watch-matic III

Watch testing unit for mechanical watches

Pictured watch-matic III

Cousins Order Nos

watch-matic III (230 V)* incl. microphone	T20113
* power supply in delivery	
Clamping microphone for wall clocks	T12050
Opto-electronical sensor for pendulum clocks	T12038
Tripod for opto-electronical sensor	T9677
Printers	P15224

The watch-matic III is an economic measuring instrument ideally suited for testing mechanical watches. The diagram is displayed noiselessly on the new, illuminated LCD graphic display. Measured values for rate deviation, amplitude and beat error are automatically calculated and displayed numerically. The beat number of all common watches will be automatically recognised. Appropriate measuring modes are available for watches with special escapements. Two novelties: the additional display mode „VARIO" and the storage of the last 5 screen contents, which later are callable. Further product features:

- **Measurement Possibilities**: Rate deviation, amplitude and beat error of mechanical watches. Diagram of the beat noises.
- **Beat Error**: Automatic selection of all common beat numbers. Manual selection of less common beat numbers. Manual selection of any beat number between 3'600 to 43'200 b/ h. Determination of an unknown beat number.
- **Measuring Modes**: Standard mode for watches with the Swiss escapement (Stnd), Mode for watches with coaxial escapement (Spe1), Mode for watches with AP escapement (Spe2), Mode with specifc amplitude filter (Spe4), only the rate measurement occurs (Rate).
- **Display**: *Cont* Continuous diagram recording of the beat noises and display of the numeric values for the rate accuracy, amplitude and beat error. The last five screen contents are callable. *Vario* Enables to examine the stability and scattering of the rate accuracy or the amplitude over a long period of time (max. 100 hours).
- **Automatic Gain Control**: Manual control facility for watches with stray or unusual beat noises.
- **Rate accuracy**: numerical display in s/d. Resolution: 1 s / d with a measuring range of ± 999 s / d or 0.1 s / d with a measuring range of ± 99.9 s / d.
- **Amplitude**: numerical display in degrees. Resolution 1°. Measuring range from 70° to 360°. Lift angle adjustable from 10° to 90°.
- **Beat error**: numerical display in milliseconds. Resolution 0.1 ms. Measuring range 9.9 ms.
- **Diagram**: recording on a illuminated LCD graphic display with 256 x 64 dots. Time scale adjustable from 1 up to 9 mm / ms (zoom). 4 selectable tracing speeds.
- **Functions**: Selectable measuring time for numerical results: 2, 4, 8, 10, 20, 30, 60 s and automatic selection of the shortest possible measuring time. Continuous renewal of the average values every 2 s over the measurement period. Display on the screen of the evaluated part of the rate measurement diagram.
- **Acoustic check**: built in loudspeaker to hear the beat noises.
- **RS232-interface**: for the connection of a PC, GPS receiver or our printer to print out of the numeric results or graphic print out of the displayed diagram.

Technical Data

Outer dimensions of unit w/d/h (mm / inch)	250 / 101 / 135 / 8 7/10 x 5 9/10 x 5 1/2
Weight incl. microphone (kg / lbs)	2,1 / 4.4
Power consumption in use / Stand by (W)	4,7 / 3,2

Operating instructions

Watch testing unit for mechanical watches

watch-matic III

• english •

Content

1 General

The **watch-matic III** is an easy, but precise instrument for testing mechanical watches.

It is essential to be familiar with the instrument and its functions in order to obtain reliable results and to avoid damage to the watch under test.

These operating instructions are intended to help you operate your instrument efficiently and correctly, and to service it properly.

2 Before using the instrument for the first time

NOTE

Please carefully read all the information given in this User's Guide. It provides you with important instructions about the use, safety and maintenance of your instrument.

Keep this manual in a safe place and if the occasion should arise, pass it on to subsequent users.

The instrument may be used only for the designed purpose in accordance with these Operating Instructions.

The manufacturer accepts absolutely no responsibility for possible damage to the test instrument, to watches or persons which results from improper operation!

3 Description

The **watch-matic III** is a test instrument that offers the watchmaker all possibilities for testing mechanical watches.

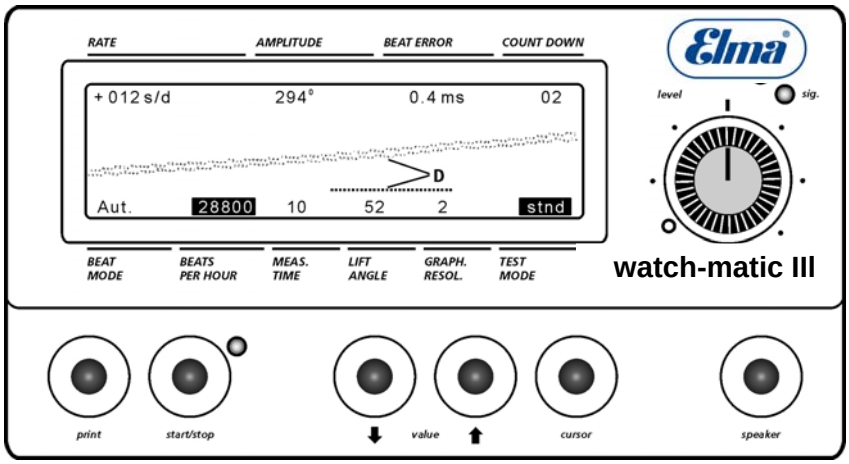
A diagram of the watch beats is presented completely silently on a LCD graphic display panel. Numeric values for the rate deviation and beat error are automatically calculated and displayed numerically, i.e. the diagram no longer has to be manually evaluated. In addition, the amplitude of the balance wheel is measured and numerically displayed.

Operation for conventional watches is largely automated. The measurement parameters can be manually selected for special watches or for special measurements.

The **watch-matic III** provides all the test facilities that are needed for a competent repair service for mechanical watches. The instrument is mainly intended for use in service centers and in leading specialist watch suppliers.
The development of the **watch-matic IIII** is based on our new measuring technology, called Chronoscope.

Measuring possibilities	Rate deviation, amplitude and beat error of mechanical watches and diagram recording of the beat noises.
Beat number	Automatic determination of all common beat numbers. Manual selection for less common beat numbers. Manual selection for any beat number in the range between 3'600/hour to 36'000 b/h. Automatic determination of an unknown beat number.
Gain control	Automatic gain control. Manual control possibility for watches with side noises or unusual beat noises.
Diagram	Presentation of the diagram on LCD graphic display, resolution of 64 x 256 dots.
	Time scale: selectable from 1 to 9 mm/ms. 4 different speeds for the diagram recording. Visible diagram length: 128 mm.
Rate measurement	Numeric display in s/d or 0.1 s/d.
	Resolution 1 s/d, measuring range: ±999 s/d or Resolution 0.1 s/d, measuring range: ±99.9 s/d.
Beat error	Numerical display in milliseconds.
	Resolution: 0,1 ms. Measuring range: 9,9 ms
Amplitude measurement	Numerical display in degrees.
	Resolution: 10 , measuring range: 700 to 3600 .
	Lift angle: adjustable from 100 to 900.
Measuring times for the numerical results	Selectable measuring time: 2, 4, 8, 10, 20, 30, 60 s and automatic selection of the minimal measuring time. Continuous averaging over the measuring time computed every 2 s. Screen display of the computed diagram section showing the rate measurement.
Function stop/start	At any time, the momentary screen-display can be stopped as long as requested.
Acoustical check	Integrated loudspeaker to listen to the beat noises.
Protocol print-out	Interface RS232 for connection of a printer or a calibration system. Printout of the numeric results or graphic printout of the full screen presentation with diagram.
Time base	High frequency quartz. Stability: max. +/- 0.08 s/24h in a temperature range from 200 to 400.
Display	LCD-graphic display 64 x 256 dots.
Mains connection	Mains adapter 230V~ or 120V~, 12VA.
Microphone	Stand microphone, can be turned in any desired position.

3.1 Operating elements and Display



Rotating knob and keys

Level Signal amplifying control and On/Off switch.

Print Starts the result printout.

start/stop Stops / restarts the measurement.

value ↓ Selection of the next lower value or for the system parameter settings.

value ↑ Selection of the next higher value or for the system parameter settings

Cursor Parameter selection

Speaker Switches the loud-speaker on and off.

Display of the results and paramter

RATE Rate deviation in seconds per day.

AMPLITUDE Display of the amplitude in degrees.

BEAT ERROR Display of the beat error in ms.

BEAT MODE Mode selection for the beat number.

BEATS PER HOUR Selected beat number.

COUNT DOWN Remaining measuring time in seconds.

MEAS. TIME Selectable measuring time in s.

LIFT ANGLE Selectable lift angle in degrees.

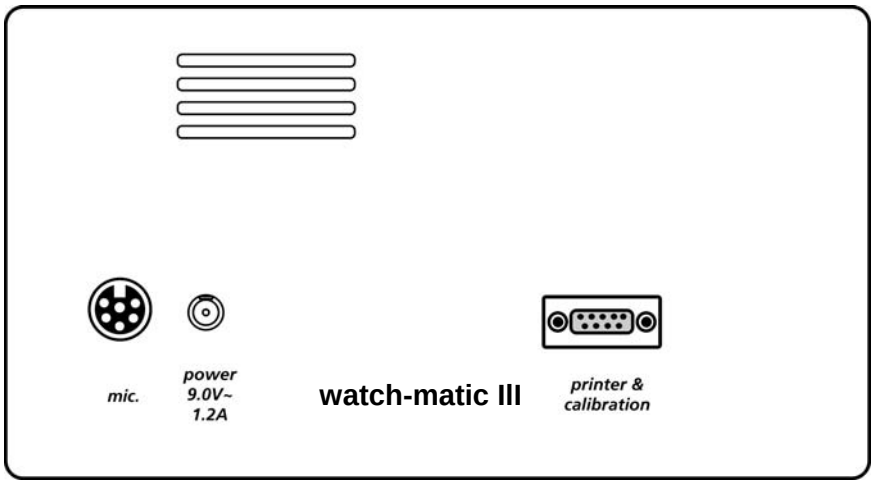
GRAPH. RESOL Graphic resolution in mm/ms.

TEST MODE Display of the test mode.

Sig LED – display of the signal intensity.

D Diagram and evaluated diagram sector for the numerical results.

3.2 Connections



Rear Panel

mic Socket for the Stand Microphone or for the following, optionally available, Signal Sensors :

- Clamping Microphone for wall clocks.
- Optoelectronic Sensor for pendulum clocks.

Power 9.0 V~ 1.2 A Socket for the mains adapter..

printer &calibration Interface RS232 for connection of a printer or a calibration system.

4 Installation

4.1 Installation of the equipment

Caution:
The instrument has to be installed in such a way that it is not exposed to direct sunlight or to extreme temperatures since such influences may affect reading of the display. High noise levels disturb signal sensing by the microphone. The microphone should therefore be placed at a sufficient distance from noisy machines, loudspeakers and particularly from ultrasonic cleaning machines. If the instrument is equipped with a printer then this should also be placed at a sufficient distance.

4.1.1 Mains supply

The **watch-matic III** is supplied from a mains adapter unit with an output of 9 V~ and a rating of 12 VA. The mains adapter is available for nominal mains voltages of 230 V~ (range 210 V~ to 240 V~) or 120 V~ (range 110 V~ to 130 V~).

Before connecting the instrument for the first time, check that the mains adapter unit voltage corresponds to your mains supply voltage

Use only an original Elma mains adapter unit.

Connect the mains adapter unit to the corresponding socket for the mains adapter.

4.1.2 Microphone connection

Connect the Stand Microphone to the socket ***mic***.

4.1.3 Connection of other Signal Sensor

You may also connect diverse Signal sensors, which are optionally available.

4.1.4 Printer connection

Before connecting the printer, remove the protection from the connector ***printer & calibration***. Connect now the printer. The printer cable is a part of the delivery.

Caution! Check whether the voltage stated on the printer corresponds to the local mains voltage.

5 Operating

Switch on the instrument with the knob marked ***level*** and adjusted to the index line to **I**. Different informations, such as manufacturer, firmware version etc. appears for 10 s on the display after switching on the instrument.

In case your instrument is equipped with the printer, switch on the printer too.

After switching on, the instruments remains in the same parameter settings which have been used before switching off.

Your instrument is now ready to operate.

Position the watch on the microphone in such a way that the crown lies between the metal leads of the signal sensor. Then turn the microphone into the required test position.

The LED ***sig.*** flashes in the rhythm of the beats of the watch, thus showing that watch's signal is received.

After one or two seconds and if the mode "***Aut***" is selected, the instrument has automatically determined the beat number of the watch (that will be displayed in the field ***BEATS PER HOUR***) and the tracing of the diagram starts. After the elapsed selected measuring time, the numerical results appear on the display and are subsequently renewed every two seconds.

When you remove the watch from the microphone, the instrument switches automatically back to the starting position or remains with the momentary display. Without any trouble you can keep the **watch-matic III** switched on for the whole day. The instrument will not show any wear and has very low power consumption.

If not used for an extended time, switch off the instrument by means of the turning knob ***level***.

In case you are not using the instrument for a long time (vacation), disconnect the power unit from the mains socket.

6 Control keys

6.1 *level* Rotary Knob

For switching on/off the instrument, and for manual adjustment of the signal amplification.

The instrument features an automatic gain control which gives a clear graph for most types of watch when the rotary knob is in the standard position (index line set to **I**).

Use the rotary knob to increase or decrease the signal amplification if no clear diagram appears with this standard setting.

If the diagram is unclear due to extraneous noises from the escapement, this problem can often be overcome by decreasing the gain.

Should the all-important first signal in the signal package be too small, it may nevertheless be correctly detected by increasing the gain. Take care though, as increasing the gain will also raise the sensitivity to other outside noises.

6.2 *print* Key

If the printer is connected to the instrument you can use this key to start the print-out of the results.

The currently displayed numerical values for the rate, the amplitude and the beat error are printed out if the key is pressed while a measurement is actually running.

The entire display is printed out in a graphic form if the key pressed while the display is frozen (after the ***stop/start*** key has been pressed).

6.3 start/stop Key

The current display is stopped and can be analyzed for as long as needed once the ***start/stop*** key has been pressed.

Normal running is resumed with continuous diagram tracing when the ***start/stop*** key is pressed again.

6.4 value 🡻 Key

The next lower value for a parameter is selected by pressing the ***value*** 🡻 key as follows:

- step by step each time the key is briefly pressed.
- continuously when the key is kept in the depressed position.
- quickly if the ***value*** 🡹 key is pressed for longer than 3 s.

6.5 *value* ↑ Key

The next higher value for a parameter is selected by pressing the ***value*** ↑ key as follows:

- step by step each time the key is briefly pressed.
- continuously when the key is kept in the depressed position.
- quickly if the ***value*** ↓ key is pressed for longer than 3 s.

6.6 cursor Key

A parameter which has to be changed can be selected with this key. The chosen parameter is displayed in inverse form (black background).

Remark: The ***value*** ↑ , ***value*** ↓ and ***cursor*** keys are also used for the system parameter settings.

6.7 speaker Key

The built-in loudspeaker may be switched on and off by pressing the ***speaker*** key.

7 Setting the system parameters

Keep the ***cursor*** key pressed down when switching on the equipment to select the menu "*system and adjustment parameters*".

You can now choose the parameter by means of the ***cursor*** key and adjust its value or function with the ***value*** keys.

7.1 Parameter *No signal*

Settings:

Clear When you remove the watch from the microphone, the instrument switches automatically back to the starting position or:

Freeze remains with the momentary display.

7.2 Parameter Graph speed

Here you can choose the tracing speed for the diagram: 1/1 (normal), 1/2, 1/4 or 1/8 of the speed.

7.3 Parameter *Unit resol*

Here you can choose the resolution of the rate display: in 1 s/d or 0.1 s/d.

7.4 Header for the printout protocol

Here you may edit two header lines with 20 characters each. Proceed as follows: select line 1 with ***cursor*** key. A ***** mark appears on the first character. With the ***value*** keys you can chose the desired character, number etc. Pressing the ***start/stop*** key moves the ***** to the next character for continuing the selection. Identical procedure for line 2.

The header appears on the printout protocol, as long as the printer is connected.

7.5 Parameter Default param

Settings:

Yes the system parameters are set back to the default setting.

No the system parameters are not set back to the default setting.

7.6 Parameter *Time base*

Settings:

Verify you can verify the time base by means of an optionally available GPS receiver or a suitable calibration system.

Adjust you can calibrate the time base by means of an optionally available GPS receiver or a suitable calibration system.

Cancel quit the module *Time base.*

8 Parameters

8.1 Caliber Parameter

Use the key marked ***cursor*** to select a parameter which should be changed. The selected parameter appears in inverse form (black background).

The ***BEATS PER HOUR*** parameter cannot be chosen if the parameter ***BEAT MODE*** is set to **AUT** or **FRQ** as it is automatically selected.

8.2 Beat Mode

The functions **AUT**, **MAN**, **SEL** or **FRQ** can be called with the ***value*** keys and for the selection of the beat number.

AUT *Automatic selection*: in this position the instrument analyses the beat number of the watch which has to be measured. The following beat numbers are selected automatically: 12000, 14400, 18000, 19800, 21600, 25200, 28800 and 36000.

MAN *Manual selection*: this position enables the less common beat numbers and those that cannot be determined automatically to be selected for the ***BEATS PER HOUR*** parameter.

List of selectable beat-numbers::

3600	6000	7200	7380	7440	7800	9000	9100	10800
11880	12000	12342	12480	12600	13320	13440	13500	14000
14040	14160	14200	14280	14400	14520	14580	14760	14850
15000	15360	15600	16200	16320	16800	17196	17258	17280
17786	17897	18000	18049	18514	19332	19440	19800	20160
20222	20944	21000	21031	21306	21600	25200	28800	36000

SEL *Individual selection*: this position enables the value of the beat number for the ***BEATS PER HOUR*** parameter to be increased or decreased in steps of 1 by pressing the ***value*** keys ↑ and ↓. This increase or decrease will occur in steps of 100 if one of the keys is pressed for longer than 3s. The **SEL** position is needed when watches with unusual beat numbers are to be tested. Any value between 3600 and 36000 b/h can be selected.

FRQ ***Frequency determination***: this function enables watches with unknown beat numbers to be tested. It shows the instantaneous beat number for a rate = 0 s/d.

Examples:

- Select the **FRQ** function by means of the ***value*** keys.
- Place the reference watch on the microphone.
- Select the function **SEL** by means of the ***value*** ↓ key as soon as the **watch-matic III** finds the beat number for a rate which is zero. The last value of the beat number is now stored.
- Remove the reference watch from the microphone and place other watches on it: they will be compared with the beat number of the reference watch.

8.3 Beats per hour

This parameter shows the value of the selected beat number.

The value can only be changed in the operating mode **MAN** or **SEL**. Setting takes place automatic-ally if the ***BEAT MODE*** is on **AUT** or **FRQ**.

8.4 Meas. Time

Display of the measuring time which is used for the establishment the average values for the numerical results.

When starting a measurement, the first results appear after the measuring time has elapsed. The average values will be refreshed every 2 s regardless of the measuring time selected.

A line under the diagram, the length of which corresponds to the measuring time, shows the part of the diagram used to build up the numerical results.

Selectable measuring times: 2, 4, 8, 10, 20, 30, 60 s or automatic selection of the minimal measuring time.

8.5 Lift Angle

Display of the selected lift angle.

This value is required to calculate the amplitude and must be selected according to the watch movement. The lift angle is 52^{o} for many common movements.

The lift angle can be set to between 10^{o} and 90^{o}.

Caution: An incorrect adjustment of the lift angle will give a false value for the amplitude.

8.6 Graph Resol.

Vertical time resolution of the diagram (zoom) and the resolution of the rate display.

By increasing the time resolution, the inclination of the diagram for a particular rate deviation will increase. Any other irregularities in the beat noise will also be displayed proportionately magnified.

To avoid the limited resolution of the screen with its 0.5 mm grid having a disturbing effect, we recommend working with the highest possible resolution relevant to the quality of the watch.

Selectable values: from 1 up to 9 mm/ms (zoom).

8.7 Test Mode

You can choose among 3 settings:

Stnd Standard test mode for all watches with Swiss lever escapement.

Rate Only rate measurement to draw diagrams and measure rates even with watches giving off a bad or unusual beat noise (i.e. watches with cylinder- or chronometer escapement).

Spe1 This mode must be set, if watches with coaxial escapement should be measured. It ensures an accurate measurement of the amplitude.

Spe2 This mode must be set, if watches with AP escapement should be measured.

Spe4 This mode must be set, if watches with a special escapement should be measured.

9 Testing mechanical watches

9.1 Continuous Mode

Select the test mode **Cont.** with the ***value*** buttons.

Place the watch to be tested on the microphone in such a way that the crown lies between the metal leads of the signal sensor.

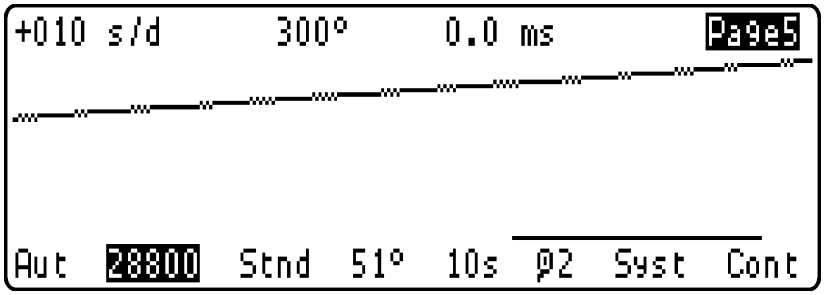
The LED ***sig.*** flashes in the rhythm of the beats of the watch, thus showing that watch's signal is received. The tracing of the diagram starts automatically.

The diagram is continuously drawn in this mode. Turn the microphone to the needed control position. Due to the display principle of the LCD graphic screen, the following differences relatively to drawing a graph on paper strips have to be mentioned:

The points of the diagram are shown as screen dots (pixels) on the display. These dots are placed at a distance of 0.5 mm from each other. An inclined diagram is thus always shown as a staircase with 0.5-mm steps; the distance between the lines will of course be a multiple of 0.5 mm.

This effect only shows in the case of accurate watches and low diagram resolution. It is gene-rally overshadowed by the natural irregularities of the diagram.

We therefore recommend always to use a resolution which perfectly fits the quality of the watch and which is the highest possible.



The numerical results concerning rate measurements, amplitude measurements and beat error measurements are shown at the end of the first cycle of the selected measuring time.

If you set up a longer measuring time, the result will be calculated as the average of the single measurements. The average is continuously re-calculated every 2 s; this means that in case of a
20 s measuring time, the last 10 measurements each 2 s will always be considered as valid for computing the average value. The running bar under the diagram indicates the diagram section that has been used.

Results are significant and stable when their diagram is also clean and smooth. The longer the selected measuring time is the more stable the displayed result is, since short-lasting irregularities in rate are not taken into account.

You can also stop the drawing at any time by means of the ***start/stop*** button. By pressing the ***print*** button follows a "print screen". A new start will clear the previous drawing.

9.2 Storage of the screen contents

Up to 6 display lengths of the traditional diagram can be stored, i.e. up to 20 minutes. It is only practicable with display mode ***Cont.*** You may view up to 5 previous stored screen contents. Press the ***start/stop*** button and then move the ***cursor*** to Page0. With the ***value*** buttons you can now select one from the stored screen contents, from Page0 up to Page5. By pressing the ***print*** button the selected screen content can be printed out. A new start of the measurement or switching off the equipment will delete the memory content.

9.3 Test Mode VARIO

The new display "VARIO" provides a clear check of the rate or amplitude stability over a long period of time. Select the test mode **Vario** with ***value*** buttons. With a click on the zoom symbol you can choose the time scale of the linear display: 1 = ± 50 s/24h, 2 = ± 10 s/24h. Choose 3 for the Amplitude measurement with a display scale of 120° to 320°.

Measuring examples

In the upper display part appear the average measuring values of the rate, amplitude and beat error over the programmed measuring time (for our example 20s).

The analysis of rate or amplitude variation occurs over the entire time run since the measuring start. The period of time (in our example 00:01:07) is displayed above the analyzed values.

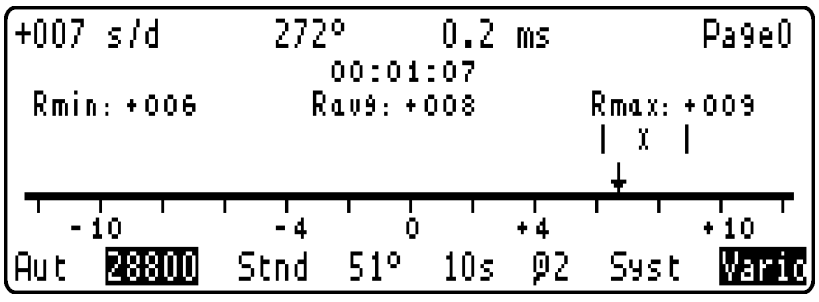
The analysis of all results of the rate measurement determines the stray of the rate and amplitude, based on the measuring time (for our example 10s), and integrated over the entire time run since the measuring start:

minimal rate or amplitude (Rmin or Amin) – lowest measured value since measuring start

maximal rate or amplitude (Rmax or Amax) – highest measured value since measuring start

average or amplitude rate (Ravg Aavg) – average of the measured value over the entire time run.

Each numeric value of the rate measurement is presented on the linear time scale with ↓ .



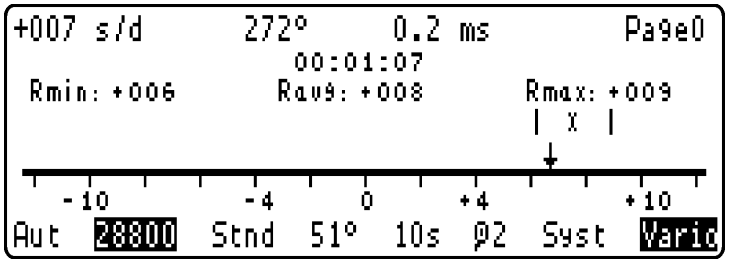
Checking the rate quality

The evaluation of the quality takes place via the interpretation of the 2 analyzed rate values.

The difference between the minimum (Rmin) and the maximum (Rmax) rate value, presented with the marks **I** and **I**, is a quality indicator of the watches condition. The smaller the difference the better is the rate stability.

The average value **x** (Ravg) is an indicator for the rate quality of the watch movement.

Checking the amplitude quality



10 The Diagram

Because of the display principle of the LCD-graphic screen, the following distinctions are to be compared with a diagram recording on paper strips:

- The dots of the diagram can be equated with the raster points of the screen. These dots
  are disposed at a distance of 0.5 mm. An inclined diagram will therefore always be
  displayed as a stair with steps of 0.5 mm and the distance of the lines can be a multiple
  of 0.5 mm only.
- This effect occurs with high precision watches only and for small diagram resolution. Normally, this effect will be overlapped by the natural irregularities of the diagram. Therefore, we recommend working with the highest possible resolution according to the quality of the watch.
- As for every beat noise of the watch one dot is recorded and the dots have a fixed distance of 0.5 mm, the recording speed, as well as the inclination of the diagram, depend on the beat number.

11 The numerical results

For all numerical results, the watch beats will always be evaluated over a time period of 2 s.

If a longer measuring time is set, the result will be the average value of the individual measurements. The average value will be recalculated continuously every 2 s. for ex., for a measuring time of 10 s. The last 5 measurements at 2 s will be considered to build the average value. The evaluated diagram part will be marked by a line under the diagram. In order that the results are significant and stable, the corresponding diagram must be clean and even.

The longer the measuring time is selected, the more stable is the displayed result, and since short time irregularities of the rate will be compensated.

12 Acoustic control

By means of a loudspeaker, which makes part of the standard accessory, you can check the beat noise for irregularities and side-noises.

An acoustic check is recommended when a clean diagram is not formed with the normal amplification adjustment or when the diagram shows irregularities which are not easily explicable.

13 Printout of the results

The following chapters can be used only if your instrument is equipped with a printer.

13.1 Numerical results

If the ***print*** key is pressed during a continuous measurement, the results shown in this moment for rate, amplitude and beat error will be printed out. In addition, the two header lines will be printed out.

After each printout the paper is feed forward, so that the strip can be tired off and attached to the watch.

13.2 Graphic printout

If the key ***print*** is pressed at the moment of a frozen display (after pressing the key ***start/stop***), the full actual display and diagram will be printed out in a graphic form.

14 Operating

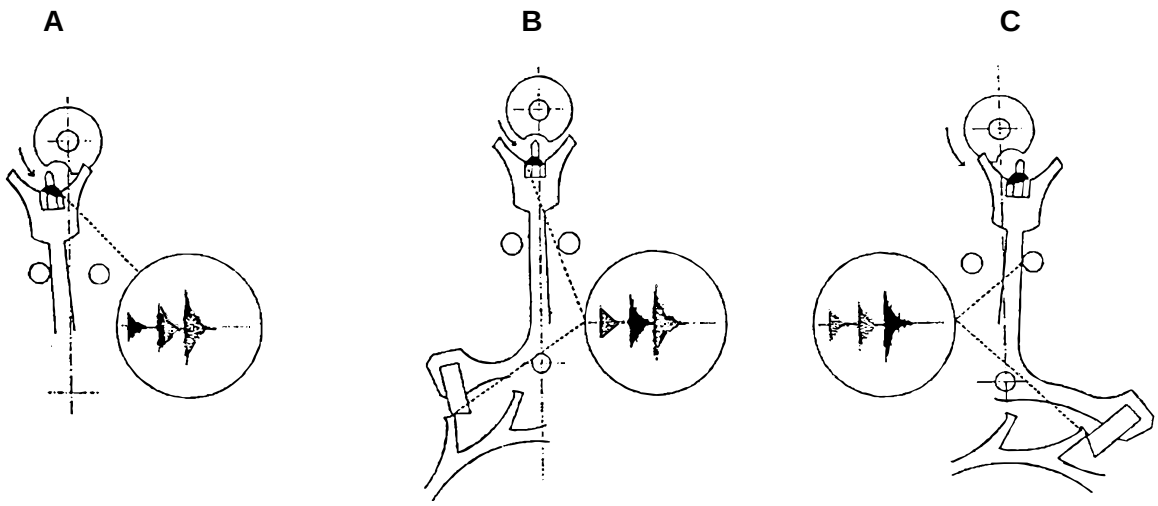
The following information is not necessary for operating the **watch-matic III**, but can help to understand the functioning of the instrument and to interpret the displays correctly.

14.1 Beat noise of the watch

The beat noise of the watch is usually composed by three different pulses:

- The first noise results when the ellipse on the balance wheel touches the fork (A). As to
  time, this beat is very precise and is used for producing the graph as well as for calculating
  the rate and the beat error.
- The contact of the escape wheel with the entry pallet produces a second pulse (B). This noise is very irregular and will not be used for the evaluation.

- The third and most intense noise is produced by the stroke of the escape wheel on the exit pallet (C). This noise is used to calculate the amplitude.



Origin of the beat noise

14.2 Diagram recording

For the diagram recording, the time between two successive watch beats (period duration) will be measured and compared with the nominal value of an exact rate. If the measured time corresponds precisely to the nominal value, the new point will be set exactly besides to the previous one. If the new beat comes a bit too early or too late, the new point will be shifted upwards or downwards, according to the time difference for the nominal value. Therefore, the rows of dots on the display form, according to the rate, a straight line or an inclined upwards or downwards line.

Of course the diagram shows not the rate only, but also other time irregularities of the watch beats; for example: beat errors, defective teeth of the escape wheel etc.

14.3 Rate deviation

To calculate this rate, the differences between the measured period duration and the nominal value are accumulated over a time space of 2 s, converted in s/d and then displayed on the screen.

14.4 Amplitude

To calculate the amplitude the time between the pulse A and pulse C of the beat noise will be measured

Between these two pulses, the balance wheel rotates in a determined angle. This so called "lift angle" is determined by the design of the watch movement and must be set as a parameter. The higher the amplitude of the balance wheel, the greater is the speed which it passes this lift angle and the shorter is the time it needs to cross this angle.

The amplitude can be calculated therefore with the time between the pulse A and B of the beat noise, under consideration of the beat number and the lift angle. The **watch-matic III** always calculates the average value of the amplitude over the measuring time.

14.5 Beat error

If the watch has a beat error, the period-duration between a Tic and a Tac is not as long as the period duration between a Tac and a Tic. The average value of the time difference is always calculated over a time space of 2 s and displayed on the screen.

15 Maintenance and customer service

15.1 Maintenance

- The instrument requires no special maintenance.
- When removing dirt or dust from the instrument, use a soft lint-free cloth only. A lightly dampened cloth can be used to clean the LCD.
- When the instrument is not in use, protect it by using the dust cover supplied.
- If the instrument is not to be used for a longer period of time disconnect the mains adapter from the mains supply.

15.2 Calibration

We recommend that the instrument be calibrated every 1 to 2 years by our customer service department to ensure its measuring accuracy.

If the instrument is connected to the optionally available GPS receiver or a suitable calibration system you can verify and, if necessary, calibrate the time base.

Caution! Is normally performed from our after sale service department. Inappropriate calibration will impair the accuracy of the instrument. Please contact the customer service department at our head office or one of our representatives.

16 Technical data

Mains voltage (Vdc)	9
Power consumption operating mode (W)	4,7
Power consumption stand by mode (W)	3,2
Outer dimensions of unit w/d/h (mm/)	250 / 101 / 135
Weight incl. microphone(Kg)	2,1
Material of housing	Plastic blue

17 Declaration of conformity

The instrument is in conformity with the following EC-Directives:

89/336/EWG CEM

Emissions

EN 55022 Conduction

EN 55022 Radiation

EN 60555-2 Harmonics

EN 60555-3 Flicker

Immunity

IEC 1000-4-2 ESD

IEC 1000-4-3 HF

IEC 1000-4-4 Burst

IEC 1000-4-5 Surge

IEC 1000-4-6 Cond. Immunity

IEC 1000-4-8 50Hz Magn. Puls

IEC 1000-4-11 Dips

18 Accessories

18.1 Delivery

- Equipment watch-matic III
- Mains adapter, available for 230V~ or 120V~
- Stand Microphone
- Dust protection
- Instruction manual

18.2 Special Accessories

- Clamping microphone: for wall clocks
- Opto-electronic sensor: for pendulum clocks
- Tripod: for Opto-electronic sensor
- Printer**:** CITIZEN DP-1014.0132A incl. universal mains adapter 90 V~ to 264 V~, graphic mode, cable and paper roll
- Printer Switchbox: for connection of two equipments to one printer
- GPS Receiver

19 Putting out of action and waste disposal

The unit can be taken to plastics and electronics recycling stations or returned to the manufacturer.