PWA090
Electronic, Self-levelling, Benchtop Isolation System

User Guide



Original Instructions

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Chapter 1 Overview

1.1 Introduction

The PWA090 electronic, self-levelling, vibration isolation system, provides a portable, lightweight, low-profile vibration-control solution for sensitive benchtop equipment and experiments.

The system comprises a set of four pneumatic isolators (which must be connected to a compressed air supply) and an electronic control box.

The control box allows manual adjustment of the level via a keypad. Once set up, the level is maintained and any further disturbances are corrected automatically.



Fig. 1.1 Benchtop, electronic self levelling vibration isolation system

Chapter 2 Safety

2.1 Safety Information

For the continuing safety of the operators of this equipment, and the protection of the equipment itself, the operator should take note of the **Warnings, Cautions** and **Notes** throughout this handbook and, where visible, on the product itself.

The following safety symbols may be used throughout the handbook and on the equipment itself.



Warning: Risk of Electrical Shock

Given when there is a risk of injury from electrical shock.



Warning

Given when there is a risk of injury to users.



Caution

Given when there is a risk of damage to the product.

Note

Clarification of an instruction or additional information.

2.2 General Warnings



Warning

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. In particular, excessive moisture may impair operation.

Spillage of fluid, such as sample solutions, should be avoided. If spillage does occur, clean up immediately using absorbant tissue. Do not allow spilled fluid to enter the internal mechanism.

Chapter 3 Installation

3.1 Installation

3.1.1 Siting

The system is designed to be mounted on a benchtop or similar surface. The isolators can be used free standing to provide a temporary isolation solution. For more permenant applications, the isolators can be bolted to an imperial or metric tapped work surface - see Section 3.1.3. for more details

Caution

When positioning the isolators, ensure that the benchtop or mounting surface is level. The legs have an adjustment range of ± 2.5 mm only.

3.1.2 Environmental Conditions

Warning

Operation outside the following environmental limits may adversely affect system performance and could endanger operator safety.

Location	Indoor use only
Maximum altitude	2000 m
Temperature range	5°C to 40°C
Maximum Humidity	Less than 80% RH (non-condensing) at 31°C

To ensure reliable operation the system should not be exposed to corrosive agents or excessive moisture, heat or dust.

If the system has been stored at a low temperature or in an environment of high humidity, it must be allowed to reach ambient conditions before being powered up.

3.1.3 Mounting

1) Position the isolators at least 400 mm (16”) apart and inside the footprint of the breadboard (a typical set up is shown in Fig. 3.1 on the next page). Ensure that the leg AIR IN and FEEDBACK connections are facing outwards and easily accessible.

Caution

Heavy loads may require the isolators to be positioned further apart to ensure good stability - see Table 3.1 for more details.

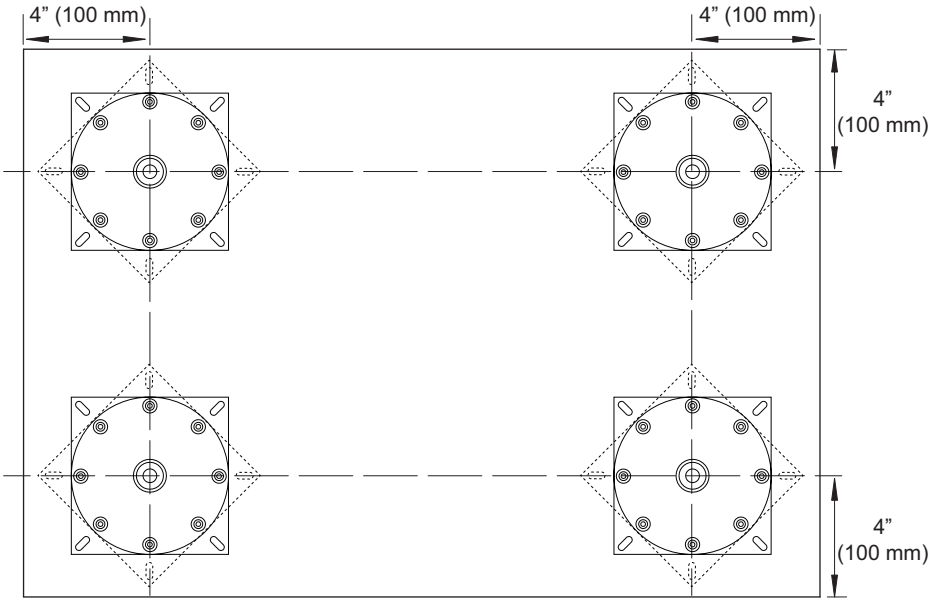


Fig. 3.1 Positioning the isolators

2) The base plate of each leg is fitted with four slotted holes to enable secure fixing to the work surface. The orientation of the legs, when mounting to imperial and metric tapped surfaces is shown below.

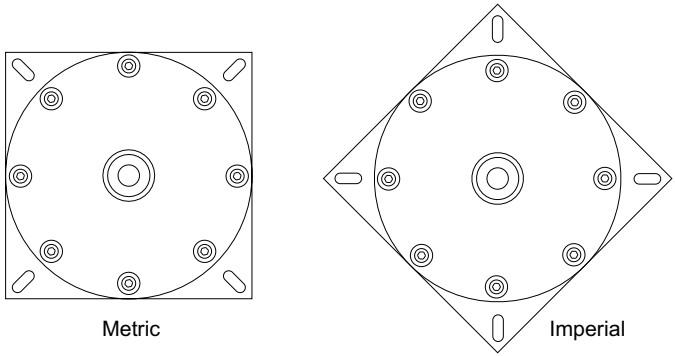


Fig. 3.2 Leg orientation for imperial and metric surfaces

3) If required, bolt the legs to the worksurface.

Note

The mounts can also be used to upgrade the PFR series rigid support frames.

3.1.4 Electrical Connections

1) Using the leads supplied, connect the Feedback terminals on the master legs, to the corresponding LEG 1, LEG 2 and LEG 3 FEEDBACK INPUT connections on the control box - see Fig. 3.3 and Fig. 3.4. The slave leg has no feedback terminal.
2) Connect the control box to the power supply shipped with the unit but DO NOT apply power.

Warning

The unit must be connected only to the power supply unit supplied.

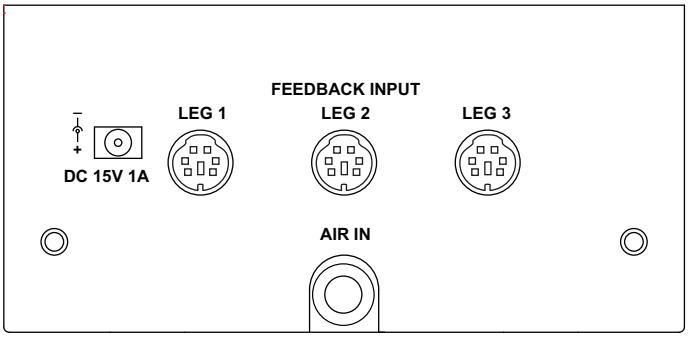


Fig. 3.3 Rear panel FEEDBACK connection

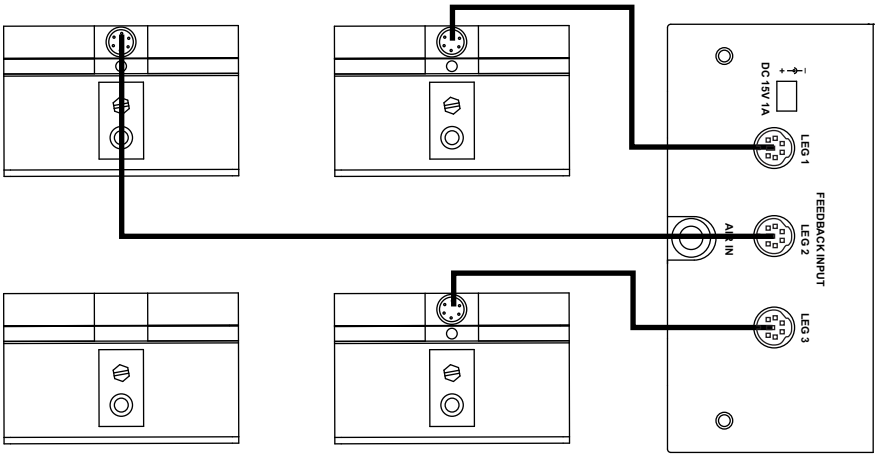


Fig. 3.4 Leg FEEDBACK connection

3.1.5 Pneumatic Connections

1) Using the 6mm outside diameter nylon tubing, connect the pneumatic connectors on each master leg, to the LEG 1, LEG 2 and LEG 3 PNEUMATIC OUTPUT connections on the control box - see Fig. 3.6 and Fig. 3.7. Note that the slave leg is driven by a master leg - see item (2).

Caution

When cutting the tubing to the required length, ensure that all cuts are made at 90° to allow the tube to fit flush against the end stop – see Fig. 3.5.

The push-in connectors on the T-pieces and bulkhead fittings accept the nylon tube in two steps.

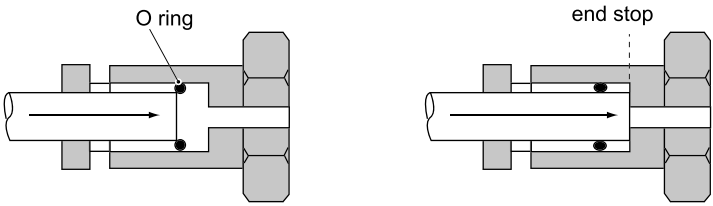


Fig. 3.5 T piece connections

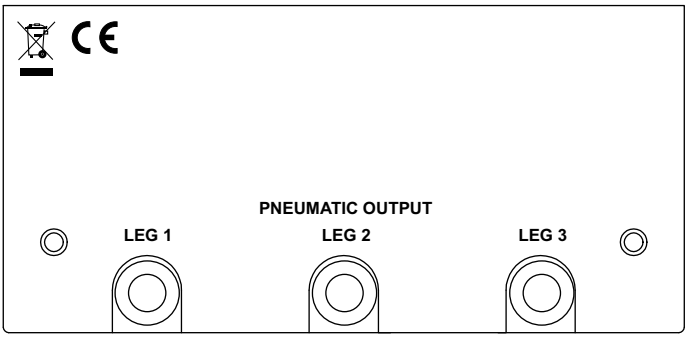


Fig. 3.6 Front panel PNEUMATIC OUTPUT connections

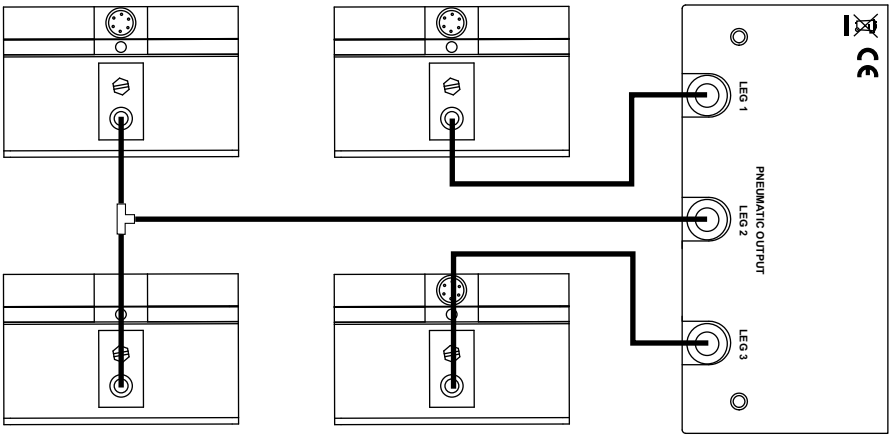


Fig. 3.7 Pneumatic connections

2) Using the 6mm outside diameter nylon tubing and the T-piece supplied, connect the slave leg to one of the master legs as shown below.

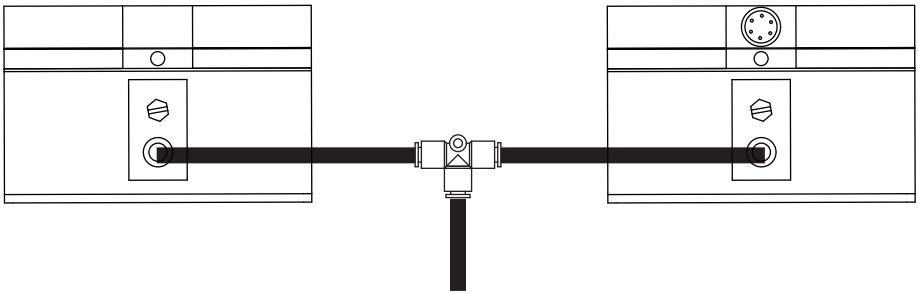


Fig. 3.8 Slave Leg connections

3) Ensure that the air supply is turned OFF, then connect the AIR IN terminal on the Control Box (see Fig. 3.3) to the compressed air supply.

Warning

The air supply may come from an air line, a compressed gas bottle, or a small compressor dedicated to this installation. In all cases the supply to the isolators must be delivered through a pressure regulator.

3.2 Fitting/Removing The breadboard

A Installation

1) Perform the installation procedures as detailed in Section 3.1.
2) Fit the lifting handles supplied to the breadboard as shown in below.

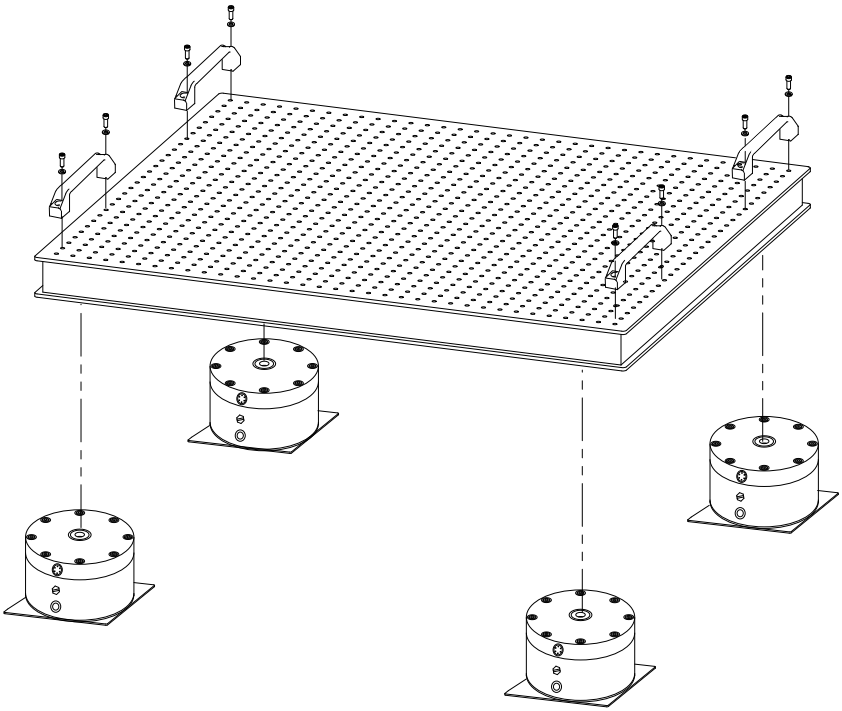


Fig. 3.9 Fitting the breadboard

Warning

During item (3):

Breadboards should be manipulated using the lifting handles supplied. If these are not available, use appropriate lifting equipment.

Breadboards must be lifted by two people and standard lifting safety precautions must be observed.

Breadboards should be lifted only in an unpopulated condition.

When lowering the breadboard into position, take care not to trap fingers or clothing.

3) Observing the warnings listed above, lift the breadboard into position - see Fig. 3.9.
4) Populate the breadboard. Wherever possible, the load should be distributed evenly. Unevens or tall loads may adversely effect the settling time and stability. See Appendix Bfor more information.

Caution

During item (4), the total load including the breadboard must not exceed 210kg (462 lb).

B Removal

Warning

Breadboards should be manipulated only using appropriate lifting equipment.

Breadboards should be lifted only in an unpopulated condition.

Caution

Before removing the breadboard, switch off the compressor or air supply and vent SLOWLY all pressure from the system. Failure to vent the pressure may cause the diaphragms to rupture when the load is removed.

To remove the breadboard:

1) Switch off the power supply to the compressor and vent the pressure.
2) Remove the air inlet pipe from the isolation system and allow any pressure in the system to vent.
3) Reverse the installation procedure.

3.2.1 Switching ON

1) Set the outlet pressure regulator to the required pressure - see Table 3.1

.

Warning

The air supply may come from an air line, a compressed gas bottle, or a small compressor dedicated to this installation. In all cases the supply to the isolators must be delivered through a pressure regulator.

DO NOT EXCEED 80 psi.

Weight	Pressure (psi)	Min Isolator Separation
<47 kg	20	400 mm
>47 kg to <98 kg	40	400 mm
>98 kg to <152 kg	60	600 mm
>152 kg to <210 kg	80	900 mm

Table 3.1 Typical pressure versus weight

Note

If the weight of the load is unknown, consult www.thorlabs.com to find the weight of the breadboard (weights are listed by part number and by size), then estimate the weight of the experiment. Further tuning can be performed once the system is 'floated'.

2) Turn the regulator outlet valve ON.
3) Connect the control box power supply to mains power and switch ON.

Note

The system will not 'float' until the 'Initial Set Up procedure has been performed

4) Proceed to Section 4.3. to perform the initial set up and tune the system for your specific load and pressure.

Chapter 4 Set Up

4.1 Front Panel Controls and Indicators

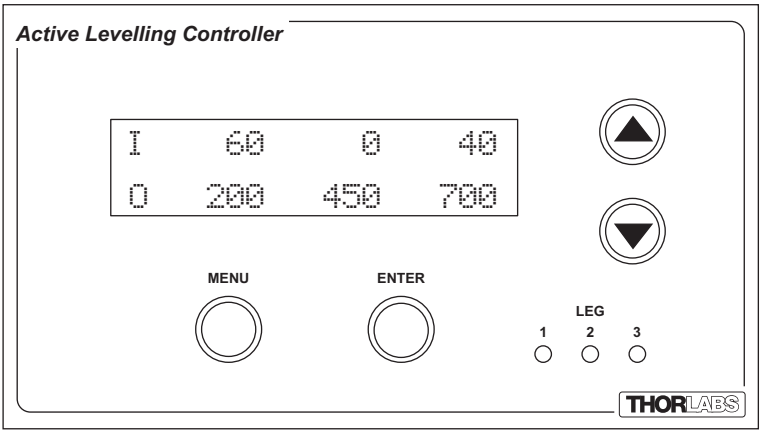


Fig. 4.1 Control Panel

Digital Display – 2-line, 16-digit liquid crystal display. In normal operation, the top line (I) shows the nominal position of each leg in 10 µm steps, (-250 to 250 which relates to ±2.5 mm), and the bottom line (O) shows the output voltage applied to each valve (in encoder counts, 0 to 999 which relates to 0 to 12 V). In Set Up mode, the display shows the various parameters being set.

MENU – Toggles access into and out of the set up level - see Chapter 4

ENTER – Used in navigation and saves parameter settings in the set up level. To save the settings so they are available after the system has been powered down, click and hold for about 3 seconds.

UP and DOWN ARROWS – Adjusts the value of the parameters when in the set up level.

LEG LEDs - These LEDs indicate that the associated leg is settled within the Error Band - see Section 4.4.2.

4.2 Menu System Overview

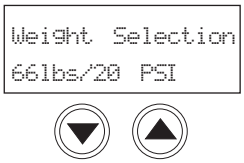
The set up menu consists of several levels which allow the various parameters to be adjusted for a particular application. These are described in detail in the following sections.

4.2.1 Set Up Menu

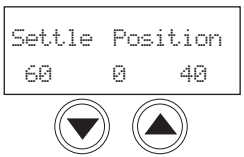


Press the MENU button to enter the Set Up Menu.

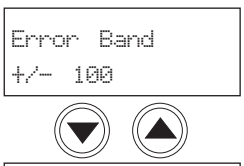
Press the Up and Down keys to move between levels.



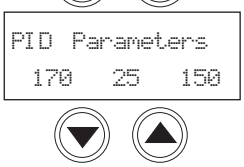
This level allows preset PID parameters for a specific load and pressure to be applied - see Section 4.3.



This level allows the demanded height (settle position) to be set for each leg, in order to level the system - see Section 4.4.



This level allows the error band to be set - see Section 4.4.2.



This level allows the PID parameters for each leg to be tuned individually - see Section 4.5.



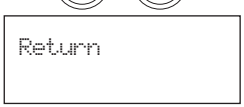
This level switches active leveling ON and OFF - see Section 4.3.3.



This level switches allows the units to be set, lbs/PSI or Kgs/Kpa- see Section 4.3.1.



This level allows the settings to be saved to memory such that they are available next time the unit is powered up - see Section 4.6.



Press the Up and Down keys to return to the PID Params level or press ENTER to go back to the normal display mode.

4.3 Initial Set Up

Before the system can be used, it must be configured to operate with the specific load and pressure with which it is being used. Perform the installation procedure detailed at Chapter 3 then proceed as follows:

Ensure that the air pressure and system power are switched ON (see Section 3.2.1.). then proceed as follows:

4.3.1 Units Selection

Press the MENU key to enter the set up level.

Press the UP/Down keys to scroll to the Units Selection panel.

Press the ENTER key to access the level.

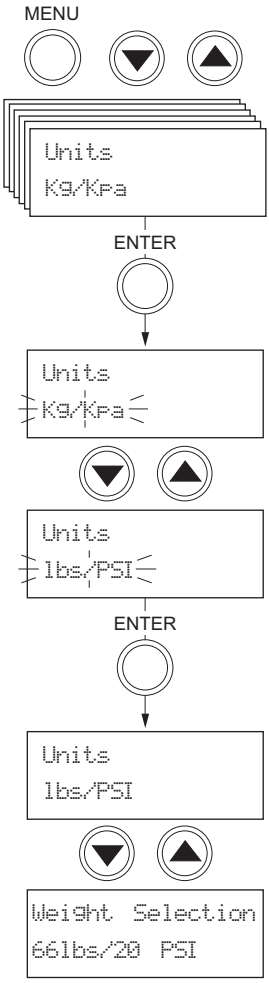
The units flash to show that edit mode is active.

Press the Up/Down keys to set either lbs/PSI or Kg/Kpa.

Press ENTER to set the units.

Press the UP/Down keys to scroll to the Weight Selection Panel.

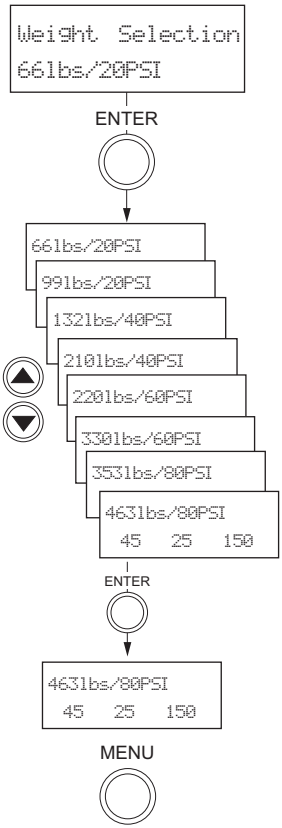
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4.3.2 Weight/Pressure (Default PID) Selection

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Before the system can be 'floated', the PID parameters must be set for the associated load and air pressure. These are applied automatically when the weight is selected.



Press the UP/Down keys to scroll to the Weight Selection panel, which contains default PID values for a range of typical loads.

Press the ENTER key to access the level.

A series of pre-defined PID settings for typical weights/pressures is displayed as follows:

66 lbs/20 PSI (30Kg/138Kpa) - 170 25 150

99 lbs/20 PSI (45Kg/138Kpa) - 155 25 150

132 lbs/40 PSI (60Kg/276Kpa) - 110 25 150

210 lbs/40 PSI (95Kg/276Kpa) - 80 25 150

220 lbs/60 PSI (100Kg/414Kpa) - 70 25 150

330 lbs/60 PSI (150Kg/414Kpa) - 60 25 150

353 lbs/80 PSI (160Kg/552Kpa) - 55 25 150

463 lbs/80 PSI (210Kg/552Kpa) - 45 25 150

Press the Up/Down keys to scroll to the weight/ pressure combination closest to the needs of your application then press ENTER to make the selection. If the weight is unknown, select the weight closest to that chosen in Section 3.2.1.

The setting is displayed on the Weight Selection panel.

Note. If the PID parameters are manually adjusted later (see Section 4.5.) the display will change to 'CUSTOM PID' instead of the weight/pressure setting shown here.

Press the UP/Down keys to scroll through to the Active Leveling panel.

Continued on next page...

4.3.3 Switching ON Active Leveling

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Before the system can be 'floated', the 'Active Leveling' system must be switched ON.

Press the DOWN key to step through to the Active Leveling panel.

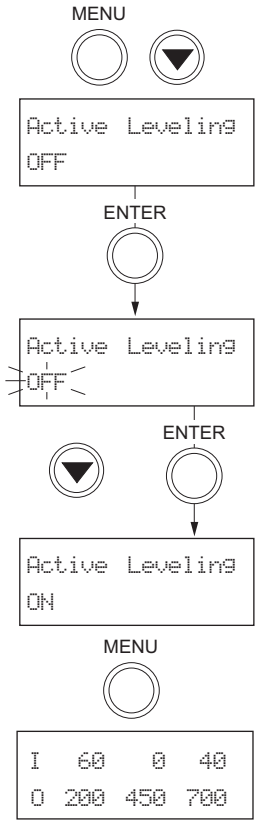
Press the ENTER key to enable parameter editing. The display flashes to show that editing mode is active.

Press the UP and DOWN keys to select ON.

To configure the system to float automatically when power is applied, press and hold ENTER to save the setting.

The valves will turn ON and the system will try to level. Allow the system to settle before proceeding.

Press MENU to return to the operating display.



Note

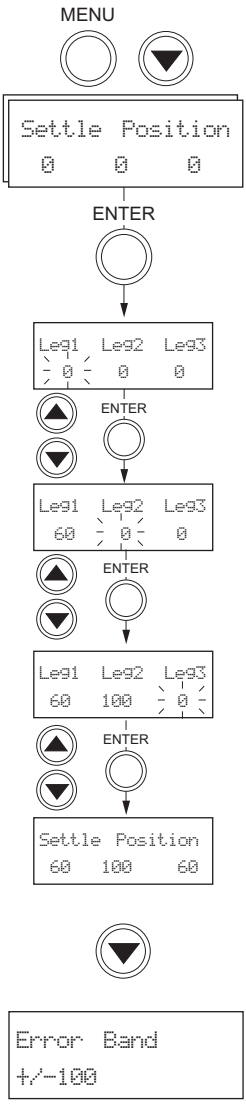
If the system will not settle or becomes unstable, the load may be incorrectly positioned on the breadboard - see Appendix B for more details

If the system is not level this can also lead to instability. If hunting or instability is apparent, level the system as detailed in Section 4.4.

4.4 Levelling the System

4.4.1 Settle Position

The Settle Position parameters are the demanded positions of each leg and are used to level the system. On initial set up, these parameters are typically set to '0' which is an arbitrary mid position (it is normal for each leg to have a different '0' position). The display shows the settle position in ADC counts, in the range -250 to 250, which relates to a ±2.5 mm range (non-linear) about the mid point.



Using a bubble level, check that the work surface is level, if not, proceed as follows:

Press the MENU button to enter the set up level then press the DOWN key to step through to the Settle Position panel.

Press ENTER to access the level. The valves will turn ON.

The present setting for each leg is displayed. The Leg1 setting flashes to show edit mode is active.

Watch the bubble level, and use the UP and DOWN keys adjust the height.

Press ENTER to save the setting and advance to Leg2 or MENU to discard the changes.

Watch the bubble level, and use the UP and DOWN keys adjust the height.

Press ENTER to save the setting and advance to Leg3 or MENU to discard the changes.

Watch the bubble level, and use the UP and DOWN keys adjust the height.

Press ENTER to save the setting and return to the Settle Position panel or MENU to discard the changes.

Using a bubble level, check that the work surface is level and repeat the above procedure as necessary.

Press the DOWN key to advance to the Error Band parameter.

4.4.2 Error Band

The Error Band setting is provided to improve the repeatability and/or settling time of the system and is defined as the allowable error between the actual and demanded position on a particular leg. A large error band results in a fast settling time whereas a small error band results in improved repeatability When the difference between the actual and demanded position is within the band, the associated LEG LED on the key pad is lit. When all 3 LEDs are lit continuously for longer than 2 seconds, the pressure system is locked and the system floats. If a disturbance occurs and the error band on a leg is exceeded, the pressure is reapplied to level the system. The error band is measured in ADC counts either side of the Settle Position (see previous section).

Press the MENU button to enter the set up level then press the DOWN key to step through to the Error Band panel.

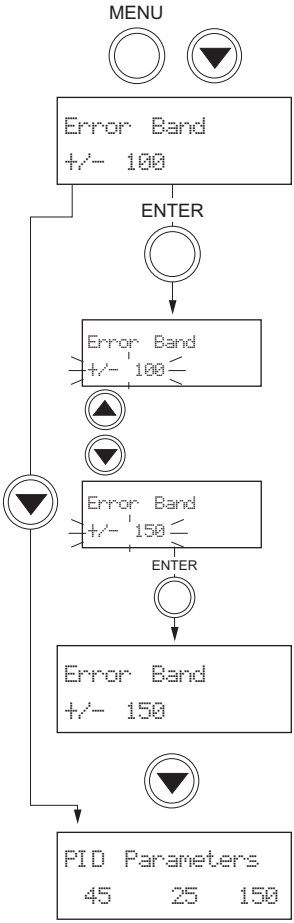
Press ENTER to access the level.

The present setting for the Error Band is shown and the display flashes to indicate that edit mode is active.

Use the UP and DOWN keys to set the required value. The value is adjusted in steps of 2 in the range ±24 to ±250 ADC counts (i.e. 0.2 to ±2.5 mm in real world units).

Press ENTER to save the setting and return to the Error Band panel.

Press the DOWN key to advance to the PID parameters panel.



System stability depends on both the error band and the PID settings, and some trial and error may be required before the ideal settings for a specific application are achieved. See the next section for details on adjusting the PID parameters.

4.5 Further Tuning and PID Parameter Adjustment

The control box contains a number of hall effect sensors which use a position control loop to determine the command output. The purpose of the position loop is to match the actual leg position and the demanded position. This is achieved by comparing the demanded position with the actual leg position to create a position error, which is then passed through a digital PID-type filter. The filtered value is the valve command output.



Caution

The PID parameters must be set according to the load being supported. Default values for specific loads have already been optimized and stored within the controller. These are loaded in the 'Weight Selection' set up screen (see Section 4.3.) and should not need adjustment under normal operating conditions.

If problems are encountered (e.g. instability/hunting of the system, or incomplete positional adjustments) these PID parameters should be adjusted further to tune the system for the given application. If instability is experienced, the proportional parameter in particular should be reduced in conjunction with the error band (see previous section). Normally, only minor adjustment of the Proportional parameter should be necessary, though some trial and error will be required before the ideal settings for a specific application are achieved.

USE EXTREME CAUTION WHEN CHANGING PID PARAMETER VALUES. PERFORM ONLY SMALL CHANGES. INCORRECT PID SETTINGS CAN CAUSE MAJOR INSTABILITY WHICH COULD RESULT IN DAMAGE TO DELICATE EXPERIMENTS OR APPLICATIONS.

Proportional term - Increasing the proportional term will increase the amount of effective pressure used to correct a given position error. Typically this is used to minimise the amount of position error when an impulse event or disturbance affects the current target position. If the proportional term is too high this can lead to overshoot and general instability. If this is too low it can result in a sloppy response. It accepts values in the range 0 to 327.

Integral term - Increasing the integral term minimises following error and final position error. If Integral is too high this will typically lead to overshoot of the demanded position. If the integral term is too low final position may take a long time to reach, if at all. It accepts values in the range 0 to 100.

Derivative term - Increasing the derivative term decreases the rate of change of controller output. Typically this is used to reduce the overshoot from a given motion. If derivative is too high it can become sensitive to noise from the measured position error. If derivative is too low, fluctuations may arise during motion. It accepts values in the range 0 to 327.

If the PID parameters loaded in the Weight Selection panel do not provide satisfactory performance, the values can be tuned to your particular application. The cautions above must be read and understood before changing PID parameters.

Press the MENU button to enter the set up level then press the DOWN key to step through to the PID Params panel.

Press ENTER to access the level.

A warning screen is displayed to guard against accidental adjustment. Press ENTER to advance or MENU to go back.

The present setting for the Proportional term is displayed.

Press the DOWN key to advance to the Integral term, or press ENTER to set the Proportional value.

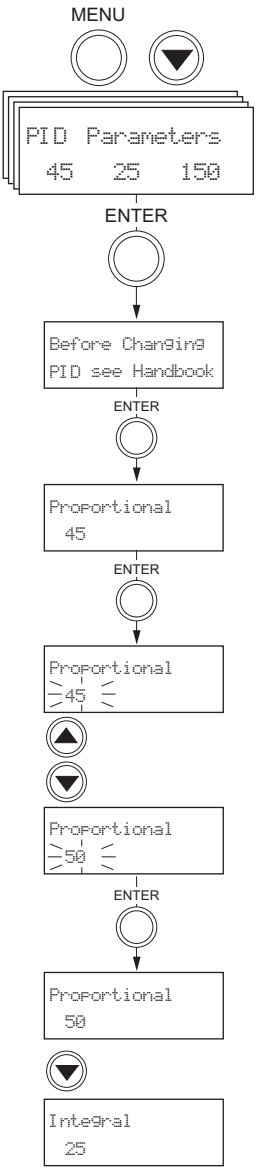
The display flashes to show that editing is active.

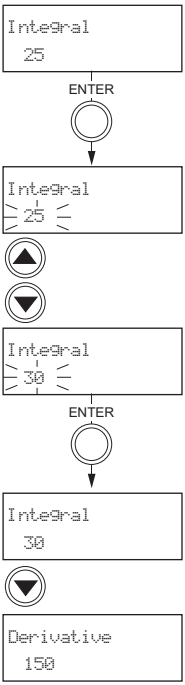
Use the UP and DOWN keys to set the desired value,

Press ENTER to save the setting or MENU to discard the changes.

Press the DOWN key to advance to the Integral term.

continued...





The present setting for the Intergral term is displayed.

Press the DOWN key to advance to the Derivative term, or press ENTER to set the Integral value.

The display flashes to show that editing is active.

Use the UP and DOWN keys to set the desired value.

Press ENTER to save the setting or MENU to discard the changes.

Press the DOWN key to advance to the Derivative term.

continued...

The present setting for the Derivative term is displayed.

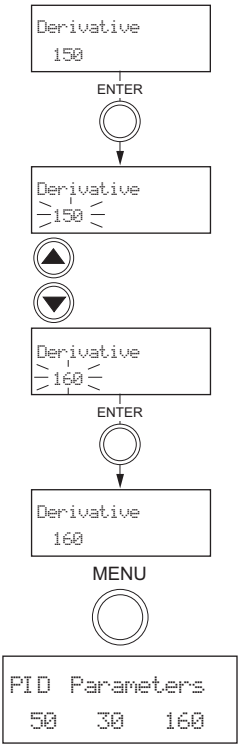
Press the DOWN key to advance to the Proportional term, or press ENTER to set the Derivative value.

The display flashes to show that editing is active.

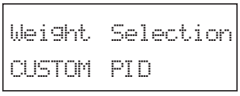
Use the UP and DOWN keys to set the desired value.

Press ENTER to save the setting or MENU to discard the changes.

Press the DOWN key to advance to the Proportional term or press MENU to exit the set up and return to the PID Params panel.



Note. If the PID settings are adjusted from the default values applied in the Weight Selection panel (see Section 4.3.2.), 'CUSTOM PID is displayed on the weight selection screen.



PID Settings Summary

System overshoots the intended position - reduce Integral and increase Derivative and Proportional terms.

System doesn't attain final position - increase the Integral and Proportional terms.

System is unstable - reduce Proportional and Integral, increase Derivative.

System sounds noisy - reduce Derivative.

Note

If the system will not settle, push down on one corner of the breadboard. This will throw the system out of resonance and may speed up the settling time. If the system is still unstable, use the control panel to reduce the proportional term - see Section 4.5.

PID Setting Optimisation

Load	**Air Supply Pressure**		**Proportional[1]**			**Integral**	**Derivative**
kg (lbs)	*psi*	*kPa*	*min (typ. <10 sec)[2]*	*Default[3]*	*max (typ. <5 sec)[4]*	*Default*	*Default*
30 (66)	20	138	60	170	190	25	150
45 (99)	20	138	60	155	170	25	150
60 (132)	40	276	50	110	120	25	150
95 (209)	40	276	50	80	90	25	150
100 (220)	60	414	50	70	80	25	150
150 (330)	60	414	40	60	70	25	150
160 (352)	80	552	35	55	65	25	150
210 (462)	80	552	35	45	55	25	150

[1] These values are typical for a default error band of +/- 100. Reduce the Proportional parameter for tighter error bands (typically 20% reduction with +/- 50 error band)

[2] <10 sec is a typical settling time for moderate disturbances and a minimum proportional value. With larger disturbances, the settling time may be longer (typically less than 30 sec)

[3] Embeded within the firmware of the controller

[4] <5 sec is a typical settling time for small disturbanceswith a maximum proportional value. A large Proportional value may take the system to an instable mode. If this occurs, first reduce the proportional parameter to the minimum value recommeded and then increase gradually within the range specified.

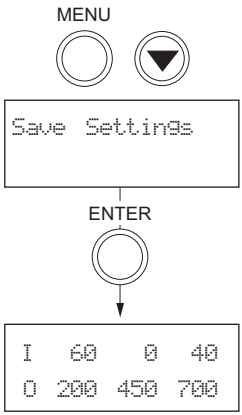
Table 4.1 Recommended PID Setting Adjustment Limits

4.6 Save Settings

Once the set up procedure has been performed, the settings can be saved to memory so they will be available next time the system is powered up. The following settings are saved:

Units, Weights/Pressure, Active Levelling ON/OFF, Settle Position, Error Band, PID settings.

Press the MENU button to enter the set up level then press the DOWN key to step through to the Save Settings panel.



Press the ENTER key to save the settings and exit to the operating mode.

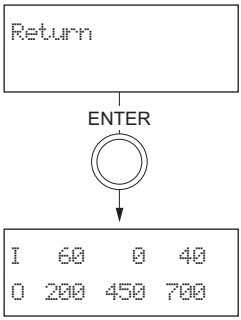
Note. The settings can also be saved to memory from the operating level, by holding down the ENTER key for around 3 seconds.

4.7 Return

This panel signals the end of the set up menu.

Press the ENTER button to return to the normal operating mode.

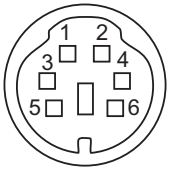
Press the UP or DOWN key to step through to the previous or next set up parameters.



Appendix A Connector Pinout Detail

A.1 Controller FEEDBACK Connectors

This 6-pin mini DIN connector provides connection to the feedback signal from the hall effect sensors in each leg. The pin functions are detailed in Fig. A.1.



Pin	Description
1	Leg Position
2	Ground
3	Ground
4	5 V
5	Not Connected
6	Ground

Fig. A.1 Controller FEEDBACK Connector Pin Identification

Appendix B Load Positioning and Stability

B.1 Maximising System Stability

B.1.1 System Stability Zone

The location and height of a load placed on a work surface can dramatically affect the stability and function of the isolation system. To ensure optimum effectiveness of the isolators, it is important to avoid any instability due to the system centre of mass being misplaced.

In order to avoid dynamic instability and oscillation due to excessive rocking, the center of mass, including that of the breadboard, should be within the pyramid defined by connecting the center point of each isolator with an apex point, whose vertical height is equal to 1/2 the shortest distance between isolators– see Fig. B.1.

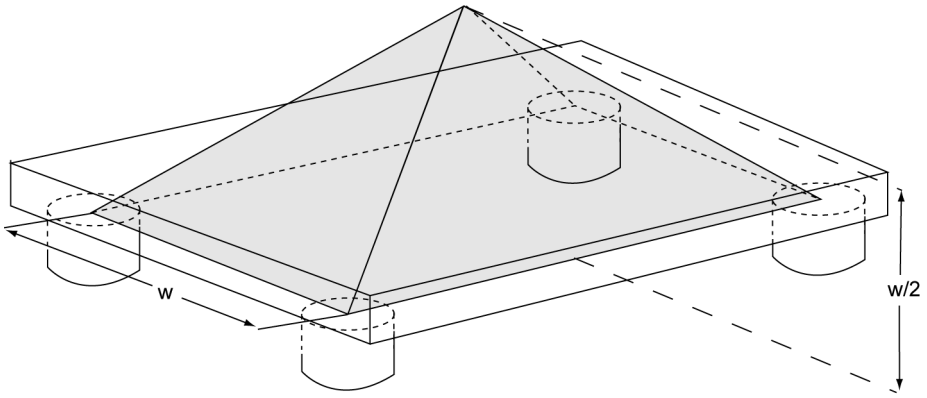


Fig. B.1 System stability zone

Since the breadboard tends to be the heaviest component, to ensure the system is within the stability zone the system center of mass should be near the center of the breadboard or below the breadboard surface. It may be necessary to lower the center of mass by relocating equipment on the work surface or by using accessory shelves situated below the breadboard surface.

Appendix C Preventive Maintenance



Warning

The equipment contains no user servicable parts. There is a risk of electrical shock if the equipment is operated with the covers removed. Only personnel authorized by Thorlabs Ltd and trained in the maintenance of this equipment should remove its covers or attempt any repairs or adjustments. Maintenance is limited to testing and cleaning as described in the following sections.

C.1 Safety Testing

The power supply should be PAT testing in accordance with local regulations on a regular basis, (typically annually for an instrument in daily use).



Caution

Insulation testing of the power supply connector should be performed using a DC voltage.

C.2 Cleaning



Warning

Disconnect the power supply before cleaning the unit.

Never allow water to get inside the casing.

Do not saturate the unit.

Do not use any type of abrasive pad, scouring powder or solvent, e.g. alcohol or benzene.

The control box fascia and the isolating legs may be cleaned with a soft cloth, lightly dampened with water or a mild detergent.

Appendix D Specifications

Parameter	Value
Vertical Resonant Frequency[1]	<1.7 Hz
Horizontal Resonant Frequency[1]	7.0 Hz
Vertical Transmissibility at Resonance[1]	14.22 dB
Vertical Transmissibility at 10 Hz[1]	-27 dB (95.66%)
Horizontal Transmissibility at Resonance[1]	16.27 dB
Horizontal Transmissibility at 10 Hz[1]	-4.5 dB
Maximum Load Capacity (set of four)	462 lb (210 kg)
Minimum Load Capacity (set of four)[2]	66 lb (30 kg)
Levelling Repeatability	± 0.2 mm
Adjustable Leveling Repeatability	± 0.2 mm to ± 1.0 mm
Average Settling Time for 0.2 mm Repeatability[3, 4, 5]	5 sec
Average Settling Time for ± 0.3 mm Repeatability[3, 4, 6]	<1 sec
Settling Time for Large Disturbances [3, 4, 7]	<60 sec
System Weight	5 kg

Note

[1] At full load.

[2] Weights smaller than 66 lb (30 kg) may be used but settling time, repeatability and isolation may be affected.

[3] Settling time defined as from valve open to all LEDS lit (within error band). The system will turn off 2 seconds after this.

[4] Settling time varies with weight, pressure, footprint, center of mass and error window.

[5] For small 'knock type' disturbances across the entire load range (66 to 462 lb (30 to 210 kg), load evenly distributed.

[6] Measured with 36 kg load, 600 mm x 600 mm footprint and 20 psi.

[7] For large disturbances such as those experienced when large weights (20 kg or above) are removed, an overpressure situation occurs which causes the legs to vent. In this case settling time is <1minute.

Appendix E Regulatory

E.1 Declarations Of Conformity

E.1.1 For Customers in Europe

This equipment has been tested and found to comply with the EC Directives 89/336/EEC 'EMC Directive' and 73/23/EEC 'Low Voltage Directive' as amended by 93/68/EEC.

Compliance was demonstrated by conformance to the following specifications which have been listed in the Official Journal of the European Communities:

Safety	EN61010: 2001 Installation Category II, Polution Degree II.
EMC	EN61326: 1997

E.1.2 For Customers In The USA

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Changes or modifications not expressly approved by the company could void the user's authority to operate the equipment.

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For technical support or sales inquiries, please visit us at www.thorlabs.com/contact for our most up-to-date contact information.



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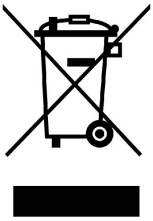
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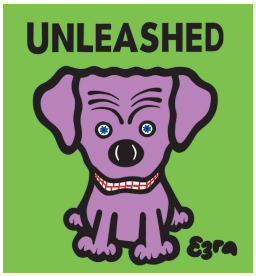
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Thorlabs verifies our compliance with the WEEE (Waste Electrical and Electronic Equipment) directive of the European Community and the corresponding national laws. Accordingly, all end users in the EC may return "end of life" Annex I category electrical and electronic equipment sold after August 13, 2005 to Thorlabs, without incurring disposal charges. Eligible units are marked with the crossed out "wheelie bin" logo (see right), were sold to and are currently owned by a company or institute within the EC, and are not dissembled or contaminated. Contact Thorlabs for more information. Waste treatment is your own responsibility. "End of life" units must be returned to Thorlabs or handed to a company specializing in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site.





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