOM FOCUS ZOOM	Set preset mode

5.4 LENS MAP

The **LENS MAP** tab is for setting the focus display calibration. This feature is enabled to make the accurate mapping between the focus indicator displayed on the Controller and the value on lens. To enable, set the **FOCUS MAP** to **MANUAL**. Set **DEFAULT** on **FOCUS MAP** to disable it. The focus mapping procedure is as follow:

1. Set **FOCUS MAP** to **MANUAL**

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2. Turn the lens to the desired position using the focus control, move the selector to the **ADD SAMPLE** option using the *DOWN* and *UP* buttons and press **SELECT**. On this very same row appear two more columns: the column on the middle is the user input focus value (this is the value we are working on) while the one on the right is the feedback value from lens in percent.
3. Select the button *DOWN* or *UP* to change the input value so it corresponds to the value on the lens. To add the the sample in the mapping table, select **CONFIRM**. The added samples can also be modified by pressing **SELECT** on the sample and edit by select the button *DOWN* or *UP* then **CONFIRM**.
4. Repeat the previous two steps until the mapping table filled with full range of the lens. The maximum number of samples is 10.
5. To delete a sample, **SELECT** on the sample and push **DELETE**.
6. To reset all samples, move to **RESET** and press **SELECT**.

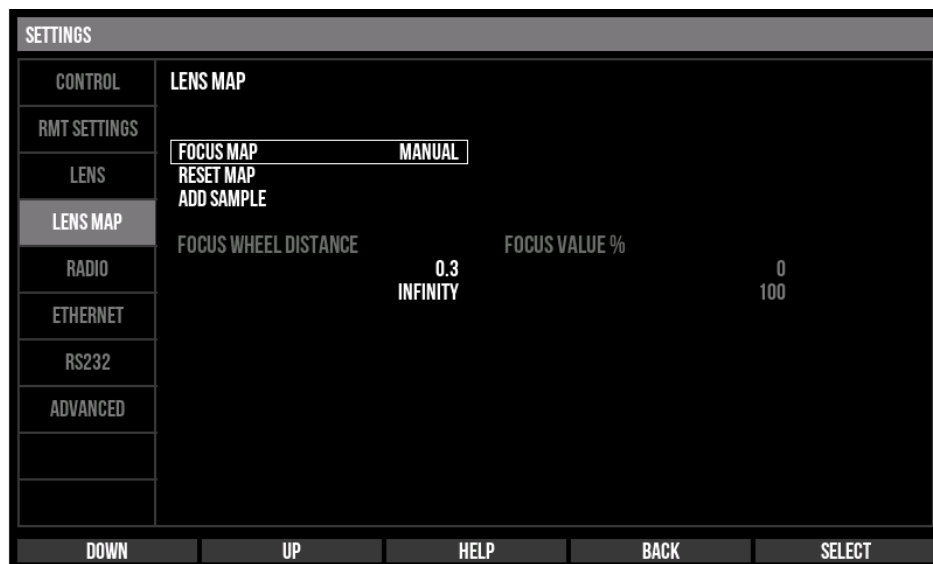


Figure 5.4: Newton Controller Settings - Lens Map tab

5.5 COMMUNICATIONS

5.5.1 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 Newton Controller is used together with a Newton S2 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**

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Figure 5.5: Newton Controller Settings - Radio tab

5.5.2 ETHERNET

Under the **ETHERNET** settings tab the Ethernet connection is configured, such as the IP address and net-mask of the Newton Controller as well as the IP address of the remote head. The Newton Controller and the remote head must be on the same IP subnet. Note that the Newton Controller and Newton S2 are configured to be compatible with each other as default.

If the setting **AUTOCONNECT** is set to **ENABLE** the Newton Controller 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 preferred 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**.

SETTINGS												
CONTROL	ETHERNET - NOT CONNECTED											
RMT SETTINGS	<div> <div>CONNECT</div> <div>AUTOCONNECT</div> <div>DISABLE</div> </div>											
LENS												
RADIO	REMOTE				LOCAL							
	IP	192	168	10	32	IP	192	168	10	16		
						NMASK	255	255	255	0		
ETHERNET						D-GW	0	0	0	0		
ADVANCED												
ABOUT												
DOWN	UP					BACK	SELECT					

Figure 5.6: Newton Controller Settings - Ethernet tab

5.5.3 RS232

The **RS232** settings tab is for configuration of RS232 communication. RS232 is the third-in-line communication after ethernet and radio. If using RS232, enable RS232 in setting tab and disable ethernet and radio. Select **BAUD RATE** to change the connecting speed. Noted that that RS232 must be enable on both Controller and Newton with the same baudrate.

SETTINGS	
CONTROL	RS232
RMT SETTINGS	
LENS	RS232 BAUD RATE
LENS MAP	DISABLED 14400
RADIO	
ETHERNET	
RS232	
ADVANCED	
DOWN	UP
BACK	SELECT

Figure 5.7: Newton Controller Settings - RS232 tab

5.6 ADVANCED

The advanced tab contains advanced settings for the Newton Controller.

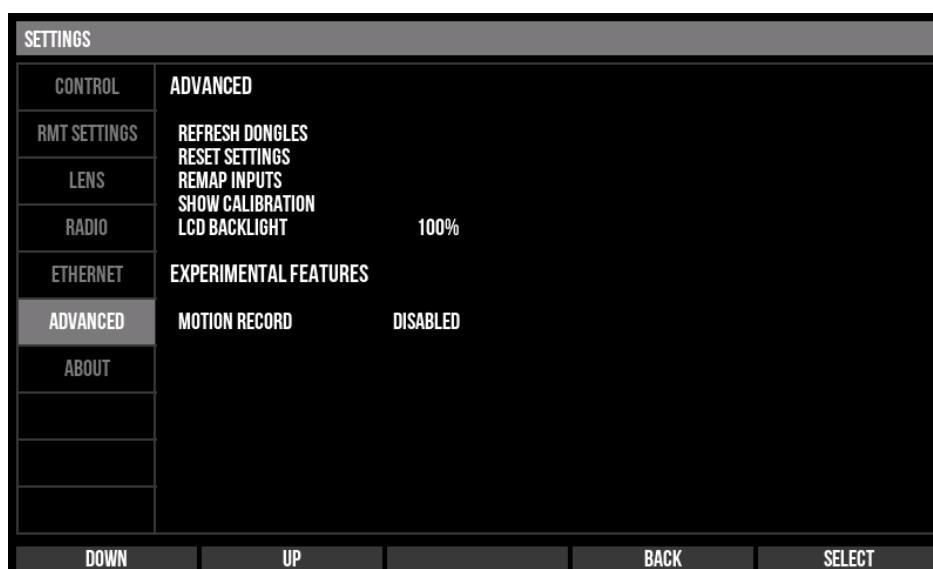


Figure 5.8: Newton Controller Settings - Advanced tab

Table 5.4: Newton Controller Settings - Advanced tab

Setting	Range	Description
REFRESH DONGLES	-	Refresh status of accessory dongles connected to Newton Controller.
RESET SETTINGS	-	Reset all settings of the Newton Controller 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.

5.6.1 CONTROL REMAPPING

Most inputs of the Newton Controller 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 Newton Controller 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*.

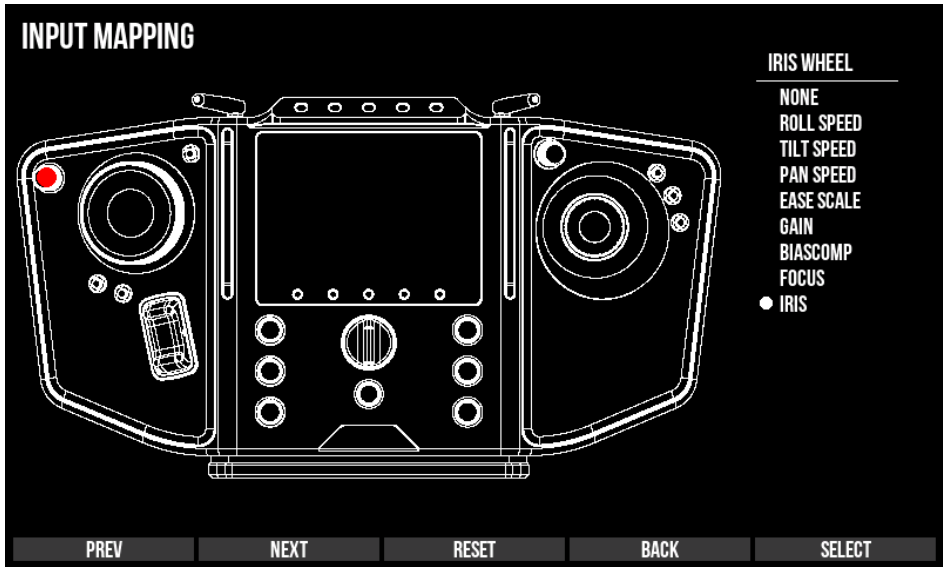


Figure 5.9: Newton Controller Settings - Remap input

5.6.2 ABOUT TAB

The About tab contains firmware version and battery information.

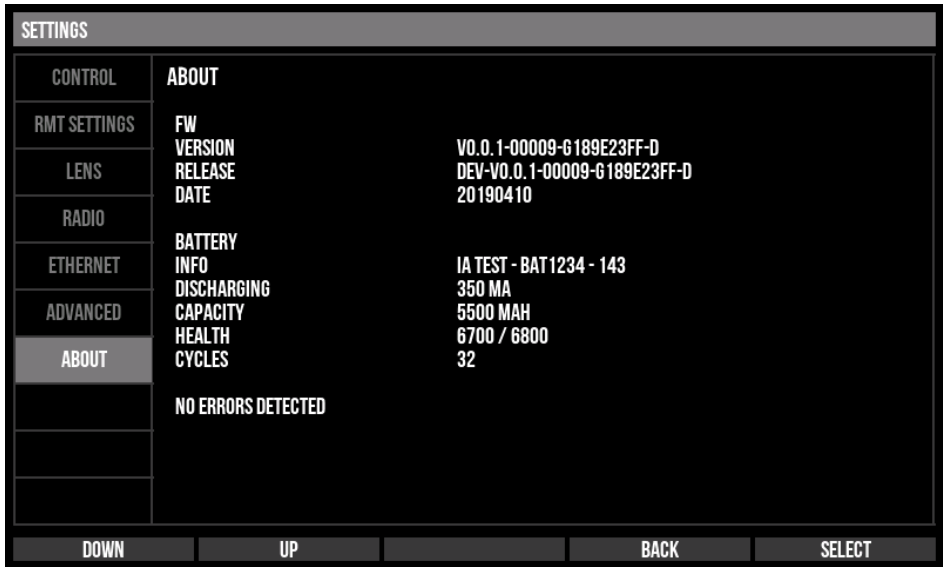


Figure 5.10: Newton Controller Settings - About tab

5.7 NEWTON S2 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*.

5.7.1 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**.

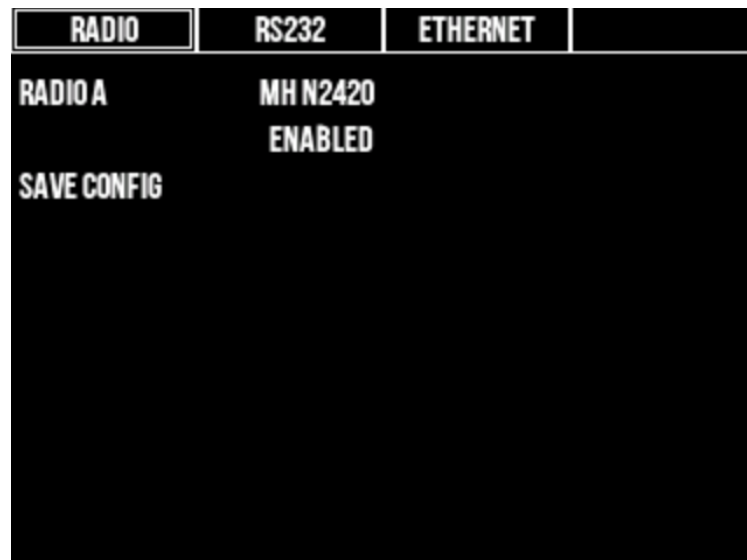


Figure 5.11: Settings - Radio tab

5.7.2 ETHERNET

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

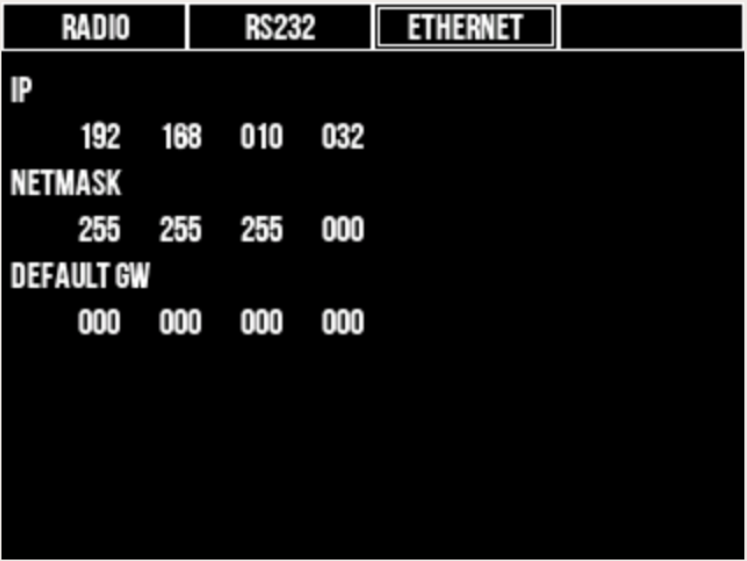


Figure 5.12: Settings - Ethernet tab

5.7.3 RS232

The **RS232** settings page is for configuration of RS232 link. To use RS232, set RS232 to enable and baudrate must be the same on both Newton Head and Controller.

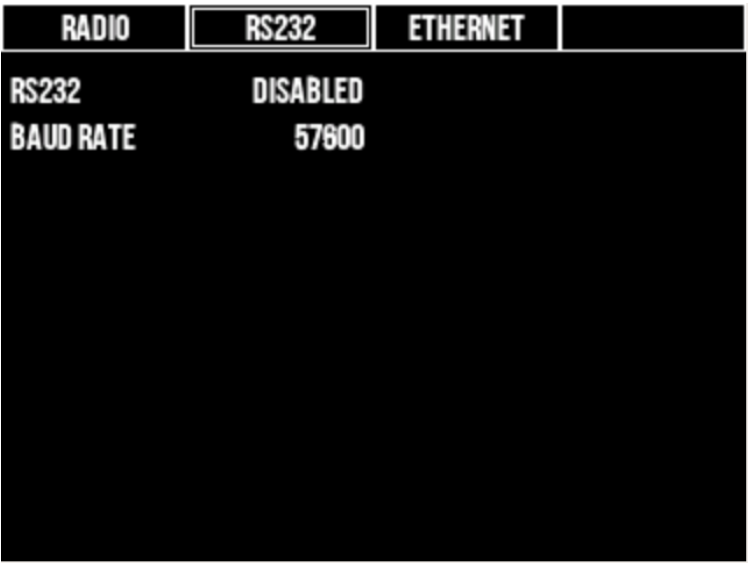


Figure 5.13: Settings - RS232 tab

6 Maintenance

The Newton S2, the Newton Controller 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 S2 and Newton Controller 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 Newton Nordic 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 S2, make sure to also update the Newton Controller and FIZC dongles to a matching version.

To upgrade the Newton Nordic 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 S2 and the Newton Controller 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 Newton Nordic support staff.

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7 Troubleshooting

7.1 ERROR CODES

Both Newton S2 and Newton Controller contains internal systems for internal diagnostics and fault reporting. Upon discovery of an internal error it will display an error code (Newton S2 displays it on the main screen, Newton Controller in the **ABOUT** settings tab). If you encounter a problem and get an error code, contact the Newton Nordic 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
Newton Controller does not start up	Battery is empty	Connect power adapter to charge
	Improper firmware loaded	Reload latest supplied firmware according to instructions
Newton Controller does not establish radio connection with remote head	Antennas are not extended	Extend antennas
	Antennas are damaged	Contact IA support for replacement
	Newton Controller and remote head are not paired	Perform pairing procedure, see section 5.5.1
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 Newton Controller	Dongle has incompatible firmware	Update dongle firmware to same version as Newton Controller
	Communication link is not established between Newton and Newton Controller	See entry above

A Technical Specification

A.1 NEWTON S2

A.1.1 MECHANICAL

Table A.1: Newton S2 - Mechanical

Parameter	Min	Typ	Max
Length ¹		35 cm	
Width ¹		30 cm	
Height ¹		35 cm	
Weight ¹		7.3 kg	

¹ Without camera

A.1.2 POWER SUPPLY

Table A.2: Newton S2 - Power supply

Parameter	Min	Typ	Max
<i>Power input</i>			
Input voltage	12 V	24 V	36 V
Input current			20 A
<i>Pan-box power out</i>			
Output voltage	14V	15 V	15.5 V
Output current			2 A
<i>Cradle power out</i>			
Output voltage	14V	15 V	15.5 V
Output current ¹			10 A
Output power ¹			150 W

¹ Depends on input/battery voltage. See table 3.1 in section 3.5.1.

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		20 kg	

¹ Including two batteries and charger

A.1.3 DRAWINGS AND DIMENSIONS

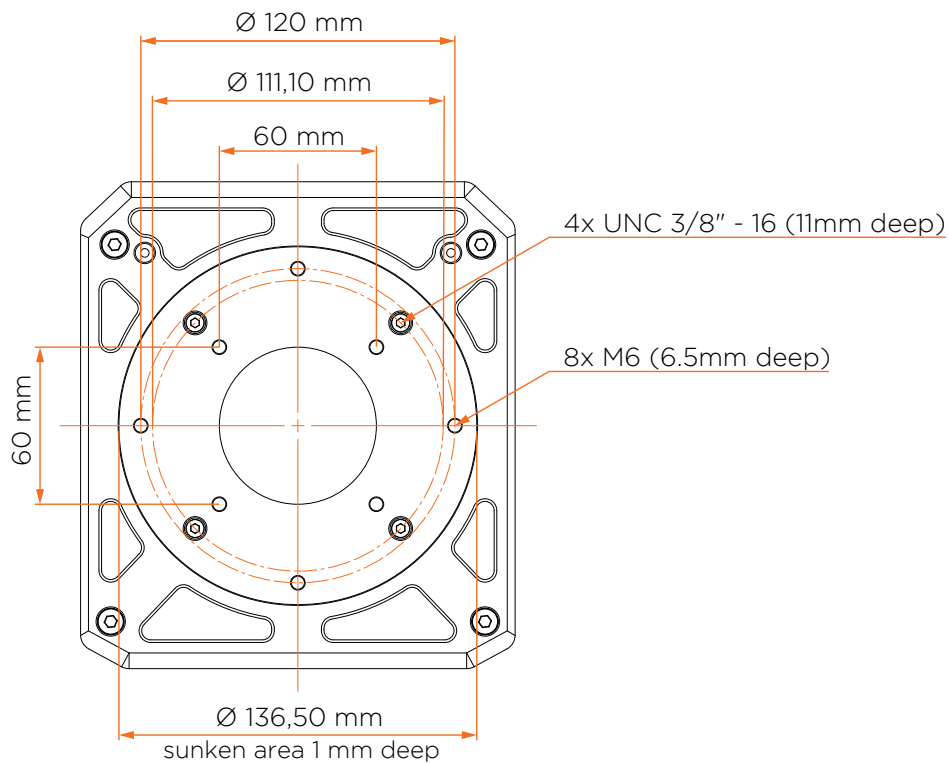


Figure A.1: Mounting hole pattern

A.1.4 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 Newton Nordic equipment.

Pan-box Power In

Newton S2 connector: LEMO EGJ.2B.304

Mating connectors: LEMO FGJ.2B.304 / FHJ.2B.304

Acceptable voltage: 12V – 36V

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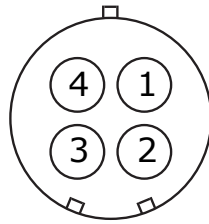


Figure A.2: Power in

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

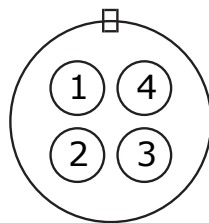


Figure A.3: Power out

Table A.6: Power out, pins

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

Cradle Power Out

Mating connector: LEMO EGG.1B.304

Output voltage: Regulated 15V

Max current: up to 10A

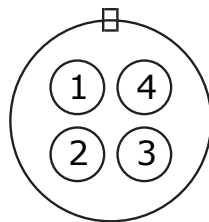


Figure A.4: Power out

Table A.7: Power out, pins

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

A.1.5 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.

¹100Mbit Ethernet utilize 1,2,3,6

A.1.6 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

A.2 NEWTON CONTROLLER C1/C2

A.2.1 MECHANICAL

Table A.9: Newton Controller - 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: Newton Controller - Power Supply

Parameter	Min	Typ	Max
<i>Power input</i>			
Input voltage	12 V	18 V	25 V
Input current			6 A
<i>Power out</i>			
Output voltage ¹	12 V	18 V	25 V
Output current			2.5 A
<i>Battery</i>			
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 Newton Nordic equipment.

RS232

Newton Controller connector: LEMO EGG.0B.306

Mating connectors: LEMO FGG.0B.306 / FHG.0B.306

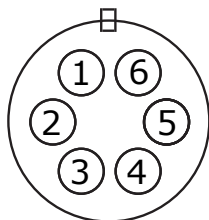


Figure A.5: RS232

Table A.11: Newton Controller - RS232, pins

Pin number	Description
1	NC
2	TX
3	CTS
4	RTS
5	RX
6	GND

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Power in

Newton Controller connector: LEMO EGJ.1B.304

Mating connectors: LEMO FGJ.1B.304 / FHJ.1B.304

Acceptable voltage: 12V – 26V

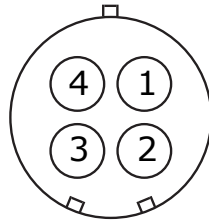


Figure A.6: Power in

Table A.12: Newton Controller - Power in, pins

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

Power out

Newton Controller 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)

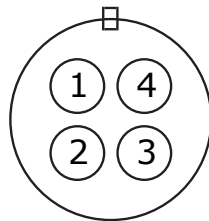


Figure A.7: Power out

Table A.13: Newton Controller - Power out, pins

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

A.2.4 SHIPPING/HARD-CASE

Table A.14: Newton Controller - 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.15: Common - Communication Interfaces

Parameter	Min	Typ	Max
<i>Ethernet</i>			
Connector		RJ45 (8c8p)	
Interface		100 Mbit/s	
Data-rate			200 kbit/s
Cable length			25 meters
<i>2.4GHz Radio</i>			
Radio type		FHSS	
Frequency	2401.6 MHz		2477.6 MHz
Transmit Power			20 dBm ¹
<i>RS232</i>			
Connector		LEMO	
Data-rate	19200 bps		115200 bps
Cable length			10 meters

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.
4	2019-11-13	Version 1.3 Rebranded to Newton, also renamed Dominion to Newton C1 Added section on focus/zoom presets
5	2020-04-28	Version 1.4 Added Variable drift setting
6	2020-11-02	Version 1.4.1 Added changes for the C2 controller
7	2020-11-24	Version 1.4.2
8	2021-04-14	Version 1.5.0 Added lens focus mapping Added RS232 settings