SCHNEIDER
MESSTECHNIK

Operating Manual

ILV 3

Digital charge amplifier

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Contents

1. General information

1.1. Information concerning the user manual

This user manual contains important information regarding the proper handling of the device. You must therefore read this user manual carefully before installation and commissioning. Any person instructed to carry out installation, commissioning or operation of the device must have read and understood the operating manual and in particular the technical safety instructions.

Follow the safety and handling instructions that are set out in this user manual. Compliance with the applicable accident prevention regulations and safety regulations as well as with national installation standards and recognised codes of practice must also be ensured.

This user manual is part of the device and should be kept accessible to staff at all times in the immediate vicinity of the installation location of the device.

We reserve the right to make technical changes.

1.2. Warning notices

Important instructions for your safety are specifically identified. It is essential to follow these instructions in or-der to prevent accidents and damage to property.

⚠ **Warning word**	**Nature and source of danger** - Measures to prevent danger

Symbol	Significance
⚠ **WARNING**	**Possible danger!** - Failure to observe may result in death or serious injury.
⚠ **CAUTION**	**Dangerous situation!** - Failure to observe may result in slight or moderate injury.
Notice	This marking draws your attention to a situation in which failure to comply with safety requirements can lead to damage to property.

1.3. General dangers of failing to follow the safety instructions

The device is state of the art and reliable. The device may give rise to residual dangers if it is inappropriately installed or operated.

1.4. Qualification of staff

Installation, commissioning, operation, maintenance, decommissioning and disposal may be carried out only by appropriately qualified specialist staff.

Work on electrical components must be performed only by a qualified electrician and in accordance with the applicable regulations and guidelines.

1.5. Limitation of liability

The manufacture shall accept no liability in the event of failure to follow the instructions or comply with technical regulations, improper use of the device or use in a manner other than that intended, or alteration or damage to the device.

1.6. Intended use

The device has to be used exclusively for measurement tasks and directly related control tasks within the application limits detailed in the data sheet. Use for any purpose other than the above is deemed to be non-designated use.

In the interest of safety, the device should only be operated by qualified staff and as described in the operation manual. It is also essential to comply with the legal and safety requirements for the application concerned during use. The same applies to the use of accessories.

The device is not intended for use as a safety component. Please also refer to chapter “1.9 Additional safety precautions”. Proper and safe operation requires proper transportation, correct storage, siting and mounting, and careful operation.

The technical data as set out in the current data sheet are authoritative. Should you not have the data sheet, please request it from us or download it from our website. (http://www.ics-schneider.de)

1.7. Package contents

Check that all of the listed parts are included in the delivered package, are undamaged, and have been supplied in accordance with your order:

- digital charge amplifier ILV 3 incl. protective caps
- CD-ROM with
    - parameterizations software “-Scaling Assistant“
    - this operating manual
    - data sheet ILV 3

1.8. Working safely

- The device must not be directly connected to the power supply system. The supply voltage must be between 10 and 30 VDC.
- Error messages should only be acknowledged once the cause of the error is removed and no further danger exists.
- Maintenance and repair work on an open device with the power on may only be carried out by trained staff who are aware of the dangers involved.
- Automation equipment and devices must be designed in such way that adequate protection or locking against unintentional actuation is provided (e.g. access checks, password protection, etc.).
- For those devices operating in networks, safety precautions must be taken both in terms of hardware and software, so that a line break or other interruptions to signal transmission do not cause undefined states or loss of data in the automation device.

1.9. Additional safety precautions

Additional safety precautions to meet the requirements of the relevant national and local accident prevention regulations must be taken in plants where malfunctions could cause major damage, loss of data or even personal injury.

The scope of supply and performance of the device covers only a small area of measurement technology. Before starting up the device in a system, a project planning and risk analysis must first be implemented, taking into account all the safety aspects of measurements and automation technology so that residual dangers are minimized. This particularly concerns personal and machine protection. In the event of a fault, the relevant precautions must establish safe operating conditions.

1.10. Rebuilding and modification

It is not allow to execute a constructive or safety-relevant modification of the device without an explicite compliance of ICS. For damages which result of modification liability is excluded.

1.11. The markings used in this document

Symbol	Significance
Important	This marking draws attention to *important* information about the product or about handling the product.
Tip	This marking indicates application tips or other information that is useful to you.
Information	This marking draws your attention to information about the product or about handling the product.
Device	Bold text indicates menu items, as well as dialog and window titles in the user interfaces. The arrows between menu items indicate the sequence in which menus and sub-menus are called
Data rate, 500	Bold text in italics indicates inputs and input fields in the user interfaces.
Emphasis *See….*	Italics are used to emphasize and highlight text and references to other chapters and external documents.

1.12. Available Accessories

Ordering number	Designation
 BDV4631	Lumberg system cable 8-wire cable for voltage supply and processing electronics, M12x1 cable plug, 10 m long, free ends
 BDV4650	Ethernet cable ILV 3 to PC, M12 to RJ45, 2 m long

2. Marking of the device

2.1. Product identification

The type plate serves to identify the device. The most important data can be taken from this. The order code is used to uniquely identify your product.

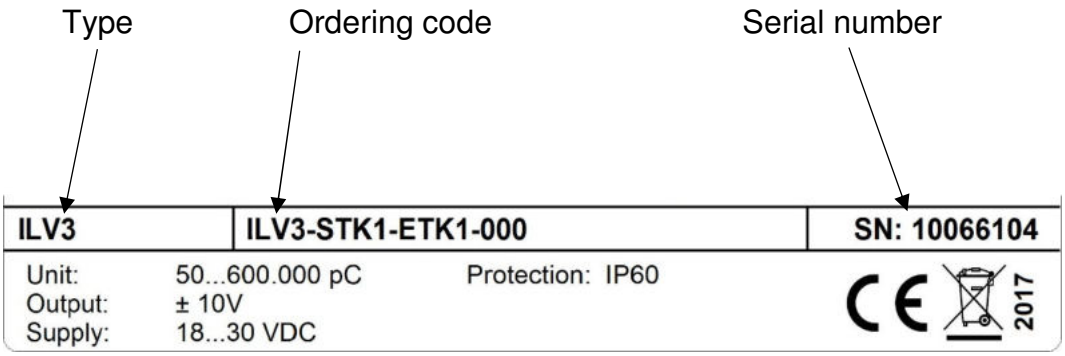


Fig. 1 Type plate

Notice

The type plate must not be removed from the device!

2.2. Symbols on the device

Symbol	Meaning
	**Statutory waste disposal mark** (*see chapter "10. Disposal")*
	**CE mark** The CE mark is used by the manufacturer to declare that the product complies with the requirements of the relevant EC directives (the Declaration of Conformity can be found at www.ics-schneider.com).
	Take details in the operating manual into account.

3. Installation

3.1 General operating conditions

- Protect the device from direct contact with water.
- Protect the device from moisture and weather such as rain or snow. To comply with the degree of protection under the DIN EN 60529 standard, all the cables must be connected and any connectors not in use must be fitted with protective caps.
- Do not expose the device to direct sunlight.
- As specified in EN 61326-1, Section 3.6, the connecting cables of the device must be no longer than 30 m (when laid within a building) and must not leave the building.
- The ILV 3 housing must be grounded to achieve EMC.
- Comply with the maximum permissible ambient temperatures and the data on maximum humidity as stated in the data sheet.
- The device must not be modified from the design or safety engineering point of view except with our express agreement. The device is delivered from the factory with a fixed hardware and software configuration. Changes can only be made within the possibilities documented in the manuals.
- The device is maintenance free.
- Please note the following points when cleaning the housing:
    - Disconnect the device from all current and voltage supplies before cleaning it.
    - Clean the housing with a soft, slightly damp (not wet!) cloth. **Never use** solvent as this could damage the labelling or the housing.
    - When cleaning, ensure that no liquid gets into the device or connections.
- In accordance with national and local environmental protection and material recovery and recycling regulations, old equipment that can no longer be used must be disposed of separately and not with normal household waste*. (see chapter "10. Disposal")*

3.2 Special conditions on using area

Important

Insulation resistance is crucial for piezoelectric transducers; it should be greater than 10^{13} ohms.

To obtain this value, all the plug connections have to be kept spotlessly clean. Positive or negative output voltage signal drift indicates insufficient insulation resistance.

Clean the plug connector contacts with a clean, lint-free cloth and isopropanol.
Cleaning agents used to clean SG measuring points are not suitable!

see also chapter "8. Tips for piezoelectric measurement technology"

Notice

The degree of protection per DIN EN 60529 is comply, when all cables are connected and any unused connections are fitted with protective caps.

Without protective caps, the device can also be damaged before the boundary conditions of the particular protection class are reached.

Important

As specified in EN 61326-1, Section 3.6, the connecting cables of the charge amplifier must not be longer than 30 m (when laid within a building) and must not leave the building.

3.2.1 Ambient temperature

The temperature has little effect on the output signal. Temperature-related measurement errors can be caused by cooling or heating on one side (e.g. by radiant heat).

3.2.2 Humidity

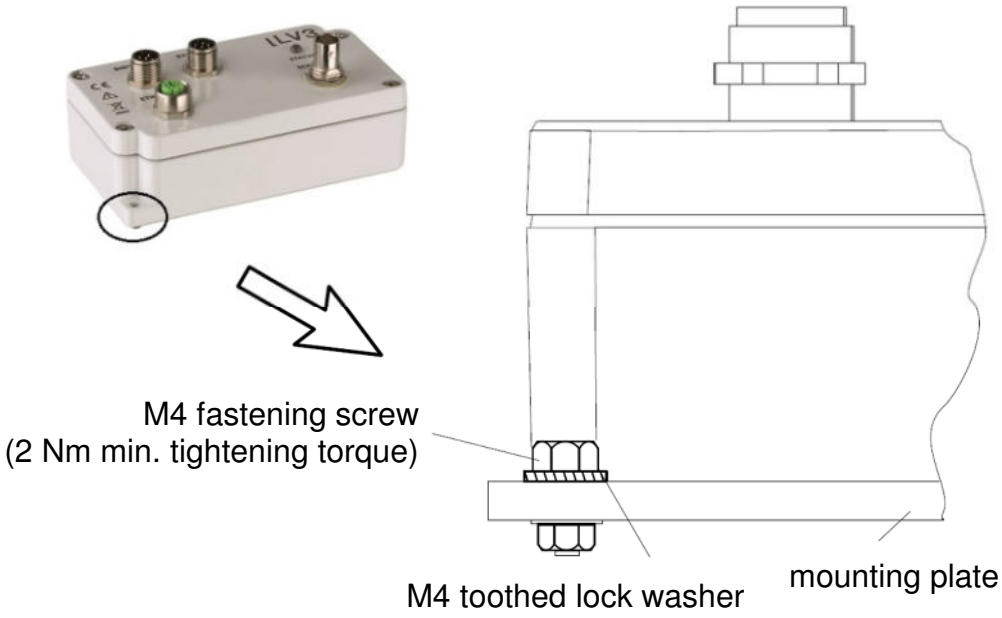
Avoid moisture or a tropical climate. When the cable is properly connected to the transducer and charge amplifier, the degree of protection of the charge amplifier is comply, as per DIN EN 60529.

3.3 Mounting

The charge amplifier must be firmly attached to a level support surface by two M4 bolts. This can be in any position. The signal inputs and outputs are electrically isolated from the ILV 3 housing. So no isolating elements are necessary.

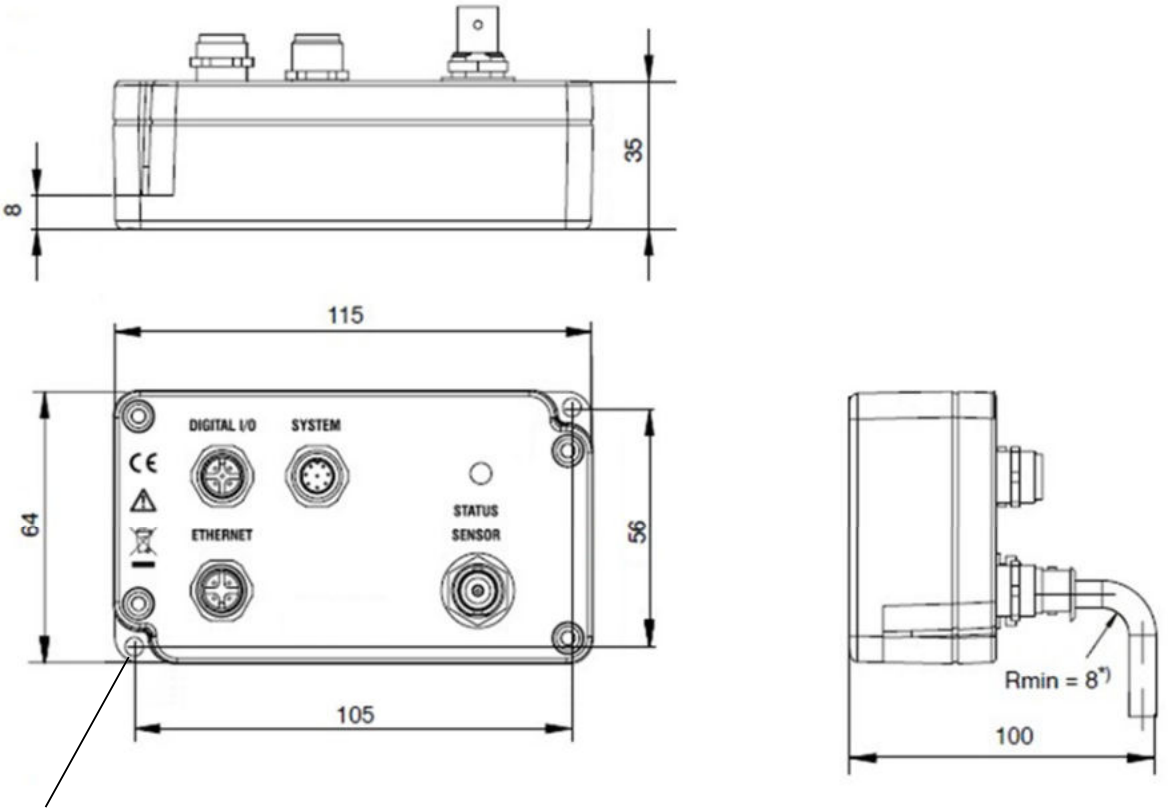
Important

If the device is used in highly electromagnetic environments, we recommend grounding the housing. A M4 toothed lock washer can be inserted between the head of the fastening bolt and the ILV 3 housing to connect it to a grounded base. The fastening bolt is tightened with a tightening torque of 2 Nm, to ensure a metallic connection.



3.4 Dimensions in mm (drilling template)

(1 mm = 0.03937 inches)



Length of M4 bolts: min. 16 mm

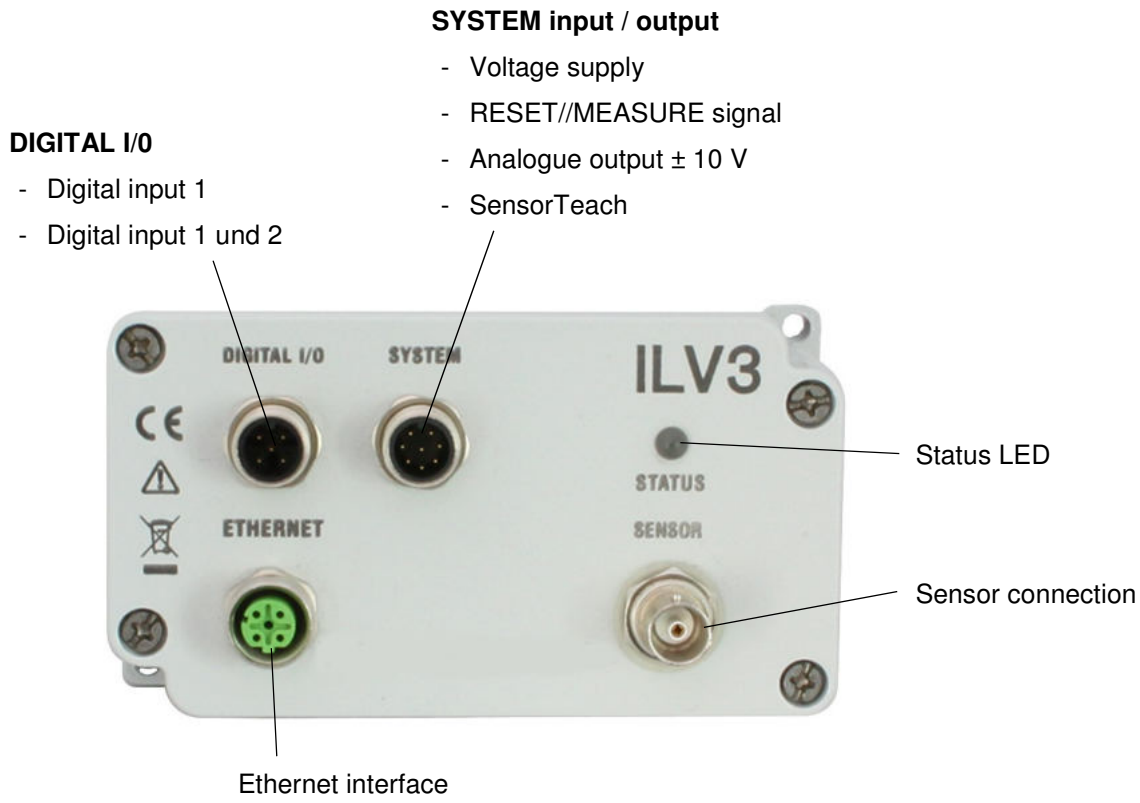
* 4 x cable diameter

Notice

Only connect the sensors to the ILV 3 once they have been mounted on the machine.

Sensors can deliver high charges during mounting, which could damage the amplifier. Seal unused connections with the supplied protective caps.

4. Device description



The ILV 3 is a single-channel charge amplifier for piezoelectric sensors. It converts the meas-urement signal of a sensor (comprising an electric charge) into a voltage signal of ± 10 V_{DC}.

Important

The ILV 3 has a compact design and good immunity from interference. All electrical signals are galvanically isolated. This means safe operation without the need for isolating elements or grounding. Only the digital input, digital outputs and the Reset / Measure signal are not electrically isolated from the mains.

The data sheet lists the permissible limits for mechanical, thermal and electrical stress. It is essential that these are taken into account when planning the measurement setup, during installation and ultimately, during operation *(also see Chapter "8. Tips for piezoelectric measurement technology")*.

IEPE/ICP sensors (current-fed, piezoelectric transducers) *cannot* be operated with the ILV 3.

4.1 SYSTEM input/output

The charge amplifier is supplied with voltage via this socket (18 … 30 VDC) *(see chapter "5.2.2 SYSTEM input/output connection")* and the measurement signal is output at max. ± 10 VDC.

RESET / MEASURE

The RESET / MEASURE input can be used to trigger measurements, or to clear (RESET) the charge amplifier input capacitors *(see chapter 8.2 Information about the charge amplifier and electrical connection)*.

SensorTeach

SensorTeach is an additional function for automatically scaling the charge amplifier *(see chapter "4.5 Principle of operation")*

4.2 Status LED

The status LED on the front of the ILV 3 indicates the cur-rent operating status of the charge amplifier.

Information

If not connected to the PC, the flashing LED displays are backed by the green light of the LED. As soon as there is a connection to the PC, e.g. with the "-Scaling Assistant", the flashing LED displays are backed by the blue light of the LED.

LED display	ILV 3 status	Explanation
green, constant on	measurement	The charge amplifier is ready to measure, but not connected via the interface.
red, constant on	reset	The charge amplifier is in RESET mode (not ready to measure).
red / green or red / blue, flashing	overload	Overload error (output voltage more than 10 V). A charge greater than the measuring range set on the device can cope with is out-put by the sensor.
green / blue, flash-ing	IP address not con-figured	The device IP address is the factory setting [1)]
blue, constant on	connection via Ethernet	The charge amplifier is ready to measure and a PC (Host) is connected via Ethernet.
yellow, flashing at 1 Hz	SensorTeach function	SensorTeach is activated

[1)] Even if the IP addresses of the PC (Host) and the charge amplifier are in the same network segment, the LED flashes green / blue.

LED display	ILV 3 status	Explanation
white, flashing at 2 Hz	ready for a firmware update	Bootloader is loaded. Once the “SensorTeach“ input has first been briefly set to the high level, you have ten seconds to start updating the firmware.
red, flashing at 1 Hz	bootloader mode	The device waits for PC input to start updating the firmware (update); the entry must be made within 10 seconds.
blue / yellow / red/ green successively, at 2 Hz	interface connections active	Use this function to identify the device currently connected via the interface

4.3 Sensor connection

The ILV 3 has a charge input (measurement channel) to which piezoelectric sensors can be connected. All piezoelectric sensors that generate max. 600 000 pC.

IE-PE sensors cannot be operated *(see Chapter “8. Tips for piezoelectric measurement technology”).*

4.4 Ethernet interface

This interface can be used to integrate the ILV 3 into a controller or connect it to a PC for parameterization.

Parameterize the ILV 3 with the “-Scaling Assistant” software on the CD.

The CD also contains drivers and a library for Lab-VIEW™, so that you can integrate the ILV 3 into this National Instruments software.

4.5 Principle of operation

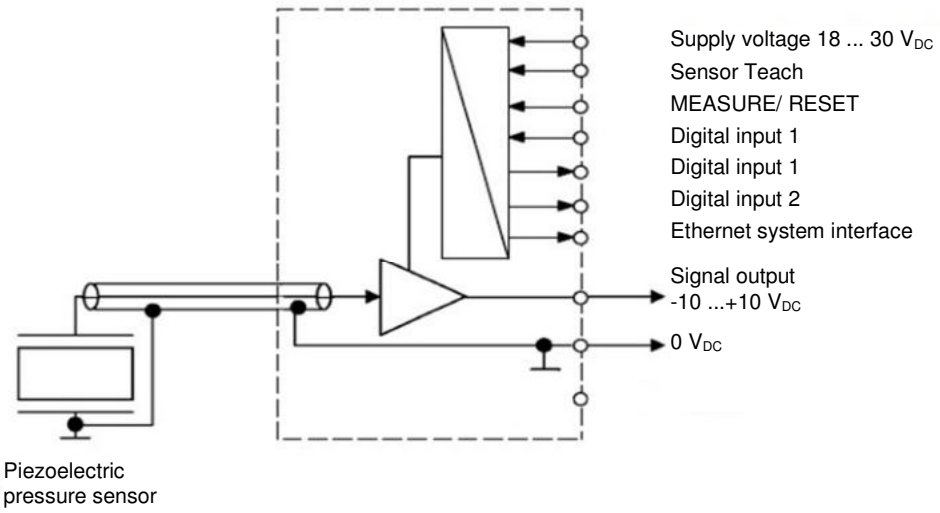


Fig. 2: Block diagram for the ILV 3 measuring chain

The ILV 3 charge amplifier is connected to a transducer for signal conditioning. The ILV 3 amplifies the electric charg-es to a output signal of -10 … +10 VDC (see the manufacturing certificate for accurate data).

The RESET / MEASURE input can be used to trigger measurement, or to clear (RESET) the charge amplifier input capacitors.

The output signals can be transferred to an industrial controller for monitoring, control and optimization of a production process.

The device is controlled via digital inputs and the Ethernet interface.

With its robust aluminum housing, wide power supply range of 18 to 30 V, and degree of protection coupling, the amplifier is designed for use in an industrial environment and for mounting really close to sensors. However, the degree of protection only applies if the connection sockets either have connection cables attached, or are covered by protective caps.

The charge amplifier is parameterized with “-Scaling Assistant” PC software. Measurement data can be visualized and also saved. Device settings can be saved to PC for backup purposes and also loaded into the charge amplifier later

4.6 The measuring chain

Accurate measured values can only be obtained with reli-able measurement technology. A typical measuring chain consists of a piezoelectric sensor with cable and a charge amplifier.

The analog voltage signal of the ILV 3 can be analyzed and evaluated in evaluation systems (data acquisition and evaluation, cycle control). This is usually implemented with a PLC.

In order to achieve correct results, the measuring chain must be individually configured and adjusted.

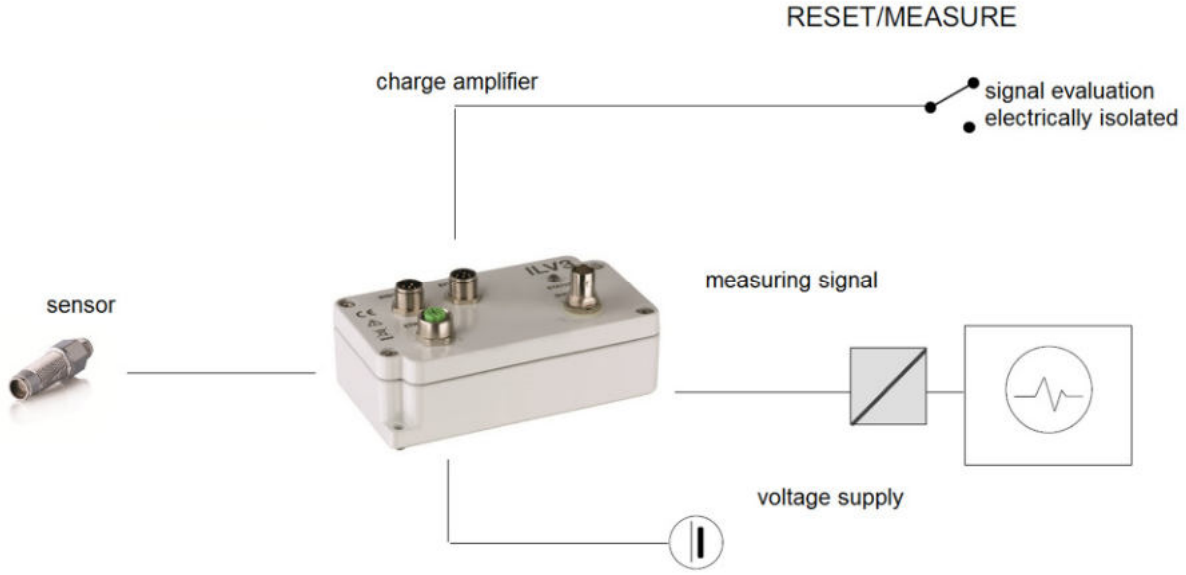


Fig. 3 Single channel measuring chain with charge amplifier

RESET/MEASURE

With an input voltage at pin 3 (RESET/MEASURE) of 0 … 5 V, the charge amplifier is in measuring mode (MEASURE). If a voltage of 12 … 30 V is applied to pin 3 (RESET/MEASURE), the charge amplifier switches to RESET.

Setting the reset signal will set the amplifier output to zero. This can be done with any force on the sensor. The advantage of the reset function is that drift factors can be compensated. A measurement can also only start from a higher force level.

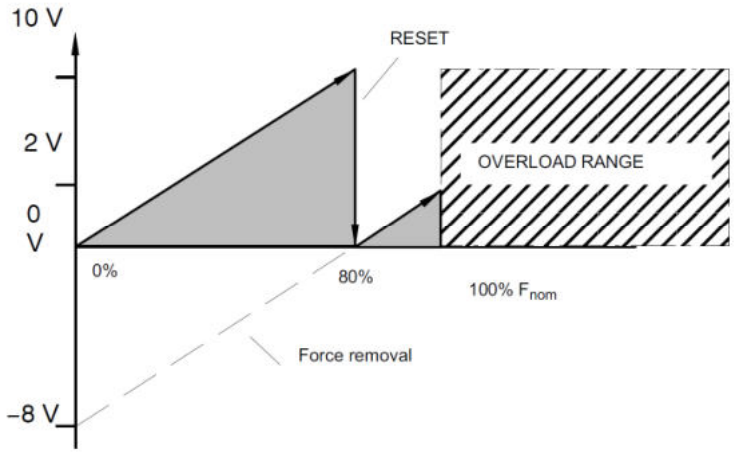


Fig. 4: Reset function

WARNING	After a reset, although the charge amplifier output is set to zero, this does not mean that no force is present at the sensor. This can cause danger for the operating staff of the system in which the transducer is installed. Implement appropriate safety measures to avoid overloads and to protect against resulting dangers.

4.7 Voltage supply, control inputs and analog out-puts

The 8-pin M12 device plug (SYSTEM socket) connects the supply voltage, analog output signal, SensorTeach and RESET / MEASURE signal with the following processing devices *(for pin assignment, see chapter "5.2.2 SYSTEM input/output connection").*

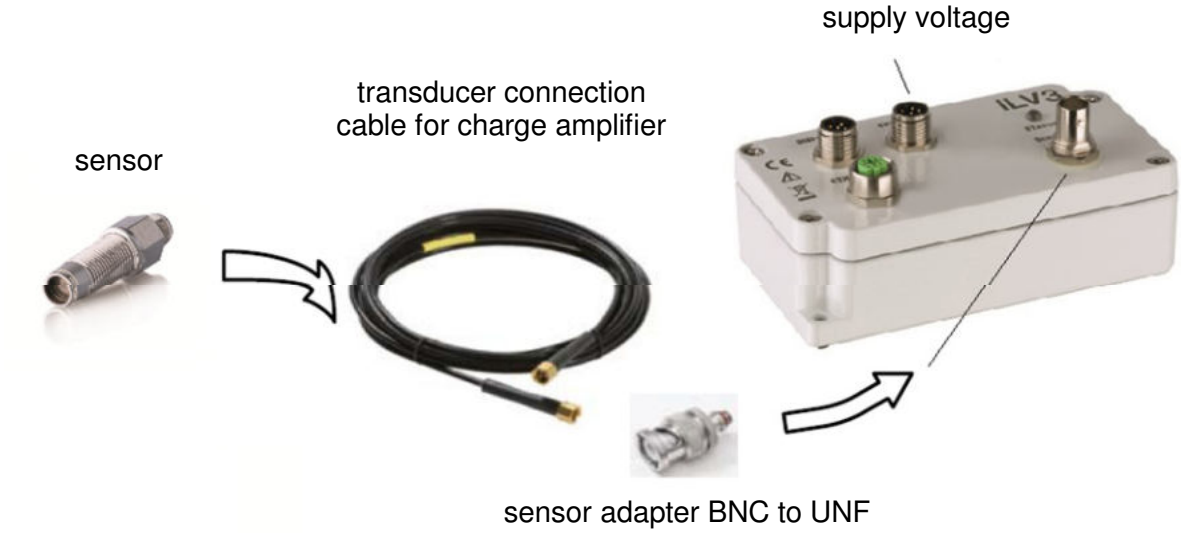


Fig. 5: Measuring chain with sensor, cable and ILV 3 (example)

Only high-insulation connection cables generating little triboelectricity (e.g. piezo input cable Teflon BDV4711) may be used for piezoelectric sensors.

The ILV 3 charge amplifier is designed for DC voltage operation (18 … 30 V). The circuit is intended for operation with separated extra-low voltage (SELV circuit).

4.8 Low-pass filter

In some cases, it is necessary to filter the measurement signal with a low pass, in order to eliminate interfering noise components, for example. An internal low-pass filter can be connected in the ILV 3. The values can be set anywhere between 1 Hz and 30 kHz.

4.9 High-pass filter

The charge amplifier has an internal selectable high-pass filter (0.15 Hz and 1.5 Hz). This allows lower-frequency interference (drift) to be eliminated, if it is not possible to reset the charge amplifier, for example.

4.10 SensorTeach

SensorTeach is an additional function for automatically scaling the charge amplifier using calibrated sensors. The calibration values (sensor sensitivity) can be found in the sensor's calibration certificate and transferred to the amplifier using "Scaling Assistant".

During the auto-scaling, the amplification is set so that the applied loads correspond to an output signal of 10 V minus the set overload reserve in volts. This function can be implemented via the "Scaling Assistant".

5. Starting up

Comply with safety instructions during installation, start-ing up and operation.

⚠ **WARNING**	Any contamination of the charge amplifier inputs and out-puts can cause drift, a reduction in insulation resistance, or even short circuits, which can invalidate the measurement results. This can cause danger for the operating staff of the system in which the transducer is installed. Protect the inputs and outputs of the charge amplifier from contamination and do not touch the contacts in the plug with your fingers.

How to proceed?

1. Connect the sensors
   (BNC coupling BDU2077; piezo input cable BDV4711)
2. Connect the supply voltage (18 … 30 VDC, SYSTEM socket);
   connection cable *Lumberg system cable (BDV4631)*
3. Connect the Ethernet interface to a PC
   (see chapter "5.2.3 Ethernet connection"); Ethernet cable (BDV4650)
4. Install the software for setting the parameters
   (see chapter "6. Software for parameterizing the ILV 3")

5.1 Behavior of the ILV 3 when switching on

When the ILV 3 is switched on, the output voltage is -10 V.

Approx. 375 ms are needed for switching on. Then all the outputs are stable. The time required increases to 13 sec. if the SensorTeach input is active when switching.

Residual charges may remain at the input capacitor after the start-up phase, which can result in a voltage signal at the signal output. The Reset / Measure process clears them and defines and sets the signal output to zero.

5.2 Electrical connection

The charge input is protected against static discharge (ground insulation) and can have a maximum potential difference of 10 V (related to the output or supply voltage).

5.2.1 Connecting the sensors

One sensor can be connected to the ILV 3 charge

amplifier. Please note the following when making the

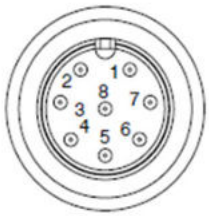
connection:

- Due to the very high insulation of the charge amplifier input, the signal or charge input must be protected against contamination. Insulation is reduced by moisture and contamination; this can lead to increased drift and invalid measurement results.

Clean the plug connection as required with a clean, lint-free paper towel or cleaning pad and pure isopropanol. *See chapter “8.2 Information about the charge amplifier and electrical connection".*

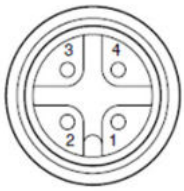
- Use the connection cable included among the items supplied, if possible. Once fitted, it should stay connected at the transducer. We otherwise recommend using high-insulation, low-noise cables from the ICS range (piezo input cable e.g. BDV4711). These have been tested for high insulation resistance, low noise and small interference charges during movement.
- Where possible, short-circuit the sensor before connection as piezoelectric sensors can generate high voltages. These could damage the charge amplifier.
- Connect the sensor cable to the transducer connection socket of the ILV 3. Comply with the maximum tightening torque of 1.5 Nm for the 10-32 UNF socket.
- To connect the sensor to the BNC socket of the ILV 3 with cable, you also need BNC coupling BDU2077.
- Cables longer than 10 m are not recommended.
- If the cable moves during operation, it should be fitted so that lengths of no more than 30 to 50 cm are allowed to hang freely.

5.2.2 SYSTEM input/output connection

Pin	Signal name	Description	Values	Colour code IEC60757	
1	ground supply	-	-	wh (white)	
2	not assigned	not assigned	-	bn (brown)	
3	reset	active high	+ 12... +30 V	gn (green)	
4	not assigned	not assigned	-	ye (yellow)	
5	output +	output signal	± 10 V	gy (grey)	
6	output -	output signal ground	-	pk (pink)	
7	not assigned	not assigned	-	bl (blue)	
8	voltage supply	voltage supply between pin 8 and 1	+18 … +30V	rd (red)	

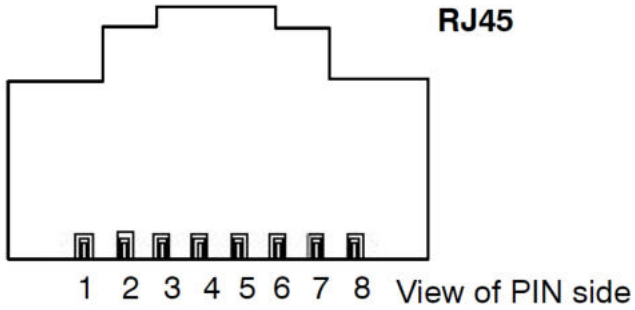
The charge amplifier is supplied with an external DC voltage source via this socket. The ILV 3 does not have an ON/OFF switch. If the correct supply voltage is connected, the LED lights up

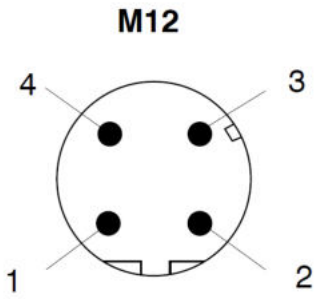
5.2.3 Ethernet connection

Pin	Signal name	
1	TX +	
2	RX +	
3	TX -	
4	RX -	

Use Category 5 shielded cable for the Ethernet connection. We recommend ICS Ethernet cable, ordering number BDV4650.

Ethernet cable pin assignment to PC

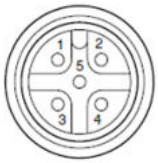




Patch cable	
RJ45	**M12**
1	1
2	3
3	2
6	4

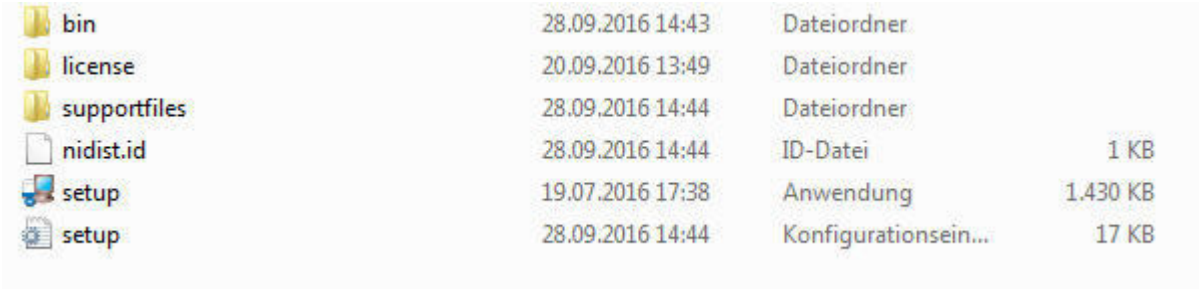
Ethernet cable (BDV4650)	
RJ45	**M12**
1	2
2	4
3	1
6	3

5.2.4 Digital connection

Pin	Signal name	Description	Value	
1	VCC	Input or output	VCC / 350 mA	
2	Digital Out	Supply for output 1, 2	+18... +30 V	
3	Digital Out	Digital output 2	VCC / 350 mA	
4	Digital In	Digital input 1	+12... +30 V	
5	Ground supply	-	-	

6. Software for parameterizing the ILV 3 (“-Scaling Assistant”)

Installation of the software works like this:
Find the folder “Volume” in the -Scaling-Assistant folder. There you find the file “Setup”. Using this file will start the installation.



You need to define a memory location for the two software parts (NI driver and software). If you have administrator rights, the installation runs automatically.

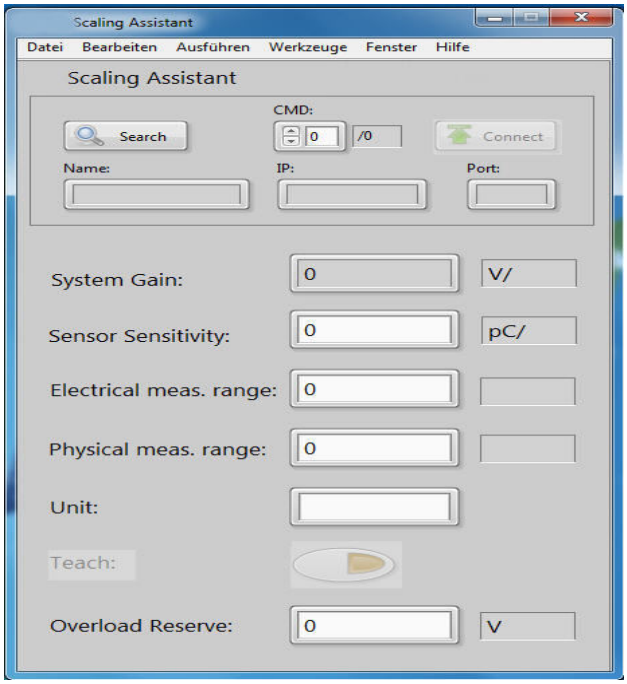
Information

Without administrator rights *it is not possible to install the software.*

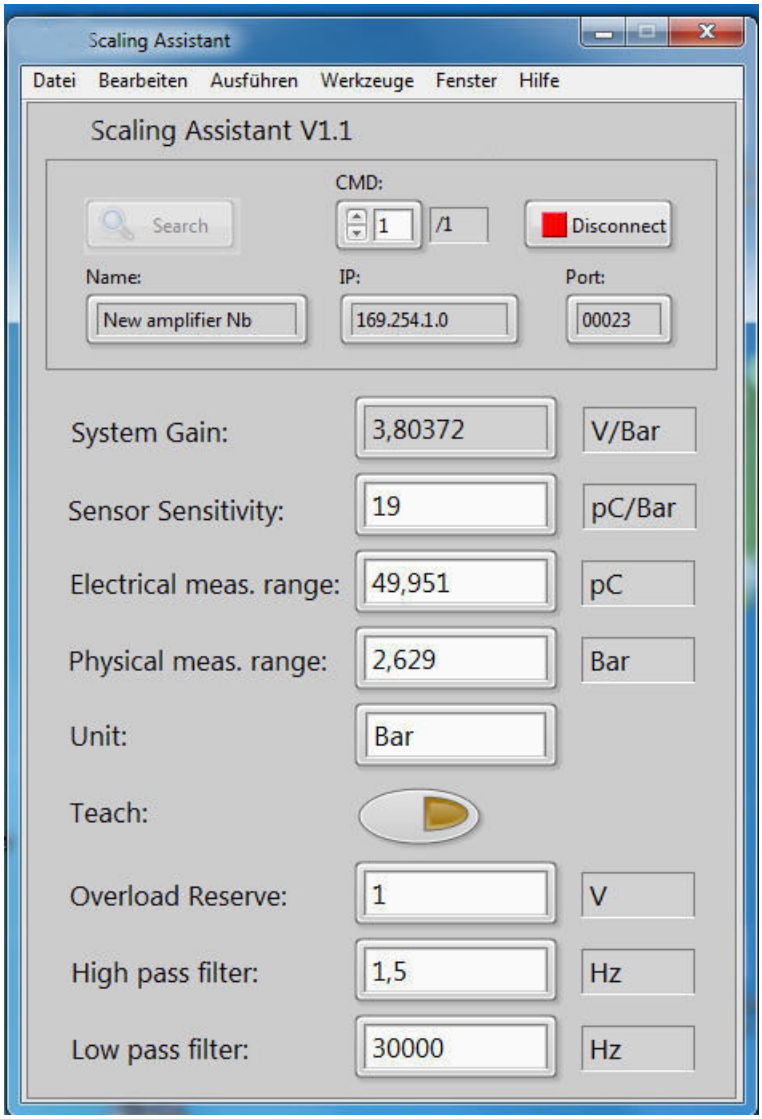
The uninstallation works over the Windows system control. In the point “Software” you will find the uninstallation manager. Find the Software in it and delete it.

The software runs from Windows XP SP3 onwards.

After the installation is finished, you can open the software and following start screen appears.



First you have to connect to the charge amplifier. For that you have to connect the charge amplifier to your pc via Ethernet. You can connect more than one amplifier, if your pc has more than one Ethernet connections. The software is able to recognize more than one amplifier but it can only work with one at a same time. If you use more than one amplifier, you have to adjust them one after another.
To find an amplifier, in the network, use the button “Search“. Next to the “Search” button you find a display of how much amplifier were found. You can now choose the amplifier you want and work with it.



If the software looks like this, you are connected to an amplifier and can adjust it.

6.1 Adjustment of the charge amplifier

The adjustment works with two variables. The first one is “Sensor Sensitivity” and the second one is “Physical meas. range”. If you input these variables, everything else will go automatically (“Electrical meas. range” and “System Gain”). In the panel “Unit” should be the value “Bar” and the “Overload Reserve” should be on the standard value (1 V).

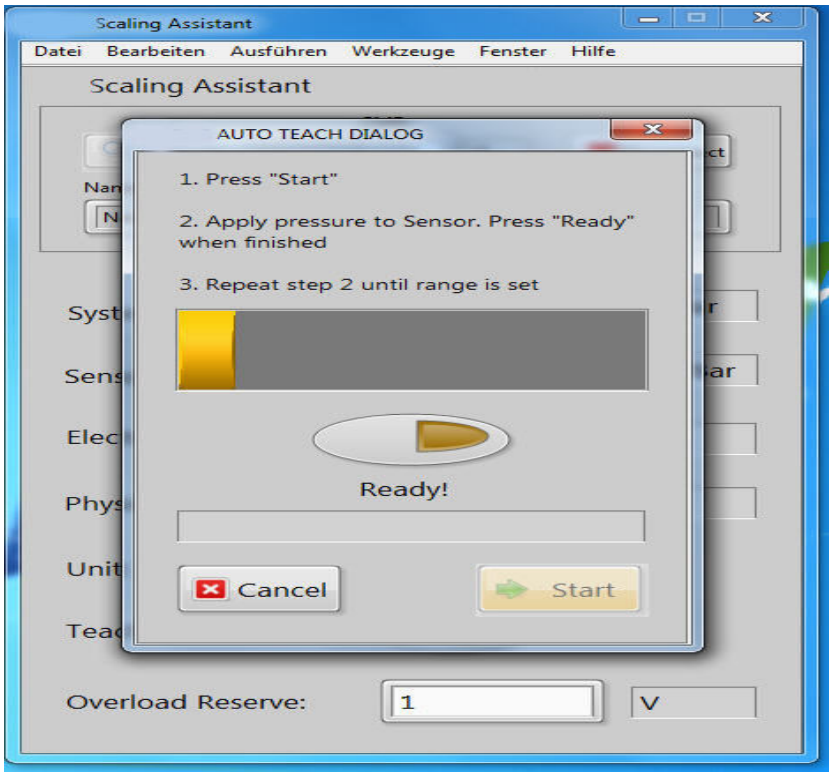
It is easy to determine the two variables. The value “Sensor Sensitivity” is found in the calibration document of your sensor. For the value of “Physical meas. range” it is recommended to use the full scale value of your sensor to measure within the complete pressure range. Basically it is possible to input every pressure value between the offset and the full scale of your sensor. It is, for example, possible to set the value to 2 bar, to get extremely high amplitudes within little pressure values. The “Physical meas. range” defines the output of the sensor. If the value is 2 bar here, the sensor will output 10 V at 2 bar pressure. What value should be inputted, is defined by your application. The safest way is to use the specified full scale value of you sensor.

Information

The software will sometimes replace your inputted values to strange comma numbers. This happens due to internal calculations in the amplifier and can be ignored by the user.

6.2 Sensor Teach (automatic adjustment)

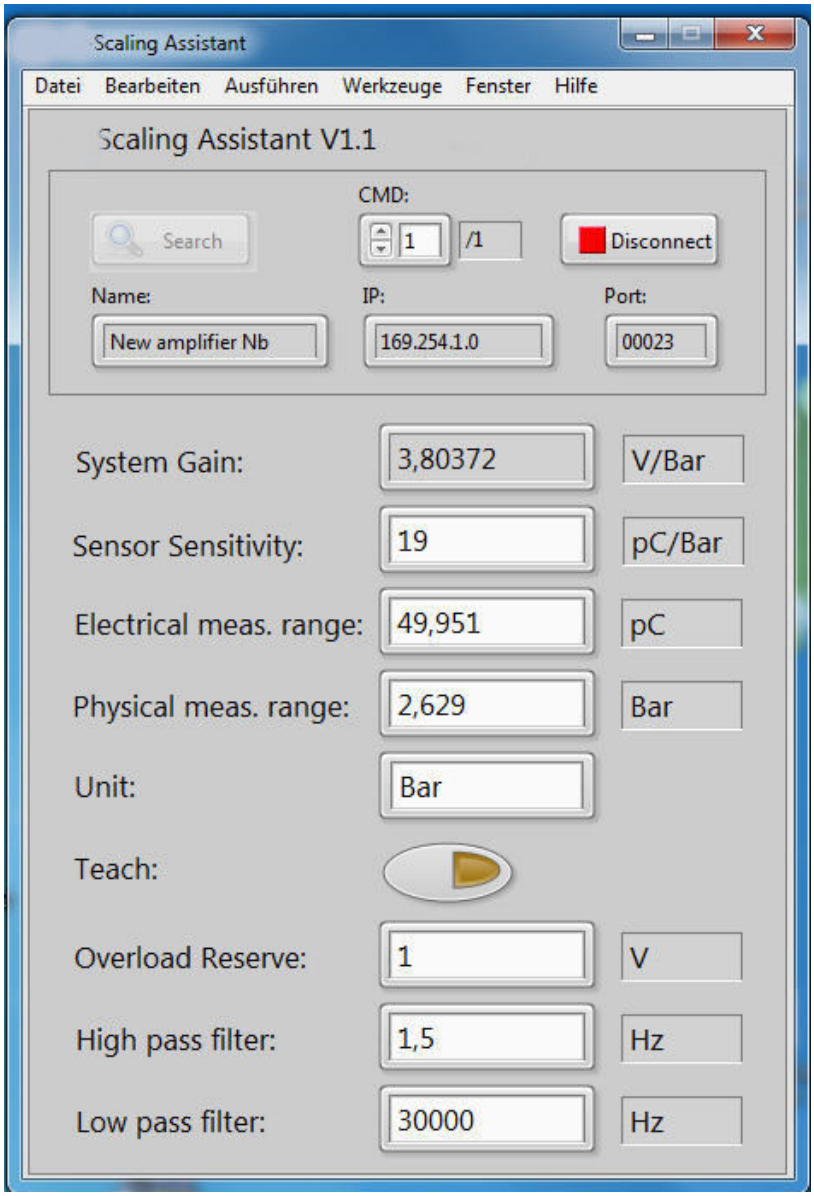
The charge amplifier has the built in function “Sensor Teach” for the automatic adjustment of piezoelectric sensors. To use “Sensor Teach” the sensor has to be connected to a pressure reference and you have to apply the full scale pressure a few times.



After pressing the “Sensor Teach” button in the software, a window opens (see above). The sensor has to be connected to a pressure generator, which is able to reach the desired maximum pressure value. Also, as with manual scaling, you can use every pressure value. What value should be used depends on your application. If you are not sure, use the specified full scale value of your sensor. When everything is ready, press the “Start” button. Now you need to get pressure on the sensor. When the pressure is reached, press “Ready”. This action has to be repeated 3 to 5 times, until the automatic adjustment has finished. The software will give a message when “Sensor Teach” is done.

6.3 High and Low Pass-Filter

The ILV 3 has two built in filter, a High- and a Low-Pass-Filter. They are activatable in the software.



Both panels are named after the filters. The High-Pass-Filter has three different settings. If you input the value “0”, the filter is deactivated. The input “0.15” or “1.5” sets the filter to 0.15 Hz or 1.5 Hz. The High-Pass-Filter can be used to combat the drift of the charge amplifier.

The Low-Pass-Filter is freely adjustable between 0 and 30.000 Hz. The values can be inputted into the panel and will be used instantly. The Low-Pass-Filter can be used to filter high frequency disruptions in the measurement signal.

7. Error messages / operating state (LED display)

LED display	ILV 3 status	Explanation	Remedy
green-blue, flashing	IP address not configured	The device IP address is the factory setting.	Match the IP addresses of the PC (Host) and the charge amplifier.
blue, constant on	connection via Ethernet	The charge amplifier is ready to measure and a PC (Host) is connected via Ethernet.	-
green, constant on	measurement	The charge amplifier is ready to measure, but not connected via the interface.	-
red, constant on	reset	The charge amplifier is in RESET mode (not ready to measure).	During operation: select the RESET/ MEASURE signal.
red (green or blue), flashing	overload	Overload error (output voltage more than 10 V). A charge greater than the measuring range set on the device can cope with is output by the sensor.	During operation: relieve system, perform a reset. While setting up: check and correct scaling.

8. Tips for piezoelectric measurement technology

Piezoelectric pressure sensors have a number of advantages: they are extraordinarily compact, offer extremely high overload capacity when the measuring chain is correctly laid out, and show negligible displacement. This results in high rigidity and therefore excellent dynamic properties.

But there are some information to take into account, to ensure maximum measurement accuracy and high operational reliability.

8.1 Functionality of piezoelectric sensors

A piezoelectric pressure sensor consists of single-crystal sensor elements and components used for force application.

The force acting on the crystal displace the positive and negative ion of the crystal lattice. This produces charges underneath and above. The displacement of the ion is proportional to the force applied and thus also to the charges occurring on the crystal surface.

8.2 Information about the charge amplifier and electrical connection

The charge output by a piezoelectric sensor is converted into a proportional voltage.

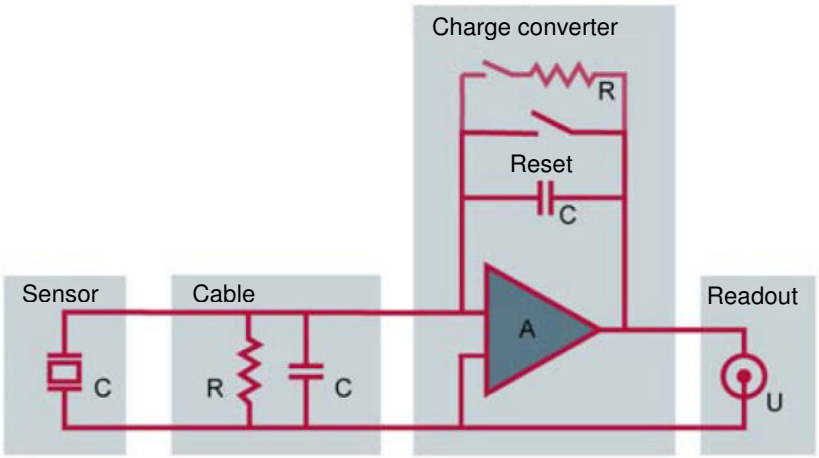


Fig. 6: Measuring chain with charge amplifier block diagram

Piezoelectric sensors are ideally suited to dynamic and non-zero point-related measurements. The drift generated by piezoelectric measurement chains is so low that it does not affect accuracy even with high requirements.

Drift is an effect of the limited insulation resistance of cables and charge amplifiers. The transducers themselves do not display drift if mounting and connection are implemented correctly. The maximum drift of a measuring chain with a ILV 3 is 0.1 pC/s, if quartz is used as sensor material, or 0.2 pC/s for the sensor material gallium phosphate.

To achieve less drift, please note the following:

1. The running-in behaviour of the charge amplifier.

   The charge amplifier should warm up for at least an hour before you start measuring.

2. The cleanliness of the connections (free of grease).

   If the insulation resistance of the cable between the sensor and charge amplifier is too low, the measuring chain will drift, as the charge can drain away via the too low insulation resistance. Insulation resistances $>10^{12}$ Ω are considered good.

   To keep the piezoelectric measuring chain drift low, all plugs and sockets must be kept clean at all times. Under no circumstances touch open contact surfaces with your fingers, or allow oil on them, as this can reduce the insulation resistance.

   So we recommend that protective caps should be left on the sockets of the sensor and charge amplifier until the sensor or charge amplifier is connected. If you disconnect, you should screw the protective caps back on again.

3. Use high-quality connection cables.

   Piezoelectric sensors must be connected to the charge amplifier by low-noise, high-insulation, coaxial cables (e.g. piezo input cable Teflon BDV4711).

4. Use the High-pass Filter of the ILV 3

The ILV 3 has a build in high-pass filter, which is adjustable to the thresholds 0.15 Hz or 1.5 Hz. For the activation of the filter please refer to chapter 6.3. The high-pass filter will, even when set only to 0.15 Hz, reduce the drift by a good margin. This method is only usable when the measurement signals are over the threshold of the high-pass filter. Otherwise the measurement signals will be filtered too.

Important

The cable must not be damaged. Should it be damaged, it must be replaced, as it is not possible to repair it.

If however, despite every precaution, sockets still get contaminated, you can clean them as follows:

- unscrew the plug
- dry wipe the white surface of the socket with a cleaning pad
- spray the socket with pure isopropanol
- clean again with a new cleaning pad

The cable plugs cannot be cleaned, i.e. if the plug is contaminated, the entire cable must be replaced.

8.3 Thermal influences

Influence of sensor temperature on the characteristic curve

The influence of temperature on the sensitivity of the sensors is very low, at 0.2% per 10 K, and is negligible for most applications.

8.4 Mechanical influences

In piezoelectric pressure sensors, the crystal lies in the direct force flow. The measuring elements (quartz or gallium phosphate) are designed for the maximum specified pressure of each sensor. Higher Pressure can damage or destroy the sensor. Refer to the datasheet of the specific sensor.

A thread in the correct dimensions is mandatory to use the piezoelectric sensors. A wrong or a bad tapped thread can destroy the sensor, too. The tightening torque of the sensors is 1.5 Nm. The 1.5 Nm must be strictly adhered to.

As the output signal is not dependent on the nominal pressure at the membrane, since it can be nullified through the reset-option, the pressure on the sensor should be monitored at all time.

8.5 The measurement chain

A piezoelectric measurement chains consist the following parts: The sensor followed by a charge amplifier and the connection cables between amplifier and sensor. Optional is a data acquisition for the output of the charge amplifier. If a data acquisition is needed, gets determined by the application. Fast measurements in kHz-range, are nearly impossible without automated data acquisition devices with a correct sample rate. The sample rate should be at least double the measurement frequency.

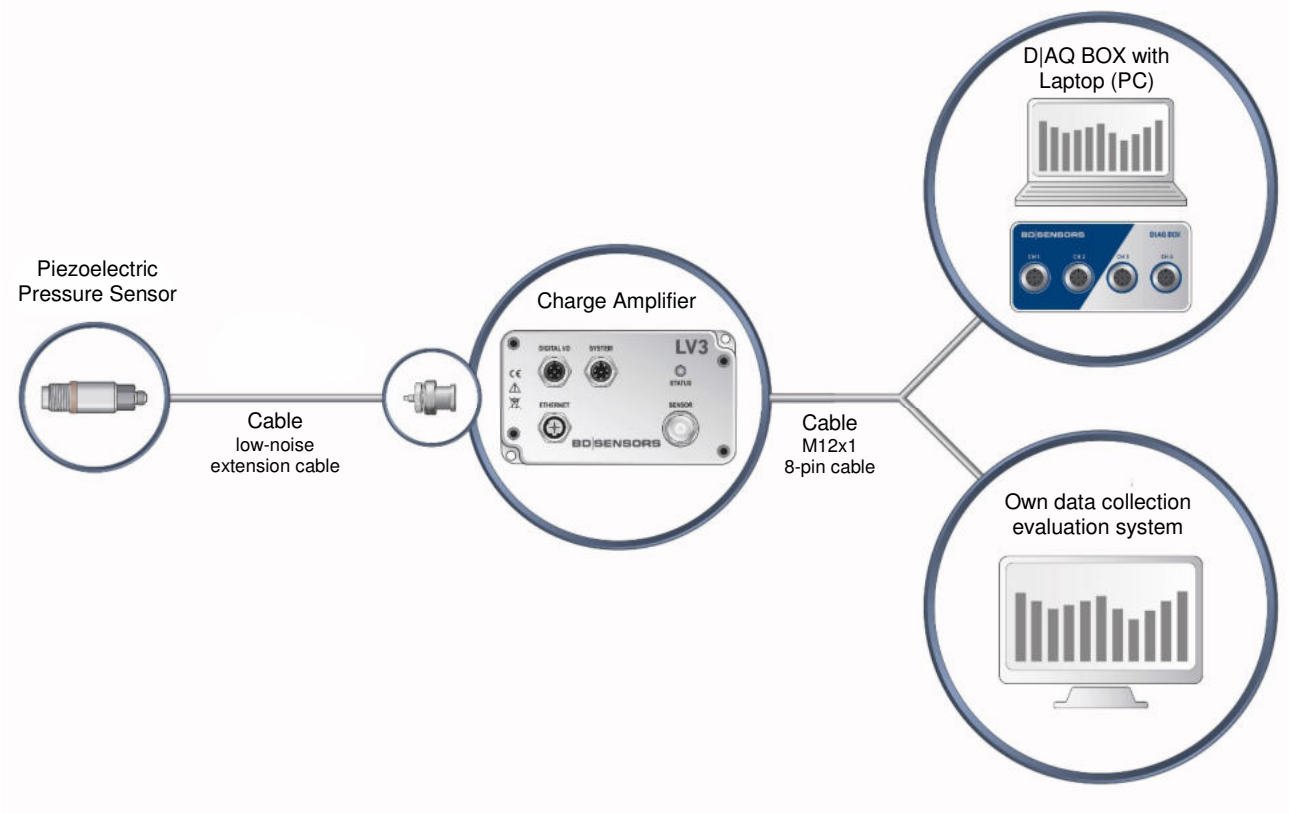


Fig. 7 Measuring chain

9. Maintenance

The ILV 3 charge amplifier is maintenance free. Please note the following points, when cleaning the housing:

- Disconnect the device from all current and voltage supplies before cleaning it.
- Clean the housing with a soft, slightly damp (not wet!) cloth. Never use solvent as this could damage the labelling or the housing.
- When cleaning, ensure that no liquid gets into the device or connections.
- Clean the plug connection contacts with a clean, lint-free cloth and isopropanol. Cleaning agents used to clean SG measuring points are not suitable!

10. Servicing / repair

For any return, such as for repair, clean the device carefully and package it to prevent damage. The device must be accompanied by a notice of return giving a detailed description of the fault. If your device has come into contact with pollutants, then a notice of decontamination will also be needed. You can find the relevant templates on our website. Download them from www.ics-schneider.de or request them from: info@ics-schneider.de

If you send in your device without a notice of decontamination and doubts with regard to the medium used should arise in our service department, repair work will commence only once an appropriate notice has been received.

11. Disposal

The device must be disposed of in accordance with European Directives 2012/19/EC (Waste Electrical and Electronic Equipment). Waste electrical products may not be disposed of with household waste!

12. Guarantee conditions

The guarantee conditions are subject to the statutory warranty period of 24 months, starting from the date of dispatch. No warranty claims will be accepted if the device has been used improperly, modified or damaged. Warranty cover also excludes any claims for defects that have arisen as a result of normal wear.

13. Declaration of conformity / CE

The supplied device fulfils the statutory requirements. The relevant directives, harmonized standards and documents are listed in the EU Declaration of Conformity applicable to the product. This can be found at http://www.ics-schneider.de. In addition, the operational safety of the device is confirmed by the CE mark on the device.