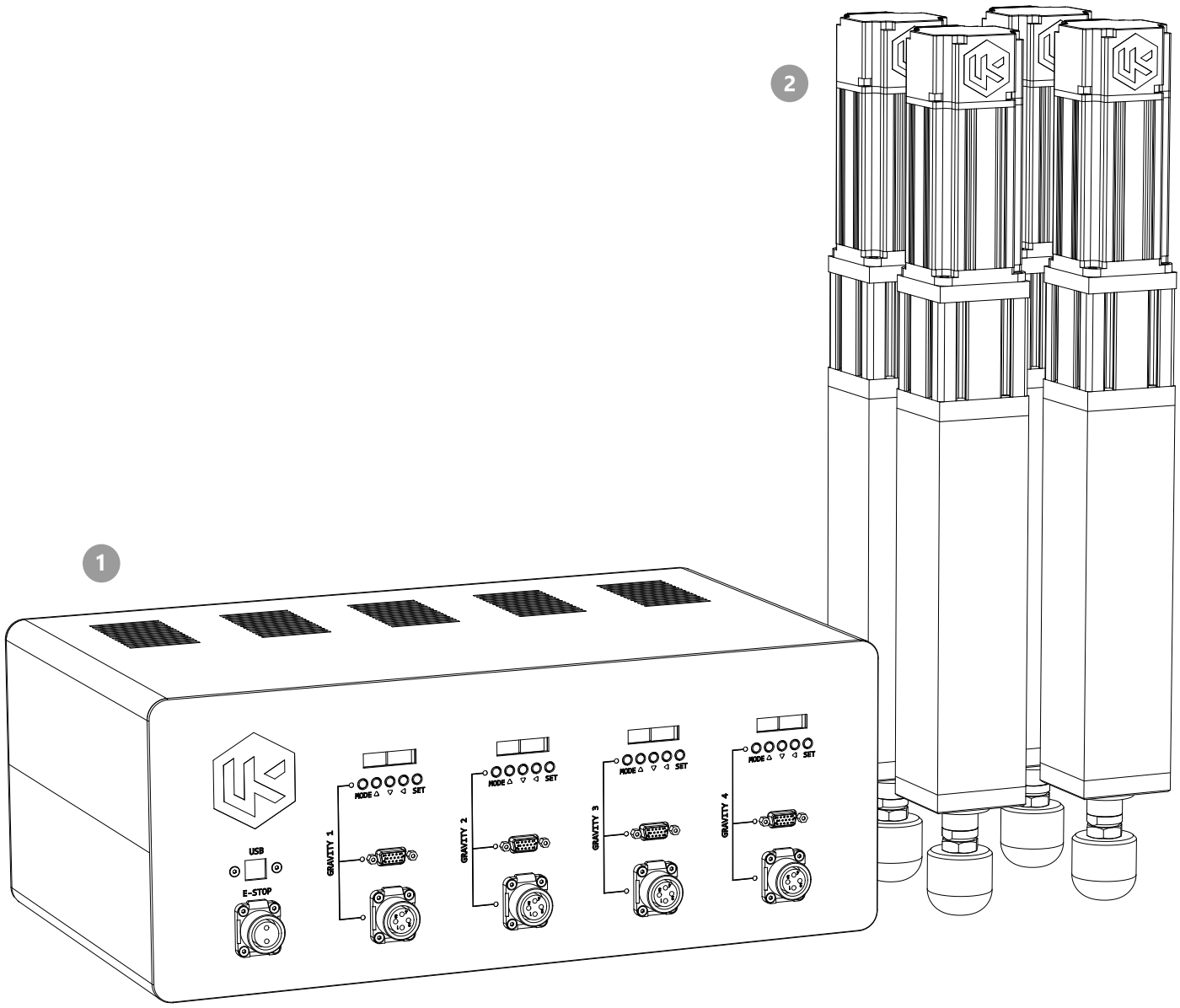
GRAVITY SYSTEM
OPERATION MANUAL



LOGYKAL
INNOVATIVE ENGINEERING

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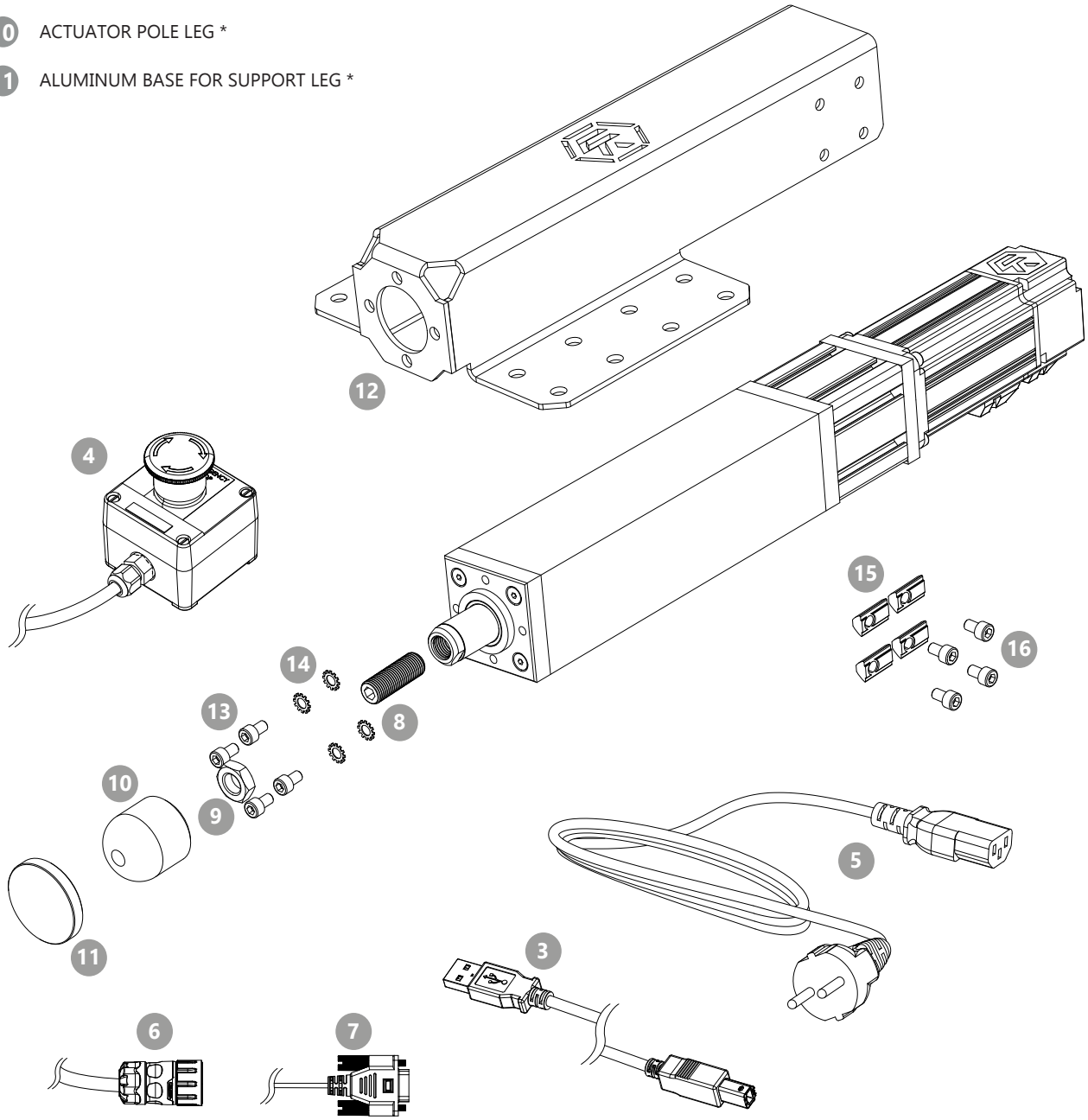
PACKAGE CONTENT

1. MOTION BOX GRAVITY
2. GRAVITY ACTUATOR *
3. USB CABLE
4. E-STOP WITH 3M CABLE
5. SCHUKO AC POWER INPUT CABLE - C19
6. ACTUATOR POWER CABLE *
7. ENCODER CABLE FOR ACTUATOR *
8. DIN 916 M14X150 STUD *
9. M14X150 LOCKING NUT *
10. ACTUATOR POLE LEG *
11. ALUMINUM BASE FOR SUPPORT LEG *
12. HIGH RIGIDITY ANCHOR FOR 40X160MM ALUMINUM PROFILE STRUCTURE **
13. 4 X ALLEN SCREW 912 M6X12 *
14. 4 X M6 PRESSURE WASHER *
15. 8 X M6 NUT WITH GROOVED PROFILE SPRING *
16. 8 X ALLEN SCREW 912 M6X10 *



* By number of actuators according to system, 2DOF, 3DOF, 4DOF.
** Optional anchor.

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OPERATING PRINCIPLE

The **Motion Box Gravity system** controls **Gravity actuators** responsible for transmitting the telemetry information collected from the simulators.

Our **Lince V2.0 software** reads the telemetry provided by the simulators and applies control algorithms to the actuators to reproduce the effects of the simulated environment as faithfully as possible.

In addition to reflecting pure movements relative to the angular and linear displacement of the different axes, calculation algorithms are also applied to replicate effects and G's forces .

SAFETY INSTRUCTIONS

This system is not a toy. To properly operate its capabilities, it is necessary to carefully read this manual and carefully follow the machinery safety regulations established in your country.

The equipment must be perimeter to prevent access to any unqualified person when it is in operation.

Depending on the design and engineering development of the cockpit where this equipment is installed, it will be necessary to signal the areas with danger of entrapment and limit their access to unauthorized personnel while it is being used.

The manufacturer and / or user of any machine that has integrated the LK Gravity movement system must properly secure or anchor the structure to avoid overturns, sinking, shocks, falls at any level, entrapments, cuts, blows and projections.

At the moment when the equipment comes to a standstill due to error, alarm, overload, loss of supply voltage or any other event that causes the system to stop being powered, the system will not be able to maintain the position and will fall sharply depending on the acceleration of fall and speed of the same of the weight of the platform / pilot set.

It is the responsibility of the user to establish the safety precautions inherent to the place of use as well as those inherent to the type of motion simulation to be executed.

Use and application

This equipment is a system to move weights with great speed, precision and high repeatability of positioning.

With our Lince 2.0 software, it performs movements that replicate the telemetry sent by automobile driving simulators, flight and air navigation, space navigation, etc ...

Use of protections

Depending on the type of simulation, we recommend the use of passive safety devices such as piloting gloves and safety belts.

Ventilation

The control elements have an electrical consumption that generates heat, it is important for the quality of the experience to have a properly conditioned and sufficiently ventilated room.

Vibrations

The system could causes vibrations and movements of all kind within the ranges established by the specifications of the actuators. The simulation environment must be properly conditioned so that these movements and vibrations do not violate any public regulations.

Noise

The system does not generate noise that poses any health risk, therefore no special protection against noise levels is needed.

Maintenance

- Keep the Motion Box Gravity control box in a ventilated area.
- Keep the ventilation slots free of objects that prevent the convection of air for cooling.
- Keep items adequately clean of dust
- Do not spill liquids on any element.

INSTRUCTIONS FOR USE

1 – Locate the Motion Box Gravity in a suitable, protected and properly ventilated place.

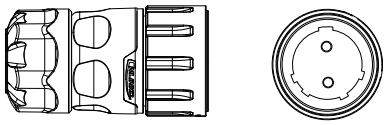
2 – Connect the power plug to a Schuko plug, if you are a user of any country outside the European community area, use an adapter that meets the appropriate power requirements. If your country does not have a 220AC / 230AC power supply, use a voltage converter.

⚠ This equipment only works at 220AC / 230AC

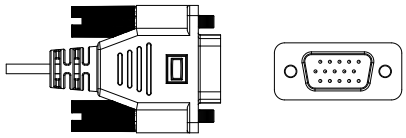
3 – Connect the USB to a USB 2. * * or 3.. ** port of your PC. This system operates with Windows 7/8 and Windows 10, verify that the operating system has correctly recognized the Motion Box Gravity in the device panel.

4 – Connect the emergency stop button to the Motion Box Gravity and place it in a suitable position and easily accessible to the system user.

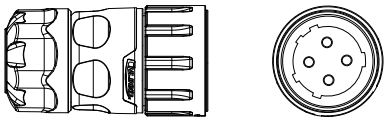
5 – Carry out the mechanical assembly of the actuators in the appropriate positions according to the simulation booth designed or acquired from the manufacturer. Use the supplied anchor and support elements for this.



6 – Connect the data and encoder cables of each actuator to one of its inputs, secure the connector with the fixing screws to prevent accidental disconnection.



7 – Insert the power connectors of the actuators, holding the bayonet connector fully until it is fixed in its safe position with a 30º turn. **Each power connector must be paired with the data connector of its own actuator, otherwise the system will present an error and will not work**.



8 – Make sure that the wiring is correctly arranged, that it does not interfere in the passageways or with moving elements.

9 – Use the support legs and aluminum bases to avoid floor deterioration and facilitate small displacements of the legs in systems that use the vertical actuator mounting mode and require movement margins.

10 – Turn on the power using the rear switch of the Motion Box Gravity. Upon receiving power, the front displays will show the encoder position that should be close to 0.

11 – Start program Logykal **Lince V2.0**, proceed to identify and select from the dropdown list the simulator you want to use, then click the settings tab and select the system you have, for instance if 4xfloating mode 4 actuators auto-suspended. Select the actuator model you are using, in this case LK Gravity 100/150 or 200mm. Go back to the previous tab and save the settings. **Restart the Lince**. You can learn more about the Lince configuration in the section "**Installation, configuration and first steps in Lince V2.0**"

12 – When restarting Lince, if everything has been configured correctly, the actuators will move to their central position and the system will be ready to start the simulation.

13 – In the event of any incident, erratic operation, loss of control or operation error, you can can stop the movement by closing the application, if it is not possible to operate the controls properly, the emergency stop button will immediately stop the actuator function.

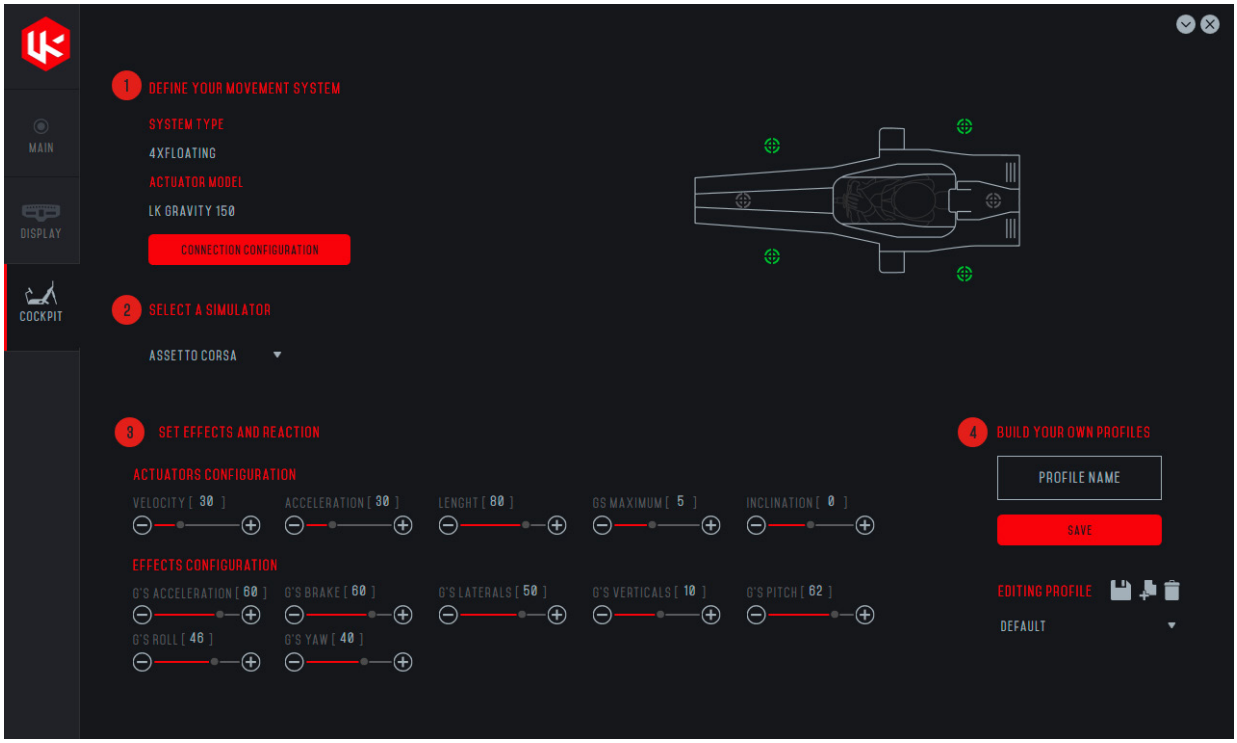
Pressing the emergency stop completely inhibits the movement of the actuators and deprives them of power. This will always and in all cases cause the sharp fall of all the elements supported by the actuators, which can cause injuries due to entrapment or breakage of elements. Logykal is not responsible for the incorrect use or omission of the safety regulations.

INSTALLATION, CONFIGURATION AND FIRST STEPS IN LINCE V2.0

1 – Download the software from the My Account / Downloads section of Logykal store (store.logykal.com/en) and install it.

2 – Start Lince V2.0, enter the license number and login with the online store credentials.

3 – Once the registration is done go to the "Cockpit" tab and click on "Connection configuration"



4 – In "System type" select the one that corresponds to our system:

SYSTEM	DESCRIPTION
1xOver	1 Linear actuator for loss of traction
1xAcceleration	1 Linear actuator for acceleration and braking
2xRear	2 two axes of freedom (x, y) placed behind
2xRear(Legacy)	2 For SCN5 / 6 actuators using a single COM port
2xFront	2 two axes of freedom (x, y) placed in front
2xFront(Legacy)	2 For SCN5 / 6 actuators using a single COM port

2xRear + 1XBelt	2 two axes of freedom (x, y) back + belt tensioner or acceleration / braking (b)
2xFront + 1XBelt	2 two axes of freedom (x, y) in front + belt tensioner or acceleration / braking (b)
2xRear + 1XOver	2 two axes of freedom (x, y) back + loss of traction (a)
2xRear + 1XOver(Legacy)	2 For SCN5 / 6 actuators using a single COM port
2xFront + 1XOver	2 two axes of freedom (x, y) in front + loss of traction (a)
2xFront + 1XOver(Legacy)	2 For SCN5 / 6 actuators using a single COM port
3 Floating	3 Actuators in freestanding platform mode, three axes of freedom (x, y, z)
3 Motion	3 Actuators in freestanding platform mode, three axes of freedom (x, y, z)
2xFront + 1XBelt + 1XOver	2 two axes of freedom (x, y) back + acceleration / braking + Loss of traction
2xRear + 1XBelt + 1XOver	2 two axes of freedom (x, y) front + acceleration / braking + Loss of traction
4xFloating	4 Actuators in freestanding platform mode, three axes of freedom (x, y, z)
3xFloating + 1xOver	3 Active in self-supporting mode, 3 axes of freedom + Loss of traction (x, y, z, a)
4xFloating + 1xOver	4 Active in self-supporting mode, 3 axes of freedom + Loss of traction (x, y, z, a)
4xFloating + 1xBelt	4 Active in self-supporting mode, 3 axes of freedom + Acceleration / braking (x, y, z, b)
4xFloating + 1xOver + 1Xbelt	4 Active in self-supporting mode, 3 axes + Traction loss + Acc / Fr. (x, y, z, a, b)
4xFloating + 2xRear	4 Active in self-supporting mode, 3 axes + 2x Loss of traction (x, y, z, a, a)
4xFloating + 2xBelt	4 Active in self-supporting mode, 3 axes + 2xAcc / Fr. (x, y, z, b, b)
2xFront + 2xBelt	2 Front act., 2 axles + Traction loss + Acc / Fr. (x, y, a, a)
Stewart Platform	Hexapod control in development

Description of axles:

Cartesians

X - Abscissa
Y - Ordered
Z - Height

Polar

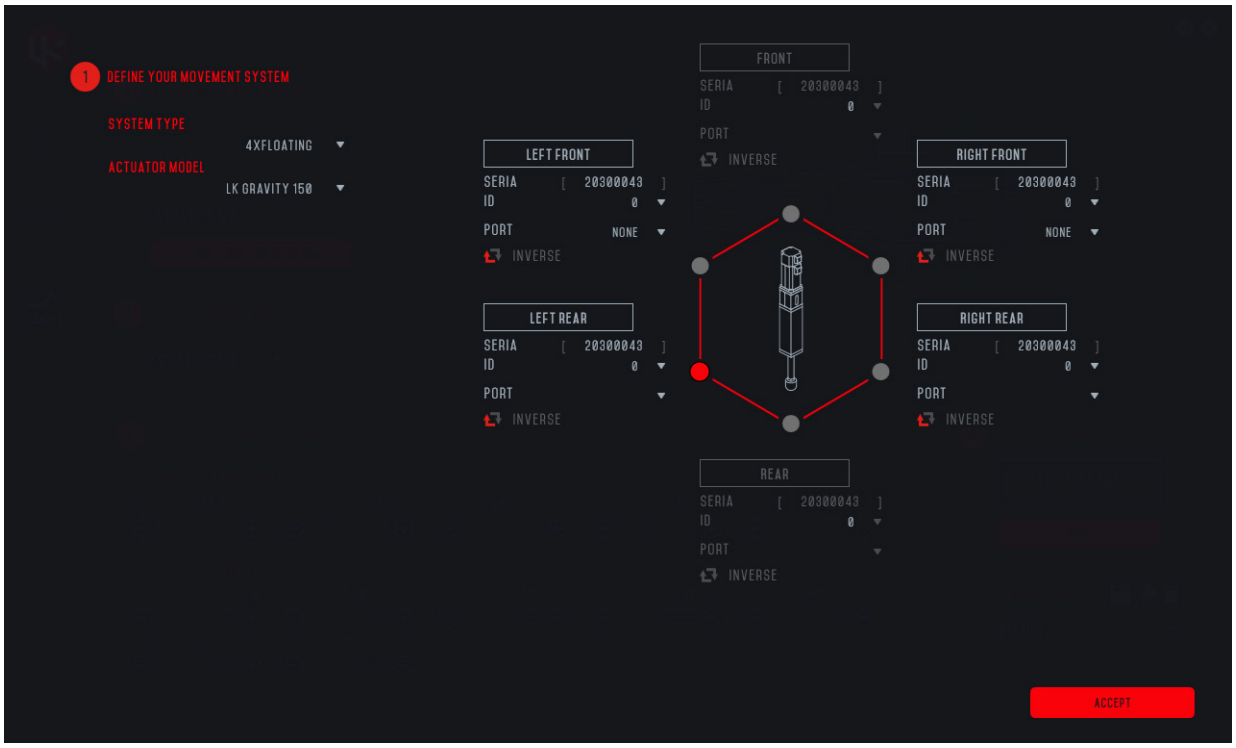
A - Rotation in the x, y plane
B - Rotation in the y, z plane
C - Rotation in the x, z plane

5 – click on "Actuator Model" and select the actuator that we have mounted.

ACTUATOR MODEL	DESCRIPTION
LK GRAVITY 200	200mm travel Gravity actuator

LK GRAVITY 150	150mm travel gravity actuator
LK GRAVITY 100	100mm travel Gravity actuator
LK TEST 200 *	200mm travel Gravity actuator
LK TEST 150 *	150mm travel Gravity actuator
LK TEST 100 *	100mm travel Gravity actuator
DIADYC SNC6 [300]	300mm SCN6 actuator
DIADYC SNC6 [200]	200mm SCN6 actuator
DIADYC HYPERAXIS [100] **	SCN6 actuator
DIADYC SNC5 [150]	150mm SCN5 actuator
DIADYC SNC5 [100]	100mm SCN5 actuator
DIADYC SNC6 [150]	150mm SCN6 actuator
DIADYC SNC6 [100]	100mm SCN6 actuator

* DO NOT USE
** Compatible with Hyperaxis and Dura-Hyperaxis



Place each actuator in one of the boxes of the position presentation hexagon. It does not matter if we do not know exactly what position they are in, in a subsequent process we will define their positions with respect to the real geometry of the simulator in which they are mounted.

In the case of Gravity, must only indicate the COM port where the actuator must be located, leaving the “serial number” box empty and the ID always set to “0” regardless of the position.

Once all the actuators are positioned, return to the previous tab, **save the configuration and restart Lince V2.0**.

When starting Lincev2.0, the actuators will search their central position automatically. With the platform centered we will return to the configuration tab. In each corner of the position representation hexagon a circle is shown that changes to red when we hover the mouse over it. Position ourselves on the first one, and press it, the actuator corresponding to the COM port defined in that position will move a few millimeters down and up.

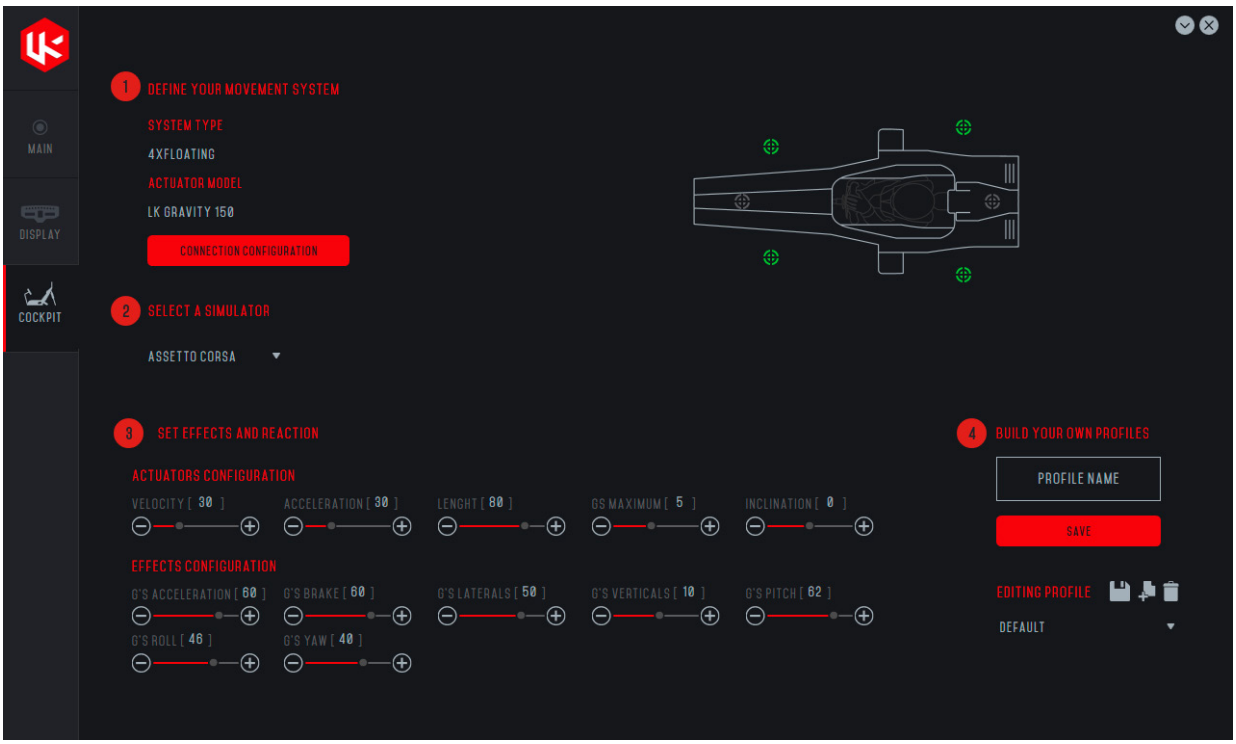
Take note of the port of that position and observe the actuator moving. If it is not in the correct position, take note of what its position should be.

Carry out the movement with all the actuators, noting the assigned com and the position in which they move. Once we have all the data, change all the COMs at the same time to the position in which the actuators have moved. Leave the configuration tab, **save the profile and restart Lince**.

When starting up, Lince will center the actuators again and we will move them again individually by clicking on the red dot of the hexagon and now they should each be in their position. If they are not correctly established, repeat the previous process.

As soon as the actuators are correctly detected and positioned, you can start using your Gravity system with your preferred simulator.

CONFIGURE MOVEMENT OF YOUR SIMULATOR, FIRST STEPS



Description of the configuration controls:

ACTUATOR CONFIGURATION	DESCRIPTION
VELOCITY	% of speed over maximum actuator performance
ACCELERATION	% of the acceleration value on the maximum performance of the actuator
LENGHT	% of travel over the maximum actuator stroke
G'S MAXIMUN *	Maximum g's that can be generated by the vehicle with which we are simulating *
INCLINATION	Only for installations where any inclination of the ground where the simulator is installed must be compensated. We strongly advise mechanically leveling the simulator and not using this software fix.

* For example, if a formula1 or Indicate generates a maximum value of 5 g's, we must set the slider at 5, if a GT2 generates a maximum G's of 1.5, we must set the slider at 1.5. It is not a G's selector itself since no actuator will be able to reproduce maintained g's but it acts as a speed filter in which 1 is the maximum designated speed and 10 is the minimum.

Description of effects configuration:

EFFECTS CONFIGURATION	DESCRIPTION
G'S ACELERATON	% effect on car acceleration
G'S BRAKE	% effect on car braking
G'S LATERALS	% effect on lateral movement in curves
GS' VERTICALS	% of effect on the Z axis
G'S PITCH *	% rotation effect in y, z plane
G'S ROLL *	% rotation effect in x, z plane
G'S YAW *	% rotation effect in x, y plane

* (only for flight simulators)

As a basis for achieving an initial configuration quickly and efficiently, the following steps should be followed:

- Set all controls to 50% and maximum G's to 1 (incline should always be at 0)
- Evaluate the behavior of our simulator with the chosen vehicle

If the behavior is too abrupt, and without taking the travel margin into account, raise the Maximum G's slider a couple of points or more, save the profile and try again. When the reaction to the g's is correct, we will define the rest of the parameters.

If you need a greater range of motion, increase the travel slider. It is not appropriate to take it to 100% because in case of reaching the maximum defined g's in braking will lose the feeling of bumpy terrain since it will reach its limit of travel and will not respond to the effects of fast bumps and vibrations of the track. We do not advise going over 85% of your route.

- Now you can work with the speed and acceleration slider until find values that bring you closer to our piloting experience. The more experience we have had on the real circuit, the better we can reflect the behavior of the vehicle. In the event that we have not had the opportunity to driver on a real circuit, we advise setting up soft responses at the beginning, as our experience with the movement consolidates, the pilot himself will require more forceful responses and less range of motion ranges than we can reduce or increase with the "travel" slider.

With some initial values of the sliders described above we can go on to **configure effects**.

- With the **acceleration G's** we will define the level of sensation we need when we accelerate to maximum power, it will also sensually inform us of gear changes and the sensation of skidding due to excess traction, providing proprioceptive information. We calibrate this value based on circling our preferred circuit until we have a suitable sensation.
- The same thing happens with the **G's braking**. We must test the maximum intensity braking until we achieve a suitable sensation. The braking effect is more complex and should provide us with more precise driving information, from the sensation of loss of traction to that of tire lock, this is the most laborious effect and will be influenced by more configuration parameters.

  If with maximum braking at maximum g's the vehicle loses the ability to reproduce fast bumps on the track, we will have to modify the travel slider and find more margin to reproduce those fast bumps and not lose the feeling of control under heavy braking. Once again it depends on our experience to fine-tune the effects and travel to find the desired point.
- With **lateral G's** and **vertical G's** we will follow the same process until we find the sensations that help us to be more efficient in riding.

  The lateral G's can cause sensations of excess movement due to the "shaking" they cause, it is advisable to be moderate with this effect. The vertical G's are very relevant in Rally simulators as they favor the sensations of "flight" in very pronounced changes in grade.

SPECIFICATIONS

LK-GRAVITY ACTUATOR

Dimensions: 500 - 550 - 600 x 60 x 60 depending on the path length (100, 150, 200mm)
Path length: 100/150/200mm
Power: 600 W / 3.5 A
Speed: 250 mm/s
Load Supported: More than 200 kg
MAX Load Capacity: 351 kg
Weight: 4.6 kg
Communication: RS485 Puerto Serie
Limits: By Software
Degree of protection: IP64

MOTION BOX GRAVITY

Dimensions: 464 x 274 x 180 mm
In*: AC 220v 10A 50/60hz
PC Communication: USB 2.0 / 3.0
Emergency stop: Switch

* For countries outside the EU where your network is different from 220v, a transformer will be required.

Supports and / or anchors for 80mm aluminum profiles & screws for anchoring the elements

POSSIBLE FAILURES

SYMPTOM	PROBLEM	SOLUTION
The front display are off	Motion Gravity has no power	» Check that the cable outlet is connected to a 220V AC outlet. » Check the main switch is activated . » Check the 20A fuse.
One or more displays have "21 Error"	Communication error with encoder	» Check that the cable and ncoder is paired with its power cable. » Check cable condition.
When starting the LINCE V2.0 control program the actuators do not center	Lince V2.0 does not detect the actuators	» Check that the emergency stop is not on. » Check the FTDI Driverrs of COM ports. » Check USB cable.

* Logykal is not responsible for the incorrect use or omission of safety regulations.

ALARM CODES

PROTECTION FUNCTION	ALARM CODE	CAUSE OF FAULT	ACTION
System error	1	» System error.	» Restore the factory parameters, if no, the driver should be repaired. » Contact customer support.
DI configuration error	2	» For PA_080 ~ PA_085 parameters, if there are two same values (except 22), then an error will be reported.	» Set the parameters differently, or 22 (invalid). » Contact customer support.
Communicati on Errors	3	» Abnormal ModBus communication.	» Check if the communication line is broken; check if the main station suddenly stops accessing the servo.
The control power is off	4	» The control power is off.	» RE-POWER ON.
Fpga internal error	5	» FPGA internal error	» Restore the factory parameters, if not, the driver should be repaired. » Contact customer support.
Zeroing timeout	6	» The origin has not been found for a long time.	» Check if the zeroing-relevant sensor input is working properly. » Check if the zeroing mode is consistent with the current mechanical installation mode, that is, whether the zeroing mode is set correctly. » Encoder Z phase missing. » Contact customer support.
Overvoltage	12	» External source input voltage is much greater than 220VAC. » Resistance braking function was not started. » In case disconnected wiring, whether the braking resistor is damaged, and whether the brake pipe is damaged. » Braking energy is too large	» Replace the appropriate input power immediately » Check brake function (PA_06C) configuration, and reset. » Rewire or repair. » Increase the reduction time; replace the resistor with smaller resistance and higher power. » Contact customer support.
Undervoltage	13	» The main power supply has no voltage but with input; the external main power input voltage is too small.	» Check if the input voltage of the power supply is correct, and correct it.
Overcurrent and grounding errors	14	» Short circuit between motor line UVW. » Short circuit of motor line UVW and earth (metal case). » Hardware circuit is damaged.	» Rewire or replace the problematic cable » Replace the cable or replace the motor. » Replace drivers.

PROTECTION FUNCTION	ALARM CODE	CAUSE OF FAULT	ACTION
Over heating	15	» Use internal braking resistor with braking energy greater than 25W. » Driverr selection power is too small. » IPM module or IGBT is damaged.	» Contact customer support. » Please use the external brake resistor and disconnect the wiring of the internal brake resistor. » Choose a driver with higher power. » Replace the driver.
Excessive load	16	» The actual torque is too large for a long time that exceeds the P72 set value. » Whether the system is vibrated. » Accelerate too fast. » Incorrect electrical angle measurement.	» Please check if there is any problem with the machine, causing the resistance increase, or replace the higher power driver or reduce the load. » Reduce system gain so that it will not cause vibration. » Extend the acceleration time. » Check if the power line UVW is wired or not; or whether there is any problem with the encoder.
Regenerative discharge resistance overload (over-braking rate is too large)	18	» Wiring disconnection, brake pipe damage, or brake resistor damage. » Braking energy is too large.	» Wiring correction, or repair it. » Contact customer support. » Replace the external braking resistor, reduce the resistance value, and increase the power. Resistance should not be less than 35 ohms; increase the reduction time, slow down speed; reduce start-stop frequency; replace driver with higher power or reduce load; reduce torque limit value.
Encoder error	21	» Encoder wiring problems or disconnection. » Encoder damages. » Interference.	» Corrected wiring. » Replace the encoder or motor. » Check whether the system wiring is standardized, replace the twisted pair shielded cable, and separate the coded line from the power line.
Excessive position deviation	24	» The position command is not fast enough, and the gain is too small. » Insufficient torque. » Position deviation level setting is too small. » Command pulse frequency is too high that exceeds system capability. » The acceleration of the command is too fast. » The motor is stuck. » The motor itself cannot be turned.	» Contact customer support. » Check speed loop gain, position loop gain, and properly adjust them. » Turn the torque limit value higher or replace the larger power driverr. » Turn the position deviation larger. » Reduce the frequency of pulses. » Reduce the acceleration of the command pulse or leng then the acceleration time. » Check the connection between the motor and the machine. » The power line UVW wiring is incorrect, or the encoder wiring is incorrect, or the encoder and motor are damaged.

PROTECTION FUNCTION	ALARM CODE	CAUSE OF FAULT	ACTION
Overspeed	26	» Motor overshoot. » The motor UVW wiring is incorrect. » The encoder wiring is incorrect.	» Contact customer support. » The PID parameter is not properly adjusted, or the given command is close to the maximum speed (1.2 times of the rated speed). » Change the UVW wiring again. » Re-update the encoder wiring.
Command pulse division frequency error	27	» The electronic gear setting is incorrect.	» Contact customer support. » Modify the electronic gear ratio numerator and denominator
Deviation counter overflow	29	» The motor is stuck. » Command pulse exception.	» Check the connection between the motor and the machine. » Command pulse exception.
EEPROM parameter error	36	» EEPROM read-write error.	» Contact customer support. » Re-restore the factory parameters, if not, the servo should be repaired.
Stroke limit input signal error	38	» 1. If PA_003 is set to 2, and any travel limit signal is valid and an error is reported. Or ifPA_003=0, the two travel limit signals are valid simultaneously.	» Contact customer support. » Check if the travel limit signal is valid; also check if the P8D polarity configuration of the travel limit is correct. The default invalid means that the optocoupler is not conducting, which is the opposite of the polarity of Panasonic.
Analog command overvoltage	39	» The input analog voltage is greater than the set value of P71.	» Contact customer support. » Modify the PA_071 setting value (to increase the size) or reduce the external voltage command value.

We want to thank you for your purchase and trust put in Logykal. For any inquiry or question you can find us in our web support at https://support.logykal.com, we will be happy to assist you.

Logykal Team

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