

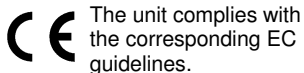
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Fig. 1: 13601-99 Universal Counter.

Operating instructions



The unit complies with the corresponding EC guidelines.

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1 SAFETY PRECAUTIONS



- Read these operating instructions carefully and completely before you put the instrument into operation. You so protect yourself and avoid damage to your instrument.
- Only use the instrument for the purpose for which it is intended.
- Make sure that the mains voltage given on the type plate

of your instrument agrees with that of your mains supply.

- The instrument is designed solely for operation in dry rooms in which there is no risk of explosion.
- Set the instrument so up that the mains switch and/or the instrument plug is/are freely accessible. Do not cover up the vent slots of the instrument.
- Before applying mains voltage, ensure that the earth lead of the experimental set-up is properly connected to the mains earth lead. The mains plug is only to be plugged into a mains socket which has an earth lead. Do not use an extension cable without earth lead, as this would negate the protective effect.
- Take care that no liquid or objects enter the instrument through the vent slots.
- Do not start the instrument up when there is visible damage to the instrument or to the mains cable.

2 PURPOSE AND CHARACTERISTICS

The electronic Universal Counter 13601-99 is intended for use as a measuring instrument for the measurements of times, frequencies, periods of oscillations, impulse rates, impulse counts and velocities. It has all of the characteristics that are expected of a present day universal counter and is additionally equipped with a series of technical specialities that fulfil the needs of practical lessons in natural science. Measured values are fundamentally displayed together with their measurement unit. Displays are automatically switched to the next higher range when their range is exceeded. The measuring range can be suited to requirements prior to the start of measurement, e.g. the number of decimals to be displayed can be physically reduced to a sensible number. A special socket is available for direct connection of a counter tube. The counting time is automatically measured during impulse counts; when a measurement is aborted, not

only the impulse count, but also the counting time and the impulse rate are displayed.
The stopwatch can be manually controlled. Electrical contacts or light barriers can be precisely started and stopped with various types of triggers.

3 TECHNICAL DESCRIPTION

The Universal Counter is held in an impact-resistant plastic housing. The handle in the housing top plate can be turned upwards for carrying the instrument. The same type of handle in the bottom plate can be turned downwards to incline the instrument with the front up. Four rubber feet ensure a slip-free and stable stand. The counter can be stacked on other instruments that have the same type of housing, whereby the rubber feet then fit in the pan-shaped depressions of the instrument below and so guard against slippage. When instruments are stacked, it is only permissible to bring the top one to the inclined position.

4 HANDLING

4.1 Start-up

Fit the instrument plug of the mains cable supplied into the socket that is above the instrument mains switch at the back of the housing. Connect the other end of the cable to the mains supply. Switch the mains switch on. The instrument is ready for use within a few seconds. It is in the "stopwatch" operating mode (manual stopwatch). The display shows "0.000 s". Before you start the first measurement, please read carefully through sections 4.2 and 4.3.

Replacement of the primary fuse:

The fuse holder is situated in the upper part of the instrument plug and is only accessible when the mains cable has been unplugged from the instrument. Use a screwdriver to open it. Remove the defect fuse from the fuse holder, insert the new fuse (see the type plate for the fuse rating) and fit the holder back in the instrument plug. Should the fuse blow when the instrument is switched on again, then under no circumstances use a fuse with a higher rating. The instrument then has a serious defect and is to be sent back to our Service department for repair.

4.2 Functional and operating elements

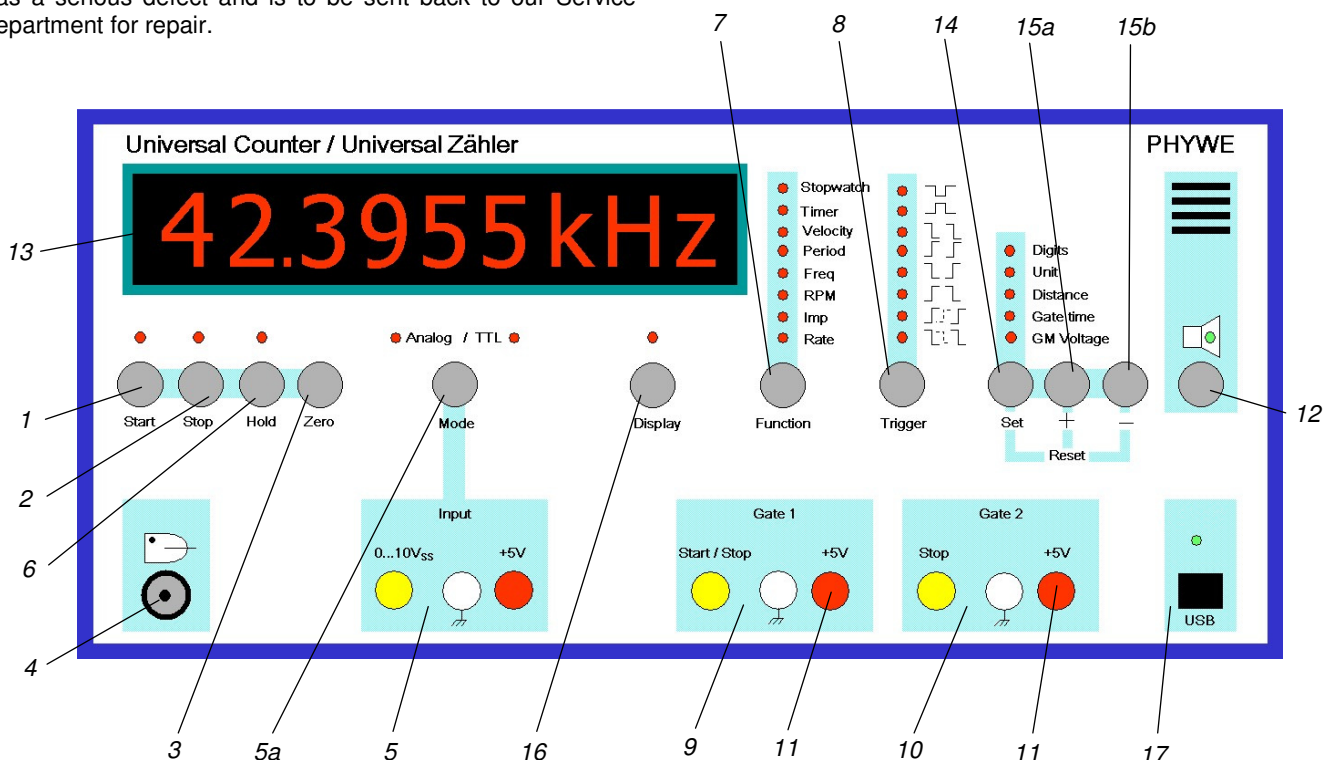
The picture below shows the functional and operating elements that are on the front plate of the Universal Counter:

- 1 **START button**
Starts a measurement in all Universal Counter operating modes.
- 2 **STOP button**
Ends a measurement process. The "STOP" condition is automatically selected when the Universal Counter is switched on.
- 3 **ZERO button**
Returns the display to zero. This button must always be pressed when the whole counting range has been exceeded (the display shows: "Ovl").
- 4 **BNC Socket**
Allows the direct connection of a Geiger-Müller counter tube.
- 5 **INPUT socket pair**
For feed in of the electrical signal that is to be examined.
Voltage range $U_{ss} = 0.1 \dots 10 \text{ V}$; Frequency range $f = 0.1 \text{ Hz} \dots 10 \text{ MHz}$

Voltage range

Switch position "TTL" TTL-compatible

Switch position "Analog" $U_{ss} = 0.1 \dots 10 \text{ V}$ (in the frequency range $< 100 \text{ Hz}$ and $> 100 \text{ kHz}$ 1 V min).



5a Mode button TTL/ANALOG

For switching over to input sensitivity, see 4.3.4, 4.3.5 and for selecting an available type of signal (periodic (analog) or TTL-similar (TTL)).

6 HOLD button

From the time that this button is pressed, the measured value that was actual at the time of pressing is held in the display, without any interruption to the progress of the measurement. The corresponding LED lights up to show this condition. Another press on this button causes the display to return to showing actual measured values.

7 FUNCTION button

For selection of the operating mode (see section 4.3). The operating mode that is currently in use is shown via the light emitting diode strip that is vertically above the button. If this button is pressed while a measurement is in progress, the measurement is stopped, the display is set to zero and the operating mode is changed.

8 TRIGGER button

For selection of the trigger types for the Timer and Velocity modes that are set under "Function" (see section 4.3.2; 4.3.3). The particular actual operating mode is shown by the light emitting diode strip above the button. The button is in the shut-off condition to the other modes that can be set under "Function".

9 "Gate 1" START/STOP pair of sockets

Used for starting and stopping the timer. This can be controlled by TTL-impulses, such as those supplied by the fork light barriers 11207.20 and 11207.30, or by contact closing and contact opening..

10 "Gate 2" STOP pair of sockets

For stopping the timer after it has been started by a circuit that is connected to the "Gate 1" pair of sockets (9).

11 Sockets + 5 V

Act as a direct voltage supply to TTL-controlling devices, in particular fork light barriers.

12 Button (Loudspeaker)

For switching the installed loudspeaker on and off (Freq; RPM; Imp; Rate).

13 Digital display

Six digit LED display with additional three letter light emitting diode matrix for display of the unit (ms, s, Hz, kHz, MHz, l/s, RPM, Imp, V, m/s).

14 SET button

In combination with buttons "+" (15a) and "-" (15b), serves to make the wanted value settings prior to a measurement. After having selected the operating mode (Function), manual range switching (selection of the number of decimals "Digits") can be carried out, or the unit "Unit", the measurement path "Distance", the gate time "Gate time" or the counter tube voltage "GM Voltage" can be defined. In each case, the actual operating mode is shown by means of the light emitting diode strip above the button. When the SET button is used for range switching, then the new number that is shown corresponds to the rounded-off value of the number that disappeared from the display.

15a Button +

15b Button -

Serves in connection with the SET button SET (14) to enter wanted values prior to a measurement.

When the SET button, the "+" (15a) and the "-" (15b) buttons

are all three simultaneously pressed, then a "Reset" is carried out and the instrument is set back to the original factory settings (see section 4.3)

16 Display button

For selection of the various saved or calculated values for display after the end of measurement. The appropriate LED lights up when further values are available (Velocity; Imp; Rate).

17 USB-socket

The USB port is used only for firmware update via PC. The green LED lights up, when connected to a PC.

Caution

The count input (5) and also the gate inputs (9) and (10) lie on the one side on a common chassis earth. Despite this it is still absolutely necessary to lead each control circuit in a two-pole manner up to the sockets of the corresponding inlet at the digital counter. The leaving out of supposedly superfluous leads can result in functional faults. Inlets and outlets in the experimental set-up that are not used should not be loaded because of EMC technical reasons.

4.3 Description of the operating modes

Note: At the moment of switching off, the settings activated at that time are saved. These are, in particular, the selected "Function", the trigger conditions and the values for "Distance", "Gate time" und "GM Voltage" selected via SET.

The simultaneous pressing of the three buttons "SET" "+" and "-" returns the counter back to the factory settings (see section 7).

4.3.1 Manual stopwatch (STOPWATCH)

To activate the "Manual stopwatch" operating mode, press the FUNCTION button (7) as often as necessary for the LED to light up that is alongside the "Stopwatch" inscription in the light emitting diode strip above the button.

To carry out a measurement:

The following steps are necessary:

- Activate by selecting the "Stopwatch" operating mode with the FUNCTION button.
- If desired, suit the display range prior to measurement. Pressing the "+" or "-" button (15a, 15b) changes the number of decimals.
- Start measurement by pressing the START button (1). The START-LED flashes during measurement.

After the start, the measuring range 0.000 to 999.999 s is first selected. When this range is exceeded, a switch to the 0.00... 9999.99 s range is automatically made.

During a measurement, a press on the STOP (2), ZERO (3), HOLD (6) buttons has the following effects:

STOP button (2): The measurement is ended; the last measured value remains in the display, the START LED is extinguished, the STOP LED lights up.

HOLD button (6): Pressing this button causes the actual numerical value to be frozen in the display until the button is again pressed. The HOLD-LED lights up to indicate the

HOLD mode. Measurement continues in the background and the START-LED flashes. A press on the STOP button ends the measurement procedure. In this case, the frozen value is still shown in the display, the START-LED is extinguished, the STOP-LED is lit up. A further press on the HOLD button brings the value to display that had been reached as measurement was stopped. The HOLD-LED is extinguished.

ZERO button (3): Sets the display to zero and ends a measurement.


Important note:


The "Stopwatch" operating mode acts as an addition stopwatch. The times for the successive measurements are continually added together, i.e. it runs on from the value that is shown in the display when the clock is started with the START button. If need be, the display can be previously set to zero with the ZERO button.

4.3.2 Gate controlled stopwatch (TIMER)


To activate the "Timer" operating mode, press the FUNCTION button (7) as often as necessary for the LED alongside the "Timer" inscription to light up.


Use the TRIGGER button (8) to select the triggering conditions. The momentary trigger type can be recognized by the red light signal alongside one of the graphical symbols. The graphical symbols correspond to the switching functions of the triggering TTL-levels at the gate inputs (9) [Gate 1] and (10) [Gate 2]. The following descriptions of functions are for PHYWE fork light barriers of order numbers 11207.20 and 11207.30. These provide "TTL-high" with brightness control and "TTL-low" on interruptions.


 The clock runs as soon as a brightness controlled light barrier connected to [Gate 1] START/STOP is first darkened. The clock is stopped when the light barrier is again brightness controlled.


 The clock runs as soon as a brightness controlled light barrier connected to [Gate 1] START/STOP is first darkened. The clock is stopped when the light barrier is again darkened.

With the four triggering types described in the following, with which starting and stopping is made via separate circuits [Gate 1 and Gate 2], the timer can also be switched by the opening or closing of a contact bridge. The other triggering types cannot be used in this way because of interfering contact bounce.

 Starts on the darkening of the light barrier at [Gate 1] START/STOP (9) or by the closing of a contact bridge. Stops in the same way at [Gate 2] STOP (10).


 Starts with brightness control of the light barrier at [Gate 1] START/STOP (9) or by the opening of a contact bridge. Stops in the same way at [Gate 2] STOP (10).


 Starts with darkening of the light barrier at [Gate 1] START/STOP (9) or by the closing of a contact bridge. Stops with brightness control of the light barrier at [Gate 2] STOP (10) or by the opening of a contact bridge.

 Starts with brightness control of the light barrier at

[Gate 1] START/STOP (9) or by the opening of a contact bridge.

Stop by darkening of the light barrier at [Gate 2] STOP (10) or by the closing of a contact bridge.

 The clock starts to run as soon as the light barrier connected to [Gate 1] START/STOP, which is first darkened, is brightness controlled. It stops after the next but one dark-bright transition.

 The clock runs as soon as the light barrier connected to [Gate 1] START/STOP, which is first brightness controlled, is darkened. It stops after the next but one bright-dark transition.

Carrying out a gate-controlled time measurement:

The following steps are necessary:

- Connect the controlling circuits (e.g. light barriers) to a START/STOP [Gate 1] or STOP [Gate 2] pair of sockets.
- Activate the timer by using the FUNCTION button to select the "TIMER" operating mode.
- Use the TRIGGER button to select the wanted type of triggering.
- If need be, use the SET (14), "+" and "-" (15a and 15b) buttons to suit the display range prior to starting measurement.
 - a.) Unit
Press the SET button as often as necessary for the LED alongside the »Unit« inscription in the light emitting diode strip to light up. Press the "+" or "-" button to select between the units:
ms; s
 - b.) Number of decimals
Press the SET button as often as needed for the LED alongside the »Digits« inscription in the light emitting diode strip to light up. Select the number of decimals by pressing the "+" or "-" button.
- Press the START button (1) to go to readiness to measure. The waiting state of the instrument is shown by the START-LED.
- As soon as the selected triggering event occurs, measurement starts and the actual values are continuously shown in the display.

STOP button (2): Ends measurement; the last measured value can be read remains in the display, the START-LED is extinguished, the STOP-LED lights up.

START button (1): If the measuring procedure was ended with the STOP button (2) or by the stop triggering condition, then the Universal Counter can be again brought to readiness for measurement with the START button.

HOLD button (6): Pressing this freezes the actual numerical value that is shown in the display. This condition is indicated by the flashing START-LED and lit-up HOLD-LED. Measurement progresses in the background until it is ended with the STOP-Button or by the stop trigger condition. In this case, the frozen value remains frozen in the display. The START-LED is extinguished and the STOP-LED lights up. The value that was actual at the end of measurement is first brought to display when the HOLD button is again pressed. The HOLD-LED is then extinguished.

ZERO button (3): Sets the display to zero and ends measurement.

FUNCTION button (7) and TRIGGER button (8): Sets the display to zero and ends measurement. The wanted operating mode or type of trigger can now be set.

Important note:

Measurement is continuous. As soon as the measuring procedure has been completed, the measured time is shown in the display. It remains there until the next measuring procedure has been completed.

4.3.3 Velocity measurement (VELOCITY)

Measurements of velocity are essentially the same as given above under the "TIMER" operating mode. Here, the velocity is determined from the time measured and the previously defined path (Distance) and the result is shown in the display.

To activate the "Velocity" operating mode, press the FUNCTION button (7) as often as necessary for the LED alongside the »Velocity« inscription to light up.

Use the trigger button (8) to select the triggering conditions. The momentary type of trigger is the one which is represented by the graphical symbol alongside which the red light is lit up. The graphical symbols stand for the switching functions of the triggering TTL-levels at the gate inputs (9) [Gate 1] and (10) [Gate 2]. Refer here to the triggering conditions explanations under 4.3.2 (Timer).

Carrying out a gate controlled velocity measurement:

The following steps are necessary:

- Connect the controlling circuits (e.g. light barriers) to the START/STOP [Gate 1] or STOP [Gate 2] pairs of sockets.
- Activate the timer by using the FUNCTION button to select the "Velocity" operating mode.
- Use the TRIGGER button to select the wanted type of triggering.
- If need be, use the SET (14), "+" and "-" (15a and 15b) buttons to suit the display range and define the measurement distance prior to starting measurement. To do this, press the SET button as often as necessary for the LED alongside the »Digits« inscription in the light emitting diode strip to light up. Press the "+" or "-" button to change the number of decimals. To determine the measurement path, press the SET button as often as necessary for the LED alongside the »Distance« inscription to light up. The display changes and the selected path is shown in the display with the unit "m". The distance can be selected from the following by pressing the "+" or "-" button:

0.001m ; 0.002m... 0.01m ; 0.015m ; 0.02m ; 0.025m ...
0.05m ; 0.06m ; 0.07m ; 2.00 m (the factory setting is 0.01m)

Note: The setting process can be speeded up by keeping the button pressed.

It is advisable to operate the ZERO button so that the measurement starts from a defined output position. It is however also possible to operate the START button and so leave the settings mode and start measurement directly.

- Bring to measurement readiness by a press on the START button (1). The waiting state of the instrument is shown by a continuously lit-up START-LED.
- As soon as the selected triggering event occurs, measurement starts and the actual values are continuously shown in the display.
The START-LED flashes.

When measurement is in progress, the STOP (2), ZERO (3), HOLD (6), FUNCTION (7) and TRIGGER (8) buttons have the following effects:

STOP button (2): Measurement is ended; the last measured value remains readable in the display, the START-LED is extinguished, the STOP and Display LED's are lit up.

ZERO button (3): The display is set to zero and the measurement is ended.

HOLD button (6): The actual numerical value in the display is frozen. Refer here to 4.3.2 / TIMER.

FUNCTION button (7) and TRIGGER (8) button: The display is set to zero and measurement is ended. The wanted operating mode or type of trigger can now be set.

After a stop signal, the START (1), ZERO (3), DISPLAY (16) buttons have the following effects:

ZERO button(3): The display is set to zero.

START button (1): If the measurement procedure was ended with the STOP button, the Universal Counter can be brought back to readiness to measure with the START button. The value in the display is extinguished.

DISPLAY button (16): Cyclically brings to display the pre-defined measurement path (m), the measurement time (s) and the calculated velocity (m/s). If the measuring procedure is again activated, the velocity is shown.

Important note:

Measurement is continuous. As soon as a measuring procedure has been completed, the velocity calculated from it is shown in the display. It remains visible there until the next measuring procedure has been completed.

4.3.4 Periodic time measurement (PERIOD)

In the measurement of a periodic time, the same procedure is used as for the measurement of a frequency. The difference in time between the voltage values at input (5) is determined. The result is displayed. Just as in the frequency measurement operating mode, this procedure is only suitable for signals with a stable impulse time difference.

To activate this operating mode, press the FUNCTION button as often as necessary for the LED alongside the »Period« inscription to light up.

The following steps are necessary to carry out a measurement:

- Select the type of signal with the MODE button (5a)
The "Analog" setting should hereby be used for periodic signals and the "TTL" setting for TTL-similar (square-wave) signals.

- Lead the signal to be measured to the input sockets (5). The input voltage should be in the range U_{ss} from 0.1 V to 10 V.

Caution

The threshold value of the input voltage is not to exceed ± 30 V, as higher values could cause damage to the instrument.

- If need be, use the SET (14), "+" and "-" (15a and 15b) buttons to suit the display range prior to measurement.

a.) Unit

Press the SET button as often as necessary for the LED alongside the »Unit« inscription to light up. Press the "+" or "-" button to select between the units:

ms ; s

b.) Number of decimals

Press the SET button as often as needed for the LED alongside the »Digits« inscription to light up. Select the number of decimals by pressing the "+" or "-" button.

During measurement, the measurement range is automatically suited to the signal applied.

- Use the START button (1) to start measurement. The START-LED flashes.

When measurement is in progress, the STOP (2), ZERO (3), HOLD (6) buttons have the following effects:

STOP button (2): Measurement is ended; the last measured value remains readable in the display, the START-LED is extinguished, the STOP and Display LED's light up.

HOLD button (6): The actual numerical value shown in the display is frozen. Refer here to 4.3.1 / Stopwatch.

ZERO button (3): The display is set to zero and measurement is ended.

Important note:

In the "Analog" setting, the trigger threshold of the measurement input sets itself automatically to the actual voltage level. When there is a change in the measurement voltage or the signal form, it could take several seconds for the new setting that is necessary to be made. During this time, a correct display cannot be given. The operating modes "Period" and "Freq" are in principle the same, the only differences are in the presentation.

The following display ranges are available:
 0.000 ms...999.999 ms (resolution 1 μ s)
 0.00000 s... 9.99999 s (resolution 10 μ s)
 0.0000 s... 99.9999 s (resolution 100 μ s)

After a stop signal, the ZERO (3) button and the DISPLAY (16) button have the following effects:

ZERO button (3): Sets the display to zero.

DISPLAY button (16): Cyclically brings the frequency and the periodic time to display. If the measuring procedure is again activated, the periodic time is shown.

4.3.5 Frequency measurement (FREQ)

In the frequency measurement, the time interval between impulses led to input (5) is determined and used to calculate the frequency, which is then displayed. This procedure has the advantage over impulse counting with a fixed gate time (see section 4.3.8) that, even at low frequencies, accurate results can be obtained in a very short time. Signals that have fluctuating time intervals, such as counter tube impulses, give a fluctuating, unusable display, however. For such signals, impulse counting with a known gate time must be used, as here the impulse rate is determined from the measured gate time. The operating modes IMP (section 4.3.6) and RATE (section 4.3.7) are suitable for this purpose.

To activate the operating mode "Frequency measurement", press the FUNCTION button as often as necessary for the LED alongside the "FREQ" inscription to light up.

The following steps are necessary to carry out a measurement:

- Select the type of signal with the MODE button (5a). The "Analog" setting should hereby be used for periodic signals and the "TTL" setting for TTL-similar (square-wave) signals.

- Lead the signal to be measured to the input sockets (5). The input voltage should be in the range U_{ss} from 0.1 V to 10 V.

Caution

The threshold value of the input voltage is not to exceed ± 30 V, as higher values could cause damage to the instrument.

- If need be, use the SET (14), "+" and "-" (15a and 15b) buttons to suit the display range prior to measurement.

a.) Unit

Press the SET button as often as necessary for the LED alongside the »Unit« inscription to light up. Press the "+" or "-" button to select between the units:

Hz ; kHz ; MHz

b.) Number of decimals

Press the SET button as often as needed for the LED alongside the »Digits« inscription to light up. Select the number of decimals by pressing the "+" or "-" button.

During measurement, the measurement range is automatically suited to the signal applied.

- Use the START button (1) to start measurement. The START-LED flashes.

When measurement is in progress, a press on the STOP (2), ZERO (3) or HOLD (6) button has the following effects:

STOP button (2): Measurement is ended; the last measured value remains readable in the display, the START-LED is extinguished, the STOP and Display LED's light up.

HOLD button (6): The actual numerical value in the display is frozen. Refer here to 4.3.1 / Stopwatch.

ZERO button (3): The display is set to zero and the measurement is ended. A further press on the ZERO button prior to a new measurement is not necessary in this operating mode.

Important note:

In the "Analog" setting, the trigger threshold of the measurement input sets itself automatically to the actual voltage level. When there is a change in the measurement voltage or the signal form, it could take several seconds for the new setting that is necessary to be made. During this time, a correct display cannot be given. The operating modes "Period" and "Freq" are in principle the same, the only differences are in the presentation.

The following display ranges are available:

0.00 Hz ... 9999.99 Hz (resolution 10 mHz)
0.0000 kHz... 99.9999 kHz (resolution 0,1 Hz)
0.00000 MHz... 9.99999 MHz (resolution 10 Hz)

After a stop signal, the ZERO (3) button and the DISPLAY (16) button have the following effects:

ZERO button (3): Sets the display to zero.

DISPLAY button (16): Cyclically brings to display the frequency and the periodic time. If the measuring procedure is again activated, the frequency is shown.

4.3.6 Rotational speed measurement (RPM)

In rotational speed measurements, the time interval between the impulses led to input (5) is determined and from this the number of revolutions per minute is calculated and displayed. The measurement principle is as for the RATE operating mode (4.3.8), whereby a gate time of 1 s or 10 s is automatically selected, according to the counting frequency.

To activate this operating mode, press the FUNCTION button for as often as it takes for the LED alongside the »RPM« inscription to light up.

The following steps are necessary to carry out a measurement:

- Select the type of signal with the MODE button (5a). The "Analog" setting should hereby be used for periodic signals and the "TTL" setting for TTL-similar (square-wave) signals.
- Lead the signal to be measured to the input sockets (5). The input voltage should be in the range U_{ss} from 0.1 V to 10 V.

For the measurement of rotational speed, connect, for example, a light barrier to input (5) ("TTL" setting) and arrange it so that it is darkened once after each revolution of the rotating object that is being examined.

Caution

The threshold value of the input voltage is not to exceed ± 30 V, as higher values could cause damage to the instrument.

When measurement is in progress, a press on the STOP (2), ZERO (3) or HOLD (6) button has the following effects:

STOP button (2): Measurement is ended; the last measured value remains readable in the display, the START-LED is extinguished and the STOP LED lights up.

HOLD button (6): The actual numerical value in the display is frozen. Refer here to 4.3.1 / Stopwatch.

ZERO button (3): The display is set to zero and the meas-

urement is ended. A further press on the ZERO button prior to a new measurement is not necessary in this operating mode.

Important note:

In the "Analog" setting, the trigger threshold of the measurement input sets itself automatically to the actual voltage level. When there is a change in the measurement voltage or the signal form, it could take several seconds for the new setting that is necessary to be made. During this time, a correct display is not possible.

The following display ranges are available:

6 RPM ... 99999 RPM (resolution 1 RPM (revolutions/ min))

4.3.7 Impulse counting (IMP)

This operating mode is generally used to measure the pulses supplied by a Geiger-Müller counter tube (e.g. a counter tube, type A, article number. 09025.11) that is connected to one of the BNC-sockets (4). A signal voltage can, however, also be put on at input (5) as described in section 4.3.5 (Frequency measurement).

Caution:

Do not simultaneously put a signal on the inputs (4) and (5). This would lead to a faulty measurement.

The number of impulses and the counting time are simultaneously captured in this operating mode. When measurement has ended, therefore, pressing the DISPLAY button can be used to also bring the counting time (s) or the impulse rate (I/s) to display in place of the number of impulses (I).

To activate the impulse counting operating mode, press the FUNCTION button as often as is necessary for the LED alongside the »Imp« inscription to light up. After the change to the "Imp." operating mode, the display is first set to zero (unit: I). At this position, an infinitely long gate time is preset.

The following steps are necessary to carry out a measurement:

- Lead the signal to be measured to input socket (4). These signals are generally those generated by a counter tube. Alternatively, lead a signal to input socket (5) (observe the note given in section 4.3.5)
- If wanted and prior to measurement, change the voltage applied to the Geiger-Müller counter tube at the BNC-socket (4) using the SET (14), "+" and "-" (15a, 15b) buttons. Refer here to section 4.3.8 / RATE.
- It is advisable to operate the ZERO button so that the measurement starts from a defined output position.
- Start the counting procedure with the START button (1).

When measurement is in progress, a press on the STOP (2), ZERO (3) or HOLD (6) button has the following effects:

STOP button (2): Measurement is ended; the last measured value remains readable in the display, the START-LED is extinguished, the STOP and Display LED's are lit up.

HOLD button (6): The actual numerical value in the display is frozen. Refer here to 4.3.1 / Stopwatch.

ZERO button (3): The display is set to zero and the measurement is ended.

Important note:

The "Imp" operating mode implements an addition mode. The impulses that are successively measured are continually added together, i.e. when measurement is started with the START button, counting continues from the value that is first shown in the display. If need be, the display can be previously set to zero with the ZERO button.

Interruption of the counting procedure with the STOP button stops the running of the internal clock. The determination of the impulse rate from the impulses and the counting time therefore remains correct even after any number of interruptions.

After a stop signal, the ZERO (3) and DISPLAY (16) buttons have the following effects:

ZERO button (3): Extinguishes the display, ends the counting procedure and switches back to the "Imp" type display.

DISPLAY button (16): Cyclically brings the impulse rate (I/s), impulses (I), counting time (s) and counter tube voltage (V) to display. When the measurement procedure is again activated, the impulses are shown.

4.3.8 Impulse rate measurement (RATE)

This operating mode is generally used for measurement of the impulses supplied by a Geiger-Müller counter tube (e.g. counter tube type A, article number 09025.11) connected to the BNC-socket (4). A signal voltage can, however, also be put on at input (5) as described in section 4.3.5 (Frequency measurement).

Caution:

Do not simultaneously put a signal on the inputs (4) and (5). This would lead to a faulty measurement.

For the determination of a rate after a manual start, impulses are counted over a period that can be selected between 1 s and 999 s and the average impulse rate (I/s) that is calculated for this period is displayed.

After the end of measurement, pressing the DISPLAY button can be used to also bring counting time (s) or number of impulses (I) to display in place of impulse rate (I/s)

To activate the "Rate" operating mode, press the FUNCTION button as often as is necessary for the LED alongside the »Rate« inscription to light up.

After a change to the "Rate" operating mode, the display first returns to zero (unit: I/s). In this position, a gate time of 1 s is first preset. A different gate time can be preset if wanted.

The following steps are necessary to carry out a measurement:

- Lead the signal to be measured to input socket (4). The signals are generally those generated by a counter tube. Alternatively, lead a signal to input socket (5) (observe the note given in section 4.3.5).
- If wanted and prior to measurement, define a finite gate time using the SET (14), "+" and "-" (15a, 15b) buttons. To do this, press the SET button as often as is necessary for the LED alongside the »Gate time« inscription in the light emitting diode strip to light up. The display changes

and the gate time selected is shown in the display with the unit "s". Press the "+" or "-" button to select the wanted value from the following:

1 s 2 s 999 s (step succession 1 s) (factory setting: 1 s)

Note: Holding the button pressed accelerates the setting process.

- If wanted and prior to measurement, use the SET (14), "+" and "-" (15a, 15b) buttons to change the voltage from the Geiger-Müller counter tube that is applied to the BNC-socket (4). To do this, press the SET Button as often as required for the LED alongside the »GM Voltage« inscription to light up. The display changes and the selected voltage value is now displayed with 'V' as unit. Press the "+" or "-" button to select the wanted value from the following:

100 V 660 V (step succession 1 V) (factory setting: 500 V)

Note: Holding the button pressed accelerates the setting process.

- If need be, use the SET (14), "+" and "-" (15a and 15b) buttons prior to measurement to change the display range. The number of decimals can also be predetermined.

During measurement, the measurement range is automatically suited to the rate applied.

It is advisable to operate the ZERO button so that the measurement starts from a defined output position. It is also possible, though, to operate the START button to leave the settings mode and directly start a measurement (the last displayed setting value is taken into consideration).

- Start the measurement procedure with the START button (1).

The measurement procedure begins and the value displayed is continually actualised according to the selected gate time.

When measurement is in progress, a press on the STOP (2), ZERO (3) or HOLD (6) button has the following effects:

STOP button (2): Measurement is ended; the last measured value remains readable in the display, the START-LED is extinguished, the STOP and Display LED's light up.

HOLD button (6): The actual value of the count is frozen in the display. Refer here to 4.3.1 / Stopwatch.

ZERO button (3): The display is extinguished, measurement is ended and a switch is made back to the "I/s" type of display. The START button allows a further measurement to be started with the values that were previously set (gate time, GM-voltage).

Important note:

Measurement is continuous. As soon as the measuring procedure has been completed, the impulse rate is shown in the display. It stays visible there until the next measuring procedure has been completed.

The following display ranges are available:

0.00 l/s ... 9999.99 l/s
 0.0 l/s ... 9999,9 l/s

The last actualisation of the display shown is made after the gate time has elapsed, which can, in particular with short gate times, give the false impression that measurement was made for longer than the set gate time.

After a stop signal, the ZERO (3) and DISPLAY (16) buttons have the following effects:

ZERO button (3): Extinguishes the display, ends the counting procedure and switches back to the "I" type display.

DISPLAY button (16): Cyclically brings impulse rate (l/s), impulse (I), counting time (s) and counter tube voltage (V) to display. When the measurement procedure is again activated, the impulse rate is shown.

5 NOTES ON OPERATION

This high-quality instrument fulfils all of the technical requirements that are compiled in current EC guidelines. The characteristics of this product qualify it for the CE mark.

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.

Following a blackout failure, operate the on/off switch for a reset.

Important note:

Should you use an electromagnetic starting device, then the induction surge that occurs on switching a coil on and off could influence the electronics of the counter. This can be acted against by the parallel connection of an attenuating diode (e.g. 39106.02) to the coil. The coil is operated by direct current and the diode is in the blocking direction. When the coil is switched off, the diode forms a short circuit and weakens the induction surge.

6 ADDITIONAL EQUIPMENT

The use of the following devices with the Universal Counter 13601.99 brings particular advantages.

Light barriers	
Fork light barrier, compact	11207-20
Fork light barrier with counter	11207-30

Counter tubes	
Counter tube, type A	09025-11
Counter tube, type B	09005-00

7 TECHNICAL SPECIFICATIONS

(Typical for 25 °C)

Operating temperature range 5...40 °C

Relative humidity < 80%

Digital display

Type of display	LED
Digital display	6-digit, 7-segment
Display of units	3-character, 5x7 dot matrix
Units	ms, s, Hz, kHz, MHz, l/s, RPM, I, V m/s
Character height	20 mm
Counting capacity	999999

Signal input

Signal bandwidth	0,1 Hz... 10 MHz
Pulse width	min. 30%/70% or 70%/30% duty factor
Individual impulse	Duration at least 1 µs at 1 V (peak to peak)

Signal level

Switch position "TTL"	
f = 0.1 Hz...10 MHz	TTL-compatible

Switch position "Analog"

f = 0.5 Hz...100 Hz	$U_{SS} = 1.0 V...10 V$
f = 100 Hz...100 kHz	$U_{SS} = 0.2 V...10 V$
f > 100 kHz	$U_{SS} = 1 V...10 V$

Input impedance	0.5 MΩ /1 kHz
Coupling	AC
Maximum permissible overvoltage	±30 V

Counter tube input

Voltage at the counting tube socket	100 V... 660 V (factory setting: 500 V)
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Gate inputs (gate 1, gate 2)

Signal bandwidth	DC, 1 MHz
Signal level	TTL-compatible
Switching threshold	TTL-compatible
Maximum permissible overvoltage	±30 V

5 V Outputs

Output voltage	5 V
Output current	max. 1 A
Overload capacity	Short-circuit proof

Manual control (stopwatch) (factory setting)

Display ranges	0.000...999.999 s 1000.00...9999.99 s 10000.0 ...99999.9 s
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Resolution	1 ms or 1 digit
Operating modes	Addition stopwatch Interval timer

Gate control (TIMER)

Display ranges	0.000ms ...999.999 ms 1000.00ms ...9999.99 ms 10.0000s ...99.9999 s 100.00s ...9999.99 s
Resolution	1 µs or 1 digit
Operating modes	Individual measurement Interval time

Speed (Velocity)

Display ranges	0.0000m/s ...99.9999 m/s 100.000m/s ...999.999 m/s 1000.00m/s ...9999.99 m/s 10000.0m/s ...19999.9 m/s
Resolution	0.001 m/s or 1 digit
Distance	0.001 m ... 2 m (factory setting: 0.01 m)

Continuous periodic time measurement (Period)

Display ranges	0.000 ms...999.999 ms 1.00000 s... 9.99999 s 10.0000 s... 99.9999 s
Resolution	1 µs or 1 Digit
Gate time and trigger threshold	Automatic matching to the measurement signal

Frequency measurement (FREQ)

Display ranges	0.00 Hz ... 9999.99 Hz 10.0000 kHz ...99.9999 kHz 0.10000 MHz...9.99999 MHz
Resolution	10 mHz or 1 digit
Gate time and trigger threshold	Automatic matching to the measurement signal

Rotational speed measurement (RPM)

Display range	6...99999 rpm
Resolution	1 rpm
Gate time and trigger threshold	Automatic matching to the measurement signal

Impulse counting (IMP)

Display range	0...999999 I
Resolution	1 I
Counting time display range	0..0000s ... 99.999 s 0.00s ... 9999.99 s
Voltage at the counter tube socket	100 V...660 V (factory setting: 500 V)

Impulse rate measurement (Rate)

Impulse rate display range	0.00... 9999.99 I/s 10000.0 ... 99999.9 I/s
Resolution	0.01 I/s (at gate time 100 s)
Gate times	1 s ... 999 s (factory setting: 1 s)
Voltage at the counter tube socket	100 V...660 V (factory setting: 500 V)

Speciality

Range switching in all operating modes	Manually (prior to measurement) und automatically on overflow
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Mains supply

The instrument corresponds to protection class I. It is only to be connected to a socket with an earth lead connection.

Connecting voltage (+6% / -10%)	see type plate
Mains frequency	50/60 Hz
Power consumption	20 VA
Mains fuse (5 mm x 20 mm)	see type plate

Housing dimensions (mm)	370 x 168 x 236 (W, H, D)
Weight	2.8 kg

8 NOTES ON THE GUARANTEE

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.

9 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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Robert-Bosch-Breite 10
D-37079 Göttingen

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