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Operating instructions

CE The unit complies with the corresponding EC guidelines.

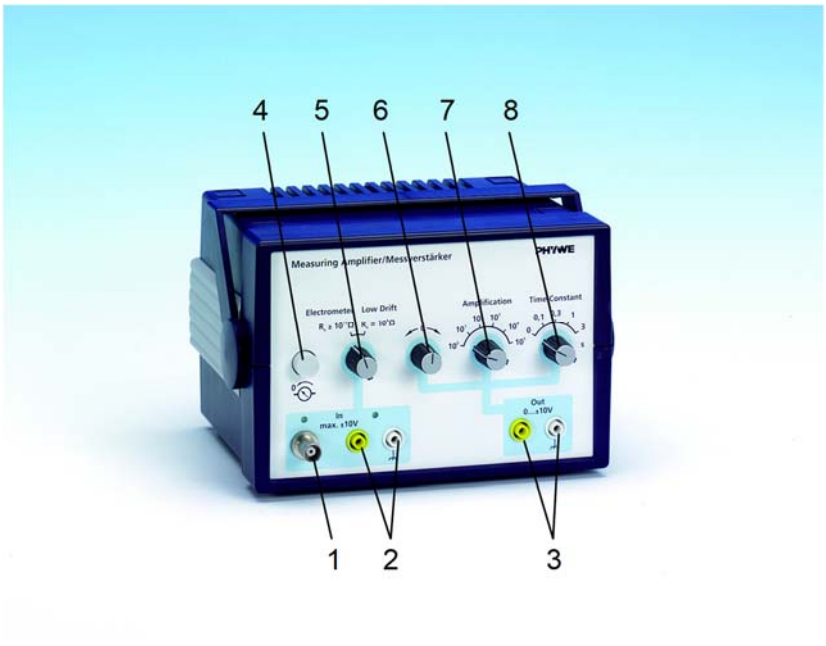

Fig. 1: 13626-93 Universal measuring amplifier

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1 SAEFTY PRECAUTIONS

Caution!

- Carefully read these operating instructions completely before operating this instrument. This is necessary to avoid damage to it, as well as for user-safety.
- Only use the instrument for the purpose for which it was designed.
- Check that your mains supply voltage corresponds to that given on the type plate fixed to the instrument.
- Install the instrument so that the on/off switch and the mains connecting plug are easily accessible.
- Do not cover the ventilation slots.
- Take care that no liquids or objects enter in through the ventilation slots.
- Only use the instrument in dry rooms in which there is no risk of explosion.
- Do not connect high voltage power supplies in series.
- Do not start up this instrument in case of visible signs of damage to it or to the line cord.

2 PURPOSE AND DESCRIPTION

The measuring amplifier is used to amplify measurement signals which cannot be measured directly, due either to high resistance of the signal source or to low amplitude. Two operating modes are available:

The “Electrometer” mode is selected for high resistance voltage sources. In this case, the input resistance of the measur-

ing amplifier is $10^{13}\,\Omega$, so that the source is practically submitted to no load.

If the measurement signals are very small (in the microvolt range), one works in the "Low Drift" mode. In this mode, the signal can be amplified by several orders of magnitude, taking particularly a stable zero position of the signal ("Low Drift") into account. In both operating modes, signals which are overlaid by higher frequency noise or other interfering signals, may be smoothened by means of a low-pass filter with adjustable time constant (0…3 s).

Next to voltages, current intensities and electric charges can also be easily measured.

3 FUNCTIONAL AND OPERATING ELEMENTS

1 BNC jack
Input jack for "Electrometer" operating mode.
The corresponding LED lights up when switch *5* is set to "Electrometer"

2 4 mm jacks
Pair of input jacks for "Low Drift" operating mode.
The corresponding LED lights up when switch *5* is set to "Low Drift"

3 4 mm jacks
Pair of output jacks to connect an indicating voltmeter or a recorder. Output resistance $R_a \leq 0.5\,k\Omega$

4 Discharge key. This is only effective in the "Electrometer" mode.
Pressure on the key discharges the input over a protective resistor.

5 Operating mode selection switch
"Electrometer" position:
high resistance input, $R_i \geq 10^{13}\,\Omega$
"Low Drift" position:
low resistance input, $R_i = 10^4\,\Omega$,
with particularly low output voltage drift.

6 Zero adjustment potentiometer (Offset Voltage position), for zero input voltage. According to the measurement task, the output voltage is set to 0 V with an open or shorted input.

7 Rotating switch for the selection of the amplification factor. $V = 10^0; 10^1; 10^2; 10^3; 10^4; 10^5$

8 Rotating switch for the selection of the low-pass filter time constant. $\tau = 0; 0.1\,s; 0.3\,s; 1\,s; 3\,s$.

4 HANDLING

4.1 Starting up the unit

The unit is connected to the grid by means of the supplied cable which is plugged into the socket at the back of the casing.

A fuse holder is found on the upper side of the connecting socket. This can only be opened, e. g. by means of a screwdriver, when the main plug has been pulled out. The mains switch is situated above.

If the unit does not work after having been correctly connected to the grid and switched on, please check whether this is not due to a failed main fuse before you send the unit to our service department for repair.

4.2 General indications

The measuring amplifier is ready to operate as soon as it has been switched on. If sensitive measurements are to be carried out in the Low Drift mode, it is advisable to switch on the unit about 15 minutes before measurements are carried out, in order to make sure stable temperature conditions prevail inside the unit.

Any voltmeter or recorder can be connected to the output. It must, however, be made sure that the interior resistance of the connected units is as large as possible, at least 10 kΩ. The output is protected against short-circuits and overcharges.

The input and output voltage ranges are −10 V…+10 V. If a too high amplification factor is selected, the output voltage rises to about 13 V at the utmost. In this case, the output is saturated. This does not damage the unit, but the measurement results are distorted. As soon as the output voltage increases above 10 V, the amplification factor should be reduced by one step.

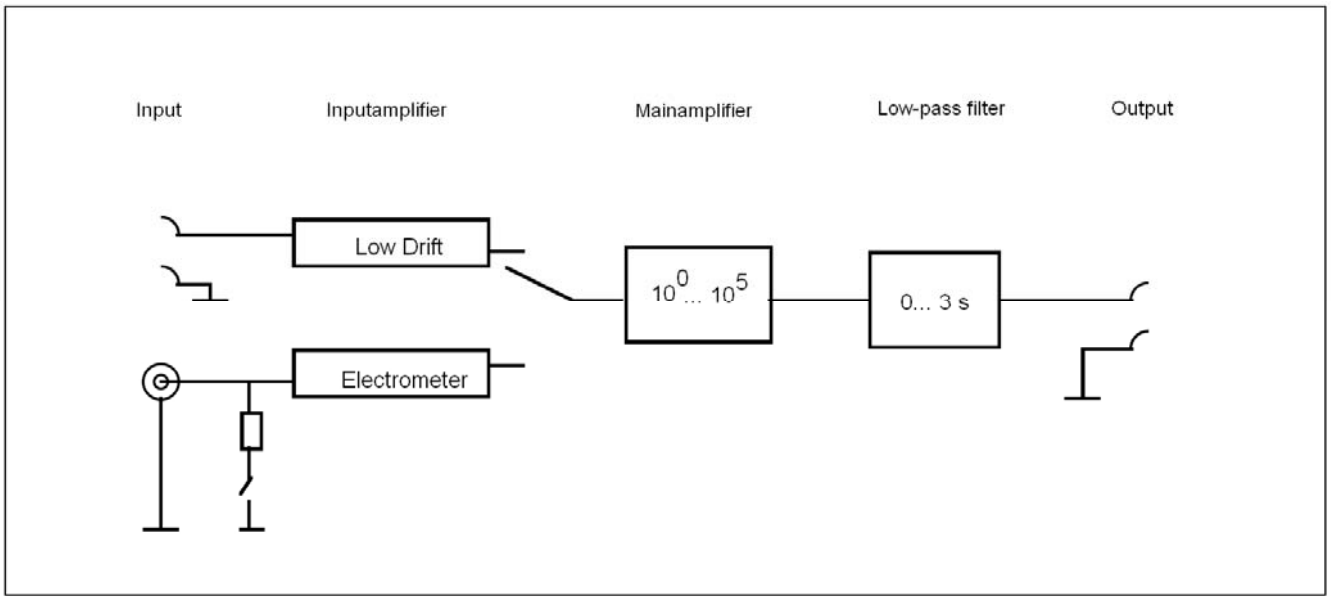

Fig. 2 Block diagram of the measuring amplifier

The output voltage has the same sign as the input voltage.

Thus, for high amplification factors, an in-phase back-coupling (capacitive or inductive) may occur from the output to the input, causing the amplifier to oscillate. This can be avoided using shielded cables at the in- and output or through addition of a low-pass filter.

As a rule, the low-pass filter is used when the measurement signal is to be recorded by means of a recorder, but has been overlaid by noise or by another interfering frequency.

The filter can be used sensibly if the frequency of the useful signal f is much lower than the frequency of the interfering signal f_s. The limit frequency f_0 of the low-pass filter must, however, be significantly higher than the frequency of the useful signal. In order to obtain a good separation of interfering and useful signal, the following relation must apply:

$$f < f_0 < f_s$$

A table with time constants and corresponding limit frequencies is found in section 6 Technical Data.

The amplifier is particularly suited for the measurement of direct voltages and slowly variable voltages. When alternating voltages are being measured, limit frequencies must be taken into account (−3 dB limit), which depend on the selected amplification factor (see 6 Technical Data).

The mass jack of the measuring amplifier is connected to the interior unit mass and to earth. In case of sensitive measurements, it must be made sure that the measurement set-up is not earthed at another point, in order to avoid so-called earth loops.

4.3 "Electrometer" operating mode

This operating mode with high input resistance (≥10^{13} Ω) must be selected if the measured object may not be submitted to loads by the measuring unit, e. g. electrostatics, photo cell.

Discharge key *4* is pressed before every measurement, in order to discharge input capacitors. The input working range is −10 V…+10 V. Voltages as high as 100 V (during a short period of time) and even higher voltages due to static charges will, however, not damage the measuring amplifier.

4.4 "Low Drift" operating mode

This operating mode with low input resistance (= 10^4 Ω) must be selected whenever the voltage source has a low resistance and the voltage is low, e. g. to measure thermal voltages or Hall voltages.

The inevitable temperature dependent drift of the amplifier is so small in this operating mode that even voltages of a few µV can be measured with sufficient precision.

4.5 Current intensity measurements

If a precision resistor is connected in parallel to the input, current intensities can also be measured as drops of voltage across this resistor.

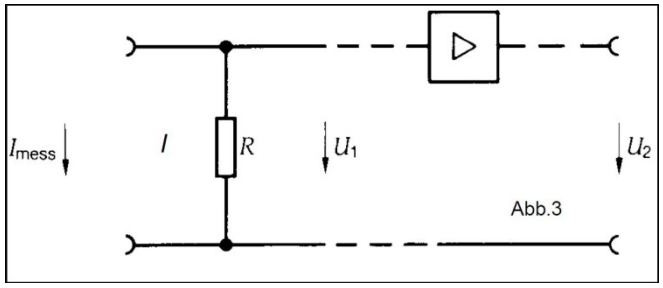

Fig. 3: Measurement of current intensities

The resistance value R can be selected freely, it should be as mall as possible, in order to keep the influence on the measured object small. For R < 100 Ω, the "Low Drift" operating mode is selected and for higher resistances, "Electrometer" operating mode. With an amplifying factor V one obtains:

$$I = U_2/(V \cdot R)$$

4.6 Measurement of loads

It is possible to measure charges, if a capacitor with a known capacity C is connected in parallel to the input in the Electrometer operating mode.

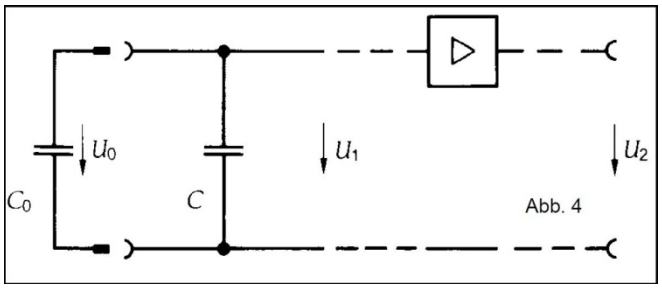

Abb. 4: Measurement of charges

The charge to be measured is generally situated on an (unknown) capacity C_0. To start with, the input capacitor C of the measuring amplifier is completely discharged by pressing the discharge key. If C_0 is now connected, the charge Q is distributed over both capacitors.

If the following relation was valid:

$$Q = C_0 \cdot U_0$$

now the following applies:

$$Q = (C_0 + C) \cdot U_1$$

The following cases must be distinguished when determining Q:

1st case: $C_0 \ll C$.

$$Q = C \cdot U_1 = C \cdot U_2/V$$

2nd case: C_0 is known

$$Q = (C_0 + C) \cdot U_2/V$$

3rd case: if $C_0 \ll C$ does not apply and C_0 is unknown, voltage U_0 must be measured in the first place before the capacitor is connected to the measuring amplifier (with discharged C).

In this case, the charge is obtained from the following relations:

$$Q = C \cdot U_1/\left(1 - \frac{U_1}{U_0}\right)$$

$$Q = C \cdot U_2/\left(V - \frac{U_2}{U_0}\right)$$

5 NOTES ON OPERATION

This instrument is only to be put into operation under specialist supervision in a controlled electromagnetic environment in research, educational and training facilities (schools, universities, institutes and laboratories).
This means that in such an environment, no mobile phones etc. are to be used in the immediate vicinity. The individual connecting leads are each not to be longer than 2 m.
The instrument can be so influenced by electrostatic charges and other electromagnetic phenomena that it no longer functions within the given technical specifications. The following measures reduce or do away with disturbances:
Avoid fitted carpets; ensure potential equalization; carry out experiments on a conductive, earthed surface, use screened cables, do not operate high-frequency emitters (radios, mobile phones) in the immediate vicinity.

6 TECHNICAL DATA

Electrometer operating mode

Input resistance	$\geq 10^{13}\ \Omega$
Input fault current	typ. < 1 pA*

Low Drift operating mode

Input resistance	$10^4\ \Omega$
Offset voltage drift	typ. < 2 µV/K*

* These values apply if the unit was switched on for 15 min in advance.

Common data

Amplification factors *V*	1; 10^1; 10^2; 10^3; 10^4; 10^5
Tolerance for *V*	typ. < 3 %
Deviation from linearity	typ. < 1 %
Input voltage	−10 V…+10 V protected in the short term against overloading up to ±100 V
Output voltage	−10 V…+10 V permanently short circuit proof

Frequency range, dependent from amplification factor V:

$V = 1$	0…22 kHz (−3 dB)
$V = 10^1$	0…22 kHz (−3 dB)
$V = 10^2$	0…10 kHz (−3 dB)
$V = 10^3$	0…6 kHz (−3 dB)
$V = 10^4$	0…2.5 kHz (−3 dB)
$V = 10^5$	0…2 kHz (−3 dB)

Low-pass filter with time constant τ which can be introduced using a switch. Following limit frequencies f_0 correspond approximately to this:

τ	f_0
0.1 s	1.6 Hz
0.3 s	0.5 Hz
1.0 s	0.16 Hz
3.0 s	0.05 Hz

Power supply:

13626-93	230 V / 50…60 Hz / 6 VA
13626-90	110 V / 115 V / 50…60 Hz / 6 VA

Fuse:
Cartridge fuse 250V 0.200A DIN M/TL 5X20MM, fuse type: time delay / slow blow

Offset voltage compensation through potentiometer.
Discharge key for high resistance input.

7 WARRANTY

We guarantee the instrument supplied by us for a period of 24 months within the EU, or for 12 months outside of the EU. Excepted from the guarantee are damages that result from disregarding the Operating Instructions, from improper handling of the instrument or from natural wear.
The manufacturer can only be held responsible for the function and technical safety characteristics of the instrument, when maintenance, repairs and alterations to the instrument are only carried out by the manufacturer or by personnel who have been explicitly authorized by him to do so.

8 WASTE DISPOSAL

The packaging consists predominately of environmentally compatible materials that can be passed on for disposal by the local recycling service.

Should you no longer require this product, do not dispose of it with the household refuse. Please return it to the address below for proper waste disposal.

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