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Document Title: Hand Control Unit Manual
Document Ref: DROV-MAN-HCU-MODEL 5
Owner: President – Delta ROV

Rev#	Description	Prepared	Signature	Q/HSE Approved	Signature	MD Approved	Signature
5.0.0	Release	EDE				EDE	

1. TABLE OF CONTENT

2. INTRO

When it comes to controlling a remotely operated vehicle or drone, the quality of the HCU, or hand control unit you use will play a major part in how your vehicle behaves.

This is why we designed our HCU with the best possible components and added all the features we could think of.

For this we use hall effect joysticks. Compared to traditional potentiometer based joysticks which are mechanical and wear off over time, the hall effect uses magnetic field and is contactless.

We also use digital encoders in lieu of potentiometers for controlling trims, gains and additional axes. Because an encoder is like a push button and that it is fed in the MCU separately, it doesn't affect the quality of the josticks.

For this new models, the encoders have been upgraded to the best available product we could find.

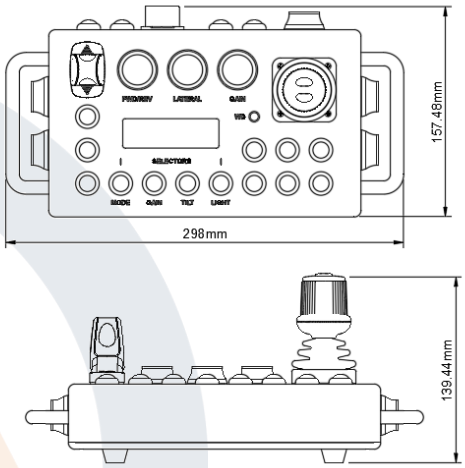
Finally, we designed our own joystick controller instead of buying one off the shelf. **This is where we separate ourselves from every other product on the market.** Having full control over the HCU before the signal is sent to the computer gives us unparallel flexibility.

This gived us the complete flexibility to custom map the axes, buttons, gain and trim.

3. SPECS

3.1. PHYSICAL

- Dimensions: 298mm X 160mm X 140mm
- Weight: 2kg
- Housing: Powder coated black, carved from a solid block of recycled 6061-T6
- Stainless Steel handles
- IP Rating: IP65



3.2. ELECTRICAL

- 1 of 3-axis joystick Hall effect Ruffy Controls HE2-30-S-A-1-BK
- 1 of 1-axis thumbwheel Hall effect APEM TW01BLK11
- 17 of waterproof push button PB12
- 8 of digital encoders with 4xSF25BAK551 + 4x SF25BAK554
- 1 of waterproof LEDs
- 1 of LCD with gasket
- 1 of IP65 USB port
- 1 of Teensy 4.1 MCU
- 1 of Delta ROV PCB

3.3. SOFTWARE

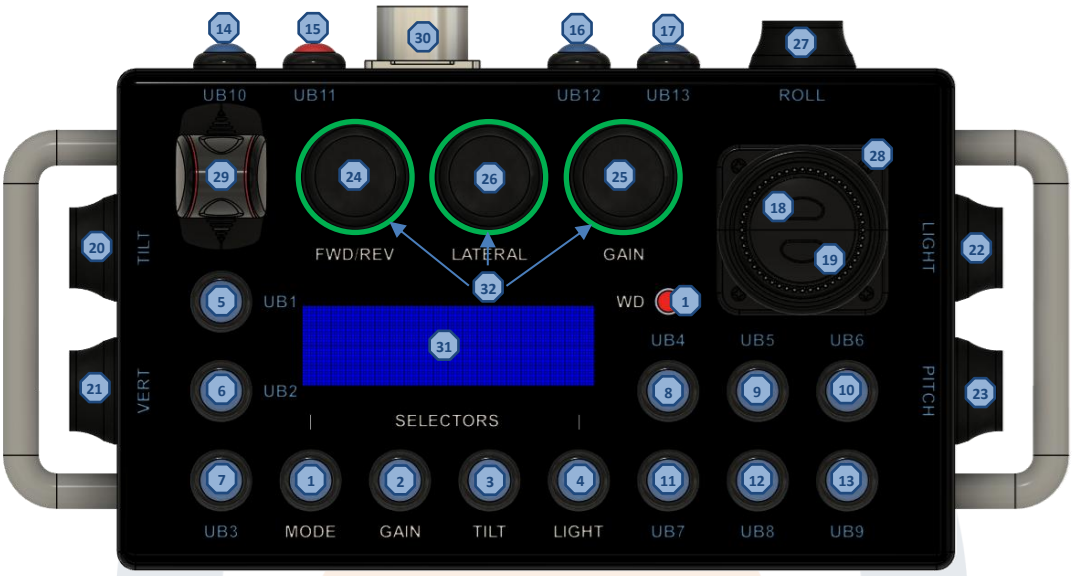
- Linux/Windows 10,11 compatible
- Uses Linux/Windows generic driver (no additional drivers required)
- Additional HCU configuration software (Windows 10,11 compatible)
- Additional HCU tester software (Windows 10,11 compatible)

3.4. FEATURES

- 13 user buttons can be programmed as button 0-64 (0 = disabled)
- 1 mode button
- 3 buttons are used as selectors for gain, tilt, light channels
- 5 encoders (and their push button) can be programmed to trigger buttons 0-64 (0 = disabled) or axis 0 to 23 (0 = disabled)
- 3 encoders are used for Fwd/Rev, Lateral, Vertical trims
- 3 modes; Normal, RED, GREEN with LED indicator on the encoders
- Shift or Normal mode for QGroundcontrol based ROV compatibility
- Programmable encoder steps
- Programmable Trigger Step
- Programmable Trigger time
- Programmable axis sample
- Programmable axis deadband
- LCD for Trim and gain feedback
- 1 HCU water ingress detect LED
- Program mode
- Flash mode

4. OVERVIEW

4.1. HCU COMPONENTS



ID	PHYSICAL	FUCTION	DESCRIPTION
1	MODE	MODE	MODE SELECTOR AND REBOOT/PROGRAMMING MODE FUNCTION
2	GAIN	GAIN SELECTOR	SOFTWARE,FWD/AFT,LATERAL,VERTICAL,ROTATE GAIN SELECTOR
3	TILT	TILT SELECTOR	SELECT BETWEEN CH1,2,3,4,5 FOR THE TILT CONTROL ENCODER (DEPENDING ON PROGRAMMING)
4	LIGHT	LIGHT SELECTOR	SELECT BETWEEN CH1,2,3,4,5 FOR THE LIGHT CONTROL ENCODER (DEPENDING ON PROGRAMMING)
5	UB1	USER BUTTON 1	USER BUTTON THAT CAN BE CONFIGURED TO TRIGGER WINDOWS/LINUX BUTTON 0-64
6	UB2	USER BUTTON 2	USER BUTTON THAT CAN BE CONFIGURED TO TRIGGER WINDOWS/LINUX BUTTON 0-64
7	UB3	USER BUTTON 3	USER BUTTON THAT CAN BE CONFIGURED TO TRIGGER WINDOWS/LINUX BUTTON 0-64
8	UB4	USER BUTTON 4	USER BUTTON THAT CAN BE CONFIGURED TO TRIGGER WINDOWS/LINUX BUTTON 0-64
9	UB5	USER BUTTON 5	USER BUTTON THAT CAN BE CONFIGURED TO TRIGGER WINDOWS/LINUX BUTTON 0-64
10	UB6	USER BUTTON 6	USER BUTTON THAT CAN BE CONFIGURED TO TRIGGER WINDOWS/LINUX BUTTON 0-64
11	UB7	USER BUTTON 7	USER BUTTON THAT CAN BE CONFIGURED TO TRIGGER WINDOWS/LINUX BUTTON 0-64
12	UB8	USER BUTTON 8	USER BUTTON THAT CAN BE CONFIGURED TO TRIGGER WINDOWS/LINUX BUTTON 0-64
13	UB9	USER BUTTON 9	USER BUTTON THAT CAN BE CONFIGURED TO TRIGGER WINDOWS/LINUX BUTTON 0-64
14	UB10	USER BUTTON 10	USER BUTTON THAT CAN BE CONFIGURED TO TRIGGER WINDOWS/LINUX BUTTON 0-64
15	UB11	USER BUTTON 11	USER BUTTON THAT CAN BE CONFIGURED TO TRIGGER WINDOWS/LINUX BUTTON 0-64
16	UB12	USER BUTTON 12	USER BUTTON THAT CAN BE CONFIGURED TO TRIGGER WINDOWS/LINUX BUTTON 0-64
17	UB13	USER BUTTON 13	USER BUTTON THAT CAN BE CONFIGURED TO TRIGGER WINDOWS/LINUX BUTTON 0-64
18	UB14	USER BUTTON 14	USER BUTTON THAT CAN BE CONFIGURED TO TRIGGER WINDOWS/LINUX BUTTON 0-64
19	UB15	USER BUTTON 15	USER BUTTON THAT CAN BE CONFIGURED TO TRIGGER WINDOWS/LINUX BUTTON 0-64
20	ENC 1	TILT CONTROL	CONTROLS THE SELECTED TILT CHANNEL VIA BUTTON TRIGGERS OR AXIS OUTPUT
21	ENC 2	TRIM VERT	ADD/DEDUCT FIXED AMOUNT OF VERTICAL THRUST TO THE VERTICAL JOYSTICK
22	ENC 3	LIGHT CONTROL	CONTROLS THE SELECTED LIGHT CHANNEL VIA BUTTON TRIGGERS OR AXIS OUTPUT
23	ENC 4	PITCH CONTROL	CONTROLS THE SELECTED PITCH CHANNEL VIA BUTTON TRIGGERS OR AXIS OUTPUT
24	ENC 5	TRIM FWD/AFT	ADD/DEDUCT FIXED AMOUNT OF FMD/AFT THRUST TO THE FWD/AFT JOYSTICK
25	ENC 6	GAIN CONTROL	CONTROLS THE SELECTED GAIN CHANNEL VIA BUTTON TRIGGERS OR DIRECT AXIS
26	ENC 7	TRIM LATERAL	ADD/DEDUCT FIXED AMOUNT OF LATERAL THRUST TO THE LATERAL JOYSTICK
27	ENC 8	ROLL CONTROL	CONTROLS THE SELECTED ROLL CHANNEL VIA BUTTON TRIGGERS OR AXIS OUTPUT
28	JOY 1	AXIAL JOYSTICK	CONTROLS AXES FWD/AFT, LATERAL, ROTATE
29	JOY 2	VERTICAL JOYSTICK	CONTROLS VERTICAL AXIS
30	USB	POWER AND DATA	CONNECTS TO THE COMPUTER FOR POWER AND DATA TO THE HCU
31	LCD	INFO DISPLAY	DISPLAYS USER DATA; TRIM, GAIN, TILT CHANNEL, LIGHT CHANNEL
32	LED RING	MODE INDICATOR	INDICATES WHICH CONFIGURATION THE HCU IS USING NORMAL/RED/GREEN (NORMAL MODE IS OFF)

4.2. BUTTON COMBINATIONS

The HCU has several additional functionalities accessed via a combination of buttons and button press duration. To access these functions, follow the table below.

ID	BUTTON 1	BUTTON 2	DURATION	FUNCTION
1	MODE	-	SHORT	CYCLES THROUGH MODES NORMAL/RED/GREEN
2	MODE	-	5 SEC	REBOOT
3	MODE	-	PRESSED	DURING BOOT PUTS HCU IN PROGRAM MODE
4	MODE	TILT	SHORT	PUTS HCU IN FLASH MODE
5	ENC	-	SHORT	RESETS THE ENCODER VALUE TO 100% OR MIDDLE
6	GAIN ENC	-	3 SEC	SAVES GAIN TO EEPROMM / ENCODER RINGS WILL FLASH

4.3. LCD STATES

The LCD will display different pages depending on the state its in.

These are the various pages.

4.3.1. STARTUP

When the HCU is first powered up it will display the startup screen.

LINE 1. Manufacturer

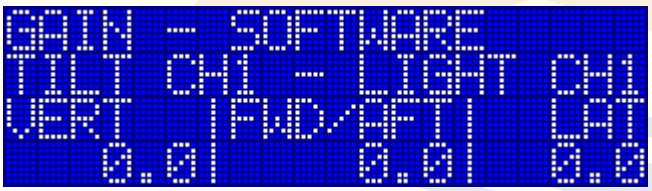
LINE 2. Version number

LINE 3. Unique Serial Number

LINE 4. Support email

4.3.2. OPERATIONAL

When the HCU completes its booting sequence, it is ready for normal use and will display the operation screen.



LINE 1. Shows the selected GAIN; Software, Lateral, Forward / Aft, Rotate, Vertical

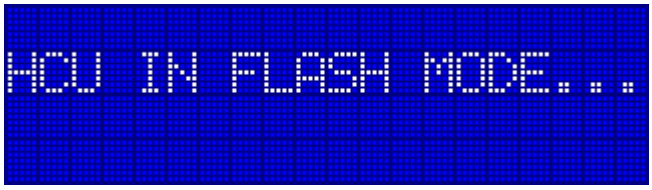
LINE 2. Shows the selected channel for TILT and LIGHT

LINE 3. Shows the trim titles

LINE 4. Displays the vertical trim, Forward / Aft trim and Lateral trim

4.3.3. FLASH

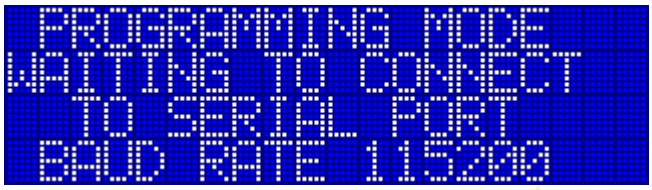
If the HCU is in flash mode, the following message will appear.



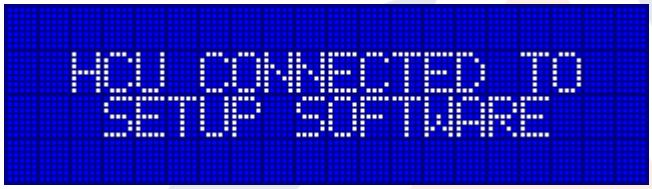
Flash mode is only used to upgrade the HCU's micro controller. Flashing will be done by Delta ROV. To put the HCU in flash mode use the button combination detailed in section 4.2 **ID# 4**.

4.3.4. PROGRAMMING MESSAGES

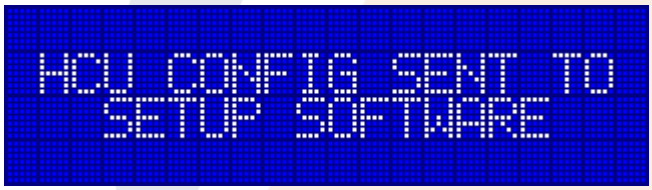
During startup, if the mode button is held, the HCU will go to programming mode and display this message while waiting for a connection.



Once the HCU is connected to the programming software, it will display the following message.

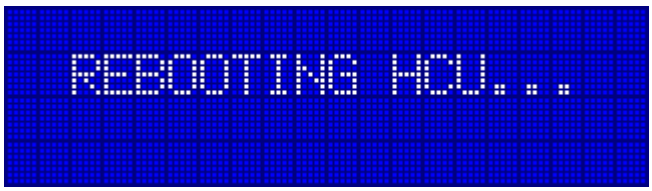


If the programming software requests the HCU's configuration, this message will be sent after the configuration is sent successfully.



If the programming software programs the HCU and it is successfully saved, the following message will appear.

When the HCU receives a request, it will reboot and display this message before the startup message appears.



5. INSTALLATION

5.1. CONNECTING THE HCU

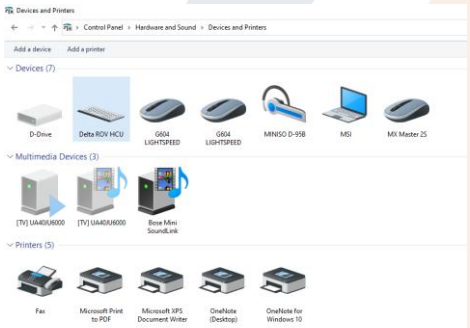
The HCU is loaded with a configuration right out of the box. It is very likely that you may want to change this configuration. If this is the case, you will need to run the HCU Config Software.

With the right configuration loaded, installation is very easy. Simply plug the HCU on your computer using the supplied USB cable and windows will automatically detect it as a generic game controller.

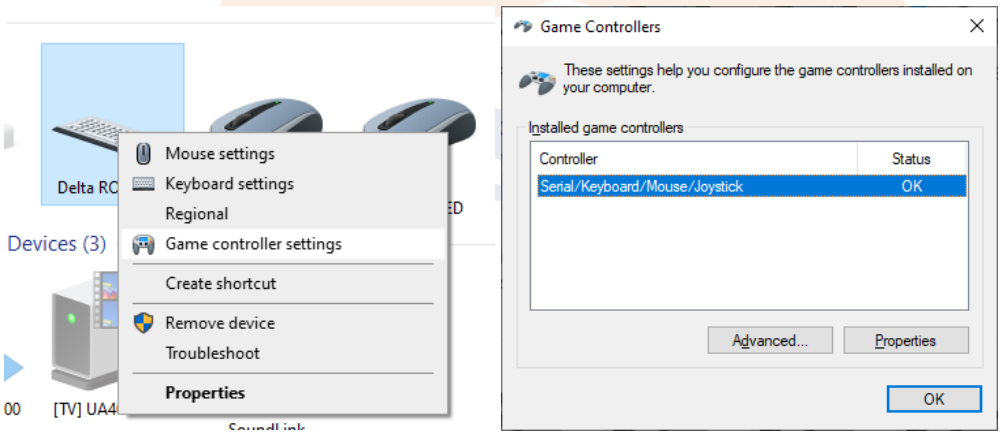
5.2. TESTING THE HCU VIA WINDOWS CONTROL PANEL

5.2.1. METHOD 1

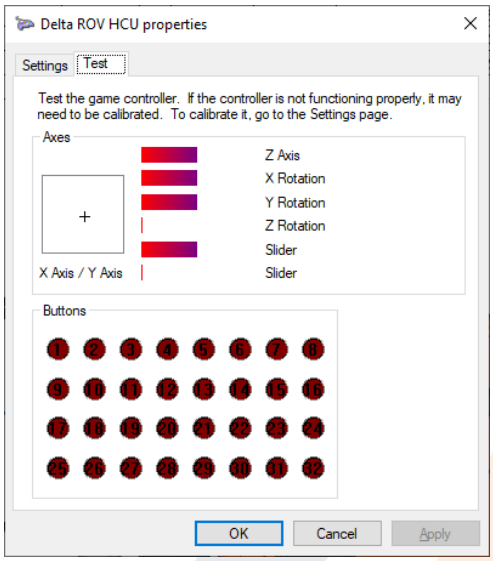
First open Devices and Printers and locate Delta ROV HCU



Right-Click Delta ROV HCU and click Game controller settings



Select Serial/Keyboard/Mouse/Joystick and click on Properties

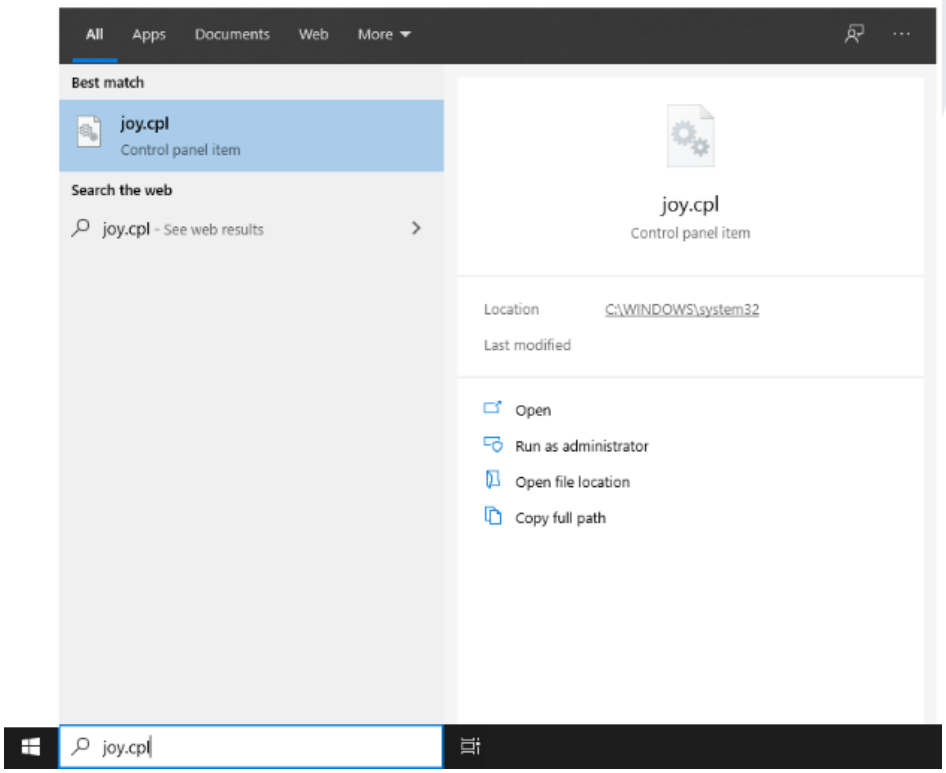


Note that this interface does not provide the facility to test more than 8 axes and 32 buttons.

For a complete testing of the HCU, Delta ROV's tester is a better option.

5.2.2. METHOD 2

Type **joy.cpl** in windows 10 search bar



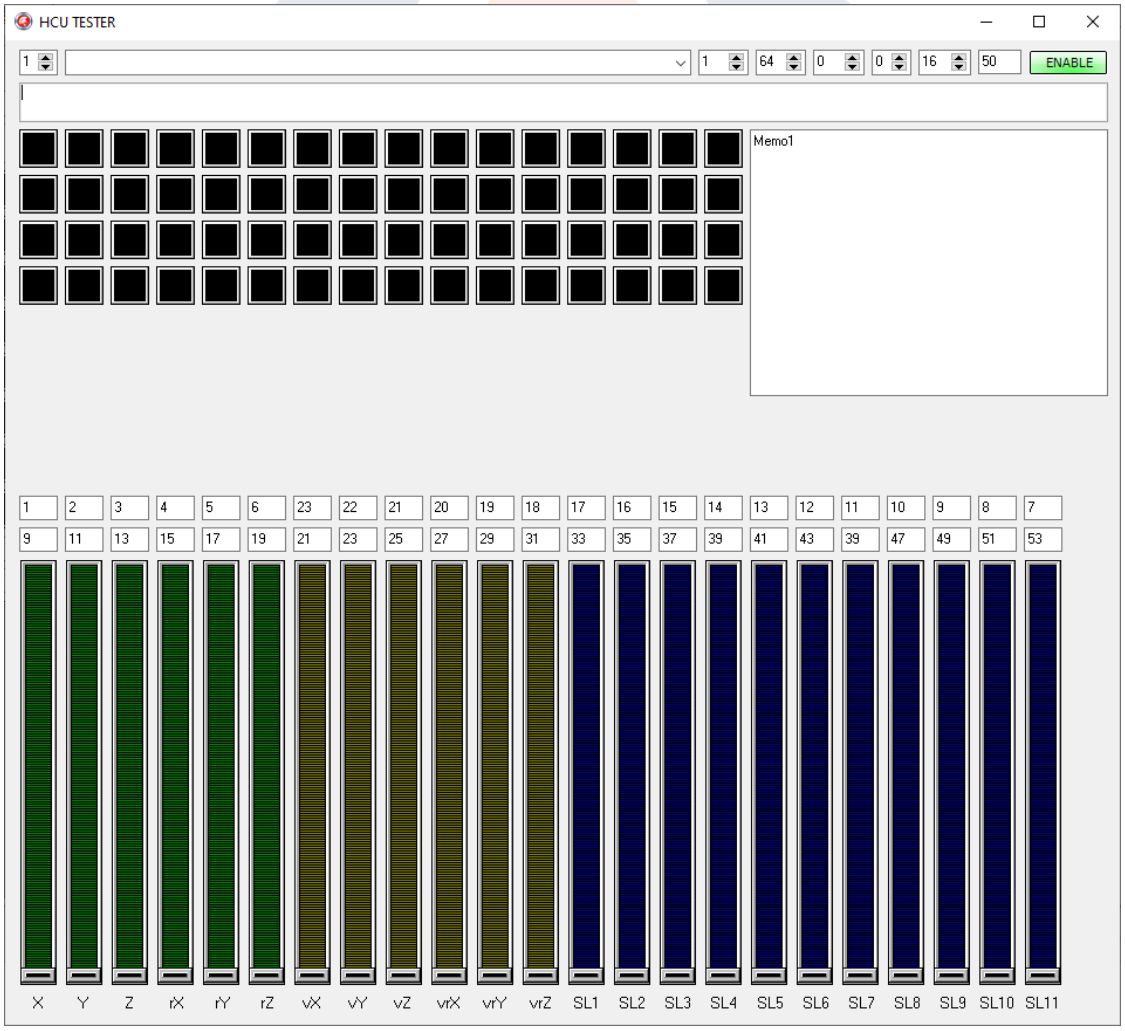
Select Serial/Keyboard/Mouse/Joystick and click on Properties

5.3. TESTING THE HCU VIA DELTA ROV'S HCU TESTER

First locate and download HCU-T from the download section of our website: www.deltarov.com

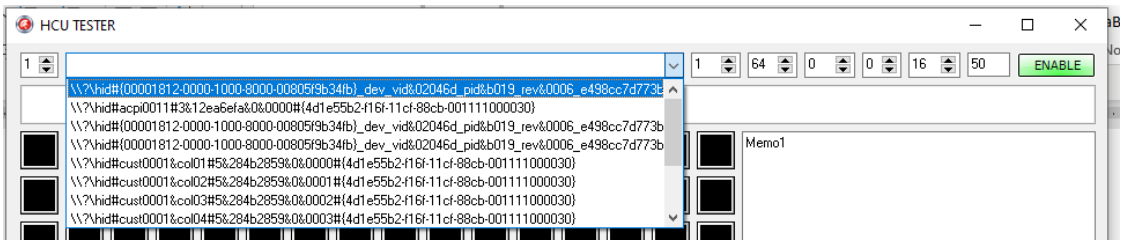
Plug in your HCU before you start the software.

Runing HCU-T.exe will launch this window

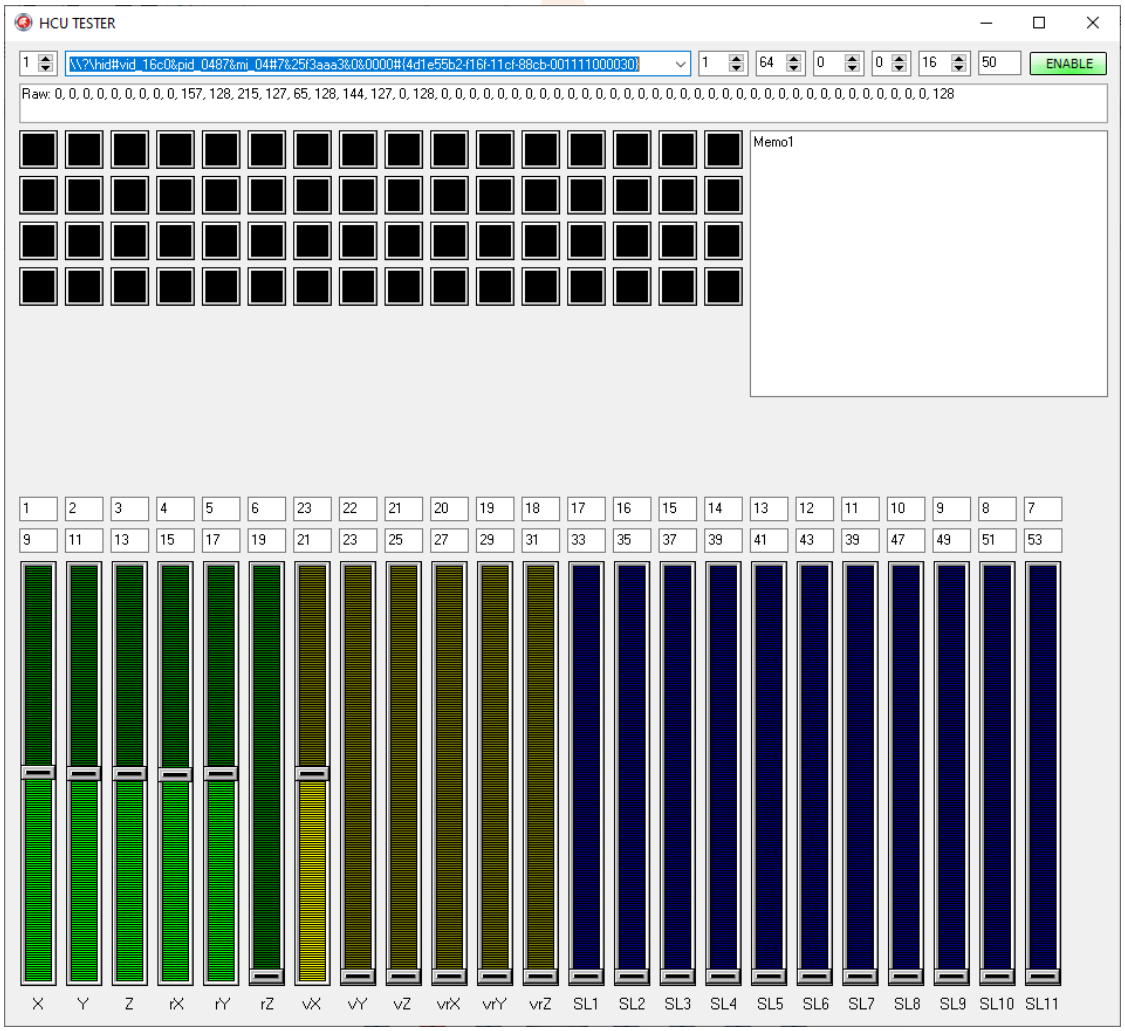


Because this software is looking for HID devices rather than windows' generic driver, you will need to find the key corresponding to your HCU. This will be saved in the config.xls file for the next time you open this software.

To find your HCU in the list, select the first item in the combo box.



Then browse through each of them until values are updating.



Once you reach this point, you have found the registry key associated with your HCU. This is unique for every HCU/peripherals installed on your PC.

You can now test every buttons and axes.

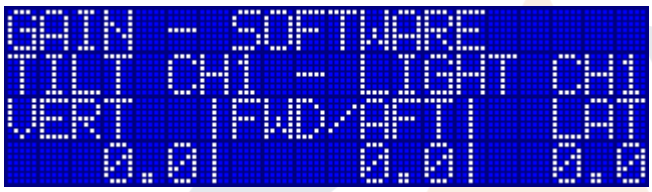
5.4. PROGRAMMING THE HCU

The joystick buttons, axes, encoders, etc can be configured to suit your own purposes.

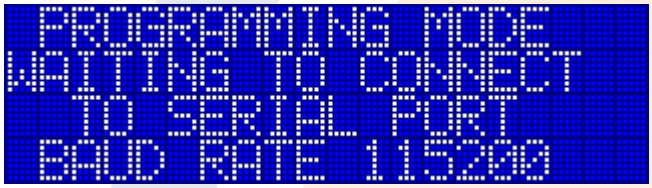
You first need to put the joystick in programming mode, then connect the HCU Congig software, make your changes and upload them to the controller.

5.4.1. PUTTING THE HCU IN PROGRAMMING MODE

To put the HCU in programming mode, you need to first plug the HCU in your computer and wait for the **OPERATIONAL** screen.



Then you execute button combination ID#5 (see section 4.2) to put the HCU in programming mode.

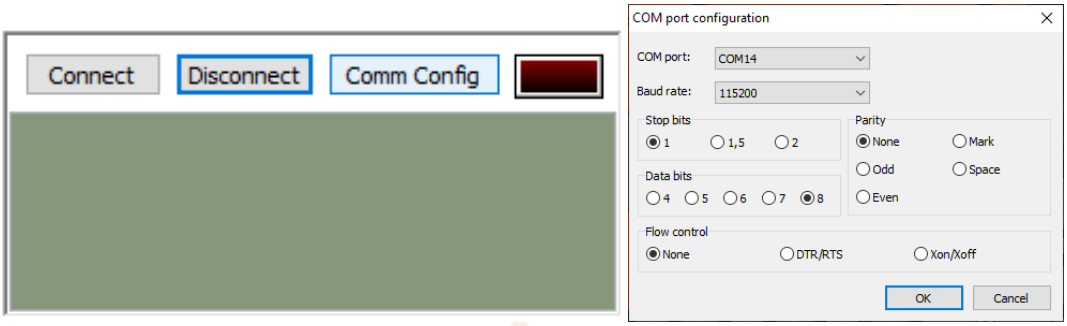


Once in programming mode you are ready to connect with the HCU Config software.

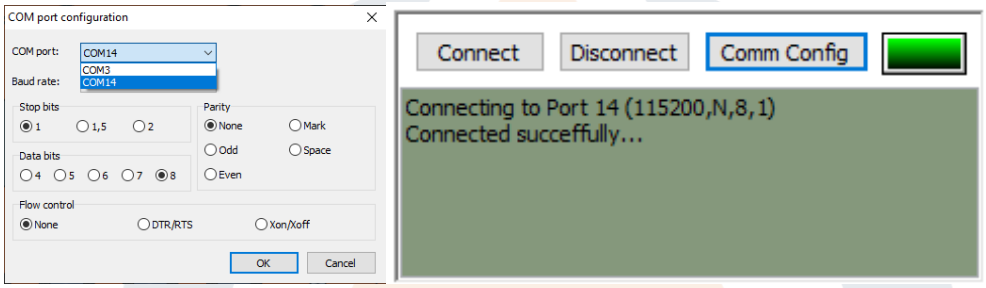
5.4.2. CONNECTING THE HCU PROGRAMMER SOFTWARE

Locate and run HCU.exe

Now click on the **Comm Config** button. This will launch the **COM port configuration** window.

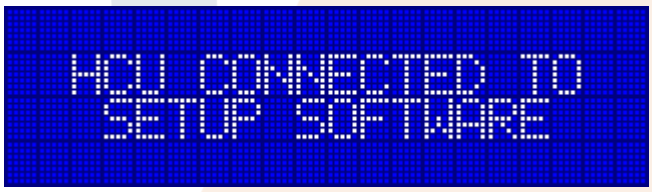


Ensure that Baud rate is set to 115200, select the COM port that corresponds to the HCU and click OK.



Once the HCU is connected, the message box will display **Connected Successfully…**

The software and HCU will display



You are now connected to the HCU and ready to make some changes.

5.4.3. READING THE HCU

A good starting point before you make any changes is to load the configuration that is presently stored on the HCU.

Since there are 3 stored configurations, you need to select which Joystick Mode you want to read. This is done by selecting the applicable radio button from the HCU software

In this example, we are selecting the **RED** mode.

Once this is done, click on the 

button.

This will load all the parameters in the HCU software

The encoder **RED** LEDs will turn on.

The software and HCU will display

You can repeat this for every mode.

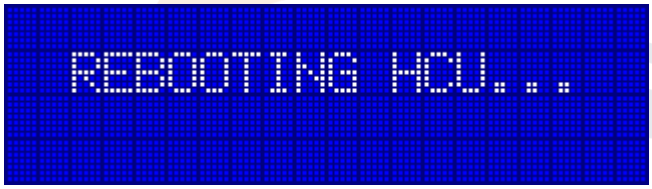
5.4.4. PROGRAMMING THE HCU

WARNING! Except for "**0**", ensure the buttons and encoder triggers have a unique number or else **the controller will NOT work properly**. The same applies for the axes.

Once you have changed all the parameters to suit your needs. Ensure you select the mode you whish to program and then press the PROGRAM HCU button.

Once programming is completed, the HCU will turn on the mode LEDs and display **PROGRAMMING RECEIVED AND SAVED TO HCU** message

From here, you can opt to program the other modes and when you are done, reboot the HCU by pressing the REBOOT HCU button.



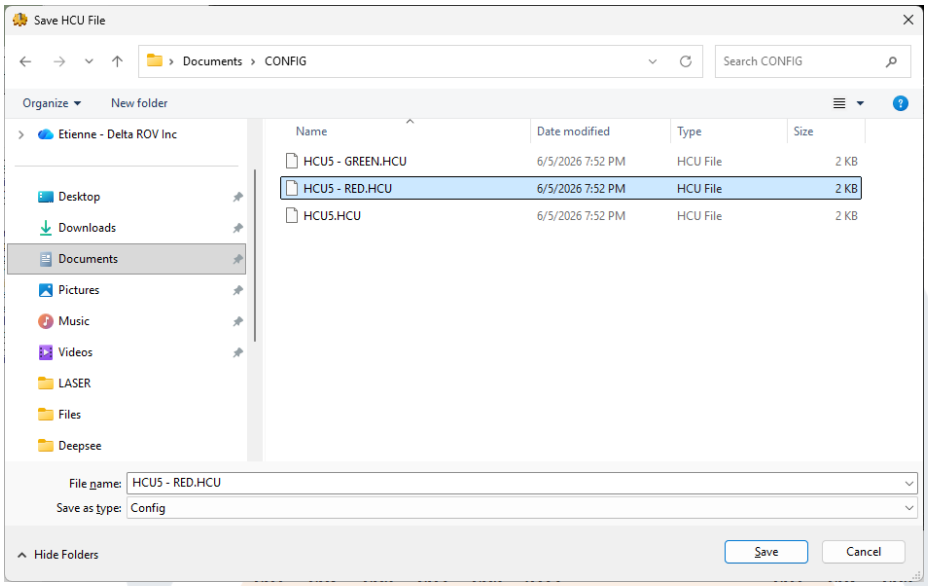
The LCD will display **REBOOTING HCU…** for about 1 second before going through Startup. Once the Operation screen appears, the HCU is ready for use. (No need to unplug/plug)

5.4.5. SAVING YOUR CONFIGURATION TO AN HCU CONFIG FILE

You may want to save your HCU configuration for a certain setup or to roll it out to other HCUs you have purchased. It's always a good idea to save your configuration for safekeeping.

It is important to note that you will only save 1 mode at a time. So, you should save 3 files, one for each mode.

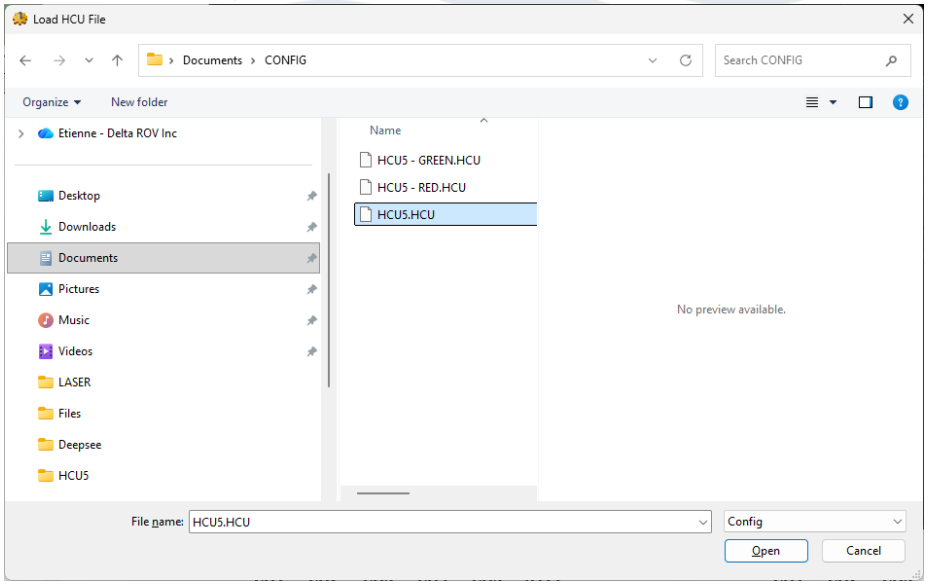
To do so. Press the SAVE button. Then choose the folder and filename.



5.4.6. LOADING YOUR CONFIGURATION WITH AN HCU CONFIG FILE

The easiest way to program your HCU is by loading an HCU config file. You can get one from Delta ROV's website or create your own.

To load a config file, press the LOAD button. Then locate and select a *.HCU file and click open.



6. HCU CONFIGURATION SOFTWARE

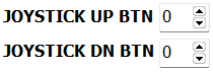
The HCU configuration software allows you to program the HCU with new button assignments, different axes etc. You can dowload it from the download section of our website.

This software is designed to work with Windows 10 and 11.

6.1. USER BUTTONS

There are 15 User Buttons. They are UB1,2,3,4,5,6,7,8,9,10,11,12,13 and JOYSTICK UP,DN buttons (see section 4.1)

Each BTN can be configured to trigger button 1 to 64 in windows. Set the button to 0 if the button is to be disabled.

This is done by changing the correcponding Speed Button AND 

6.2. SELECTOR BUTTONS

There are 4 selector buttons. They are MODE, GAIN, TILT AND LIGHT (See section 4.1)

6.2.1. MODE BUTTON

The Mode selector button will allow you to cycle through the 3 different configurations stored on the HCU from normal (off) to red, to green and back to normal.

These modes are very useful for storing different configurations of your HCU. For example, you could store 3 different ROV configurations on the HCU and use the same HCU for 3 different ROVs. You could also opt to use Normal configuration and on red use a Reverse stick configuration to make it easier to fly the ROV reverse. Etc.

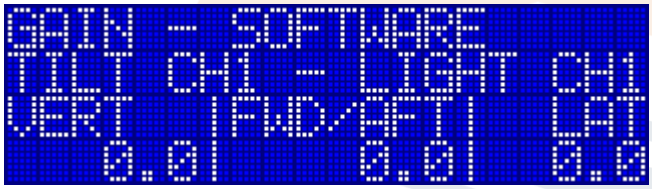
6.2.2. GAIN SELECTOR BUTTON

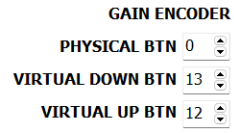
The gain selector button will change the selection from Software, Lateral, Forward / Aft, Rotate, Vertical. This selection will dictate what the Gain encoder will do.

Software is used to trigger gains in the piloting software such as QGroundcontrol or NavX. This usually affect the thruster output of all axis at the same time.

The other gains are internal to the HCU and can be set independently. This is particularly useful when the software gain is set to 100% and the pilot wants a smoother control of the other axes such as rotate. Making it easier to control the ROV at high thruster output.

Software Gain: Triggers the virtual buttons specified on the GAIN ENCODER speed buttons shown on the left.

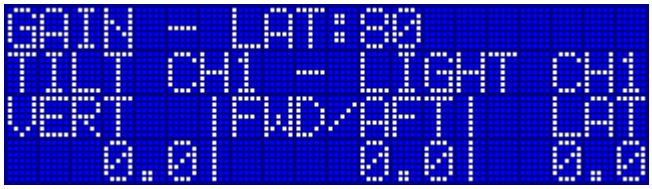




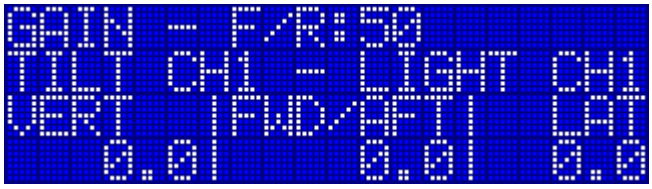
In other words, 13 will be GAIN DOWN in QGroundcontrol and 12 will be GAIN UP. Rotating the Gain encoder will be the equivalent of pushing button 13 or 12 on a regular joystick. The PHYSICAL BUTTON is the button triggered when the encoder is pressed down. The number of steps required by the encoder before the button is triggered is setup by TRIGGER STEP 3. When turning an encoder, every "tick" felt corresponds to 4 steps. What works best is to leave the default of 3 steps.

How long the virtual button is pressed is defined by TRIGGER TIME 250.

Lateral Gain: Changes the joystick's output before it is sent to the computer. In the example below the LAT gain is set to 80%. This means that when the joystick is moved side to side, the resulting output will be multiplied by 80%. Leaving the other axes untouched.



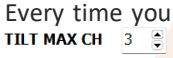
Forward / Reverse Gain: Changes the joystick's output before it is sent to the computer. In the example below the F/R gain is set to 50%. This means that when the joystick is moved forward and back, the resulting output will be multiplied by 50%. Leaving the other axes untouched.



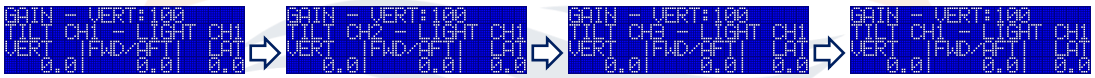
Rotate Gain: Changes the joystick's output before it is sent to the computer. In the example below the ROT gain is set to 20%. This means that when the joystick is rotated CW and CCW, the resulting output will be multiplied by 20%. Leaving the other axes untouched.

Vertical Gain: Changes the joystick's output before it is sent to the computer. In the example below the VERT gain is set to 100%. This means that when the vertical joystick is pushed UP and DOWN, the resulting output will be multiplied by 100%. Leaving the other axes untouched.

6.2.3. TILT SELECTOR BUTTON

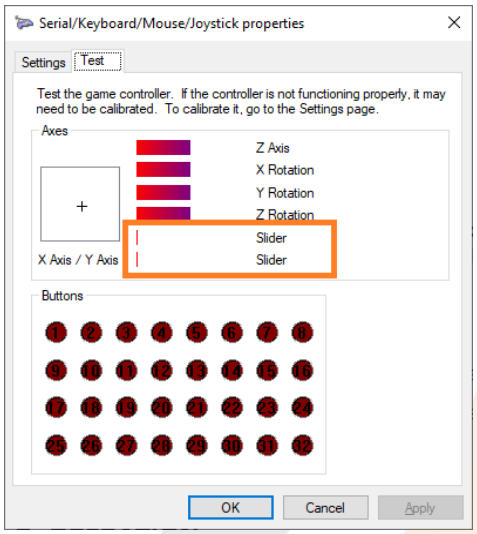
Every time you press the TILT Selector the channel on the HCU LCD will go in a loop from CH1 to 

and back to CH1. In the example below MAX CH is set to 3.



The TILT encoder will either trigger the buttons associated with the selected channel or change the slider value. In windows a slider is like an axis but usually used to control something linear like a TILT, LIGHT, POWER etc.

In the window below, the Slider 1 and 2 are highlighted in orange.



TILT ENCODER

	CH1	CH2	CH3	CH4	CH5	STEP
PHYSICAL BTN	8	0	0	0	0	
SLIDER ALLOCATION	0	0	0	0	0	100
VIRTUAL DOWN BTN	10	0	0	0	0	
VIRTUAL UP BTN	11	0	0	0	0	

The HCU allows up to 5 Tilt Channels.

The Physical button will either trigger the assigned button or will set the slider value to 50%. (Tilt center)

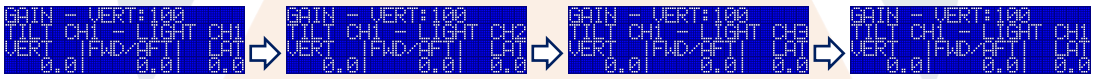
The virtual buttons will be triggered as if a physical button is pressed.

The slider allocation will send the encoder value will be sent to the corresponding slider.

If a value in SLIDER ALLOCATION is greater than 0, the PHYSICAL BTN, VIRTUAL DOWN BTN AND VIRTUAL UP BTN values will be ignored.

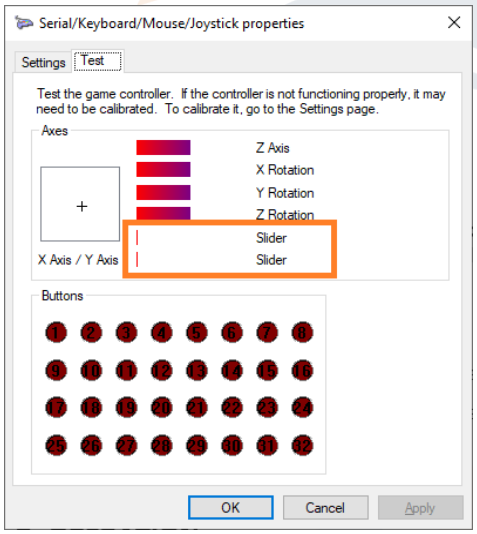
6.2.4. LIGHT SELECTOR BUTTON

Every time you press the LIGHT Selector the channel on the HCU LCD will go in a loop from CH1 to LIGHT MAX CH 3 and back to CH1. In the example below MAX CH is set to 3.



The LIGHT encoder will either trigger the buttons associated with the selected channel or change the slider value. In windows a slider is like an axis but usually used to control something linear like a TILT, LIGHT, POWER etc.

In the window below, the Slider 1 and 2 are highlighted in orange.



LIGHT ENCODER

	CH1	CH2	CH3	CH4	CH5	STEP
PHYSICAL BTN	0	0	0	0	0	
SLIDER ALLOCATION	0	0	0	0	0	100
VIRTUAL DOWN BTN	14	0	0	0	0	
VIRTUAL UP BTN	15	0	0	0	0	

The HCU allows up to 5 LIGHT Channels.

The Physical button will either trigger the assigned button or will set the slider value to 0%. (Light Off)

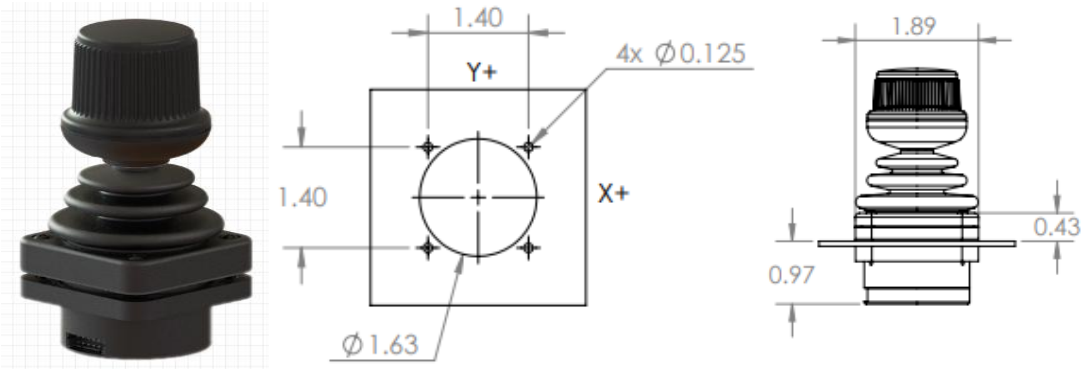
The virtual buttons will be triggered as if a physical button is pressed.

The slider allocation will send the encoder value will be sent to the corresponding slider.

If a value in SLIDER ALLOCATION is greater than 0, the PHYSICAL BTN, VIRTUAL DOWN BTN AND VIRTUAL UP BTN values will be ignored.

6.3. 3-AXIS HALL EFFECT JOYSTICK

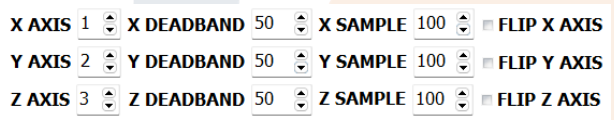
The standard joystick we use is a RUFFY CONTROLS HE2-30-S-A-1-BK.



This is an off-the-shelf product that is used is many commercial HCU solutions worldwide. The hall effect sensor is a chip and the joystick has a magnet that moves above it. This means that there is no friction like a tradditional potentiometer based joystick. The signal will not degrade over time and will remain consistent.

The axes X,Y,Z traditionally controll the lateral, forward/aft and rotate of the ROV/Drone.

The HCU Configuration software allows you to change several axis parameters as follow:



The AXIS speed buttons specifies which axis will be controlled. In the example on the left, X AXIS (left/right) is assigned 1. This is equal to X-axis in Windows.

The deadband speed button specifies a “dead zone” from the center of the joystick. Since the controller is 16 bits the value range is +/-32676.

In the example on above, the X Deadband is set to 50. This is less than 0.2% but is usefull to filter out the noise from the power supply resulting in a smooth joystick output from the HCU.

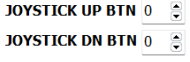
The SAMPLE speed button is used to specify how many time the joystick analog voltage is read before the value is used for windows.

In the example above, the X SAMPLE is set to 100 which means that the joystick X axis voltage will be read 100 times, then averaged before the value is used in windows.

Although this might look like a lot, the MCU runs at 600 MHz, and the Cortex-M7 core can issue up to two instructions per cycle, so real-world throughput is on the order of several hundred million to roughly a billion instructions per second depending on what the code is doing and where it lives in memory.

Sampling 100 times is not noticeable by eye. This is mostly useful for smoothing the signal. You can test this by setting it to zero and you will find that the joystick value in the joystick properties will vibrate a lot.

The Flip checkboxes will flip the direction of the axis. For example, if you want the joystick to go backward when you push forward, put a checkmark in the FLIP FWD/REV checkbox.

Optionally the joystick can be ordered with 2 buttons on the top. This would have a different part number: HE2-32-S-A-1-BK HE2 and button assignments are 

6.4. SINGLE AXIS HALL EFFECT JOYSTICK

Several options are available depending on user preference and budget.

These off-the-shelf controls are ideal for controlling the vertial direction of your ROV/Drone.

You can find the control variables on the HCU software as follow:

These parameters work exactly the same as the one discussed in section 6.3. Please refer to that section for more information.

6.4.1. OPTION 1 – APEM BL SERIES

This paddle style joystick (BL140A01BKBK0500) is self centering and sits higher than the other options. It requires the index and thumb to be used properly and offer a very smooth control of the ROV vertical axis. Best for fine tune flying.

6.4.2. OPTION 2 – RUFFY MSA SERIES

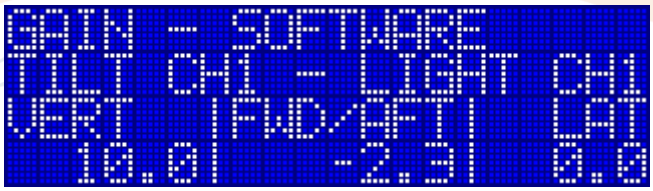
This thumb style joystick (MSA-1-1-BK-1-4) is self centering and sits lower than the other options. It only requires the thumb to be used and allows the operator to hold the HCU in his hands while flying the ROV. Best for pilots that are mostly standing while flying.

6.4.3. OPTION 3 – APEM TW SERIES

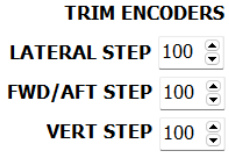
This hybrid style joystick (TW01BLK11) is self centering and sits slightly higher than the MSA option. It can either be used with the thumb or with thumb and index finger. It offers a combination of both advantages of the above options but is not as comfortable to use long time.

6.5. TRIMMING ENCODERS

The trimming encoders are VERT, FWD/AFT and LATERAL.



The values are displayed as +/- 100.0% on the LCD



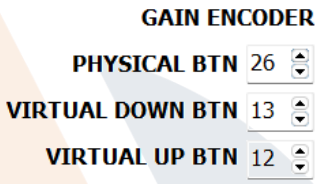
The trimming encoders are used to add or substract values to the output. Since the controller is 16 bits the value range is +/-32676. For every tick that the encoder is rotated, it takes 4 steps. This is then multiplied by the value in the HCU config software. In the example below, each axis is set to 100. This means tha for each tick, the actual step will be 400. There are 20 ticks per revolution so each revolution will be 8000 steps. It will therefore take approximately 4 turns to travel from 0 to 100% trim. Adjust the steps depending if you want a coarse of fine trim of your thrusters.

Each encoder have a push button which will reset the trim back to zero.

6.6. GAIN ENCODER

The gain encoder can either trigger buttons or adjust the gain of Lateral, Forward / Aft, Rotate, Vertical joystick commands depending on which option is selected. (See section 6.2.1)

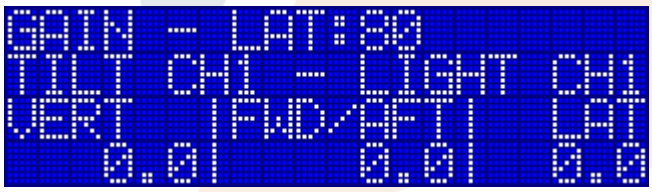
When software GAIN is selected, the encoder will trigger the buttons assigned to DN/UP. As per the example underneath.



In addition, the encoder puch button can trigger a button if specified in the PHYSICAL BTN shown above.

In this example windows button 26 will be triggered if you push the encoder when SOFTWARE GAIN is seleced.

When Lateral or Forward / Aft or Rotate or Vertical GAIN is selected, the encoder will change the gain from value 100% to 0%. The example below shows the Latitude being set to 80%.



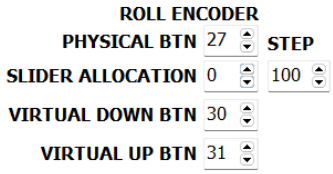
This means that when you push the joystick fully left or right, you will have a maximum of 80% command.

Gain control is particularly useful if you wish to distribute power to the ROV where it matters. Also, you might want to limit the speed of turn when you are operating at full power.

TIP. You can save your gain setting by executing combo **ID#6** as seen in section 4.2.

6.7. ROLL ENCODER

The roll encoder can either trigger buttons or update an axis/slider in windows.



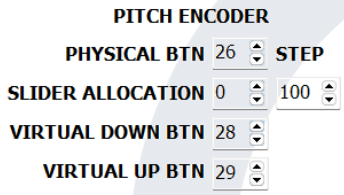
If the slider value is different than 0, the button triggers will be ignored.

In the example on the left, buttons 30 and 31 will be triggered when the encode is rotated and button 27 will be triggered if the encoder is pushed down.

Adjust the steps depending if you want a coarse of fine trim of the roll slider.

6.8. PITCH ENCODER

The pitch encoder can either trigger buttons or update an axis/slider in windows.



If the slider value is different than 0, the button triggers will be ignored.

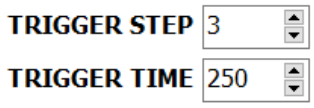
In the example on the left, buttons 28 and 29 will be triggered when the encode is rotated and button 26 will be triggered if the encoder is pushed down.

Adjust the steps depending if you want a coarse of fine trim of the pitch slider.

6.9. TRIGGER SETUP

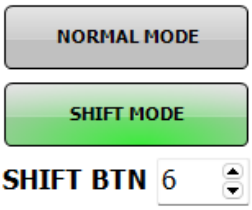
The encoder triggers can be setup so that it triggers after a certain number of steps. Since each **tick** when rotating the encoder is 4 steps, setting **TRIGGER STEP** too low will make it too sensitive and setting too high may require several **tick**s of the encoder before the button is triggered.

In the example below, the **TRIGGER STEP** is set to 3 which is the ideal value to ensure the button gets triggered each **tick**.



Since the HCU **presses** the button for you, **TRIGGER TIME** will specify how long the button is pressed for.

6.10. SHIFT BUTTON



On Logitech, X-box, joysticks, there is a shift button.

In order to be compatible with Qgroundcontrol based ROVs such as the BlueROV2, the HCU has a **SHIFT MODE** function. If **SHIFT MODE** is selected, buttons numbered 17 to 32 will instead trigger the **SHIFT BTN** and button number minus 16.

SHIFT BTN sets which button will be triggeres as the SHIFT.

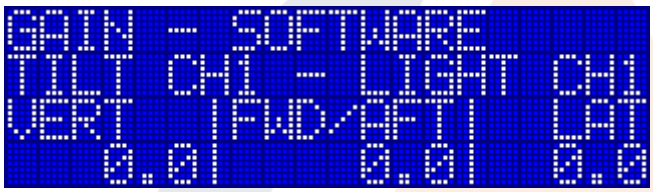
This way, you do not have to press a shift button yourself to access more button functions.

7. OPERATION

7.1. STARTUP

Upon startup the welcome screen will show up for 5 seconds.

Then the main screen will appear.



The HCU can then be used to control your ROV/Drone.

7.2. MODES

Pressing the mode button will cycle through the different modes.

HCU from normal (off) to red, to green and back to normal.

The HCU has 3 modes of operations; Normal, Red, Green. This is basically 3 different sets of configurations saved in the HCU memory. IE when you press **MODE** button, the HCU will load the RED configuration into the active settings.

The active settings are what is being sent out of the HCU.

This basically allows the pilot to switch to reverse to follow the tether back to the launching point or switch to crawler mode to ride inside a pipeling if a crawler is installed for example.

8. QUALITY CONTROL FORM

8.1. ASSEMBLY

Serial Number	
Assembled by	
Assembly Completion date	
Signature	

8.2. QC CHECK

QC Assessor	
QC Date	
Configuration loaded	
Assessment result	
Comments	
Signature	

8.3. WARRANTY

The HCU is covered 1 year for parts and labor against manufacturing defects.

Invoice number	
Start of warranty	
End of warranty	