## Related topics

Electrocardiogram according to Einthoven II, heart rate, quiet and strained heart, ECG segments, atria, ventricles, AV nodes.

## Principle

To record an electrocardiogram (ECG) between the left leg and the right and left arm (lead II according to Einthoven). To relate the ECG segments to the course of heart contraction (P wave, P-Q segment, QRS complex, T wave).

## Material

| | | |
|---|---|---|
| 1 | Cobra4 Wireless Manager | 12600-00 |
| 1 | Cobra4 Wireless-Link | 12601-00 |
| 1 | Cobra4 Sensor-Unit Electrophysiology | 12673-00 |
| 1 | Shielded leads for electrophysiology, color-coded, 3/pkg | 12673-01 |
| 1 | ECG electrodes, 3/pkg | 65981-01 |
| 1 | Potassium chloride, 250 g | 30098-25 |
| 1 | Spoon with spatula end, l=150mm, steel, wide | 33398-00 |
| 1 | Balance MXX-212R, 210 g / 0.01 g, RS232, 230 V | 49111-93 |
| 1 | Graduated cylinder, 100 ml | 36629-00 |
| 1 | Software Cobra4 - Single user and school licence | 14550-61 |

**Additionally required**

| | |
|---|---|
| 1 | PC with USB port, Windows XP or higher |
| 1 | Tempo / Kleenex tissues |

Fig. 1: Experimental setup



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## Setup

- Set up the equipment as shown in Fig. 1: plug the Sensor-Unit Electrophysiology into the Wireless-Link and the Wireless Manager into the USB port of the computer.
- Connect the color-coded shielded leads for electrophysiology (red, yellow, green) into the Sensor-Unit Electrophysiology. To connect, use the allocation information on the display of the Sensor-Unit.
- Prepare a 1% KCl solution. Cut Kleenex/Tempo tissues to size such that they are approximately as large as ECG electrodes. Moisten the pieces of cut tissue with KCl solution.
- Using tightening bands, attach one electrode each to the inner sides of the right and left wrists as well as to that of the left ankle as shown in fig. 1. In the process, place a piece of the cut tissue that has been moistened with KCl solution between the skin and the electrode in each case.
- Have the experimental subject sit in a relaxed posture with his or her underarms resting on his or her knees or on the tabletop.
- Connect the color-coded leads as shown on the display of the Sensor-Unit: attach the electrodes on the inside the left wrist; on the inside of the right wrist; and on the inside of the left leg just above the ankle.

## Procedure

- Open the measure Cobra4 software.
- Switch on the Wireless-Link so that it can communicate with the Wireless Manager.
- Select “Open experiment…” in the “Experiment” menu. This will preset the experiment settings and open the measurement window required for this experiment.
- Start the measurement. The measurement window will display the ECG recording.
- Stop the measurement after about 10 seconds and send the data to measure to display and eva-

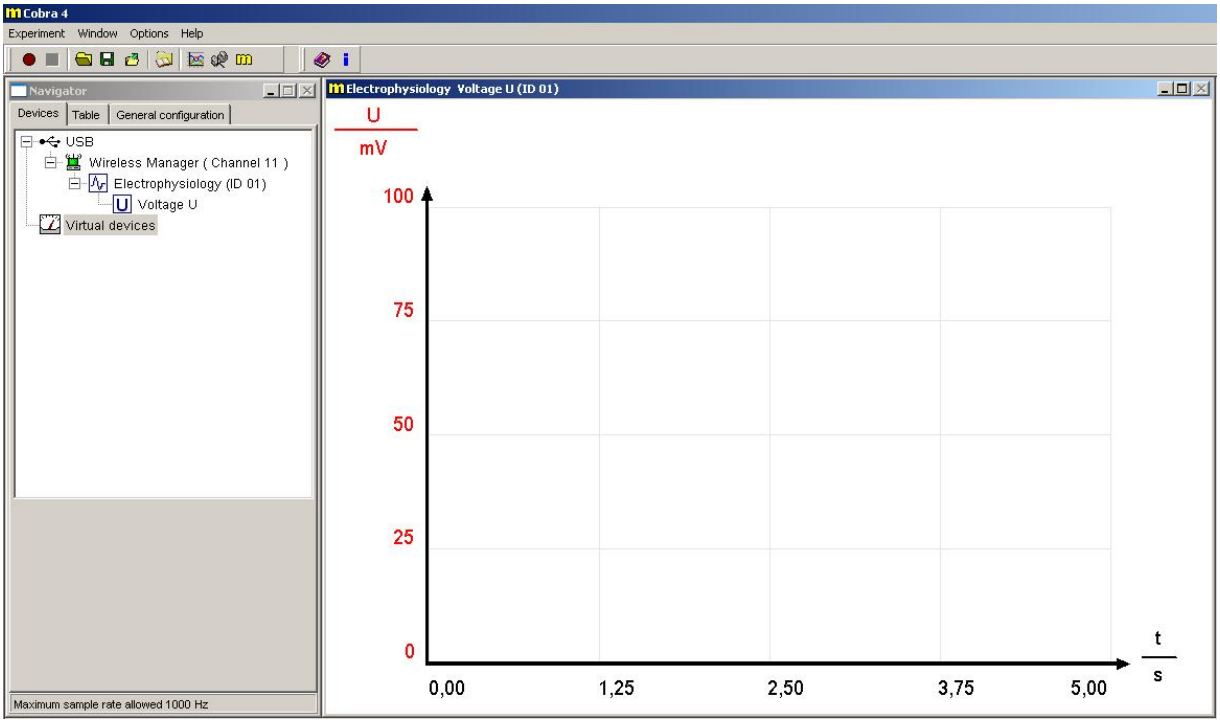


Fig. 2: Measurement window after opening the experiment

luate the electrocardiogram. **Please note that the purpose of the Cobra4 Electrophysiology System is solely didactical. It is not a medical monitoring system to diagnose heart diseases.**


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- To study a segment of the electrocardiogram in detail use the zoom tool  .

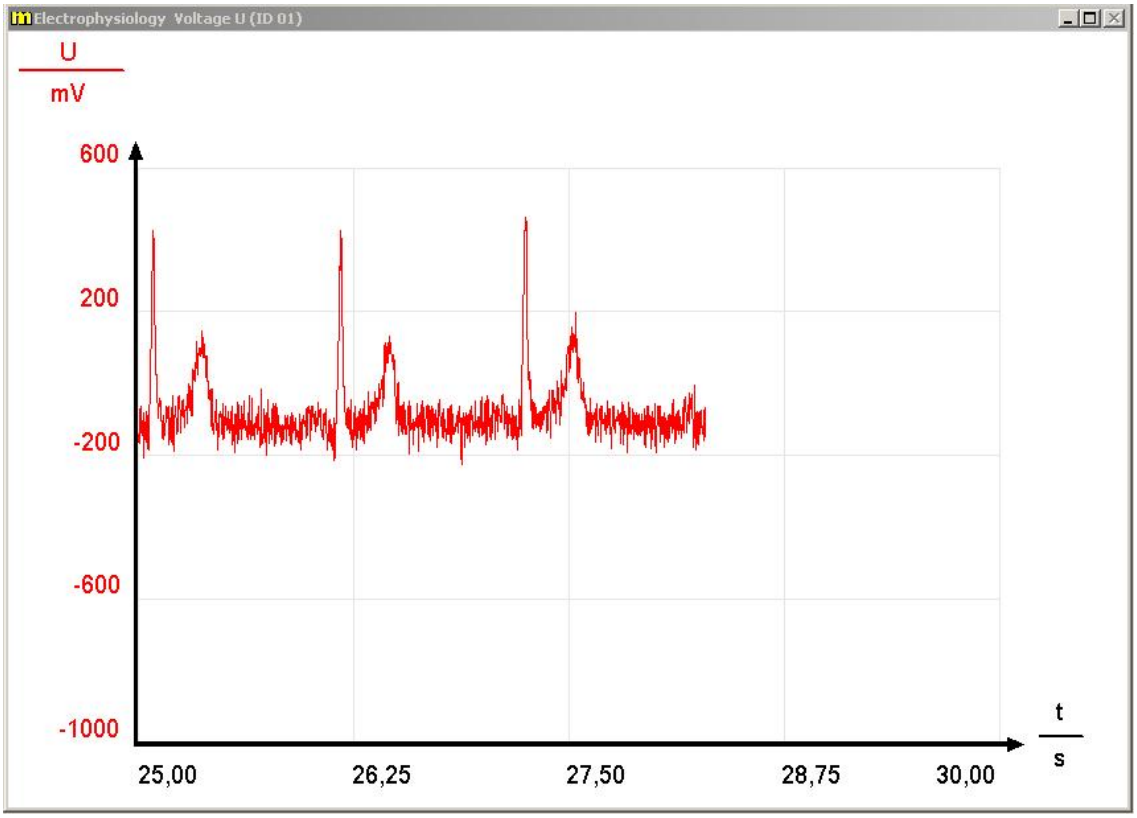


Fig. 3: Electrocardiogram during measurement

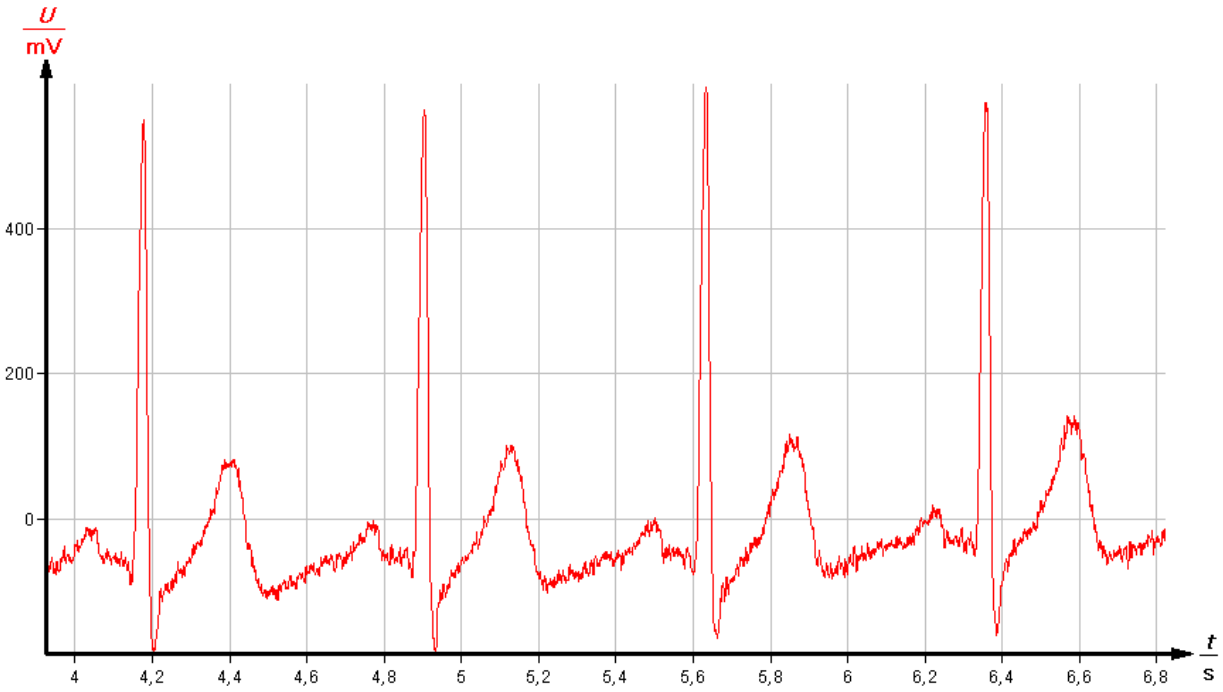


Fig. 4: Typical result. For interpretation consult Wikipedia's entry "ECG".


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**Results and evaluation**

- The diagram (fig. 4) shows all the expected elements that can be expected in an electrocardiogram: P wave, PR segment, Q wave, R wave, QRS complex, S wave, ST segment, and T wave of a normal sinus rhythm for the human heart.
- By using the survey tool in measure you can determine the heart rate: simply convert the time between two or more R wave peaks into heart beats per minute. To average out variation between heart beats, spread out the survey across several R wave peaks.


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