The Q TEST 6000 is an extremely versatile instrument for testing quartz watches which offers watchmakers the following testing and measuring features:

- Rate variation tests for all kinds of quartz watches as well as tuning fork and mechanical watches.
- Integrating measurement of current consumption.
- Variable voltage watch power supply together with measurement of the starting voltage.
- Resistance measurement, short and open circuit testing.
- Stepping motor check by means of a pulse generator.
- Alarm test.
- Watch battery test.
- Programming of watches with trimming by EEPROM.
- Print out of a test protocol on a printer(optional).

Although the operation of Q TEST 6000 is simple and straight forward, the following operating instructions should be carefully studied in order to be able to make full use of versatility offered by this instrument.

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Congratulations!

You have made an excellent choice.

By buying the Q TEST 6000 you have chosen a test instrument which combines the highest of technical standards with an operating convenience specifically designed for practical applications.

If you operate it correctly, your new instrument will give you many years of service. We wish you much pleasure and success in its application.

1 BEFORE USING THE INSTRUMENT FOR THE FIRST TIME

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 only be used for the designed purpose in accordance with this Operating Instructions.

THE MANUFACTURER,

Witschi Electronic Ltd in CH -3294 BUREN a.A., SWITZERLAND

ACCEPTS ABSOLUTELY NO RESPONSIBILITY FOR POSSIBLE DAMAGE TO THE TEST INSTRUMENT,TO WATCHES OR PERSONS WHICH RESULTS FROM IMPROPER OPERATION!

1.1 OPERATING ELEMENTS AND INDICATORS\

Front panel Q TEST 6000

To simplify the operation of the instrument, all related indicators and operating elements have been grouped together in common fields on the front panel.

I/O	To switch the instrument on and off.
DISPLAYS	The following results and parameters are displayed:
RATE	Display of the result for the rate measurement.
• quartz	Indicates the strength of the 32kHz quartz signal received (acoustically, capacitively or from the supply current).
• LCD	Indicates the strength of the LCD signal received(capacitively) or –in the ***mechanical*** test mode –the strength of the mechanical sound(acoustic).
• motor	Indicates the strength of the stepping motor magnetic field received(magnetically).
• sec/day	The result for the rate measurement is displayed in seconds per day.
• sec/month	The result for the rate measurement is displayed in seconds per month.
MODULE	Indicates the results of current-,battery voltage- or resistance measurement.
• open	Lights up if the module supply circuit or the resistance measurement is interrupted.
• short	Lights up if the module supply circuit or the resistance measurement is shorted.
• μA	Lights up if the result is displayed in microamperes.
• mA	Lights up if the result is displayed in milliamperes.
• V	Lights up if the result is displayed in volts.
• kOhm	Lights up if the result is displayed in kilo-Ohms.
PARAMETER	Indicates the value of the parameter selected.
SIGNAL SENSORS	
acoustic	Acoustic sensor.
megnetic/capacitive	Magnetic and capacitive sensor.
CONNECTIONS AND BUTTONS	+ Positive connection for module supply and battery test(the two red sockets and the battery support are connected

together).

- Negative connection for the module supply and battery test(the two black sockets are connected together).

BATTERY TEST ***low drain*** Load for low drain batteries.

high drain Load for high drain batteries.

TEST CONTROL ***start test*** Interrupts the current measurement and starts a new one.

print result Prints out a measurement protocol with the currently valid readings. Pressing the ***start test*** and ***print result*** buttons simultaneously starts a programming cycle.

TESTMODE RATE Indicates the method selected for the rate measurement; the letter(s) following the inscription indicates the sensor to be used. By means of the button the mode for the rate measurement can be selected.

TESTMOOD MODULE Indicates the measuring method selected for the module test. By means of the button the measuring mode for the module test can be selected.

PARAMETER Indicates the parameter selected. By means of the button the parameter can be selected. By means of the rotary knob the value of the selected parameter can be changed.

Rear panel Q TEST 6000

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

printer output Socket for the connection of a protocol printer.

sec/day ***sec/month*** Selector switch for the rate variation display mode.

module carrier Socket for the **PM 6000** module holder.

external sensor Socket for the external sensor.

2. Installation

Attention: Signal detection may be influenced by stray electric and magnetic fields from other electrical appliances. Particularly intense disturbances are caused by computer terminals, fluorescent tubes and ultrasonic cleaning equipment. The **Q TEST 6000** therefore has to be set up at a sufficient distance from any such appliances or devices. Paging installations, too, may disturb signal detection.

2.1 MAINS SUPPLY

The **Q TEST 6000** is supplied from the mains adapter unit with an output of 9 V~/12 VA. The mains adapter is available for nominal mains voltages of 230 V~(range 210 V~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 **Witschi** mains adapter unit.

Connect the mains adapt unit to the 9 V~ socket for the mains adapter.

It takes about 3 minutes for the oven –controlled quartz time base to settle to its operational temperature when the instrument is initially connected to the supply.

Thereafter, the quartz time base remains constantly heated as long as the instrument is remains connected to the mains supply. The **Q TEST 6000** is therefore always ready for use upon switching on.

If the device is not going to be used for lengthy periods(e.g. during holidays),we recommend unplugging the mains adapter from the mains supply.

2.2 PRINTER CONNECTION

Before connecting the printer (available as an option),remove the protection from the connector ***printer output***. The appropriate interconnection cable is supplied with the printer.

WARNING! Before connecting the printer to the mains, check that the printer voltage corresponds to that of your mains supply.

2.3 SWITCHING THE DISPLAY OF THE RATE FROM SEC/DAY TO SEC/MONTH

Select the required unit for rate measurements by means of the slide-switch ***s/day s/month*** on the rear panel of the instrument.

2.4 TEST MODE SELECTION

The required test mode for the rate measurement is selected with the button in the ***TESTMODE RATE*** field of the front panel. The selected test mode is indicated by a LED. The letter(s) following the inscriptions by the LED's refer to the sensor to be used.

The test mode for the module test is selected with the button in the ***TESTMODE MODULE*** field of the front panel.

The most frequently used test modes, ***quartz 32 kHz*** and consumption μA,are automatically selected when the instrument is switched on.

Detailed information concerning the various test modes is given in the following sections.

2.5 TEST PARAMETER SELECTION AND SETTING

Some of the test parameters may be changed by the user.
The required parameter is selected with the button in the ***PARAMETER*** field of the front panel. The current value of the parameter is shown by the ***PARAETER*** display. The parameter value can be incremented or step-by step using the control knob.

All the parameters are set to the most common values and the parameter ***supply voltage*** is displayed when the instruments is switched on.

countdown rate and ***countdown cons***. are not variable parameters. In this case, the ***PARAMETER*** display shows the time remaining until the end of the currently running measurement sequence.

3 RATE MEASUREMENT-GENERAL INFORMATION

3.1 PRINCIPLE OF OPERATION

The sensor picks up a signal whose period depends on the rate variation of the watch. Depending on the test mode ,this can be the quartz oscillator frequency, the operating frequency of the LCD-display or the running frequency of the stepping motor.

The detected signal is amplified, filtered and digitized. This signal is divide until its period approximately corresponds to the selected measuring time. The period of subdivided signal is measured against a highly accurate time base which serves as a reference. The difference between the measured period and the reference period relative to zero deviation is calculated and displayed in terms or s/day or s/month.

3.2 MEASURING PROCEDURE

The appropriate test mode is selected by means of the button in ***TESTMODE RATE*** field.

The watch is placed on the relevant sensor and, if necessary, moved or rotated until the respective ***Signal*** LED lights up clearly or flashes in synchronism with the watch pulses.

The measurement starts automatically as soon as a watch signal is detected. The result is displayed at the end of the measurement period. The measuring procedure continues as long as there is a detectable signal with the result being updated at the end of each measurement period. The transfer of a new result is indicated by a brief flashing of the display.

A currently running test sequence can be terminated and a new cycle begun at any time by pressing the ***start test*** button.

The first measurement often provides an incorrect result because the watch was being moved at the start of the measuring process. In case of long measuring times, we recommend re-starting the measuring procedure once the watch has been properly positioned on the sensor. In this way the first measurement already provides a correct result.

Should the result be outside the measuring range of 10 s/day, the result H is displayed to indicate that the watch is running fast or L to indicate that it is running slow.

No value is displayed if the watch signal is far outside the measuring range or is disrupted that it cannot possibly be evaluated.

No value obtained remains on the display until the end of the current measuring period even if the watch is removed in the meantime.

3.3 TEMPERATURE EFFECTS

The rate of a quartz watch largely depends on the ambient temperature. It is therefore important that rate accuracy measurements are executed at room temperature or the normal working temperature on the wrist. In particular, comparative measurements must always be carried out at the same ambient temperature.
The accuracy of **the Q TEST 6000** is not influenced by fluctuations in the ambient temperature.

3.4 TESTING OF WATCHES WITH DIGITAL TRIMMING(INHIBITION)

Erroneous measurements may occur when testing watches with digital trimming if the watchmaker is not familiar with their special characteristics which are explained below.
In the case of watches with digital trimming, the quartz oscillator frequency is not adjustable (no trimmer). A fixed capacitor within the IC itself is so dimensioned that the oscillator frequency for all quartzes is slightly too high. A programmable number of oscillator pulses is inhibited once per minute(or every 20 s, 30 s or every 2, 4 or 8 minutes in the case of some watches) during frequency division ,i.e., they are not transferred to the next divider stage.
The watch therefore runs slightly fast for 59 seconds as determined by the oscillator frequency and extremely slowly during the second when the pulses are inhibited. The number of pulses that are inhibited is programmed so that the mean deviation is 0.As only a whole number of pulses can be inhibited at any one time, the adjustment is usually made in steps of 2/10 s per 24 h.

The programming of such watches is carried out by either selectively cutting traces on the printed circuit board of the watch or by a special pulse sequence applied to the battery connections of the IC.

If such a watch is measured by means of the quartz oscillator frequency, the result obtained constantly shows a tendency for the watch to be fast (normally between 1 to 10 s/day).

If the watch is measured over a period of 2 s on the basis of the motor pulses or the LED frequency, every 30 th. measurement would show a result that is extremely slow. The results of the rest of the measurements would be fast since they correspond to the oscillator frequency.

In order to obtain a correct result, such watches have to be measured by means of the stepping motor pulses. In this case, the measuring period has to be equivalent to the inhibition period or a multiple of it, that is, it has to be set to 20 s, 60 s, 120 s, 240 s or 480 s respectively.

4 RATE MEASUREMENT MODES

4.1 32 kHz QUARTZ TEST MODE

The mechanical or electrical oscillations generated by the quartz oscillator are sensed directly in the **quartz 32 kHz** mode. Both the acoustic and capacitive sensors are active in this mode. The signal may also be sensed by way of the supply current.

The measuring period is 1 s and cannot be altered.

Application

This method is suitable for testing all watches with a 32 kHz quartz frequency and rate trimming of the oscillator (which applies to practically all watches with a trimmer).

Watches with digital trimming (inhibition) produce incorrect results (very fast) with the quartz testing method.

Sensors

The acoustic sensor (left sensor field) picks up the mechanical oscillations of the quartz crystal which are transferred through the case to the sensor pin. The watch therefore has to touch the sensor pin in the center of the sensor panel. The Signal quartz LED shows the intensity of the signal received. In the event of the signal being too weak, the watch should be moved or rotated on the sensor in order to find a better position for signal detection.

This sensor is particularly useful for watches in closed metal cases, but also be used for open modules. The sound of the stepping motor in analogue watches may disturb signal reception and lead to unstable results. Should such instabilities occur, the stepping motor may be stopped by pulling out the watch crown.

The **capacitive sensor** (right sensor field) picks up the stray electrical field produced by the quartz oscillator. The **Signal quartz** LED indicates the intensity of the signal detected. In the event of the signal being too weak, the watch has to be moved or rotated slightly on the support , in order to improve signal reception. The capacitive sensor is suitable for open watch module s and watches with plastic cases. The sensor is not suitable for watches with completely closed metal cases.

If the watch is powered from the **Q TEST 6000**, the oscillator frequency can be filtered out of the supply current. Rate measurement by means of the supply current only works in the μA measuring range. Because of the numerous disturbing signals in the supply current, the measurement may be somewhat unstable in which case a measurement by means of the motor current pulses will give a better result.

Attention: No other watch may be powered simultaneously if the watch is being tested on the acoustic or capacitive sensor.

4.2 LCD TEST MODE

The LCD test mode evaluates the working frequency of the LCD-display of a watch for measuring purposes. Any frequency may be used that is a quadruple of 4 Hz.

Application

This test mode is used for LCD watches which cannot be tested by means of quartz frequency, e.g. watches that run at a special frequency (such as timers and calculators with a watch function) or watches with digital trimming.

Sensor

For testing purposes, the watch is put face downwards onto the capacitive sensor (right sensor field).

The ***signal LCD*** LED indicates the intensity of the signal received. If the signal is too weak, the watch should be moved or rotated on the sensor to improve its position for signal detection.

Measuring time

The measuring time is normally left at the initial value of 2 s. In the case of watches with digital trimming, this should be set to the equivalent of the inhibition period or a multiple of it.

In order to alter the measuring period, select the ***meas. time rate*** parameter and set the required value with the rotary knob. The range extends from 2 s to 960 s.

The time left until the end of the current measurement period is indicated if the ***countdown rate*** setting is selected in the ***PARAMETER*** field.

4.3 STEPPING MOTOR TEST MODE (stepp. motor)

The stray magnetic field or the electrical current pulse of the motor coil is sensed in this test mode.

Application

This test mode may be used for all watches with a stepping motor. It is mainly used for watches which can otherwise only be measured with great difficulty or not at all by means of the oscillator frequency, e.g. watches with a special quartz frequency, watches with digital trimming or for watches where no stable result can be achieved in the quartz test mode.

Information: Practically any analogue watch can be tested in the ***stepp. motor*** test mode with a measuring time of 60 s, irrespective of the quartz frequency, the stepping period or the rate trimming principle. This setting may be universally used if the long measuring period is not disadvantageous.

sensor

The watch is placed on the magnetic sensor (right sensor field) for testing purposes. The ***Signal motor*** LED blinks for each motor pulse, thereby indicating the signal intensity. The watch should be moved slightly on the sensor if the signal is too weak.

Measurement by means of the current pulses

The motor pulses are filtered out of the supply when the watch is powered from the **Q TEST 6000**.

Rate measurement by means of the supply current only works in the μA measuring range. To avoid the risk of other signals interfering, the magnetic sensor is automatically switched off as long as a supply current flows.

Attention: No other watch may be powered simultaneously if the watch is being tested on the magnetic sensor.

Measuring period

The measuring period has to correspond to the period of the stepping motor or a multiple of it. Watches with digital trimming (inhibition) have to be measured over an inhibition period or a multiple of it .The initial setting of 2 s is suitable for watches with 1 s steps and a trimmer. A setting of 60 s is correct in most cases for inhibition watches.

In order to alter the measuring period, select the ***meas. time rate*** parameter and set the required value with the rotary knob. The range extends from 2 s to 960 s.

The time left until the end of the current measurement period is indicated if the ***countdown rate*** setting is selected in the ***PARAMETER*** field.

4.4 MECHANICAL TEST MODE (mechanical)

In this test mode, the sound of the movement in a mechanical watch is evaluated for rate measurement purposes. Results are indicated in s/day.

Application

Mechanical watches running at 18000, 19800, 21600, 28800, or 36000 beats per hour may be tested with the **Q TEST 6000**. The instrument is ideally suitable for rapid testing of mechanical watches and may also be used for adjustment purposes. For trouble shooting and repairs, however, we recommend the use of an instrument with graphical recording (e.g. the **WATCH EXPERT**).

Sensor

The watch is placed on the acoustic sensor for testing purposes. The watch case has to touch the sensor pin. The Signal LCD LED indicates the signal intensity.

Measuring period

The measuring period is 4 s and cannot be changed.

4.5 TUNING FORK TESTMODE (tuning fork)

The stray magnetic field of the tuning fork oscillator is sensed for tuning fork watches in this test method. Results are indicated in s/day.

Application

The watch is placed on the magnetic sensor for testing purposes. The Signal motor LED indicates the intensity of the signal received. The watch has to be moved around on the sensor field until an optimal signal intensity is achieved.

Measuring period

The measuring period is 4 s and cannot be changed.

4.6 SPECIAL PROGRAMS FOR PROGRAMMABLE ICs (special program)

Various IC's can be programmed or be quickly tested through the supply current.

1 Set the voltage to 1.55V in the ***PARAMETER*** field with ***supply voltage***.

2 Select ***special program*** in the ***PARAMETER*** field. Use the rotary knob to set the program number, making absolutely sure that it is the correct number for the particular IC. The number is shown on the ***PARAMETER*** display. Any of the following numbers can be chosen:

- P 1 for Philips IC's series **PCA 1400**
- P 2 for Philips IC's series **PCA 1460-1600**
- P 3 for MEM IC's series **H-1138,H-1140,H-1238,H-1138,H-1538**
- P 4 for MEM IC's series **H-1221,H-5222 SPL**

3 Select ***quartz 32 kHz*** in the ***TESTMODE RATE*** field.

4 Make contact to the watch movement or electronic module by means of the movable probe arms. If a module holder type PM 6000 or a dummy battery is connected to the instrument, the watch movement can be powered alternatively through either of these.

5 Once the movement has been connected, check that the ***Signal quartz*** LED has lit up in and that the frequency is shown on the ***RATE*** display. In the event of the signal being too weak (unstable or no rate display at all), select ***stepp. motor*** in the ***TESTMODE RATE*** and set ***meas. time rate*** in the ***PARAMETER*** field.

6 Accelerated test. Briefly press and then release the ***start test*** button in the ***TEST CONTROL*** field. The rate of the movement will now be displayed for a few seconds.

7 Program and test the IC. Simultaneously press the buttons ***start test*** and ***print result*** for about 2-3 seconds and then release both of them. The IC will be newly programmed, tested and the rate of the movement displayed for a few seconds.

The module cannot be adjusted precisely to 0 since the adjustment is normally carried out in steps of 0.2 s. Adjustment is made as close as possible to 0 but always remains in the positive value range.

5 CURRENT CONSUMPTION MEASUREMENT

5.1 GENERAL INFORMATION

The current consumption of a watch provides information about the expected life of the battery and is an important quality criterion for quartz watches.

In the case of analogue watches, the current is a combination of the IC current in the range of a few 100 nA and peak loads during motor pulses of up to 1mA. The **Q TEST 6000** registers the entire current by summing all portions of the current flow throughout the measuring period (integrating measurement). The result of this measurement provides the mean value of the entire current consumption (IC current and motor current) throughout the measuring period.

The stepping motor can be switched off by pulling out the crown (possible with most watches) if only the IC current is to be measured.

The manufacturer's data should be consulted for the maximum permissible current consumption of a watch.

Generally, the current consumption of the watch should be lower the smaller the battery is.

The typical current consumption of modern quartz watches amounts to between 1 and 2 µA for analogue watches with 1 s/step and for watches with longer stepping periods 0.5 up to 1.0 µA.

5.2 CONTACT TO THE WATCH

To measure the current consumption and the minimum working voltage, take the battery out of the watch and power it from the **Q TEST 6000** instead.

To make contact with the watch, fix it in the module holder and place it on the glass window of the Q TEST 6000. The movable probe arms should be set to the points to be contacted and pressed down far enough to depress the telescopic probes by about 1mm. The probes should be grasped at their rear ends to adjust the height.

The red positive(+) probe is placed on a point normally connected to the positive pole of the battery (battery case). The entire bottom plate is connected to the positive pole in most watches.

The black negative (-) probe is placed on a point normally connected to the negative pole of the battery (battery lid). The contact spring for the negative battery connection is usually the most accessible point in the majority of watches.

The two LED's **open** and **short** give an immediate indication of having made successful contact. Both LED's are extinguished as soon as correct contact has been established. If the circuit is open, the **open** LED lights up. The **short** LED lights up in the case of a short circuit or wrong polarity.

The watch hands can be observed in the mirror below the window. If the watch runs the contacts are in order.

Attention: Although the maximum supply current is limited to 3mA in the µA range, the watch may be damaged by contacting the wrong points or applying the wrong polarity.

In the case of clocks, the module supply is best connected with the help of the measuring leads and crocodile clips.

5.3 SUPPLY VOLTAGE

When the ***supply voltage*** parameter is selected, the ***PARAMETER*** display indicates the voltage at the test socket, which may then be changed within the range from 0 to 3.5 V by turning the knob.

Current consumption measurements should be effected with the nominal battery voltage which has the following values for the various battery types:

Silver oxide battery (standard watch battery):	1.55 V
Mercury cells (old battery type):	1.35 V
Lithium battery 2.0 V type:	2.10 V
Lithium battery 3.0 V type:	3.00 V
Zinc-carbon or alkali battery (for clocks):	1.40 V

5.4 MEASURING PERIOD

To ensure an accurate measurement of the mean current consumption, the measuring period in the case of analogue watches has to be equivalent to a stepping period or a multiple of it.

The currents for the positive and negative motor pulse are often unequal which can cause small fluctuations when the measuring time is only based on a single stepping period.

A measuring time of 1 s is sufficient for LCD watches.

To set the measuring period, select the ***meas. time cons.*** parameter and set the measuring period to the required value by means of the adjustment knob. The range extends from 1 to 60 seconds.

The time left until the end of the current measurement period is indicated if the ***countdown cons***. setting is selected in the parameter field of the front panel.

5.5 THE µA MEASURING RANGE (consumption µA)

consumption µA consists of the 100 µA (10 nA resolution) and 1000 µA (100 µA resolution) measuring ranges with automatic range selection. Peak loads of up to 2 mA may be correctly measured in this test mode. Current limitation limits the maximum supply current to about 3mA.

Application

The current consumption of any type of quartz watch can be measured in this test mode. Rate measurement by means of the supply current is possible only under these circumstances.

Neither lamps for LCD-displays nor alarm buzzers may be operated in this test mode.

5.6 THE mA MEASURING RANGE (consumption mA)

consumption mA consists THE 10 mA (1 µA resolution) and 20 mA(10 µA resolution)measuring ranges. The maximum supply current is limited to about 50 mA.

Application
Measurement of the current consumption of watch alarms and lamps for LC-displays. Rate measurement by means of the supply current is impossible in this test mode.

6 STARTING VOLTAGE

The minimum operating or starting voltage is an indicator of the power reserves of the watch and the capacity to continue running in spite of an almost exhausted or heavily loaded battery (LCD watches with the light switched on).
In order to measure the starting voltage, supply power to the watch as explained in Section 5. While observing the hands of the watch in the mirror, reduce the supply voltage until the watch stops, then slowly increase it once more until the watch starts running again.

Normally it is sufficient to check that the watch runs correctly at .a reduced supply voltage. The minimum supply voltage usually in the order of 1.25 V in the case of watches with a silver oxide battery.

7 BATTERY TEST

7.1 GENERAL INFORMATION

The voltage of a watch battery remains constant almost to the end of its life and only drops when it is fully run down. The test, even under load, only shows whether the battery is still usable or entirely exhausted. No information concerning the remaining battery life can be derived.

The battery should also be checked for leaks during the test. The battery must be replaced if salt crystals are visible between the case and lid even though the voltage may still be high enough.

The polarity of the battery must be observed when testing. Generally speaking, the case of a battery for a wrist watch is normally the positive (+) pole and the lid is the negative (-) one.

Conversely, the case serves as negative pole and the contact on the lid as the positive one for clock batteries and lithium batteries.

For testing purposes, the battery has to be placed on the battery support in the ***BATTERY TEST*** field on the front panel with its positive side downwards and contacted at the negative pole by the black test probe or the black measuring lead.

The battery may also be checked directly in the watch with the help of the measuring leads.

The measured battery voltage is displayed in the ***MODULE*** panel field.

7.2 BATTERY LOAD

Loading the battery with a load resistor whether it can supply the necessary current without the voltage dropping out of tolerance.

The basic load without activating any buttons amounts to about 2 μA. This load corresponds approximately to the current consumption of a watch. The battery should not show any substantial voltage drop.

A load of 1kΩ can be switched on by pressing ***low drain*** button. This load corresponds approximately to the peak load during a motor pulse.

A load of 100Ω may be added by pressing the ***high drain*** button. This load corresponds approximately to the current drawn when the light in an LCD watch is activated. The 100Ω load is only practicable for high drain and clock batteries. The button should not be pressed for longer than necessary otherwise the battery will be quickly drained.

7.3 NORMAL BATTERY VOLTAGES

Silver oxide batteries,1kΩ load (low drain)

battery good	1.45-1.55 V
end of battery life	below 1.40 V

"High drain" silver oxide batteries,100Ω load(high drain)

battery good	1.25-1.50 V
end of battery life	below 1.20 V

Mercury cells, 1kΩ load (low drain)

battery good	1.25-1.35 V
end of battery life	below 1.20 V

Clock batteries, 100Ω load(high drain)

battery good	1.30-1.50 V
end of battery life	below 1.20 V

Lithium batteries, no load

	2.1 V type	3.0 V type
battery good	1.90-2.10 V	2.85-3.10 V
end of battery life	below 1.80 V	below 2.75 V

8 RESISTANCE MEASUREMENT

8.1 GENERAL INFORMATION

The ***resistance*** measuring range is predominantly used for the location of open or short circuits in the motor coil of analogue watches or insulation defects between coil and coil core or mounting plate.

Resistance measurements are also useful for continuity and insulation testing of connections, circuits and switches.

The measurement is made with a constant voltage of 0.3 V. With this low test voltage, components which are connected to an integrated circuit can also be checked without falsifying the result. The measuring range extends from 15 Ω to 5 MΩ with automatic ranging.

The battery has to be taken out of the watch for all resistance measurements.

Contact to the measuring points is effected by using the movable probe arms or measuring leads.

8.2 COIL RESISTANCE AND COIL INSULATION

Coil resistance

The two coil connections on the watch module are contacted for the measurement of coil resistance. Polarity in unimportant.

The resistance value in the case of analogue watches is normally between 1kΩ and 3kΩ. Please consult the watch manufacturer's data for more precise values.

A break in the coil is indicated by the H display and by the ***open*** LED lighting up.

Insulation

one of the two coil connections and the mounting plate of the watch have to be contacted to test the coil insulation. A break is indicated if the insulation is good (H display and the ***open*** LED lights up). A low resistance value is indicated in the case of defective insulation.

8.3 CONTINUITY AND INSULATION TEST

Observation of the two LED's, ***short*** and ***open***, suffices for continuity and insulation tests on arbitrary watch components.

If the **short** LED lights up the two test points are interconnected and if the ***open*** LED lights up they are insulated from one another. The resistance value may be read on the display if there is no LED signal.

9 PULSE GENERATOR

9.1 APPLICATION\

The stepping motor and the mechanical parts of analogue quartz watches can be tested independently of the IC in the pulse generator test mode.

The pulse generator supplies bipolar pulses with adjustable voltage and pulse width. The pulse repetition frequency is either 8 or 16 Hz depending on the pulse width selected.

The battery has to be taken out before the test is carried out. The watch is fixed in the module holder and placed on the glass window. The coil connections are contacted with the two probes. Correct operation of the watch can be checked in the mirror.

The ***pulse generator*** function provides no numerical results.

9.2 PARAMETER SETTING

Pulse voltage

The pulse voltage can be set when the ***supply voltage*** parameter is selected. Under normal conditions , the pulse voltage is 0.1 to 0.2 V lower than the actual battery voltage due to the voltage drop across the output transistors. The pulse voltage should be appropriately adjusted to ensure that the operation with the pulse generator is subject to the same conditions.

Pulse width

Select the pulse width parameter to set the pulse width which can be adjusted with the rotary knob. The ***PARAMETER*** display window shows the pulse width in ms. The pulse frequency is 16 Hz for pulse widths below 16 ms and 8 Hz for those above 16 ms.

The correct pulse width has to be set to accord with the data from the watch manufacture. The standard pulse width of 6.8 ms may be taken for a simple function test if the correct pulse width is not known.

Chopped pulses

The pulse generator in the **Q TEST 6000** supplies no chopped pulses. Such pulses can, however, be simulated to a large degree by reducing the pulse voltage in proportion to the chopp ratio.

10 ALARM TEST

The **Q TEST 6000** supplies a test frequency of 2 kHz in the ***alarm test*** mode to test the magnetic or piezoelectric alarm buzzer in a watch.
The voltage can be set with the ***supply voltage*** parameter.

11 TROUBLE SHOOTING FOR QUARTZ WATCHES

The following notes contain some recommendations to watchmakers, on how to locate defects in quartz watches both quickly and reliably.

11.1 SYSTEMATIC TROUBLE SHOOTING

Proceed as follows to localize a defect quickly in a quartz watch that is not running:

- Place the watch on the acoustic sensor and check to see whether any signal exists (quartz LED lights up). Check the battery if there is no signal.

- If the battery is found to be in order and the quartz signal is indicated, test the resistance and insulation of the motor coil.

- If the coil is in order, place the watch on the ***magnetic*** sensor and check whether there are any motor pulses (***motor*** LED lights up with each pulse).

- If the watch passes all of the above checks, there must be a mechanical defect, such as: hands catching, blocked or extraneous matter in the movement, fine steel particles on the rotor magnet, etc.

11.2 BATTERY

Whatever the defect, check the battery first (see Sections 7-7.3). Remove any dirt or oxidation from the battery contacts and bend the contact springs back into shape as necessary.

11.3 IC DEFECTS

Oscillator test

In the ***quartz 32 kHz*** test mode, the ***quartz*** LED shows whether the quartz oscillator is functioning and whether the 34 kHz signal is present. If no signal is displayed, either the quartz crystal, the trimmer or the integrated circuit (IC) is defective.

Testing the motor driver stage

The ***motor*** LED lights briefly with each motor pulse in the ***consumption µA*** test mode. If there is no signal in spite of the fact that the motor coil is in order, then the following applies:

- either the IC is defect, or
- the reset remains activated although the hands setting stem is pressed in (defective mechanism, stem too short).

11.4 MECHANICAL DEFECTS

If a watch runs very slow or does not run at all, although the electronic module and motor coil are perfectly operational, the cause is to be sought in the mechanics of the watch. Possible defects are:

- Steel particles adhering to and blocking the rotor magnet. Small chips can be set free as the case bottom is screwed or snapped on.

- The mechanism does not run freely or is completely blocked. Small particles in the gears may partially or even entirely block the movement. Test for free running and cleanliness.

- Check whether the hands catch, or touch the glass or face.

- The “reset by stem” mechanism is defective. When the hands setting stem is pulled, the seconds hand is mechanically blocked and the reset contacted. The mechanism should not touch the seconds gear wheel when the hands setting stem is pressed in and the reset contact must be opened. This fault occurs if the mechanism is defective or the stem is too short.

11.5 LCD-DISPLAYS

No display on an LCD watch.

- First test the battery.

Place the watch on the acoustic sensor and select the ***quartz 32 kHz*** test mode.

- If the ***quartz*** LED does not light up, either the quartz crystal, the trimmer or the IC is defective.
- If the ***quartz*** LED lights up, the IC or the display is defective.

The LCD display lacks several segments.

Possible faults:

- Insufficient contact between the printed circuit and the display; carefully clean the contact pads and contact strips;

- IC or display defective.

12 PM 6000 MODULE HOLDER

The **PM 6000** module holder is an accessory for the serial testing of watches. It does not belong to the standard equipment supplied with the **Q TEST 6000**.

13 TECHNICAL DATA

RATE MEASUREMENT

Measuring modes:

- By means of the quartz oscillator frequency of 32 kHz. Signal detection: acoustic, capacitive or through the supply current.
- By means of the stepping motor pulse. Capacitive signal detection.
- By means of the LCD operating frequency. Capacitive signal detection.
- Measurement of mechanical watches. Acoustic signal detection.
- Measurement of tuning fork watches. Magnetic signal detection.
- Special programs for the adjustment and accelerated measurement of watch ICs using an EEPROM.

Measuring periods:

- Measurement via the quartz frequency: 1 s.
- Measurement via the stepping motor pulses or the LCD frequency: adjustable from 2 to 960 s.

- Mechanical and tuning fork watches: 4 s.
- Display of the time left until the end of the current measurement.

Sensors:
- Built-in , highly sensitive and selective sensors for acoustic, magnetic and capacitive coupling.
- Signal detection by means of the module supply current.
- LED's to display signal intensity.

Display of results:
- Large, 3 digit LC-display.
- Display mode switchable to s/day or s/month.
- Measuring range 9.99 s/day, or 300 s/month.
- Resolution 0.01 s/day, or 1 s/month.

Time base:
- Pre-aged, oven-controlled high frequency quartz crystal oscillator.
- Temperature deviation: 0.01 s/day max. in the range of 10-30℃.

MODULE POWER SUPPLY

- Supply voltage: adjustable from 0-3.5 V in steps of 0.05 V.
- Current limiting: 3 mA in the μA measuring ranges, 50 mA in the mA measuring ranges.
- Immediate indication of open or short circuits by LED's.
- Contacting: universal movable test probes for making direct contact to the work surfaces on the module; additional measuring leads with probe tips and crocodile clips.
- Built-in mirror to observe the watch face during measurements.

CURRENT MEASUREMENT
- Measuring method: integrating measurement of the mean current drawn during the measuring period.
- Measuring ranges:
  -100 μA,10 nA resolution.
  -1 mA, 100 nA resolution.
  -10 mA, 1 A resolution.
  -20 mA, 10 A resolution.
- Range adjustment: manually between μA and mA ranges, automatically within these ranges.
- Measuring periods: adjustable from 1 -60 s. Display of the time left until the end of the current measuring period.

BATTERY TEST/VOLTAGE MEASUREMENT

- Measuring range: 0- 5V.
- Measurement of the open circuit battery voltage, or the voltage with a 1 kΩ (low drain) or 100 Ω (high drain) load resistor.
- Measuring time: 1 s.

RESISTANCE

- Measuring ranges: 1 kΩ, 10 kΩ, 100 kΩ, 1 MΩ and 5 MΩ .Automatic ranging.
  Measuring period: 1 s.
- Immediate indication of short or open circuits by LED's.

DISPLAY

- 4-digit LCD-display for current, voltage and resistance.

PULSE GENERATOR

- Pulse generator for powering the motor coil of analogue watches directly.
  -Pulse shape: bipolar.
  -Pulse width: adjustable from 1 to 80 ms.
  -Frequency: 16Hz for pulses<16 ms, 8Hz for pulses>16 ms.
  -voltage: adjustable in the range 0 -3.5 V.

ALARM TEST

- Test signal for alarm buzzers.
  -Frequency: 2 kHz.
  -Pulse voltage: adjustable from 0 -3.5 V.

PARAMETER SETTING

- All the measurement parameters can be set to the required value by means of the rotary knob (incremental setting).
- The value of the parameters is shown on a separate 4-digit LCD-display.

PRINTER OUTPUT

- RS 232 port for the connection of a matrix printer. A measurement protocol listing the current measured values can be printed out on the printer.

HOUSING

- Hardwood frame, scratch-resistant aluminum front panel.
  - Dimensions: 354×233×75 mm (w×d×h)
  -Weight: 2.6 kg

MAINS SUPPLY

- Mains adapter, available for 230 V~ (210 -240 V~ range) or 115 V~ (110 -130 V~ range) operation.

DECLARATION OF CONFORMITY

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

89/336/**EWG**	**EMC**
EN 55011 :1991	Emissions
EN 50082-1 :1992	Immunity, public environments
EN 50082-2 : 1995	Immunity, industry

14 STANDARD ACCESSORIES

- Pair of movable contact probes
- Measuring leads with probe tips and crocodile clips
- Telescopic module holder
- Dust-cover
- Operating manual

15 ACCESSORIES

Sensors

- Hand-held acoustic, capacitive or magnetic sensors to test the watch directly in its box;

Module Holder

- Module holder and contacting device PM 6000 for serial testing. Can be equipped with adjustable laboratory probes or with fixed sensor plates.

Printer

- CITIZEN iDP 562 incl. graphic mode, cable and paper. Available for 230 V~ or 120 V~.
- CITIZEN CBM 910 (without graphic mode) incl. cable and paper. Available 230 V~ or 120 V.
- Printer Switchbox for connection of 2 equipment’s to one printer.

Dummy batteries

- Set of dummy batteries including connection cable and wooden case.

16 CALIBRATION

We recommend that the instrument should be calibrated and check once a year to guarantee its measuring accuracy.

Please contact the customer service department at our head office or one of our representatives.

17 CONTAT POINTS FOR SOME COMMON CALIBERS

The following pages show the contacting points for some commonly available module caliber's.

Please contact the manufacturer or his representative directly for data sheets concerning watch movements not shown below.