OPERATING INSTRUCTIONS

DIFFERENTIAL LOW PRESSURE TRANSDUCER
DLP 2.5

Type 381

Version 1.00

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NOT FOR HUMAN USE

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Contents

1. Introduction, manufacturer's details

These Operating Instructions describe the function and use of the Differential Low Pressure Transducer DLP2.5 Type 381 (named in the following DLP2.5)

All the information in these Instructions has been drawn up after careful examination but does not represent a warranty of product properties. Alterations in line with technical progress are reserved.

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1.1 Copyright

2. Safety notes

Warning:

- This DLP2.5 is not suitable for operation in hazardous areas and/or in a flammable atmosphere.
- The DLP2.5 is only for use in animal experiments. **Not for Human Use !**
- The DLP2.5 is designed for use in general laboratories, light industrial and office environments.

3. CE Declaration of Conformity

CE

This product conforms to the requirements of the Low-voltage Directive 73/23 EEC as well as the EMC Directive 89/336 EEC and are accordingly marked with the CE mark. For conformity to the standards during operation it is essential that the details in the instructions provided are observed.

3. Application, general description,

The primary application for this transducer is the measurement of respiratory flow in combination with a pneumotachometer. The pneumotachometer is based on the principle of pressure drop along a pipe. Any pipe offers some resistance to gas flow owing to the internal resistance of the medium, i.e. the viscosity gas. The pressure drop along the pipe can be used as a measure of the flow. If the flow is sufficiently low so that the flow is laminar, then the pressure difference measured between two points along the pipe is proportional to the flow.

3.1 Measuring principle

The basic sensor is a monolithic silicon piezoresistor. The resistive element is embedded on a thin silicon diaphragm. The special manufacturing technic as well as the configuration of the membrane result in a high sensitivity and a low temperature drift. The sensor is mounted in a user friendly plastic case.

The transducer can be fixed on a stand using the removable mounting rod

Electrically the transducer is equivalent to a Weatstone bridge. It can be connected to any DC bridge amplifier.

4. Technical description

4.1 Pressure connection

The transducer is a differential pressure transducer and therefore equipped with two pressure ports. These are labelled (+) for the positive pressure side of the membrane and (-) for the negative pressure side.

4.2 Pressure media

The pressure transducer can be used without restrictions with dry air. If water vapour containing air is used as media the user must take care that condensing water drops will not enter the ports. To prevent this, the transducer must be mounted in an inclined position with the ports looking downwards.

4.3 Electrical connection

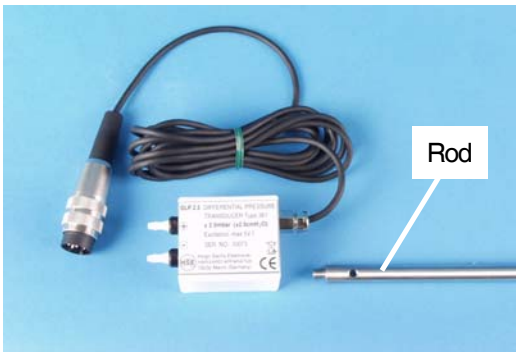
This transducer can be connected to any type of full bridge amplifier also sometimes named strain gauge amplifier.

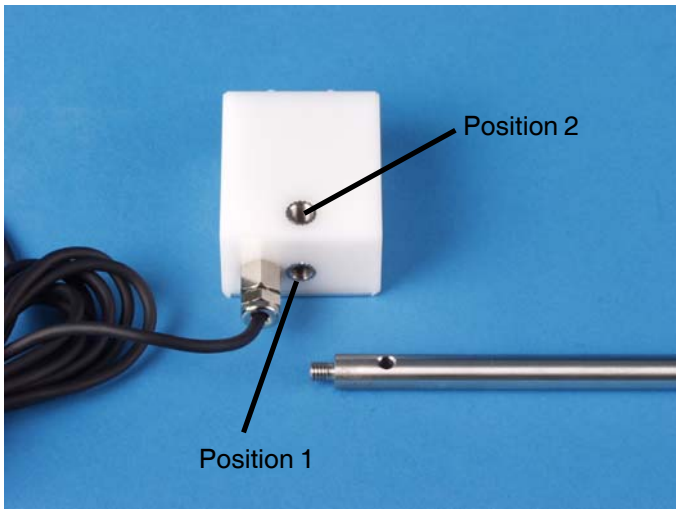
Input impedance:	5000 Ohm
Output impedance:	3000 Ohm
Zero pressure error:	1 mV max. (Offset at excitation voltage of 5V)
Excitation voltage:	5 V (10 V)

5. Application:

5.1 Fixing / Mounting the transducer

The DLP2.5 is equiped with a Stainless steel rod for mounting on a Laboratory stand or on a mountung rod on a unit such as a system for isolated perfused lung.
The rod can be mounted in two different positions depending on the requirements. Position 1 in line with the pressure inputs, position 2 in 90degrees to the pressure inputs. The rod shows a small hole were a little screw-

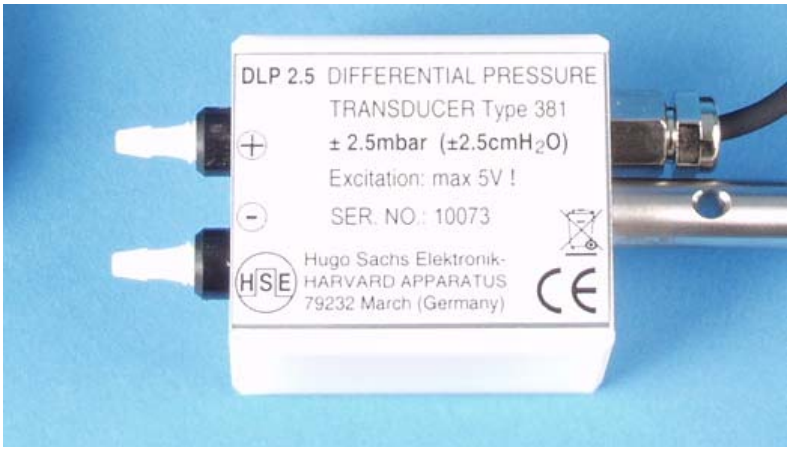




driver can be introduced to tighten the rod on the transducer.

5.2 Connections

The DLP2.5 is a differential pressure transducer. Therefore it has two pressure input ports. The ports are named (+) and (-). The output signal of the transducer is proportional to the pressure difference between Input port (+) and input port (-). If the input port (-) is left open to air the transducer can be used to measure a pressure referenced to the atmospheric pressure, of course in the range of ± 2.5 cmH_2O.
The input ports have a diameter of 3mm and are connected to the differential pressure source (Pneumotach) via tubing. As we are dealing with very low pressures it is recommended to keep the dead volume of the connecting tubing at small as possible, that means as short and as narrow as possible to reduce the compressibel air volume and the mass of air to displace.

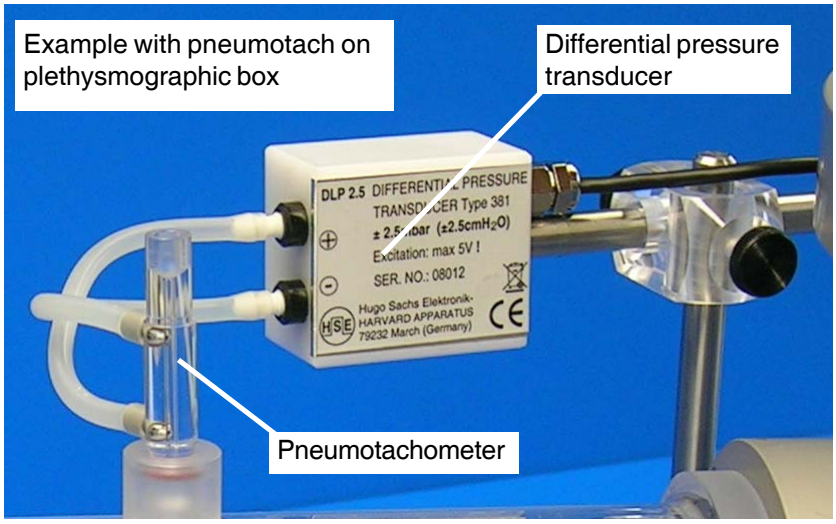


5.3 Example of connection to a pneumotachometer

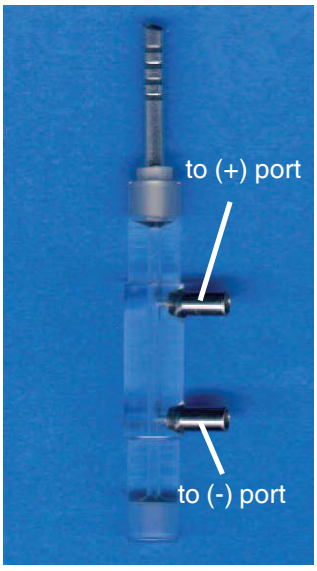
A pneumotach is a device generating a small pressure difference proportional to the airflow passing. The DLP2.5 is used to measure that pressure difference and therefore generate an electrical signal proportional to the airflow. The pneumotach consists of a tubing with an airflow resistance built in. The pressure difference across this resistance is mesausred with the DLP2.5.
The pressure diffence is availabel on two ports of the pneumotach which must be connected to the two pressure inputs of the DLP2.5.
The (+) input port of the DLP2.5 is allways connected to the port of the pneumotach on the side where the airflow enters the pneumotachometer during inspiration.
That is different if the pneumotach is used in combination with an intubated / tracheotomized animal, or with a plethysmographic box.

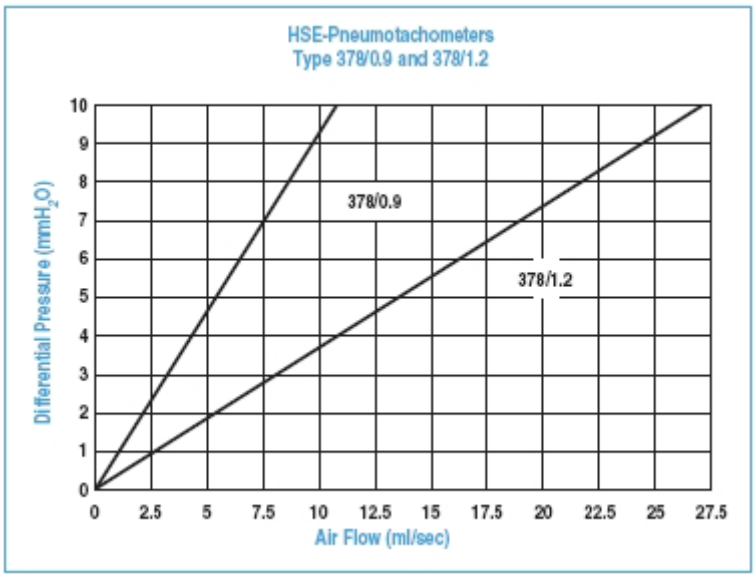
With an intubated / tracheotomized animal the side of the pneumotach not connected to the animal is the side where the air enters the pneumotach during inspiration (+ input port).

With a pneumotach in combnation with a plethysmographic box, we measure the changes of the body volume. During inspiration ,the body volume increases and air escapes from the plethysmographic box, the side of the pneumotach being connected to the box is connected to the (+) input port of the DLP2.5.



Standard HSE Pneumotach for Mice PTM0.9 or Rats PTM1.2





Output signal of the HSE Pneumotachs for mice or rat

6. Calibration

6.1 Pressure calibration

In the following procedure we expect that an amplifier TAM-A is used as well as the software "PULMODYN"

6.1.1 Zero Adjustment

Zero adjustment (on the bridge amplifier) is used to correct inaccuracies in the sensor system at pressure = zero. Zero adjustment has to be performed before each measurement, and should if necessary be repeated during longer series of measurements. Ensure that bridge amplifier and pressure transducer are at their operating temperature during zero adjustment. With both input ports open to air
Adjust now the zero of the PLUGSYS TAM-A module. Follow the procedure described in the relevant instruction manual of the amplifier.
For the TAM-A:

- put the switch "CAL-OFF-MEASURE" in position "MEASURE"
- press for a 3 seconds the "AUTO" button
- The LED above the button should go on for a few seconds and automatically go off. The fixed and the mobile LED's on the bargraph should now be overlapping
- If the LED above the "AUTO" button is flashing, the range for the auto-ZERO adjustment is too small. Use the delivered small screewdriver and turn the "COARSE" and "FINE" trimmers to have the fixed and the mobile LED's on the bargraph overlapping. Restart the operation by pressing the "AUTO" button.

6.1.2 Calibration Value

Calibration before or during use allows the complete measurement chain to be properly matched. The measurement chain can take different forms. It consists essentially of pressure transducer, bridge amplifier, and pressure indication, recorder and/or data acquisition system by PC and appropriate software. Calibration is absolutely essential in order to obtain accurate measurements which can be evaluated. Regular calibration is also important in order to recognise any instrumental errors which may arise.
A known pressure 10 mmH_2O is applied to the pressure transducer (+) input port the pressure indication is then adjusted by altering the gain of the bridge amplifier. Calibration therefore requires a very precise pressure standard which provides the necessary calibration pressure (e.g. HSE KAL 84L, part number 73-0017 for the 230V version, 73-0016 for the 115V version).

PLEASE NOTE: the most accurate results are obtained when selecting the calibration pressure as close as possible to the measured pressure. As pneumotachometers mainly show pressure differences in the range of 0-10 mmH_2O using a calibration pressure of 10 mmH_2O would be a good choice.

Apply now the pressure 10 mmH_2O to the (+) input port
Calibration of the TAM-A

- Have the switch "CAL-OFF-MEASURE" in position "MEASURE"
- The fix LED on the bargraph shows pressure zero and the mobile LED on the bargraph shows the pressure of 10 mmH_2O
- Adjust now the "GAIN" trimmer to bring the mobile LED to the required position on the bargraph. The fix LED shows the Zero pressure, the top of the bargraph is 100% of the measuring range, if the mobile LED is at 50% (about 5 Volt at the recording output of the amplifier), the maximum pressure which can be measured is than 20 mmH_2O.

This is a good adjustment for measurements with pneumotachometers.

6.2 Volume calibration of a system

Before any measurement can be performed, the entire measurement system must be calibrated. It includes (the plethmographic box), the pneumotachometer, the DLP2.5, the amplifier and the software. All these compounds are considered as an entity and calibrated in one step.

Before starting calibration you must ensure that the pneumotachometer, the DLP2.5 and the amplifier are properly connected according to the relevant instruction manuals.

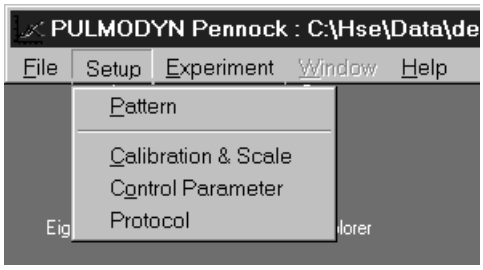
In the following procedure we expect that an amplifier TAM-A is used as well as the software "PULMODYN"

6.3 Calibration of a system

When the system is ready for calibration and it requires the following steps:
- Adjusting the Transducer / Amplifier Baseline
- Entering the Baseline value to the software
- Proceeding with the Volume calibration

6.3.1 Adjusting Baseline for transducer and amplifier

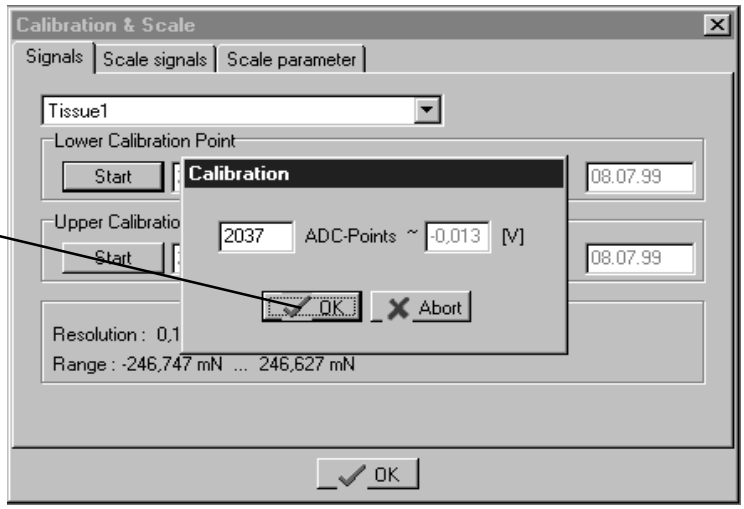
Adjust know the zero of the amplifier on the PLUGSYS TAM-A module. Follow the procedure described in the relevant instruction manual of the amplifier.
For the TAM-A:
- put the switch "CAL-OFF-MEASURE" in position "MEASURE"
- press for a 3 seconds the "AUTO" button
- The LED above the button should go on for a few seconds and automatically go off. The fixed and the mobile LED's on the bargraph should now be overlapping
- If the LED above the "AUTO" button is flashing, the range for the auto-Zero adjustment is too small. Use the delivered small screwdriver and turn the "COARSE" and "FINE" trimmers to have the fixed and the mobile LED's on the bargraph overlapping. Restart the operation by pressing the "AUTO" button.



6.3.2 Entering the Baseline value to the software

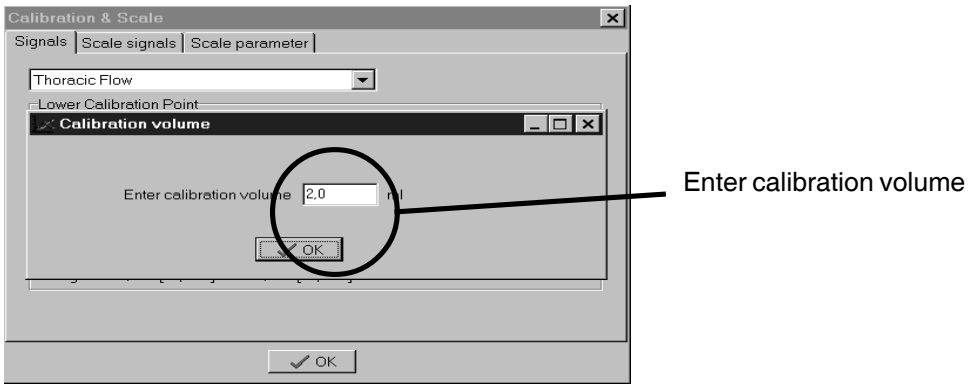
Now select in the “Calibration & Scale” menu the “Start” button for “Lower Calibration Point”. This opens the small calibration window showed below, where the measured AD points and the corresponding voltage is displayed. For Baseline, the AD point value is around 2048 and the voltage should read near zero Volt. If the received value is stable quit this menu with “OK”. The zero value is now displayed. Take care that the assigned physical value is set to 0 ml/min.

By starting the lower calibration the software reads the actual zero signal, after a stable reading 2048 (±3 to 5 points) click the Ok button.

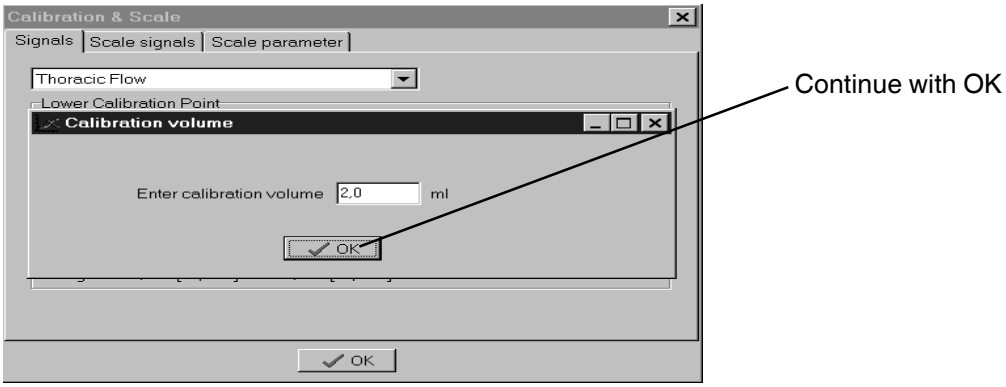


6.3.3 Proceed with the Volume calibration

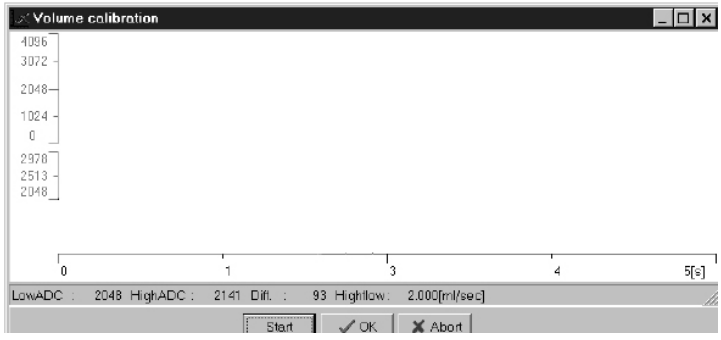
Select the “Start” button for “Upper Calibration Point” . This opens the small window below, where the calibration volume must be entered. Enter the volume of the calibration syringe used in this window e.g. 2ml for a rat pneumotachometer, 200 or 500µl for a mouse pneumotachometer . If you use a different value than 2ml for calibration enter your choosen value. The calibration volume should be in the range of the animal tidal volume (e.g. 2 to 4ml for rats or guinea pigs).



Prepare a syringe, filled with the choosen volume of air (in our case 2 ml for a rat pneumotach (0.5ml for a mouse pneumotachometer) connect the syringe to the pneumotach or to the plethysmographic box.

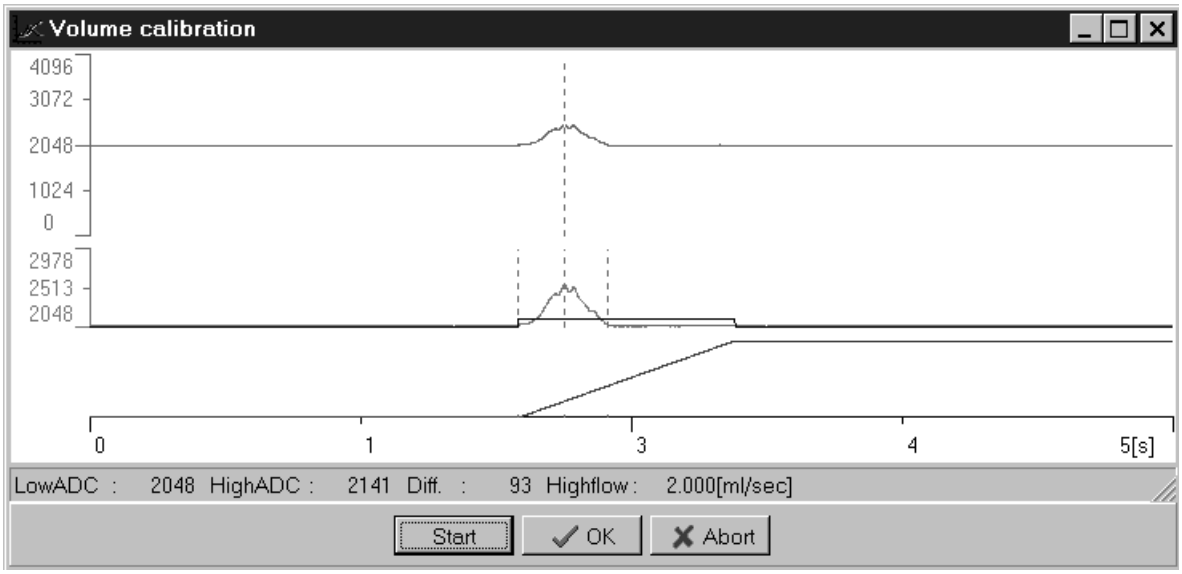


The next window is

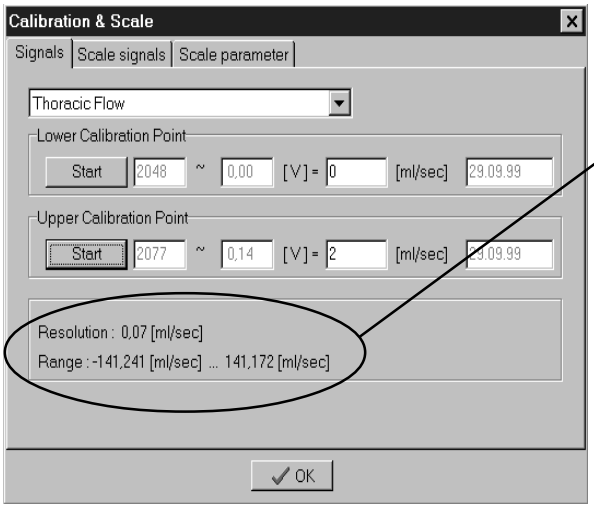


Click the “Start” button to start the volume calibration. You hear a beep and in the upper scale of this window you see the measured zeroline displayed in green colour at 2048. Now inject the choosen syringe content of air through the pneumotach or pull it out of the plethysmograph box. This results in a peak curve like displayed below. **This procedure only accepts positive going signals !**

After 5 seconds the window is updates. Scale 2 (red curve) shows the peak with amagnified scaling. Begin and end of the peak are marked with green dotted lines. The peak flow is marked with a red dotted line. Please check your curve. It depends a little on the speed you use to empty the syringe. Important is that the software detects a maximum (red line appears) and the beginning and the end of the peak (green lines). The area under the red curve is the same as the area under corresponding square wave. Scale 3 (blue) shows a simulated signal with constant flow to reach the same volume over time. From this volume curve the software calculates by differentiation the corresponding airflow.



Check carefully this window for the localization of the lines. Important are the two lines showing the beginning and the end of injection.
If these lines are not properly placed repeat the procedure by using the “Start” button. I they are well placed click on “OK”.
This will return you to the calibration window and the calibration for this restrainer is accomplished



Here the resolution and the maximal range for the signal is displayed. It is important to check these values. If the resolution is not as good as required (less than 0.1 ml/sec) the gain of the amplifier must be increased, so that higher values for the upper calibration point are received. If the calculated range seems too small, the gain of the amplifier must be reduced. If gain has been changed also redo the lower calibration (see 7.3.2)

After having done the calibration procedure your system is ready for measurement.

7. Faults, causes and remedies

- *No signal measured*

  - Amplifier TAM in "CAL" or "OFF" position: set the amplifier in "MEASURE" mode
  - Tubing to pneumotachometer not connected or leaking
  - Pneumotachometerside ports are blocked with mucus: the pneumotachometer must be cleaned

- *Signal out of range or signal clipping*

  - too high air flow or wrong "GAIN" calibration: recalibrate the measurement system
  If the system is pressure calibrated use a lower "GAIN", e.g. 30% instead of 50%
  If the system is volume calibrated, reduce the "GAIN" on the amplifier module TAM

- *Signal is inverted, inspiration is displayed as a negative signal deflection*

  - Exchange tubing connected on (+) and (-) input ports, on the pneumotachometer or on the DLP2.5 side.

8. Technical data

Pressure range:	±2.5 cmH_2O
Sensitivity:	65 to 67 mV/cmH_2O at 5 V excitation
Linearity:	±0.25% FSS
Temperature effects(0-70°C):	±1.5% FSS
Input impedance:	5000 Ohm
Output impedance:	3000 Ohm
Excitation voltage:	5 V (10 V)
Proof pressure:	250 cmH_2O
Pressure connection ports:	fit to tubing with ID :1.5 - 3.2 mm
Polarity:	a positive output voltage is generated by applying a positive pressure on the (+) port

Electrical connection:

Standard connector:	Binder, 6-pins, male
Excitation (+):	Pin 1 (white lead)
Excitation (-):	Pin 5 (brown lead)
Output (+):	Pin 4 (green lead)
Output (-):	Pin 2 (yellow lead)
shield:	connector case
	(Pin 3 is not used)

Dimensions:

Plastic case:	36 mm x 24 mm x 42 mm
Mounting rod:	8 mm x 155 mm, can be unscrewed (thread: M 5)

Part numbers:

73-3882	DLP2.5, HSE CONNECTOR
73-3989	DLP2.5, GRASS CONNECTOR
73-3999	DLP2.5, CONNECTOR FOR ADI ML110 & ML112 OR NEWER VERSIONS
73-4000	DLP2.5, CONNECTOR FOR ADI ML118 & ML119
73-4060	DLP2.5, FORGOULD 6600 SERIES, GE14P PLUG

9. Reply Form

Please take a few minutes of your time in order to write to us on any difficulties in understanding the Operating Instructions or in the use of the apparatus. With your feedback you will help to improve our products and the system documentation and make them more user-friendly.

Please tell us

- ☞ where you have found mistakes,
- ☞ where the arrangement was not clear and what you did not understand,
- ☞ and where you would like to see improvements.

Many thanks for your *kind assistance.*
Yours HUGO SACHS ELEKTRONIK-
HARVARD APPARATUS GmbH.

Your name _____

Organisation _____

Street _____

Town _____

Phone / Fax _____

eMail _____

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Please send this sheet or a copy to:

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