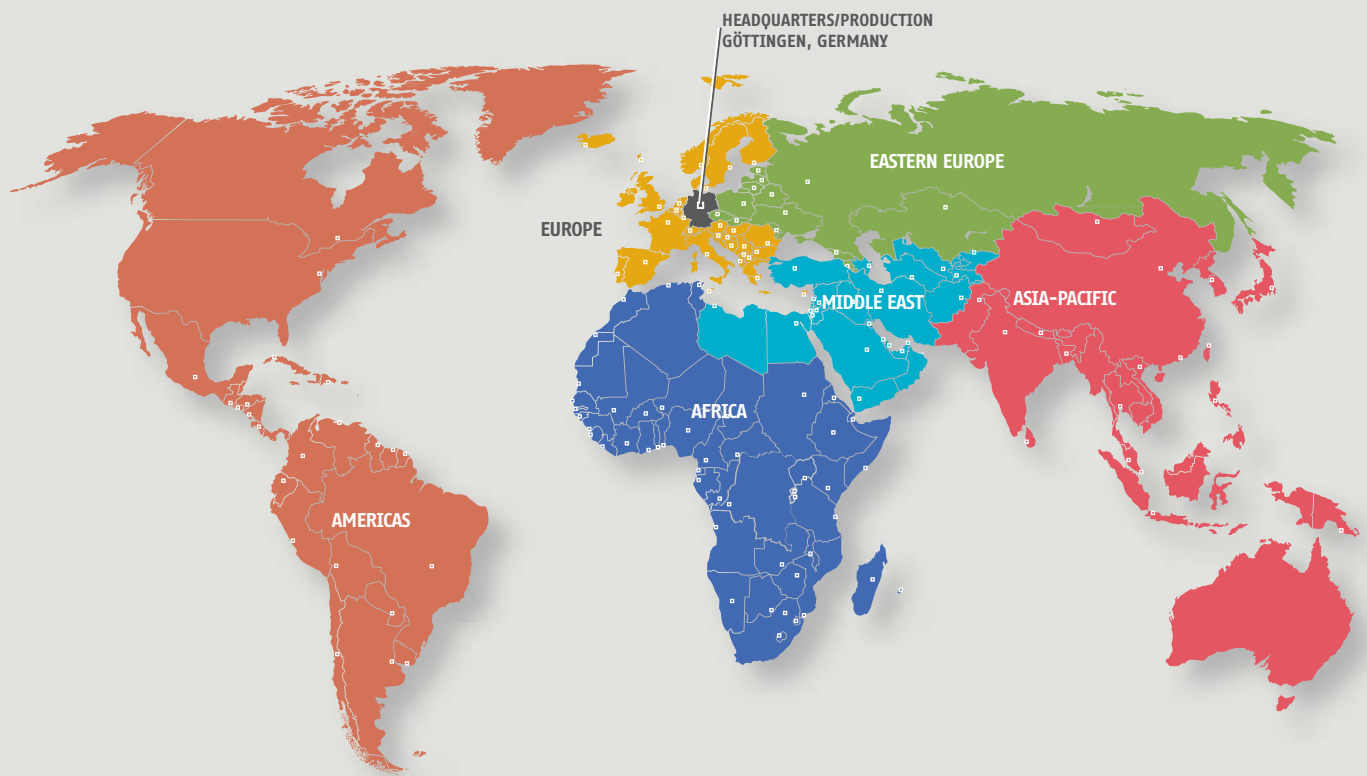


Experiments with Cobra4 – wireless, modular, intuitive



Global network

Your partner is never far away!



Our worldwide presence enables us to offer you customised local solutions. More than 145,000 customers in over 95 countries appreciate our experience and reliability, our high technical standards, and the ease and clarity with which our innovative products can be operated.

Are you looking for a partner near your location?

Please do not hesitate to call us. We would be pleased to assign you a personal contact.

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Cobra4 Brochure

1	Introduction	2
2	Basic Units	13
2.1	Cable Free - Wireless	14
2.2	Outdoors - Mobile	16
2.3	Fast or Easy Measurements - USB	18
2.4	Signal-Link	19
2.5	Digital Function Generator	20
3	Physics	21
3.1	Experiments and Sensor-Units Physics	22
3.1.1	Motion	24
3.1.2	Force, Mass	26
3.1.3	Pressure	27
3.1.4	Electricity, Charge	28
3.1.5	Temperature	31
3.1.6	Light	33
3.1.7	Sound	34
3.1.8	Radioactivity	35
3.1.9	Magnetism	36
3.2	Sets and Literature Physics	37
4	Chemistry	39
4.1	Experiments and Sensor-Units Chemistry	40
4.1.1	pH-Value, Redox Potential	42
4.1.2	Conductivity	44
4.1.3	Titration and Colorimetry	45
4.2	Sets and Literature Chemistry	46
5	Biology	47
5.1	Experiments and Sensor-Units Biology	48
5.1.1	Environment: Light Intensity, Humidity, Temperature, Air Pressure, Altitude	50
5.1.2	Wind	51
5.1.3	Salinity	52
5.1.4	Carbon Dioxide and Oxygen	53
5.1.5	Pulse Measurement, ECG, and Blood Pressure	54
5.1.6	Respiration and Skin	55
5.2	Sets and Literature Biology	56
6	Applied Sciences	57
6.1	Experiments and Sensor-Units Applied Sciences	58
6.1.1	Energy	59
6.1.2	Human Physiology	60
6.2	Sets and Literature Applied Sciences	62
7	General Sets and Accessories	63
8	Ordering Overview	67
8.1	Sets	68
8.2	Literature	71

Measurement data acquisition for science experiments



Cobra4 is the computer interface system that offers completely new experimentation possibilities. It combines classic experiments with modern measurement data acquisition methods. More than 200 detailed experiments integrate the sensors into various topics and fields.

You know your topic, and we have the perfect sensors! The Cobra4 system and the experiments are adapted to the national and international curricula for schools and universities.

Benefits

- wireless measurements – comfortable and modern
- more than 30 sensors for more than 50 measurands
- more than 200 detailed experiments with Cobra4
- intuitive, flexible handling
- time-saving: settings can be saved
- fully automatic sensor identification

Principle



Sensor-Unit
(30 different sensors available)

Interface
(4 different interfaces available)



one of more than 30 sensors

quick and secure connection



optional GPS

SD card for data storage

2.4" display with 65,536 colours

integrated acceleration sensor

intuitive handling

New generation as of 2013!

USB connector for data transfer and charging

HOW would you like to measure?

The perfect link for your requirements



Wireless measurements with the Wireless-Link & Wireless Manager + Remote-Link



Without a PC with the Mobile-Link – even more functions included as of 2013



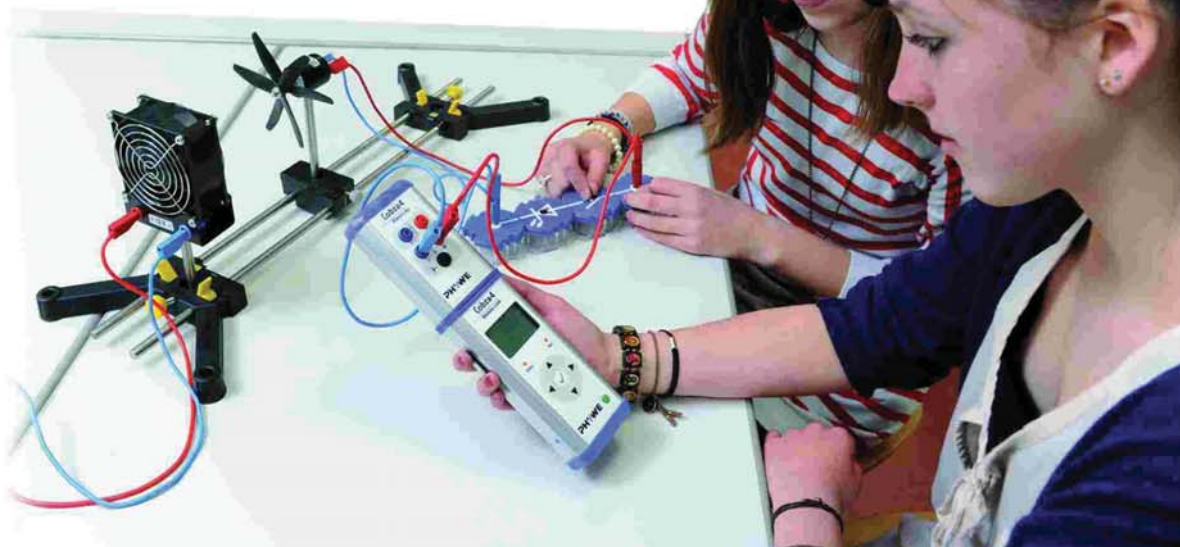
For high data rates with the USB-Link



Easy and cost-effective with the Junior-Link



TESS expert experiments with the Signal-Link



WHAT do you want to measure?

The right sensor for your experiment



Motion



12651-00

Timer-Counter

Motion with light barriers



12649-00

Motion

Distance, velocity, acceleration



12650-00

Acceleration

3D acceleration

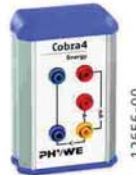
Electricity



12644-00

Electricity

Current, voltage



12656-00

Energy

Current, voltage, work, power

Radioactivity



12665-00

Radioactivity

Count rate

Sound



12669-00

Sound level

Sound level

Forces



12661-00

Forceplate

Force



12643-00

Force 40 N

Force 40 N



12642-00

Force 4 N

Force 4 N

Magnetic field



12652-00

Tesla

Magnetic field

Temperature + Pressure: Thermodynamics



12640-00

Temperature

Temperature



12641-00

2 x Temperature

Temperature (2 x NiCr-Ni)



12647-00

Pressure

Pressure (7 bar)



12638-00

Thermodynamics

Pressure, temperature



ph-Value (+ Temperature)

pH
pH-value

Chemistry
pH, temperature
(2 x NiCr-Ni)

Gas Analysis

CO₂
CO₂ content in air

Oxygen
Oxygen in air / dissolved

Available as of 2013!

Titration

Drop counter
Titration

Thermodynamics

Thermodynamics
Pressure, temperature

Conductivity

Conductivity
Conductivity, temperature

Conductivity+
Conductivity, temperature (Pt1000)

Colorimetry

Colorimeter
Coloration of liquids

Available as of 2013!



Plant Physiology

Conductivity
Conductivity, temperature

CO₂
CO₂ content in air

Oxygen
Oxygen in air / dissolved

Available as of 2013!

Ecology

Weather
Air pressure, humidity, altitude, temperature, light intensity



Human Physiology / Medicine

Skin resistance
Skin resistance

Spirometry
Respiratory volume, wind speed

Electrophysiology
ECG, EMG, EOG

Pulse
Heart rate

Available as of 2013!

Cobra4 – the modern way of teaching



Robust technique, intuitive software, reliable results

Easy handling

Grab your Cobra4 and you are only 4 steps away from measurement results:

- 1 „CLICK“: Attach sensor to basic unit
- 2 START software: Automatic detection of Sensor-Unit
- 3 LOAD configuration
- 4 MEASURE!



Enhance your experiments

Wireless

Computer assisted measurements offer you a number of advantages compared to classical experiments:

- Record data without cable tangle
- Record changes that are not visible (e.g. temperature)
- Record parameters that are changing fast (normally not possible)
- Record very slow changes (longer than the lesson / lecture)
- **Go outdoors**



The software „measure Cobra4“ ist available in 24 languages

Multi-lingual

Choose your language – and the list is constantly growing!

German, English, Ukrainian, Hungarian, Russian, Polish, Arabic, Turkish, French, Portuguese, Kazakh, Italian, Spanish, Vietnamese, Czech, Croatian, Korean, Latvian, Chinese, Lithuanian, Swedish, Dutch, Rumanian, Greek



Efficient teaching

State-of-the-art teaching

Profound understanding and lasting learning success with Cobra4:

- Train students on computer, apply modern methods
- Outdoor experiments
- Change of focus in teaching:
 - Less routine works (take measurement data, draw graphs)
 - More interpretation (of the graphs and change in graphs)



All of the experiment descriptions, configuration files, and example measurements are included FREE OF CHARGE on the measure Cobra4 DVD.

Fast preparation of lessons

You save time

- 1 Choose subject
- 2 Find corresponding PHYWE experiment - use our curriculum and experiment overviews
- 3 Print out experiment description - for free on every DVD of measure
- 4 Start lesson



ENVIRONMENT, ECOLOGY, METEOROLOGY	
Soil - constitution, function, pH, water and salt content	
The pH value of various soils	P1521062
Salinity of soils and plant substrates	P1521162
Insulating effect of body coverage	P4100360
Learning stations using the experimentation case Cobra4 Mobile, Environment and outdoors	P1521562
Raised bog and fen	P1521262
Drinking water, pH, oxygen content, salt content, pollutionP1360960	
Conductivity of various water samples	P1520060
We examine our drinking water	P1520062
Water quality - contamination with heavy metals	P0990162
Acidity changes of a watercourse	P1520862
Salinity changes of a watercourse	P1521462
We visit a wastewater treatment plant	P1521662
Weather and climate	
24-hour weather observation	P1520461
Relative humidity	P1520560
Changes of the light conditions in a deciduous forest	P1520762
Comparison of the heat capacities of water and soil	P1350960
Comparison of soil and air temperatures in the course of a day	P1520962
Air pollution, ozone, exhaust gases by cars	
Weather observation with the Cobra4 Mobile-Link	P1520462
Impact of the forest type on humidity, temperature and brightness	P1521762
The origin of acid rain	P4100760
Effects of humans on the ecosystem and ground water pollution	
We examine our drinking water	P1520062
Water quality - contamination with heavy metals	P0990162

Attractive Sets – complete solutions for your experiments

Get all the Sensor-Units and Links to your desired topic in one compact set. The experiment descriptions and the software are included.

Your benefits:

- Fitting sets for different topics.
- The equipment is stored safely in an aluminium case with foam insert.
- Clearly arranged, quick check for completeness.
- Special extension sets are corresponding perfectly to sets of the TESS advanced program.
- For student experiments sets with equipment for 4 – 8 groups are available.

**Attractive
set discount**

Physics	
Basic Set	
Basic Set Physics (12605-89)	Temperature Semiconductor, Sensor-Unit Current/ Voltage, 3D Sensor-Unit Acceleration, Cobra4 Sensor-Unit Force.
Student Set	
Junior-Link Basic Set Physics for 5 groups (12616-89)	The set contains sensor-units to measure force, motion, pressure, energy, and temperature. Experimental options: motion, hydrostatic pressure, energy consumption.
Special Sets	
Linear motion, Extension Set (12651-89)	In combination with TESS set linear motion (11305-77) suitable for all experiments concerning linear motion, laws of collision...
Extension Set for TESS Mechanics, Electricity and Heat (12604-89)	This set is ideally suited to perform student experiments with the PHYWE TESS experiment sets Mechanics, Electric Building Blocks system and Heat.



Chemistry	
Basic Set	
Basic Set Chemistry (12606-89)	Topics covered by the sensors in this set: pH-value, conductivity, temperature.
Student Set	
Junior-Link Basic Set Chemistry for 5 groups (12617-89)	Measure pH-values, conductivity, pressure, and temperature. Experimental options: temperature, titration, conductivity of different water samples, gas laws
Special Set	
Gas laws with the glass jacket system (43020-00)	Complete device compilation for a comfortable way to derive the ideal gas laws experimentally with help of the Cobra4 Sensors-Unit Thermodynamics and the glass jacket system.



Find an overview of the content of all sets on page 68-70.

Biology		Bic
Basic Set		
Biochemistry & Plant physiology (65982-89)	Instrument set with the wireless computer interface Cobra4 to perform the following experiments: photosynthesis, transpiration of leaves, Glycolysis, Enzyme kinetics	
Student Sets		
Junior-Link Basic Set Biology for 5 groups (12618-89)	Experimental options: temperature, weather observation, conductivity of different water samples, lung diseases.	
TESS Applied Sciences Cobra4 environment and outdoors, Set for 4 groups (12622-77)	Ideal set for outdoor experiments with different groups. e.g. investigate light and humidity changes during the day.	
Special Set		
Cobra4 Environment and outdoors (12619-77)	Perform experiments dealing with air pressure, humidity, ambient temperature, brightness. Furthermore a temperature and a conductivity sensor are included.	



Applied Sciences		Sci
Special Sets		
Electrophysiology (15673-89)	Complete instrument set and accessories to perform computer-assisted experiments in human and animal physiology of heart, muscle and eye.	
Cobra4 Extension Sets for DEMO Renewable Energy (12608-88)	To perform computer-aided demonstration experiments in the field of renewable energy. It is optimally adjusted to the experimentation set Demo Renewable Energy ENT1 (09492-88) and ENT2 (09493-88).	



Sets corresponding to all subjects		
Comfort Set		
Cobra4 Demo-Set, incl. Computer (12609-89)	Multi-purpose set for many sensors used in physics, chemistry, biology and applied sciences. All important sensors in one case. Computer is included (Cobra4 Data Unit).	
Student Set		
Mobile-Link, for 8 groups (12621-89)	8 Mobile-Links in one case.	
Special Set		
Cobra4 Display-Connect, Basic Set with large display and Mobile-Link (12607-89)	For cable-free representation of values with a digital large-scale display, which are measured with the Cobra4 Mobile-Link. Complete set in an attractive suitcase.	



measure Cobra4 software:

modern, intuitive, and easy to use

Navigator

This is where you control your sensors and interfaces:

- Adjust the parameters for your measurements
- Add additional channels to your measurement based on the calculated values
- Click the "Table" tab in order to display the current measurement values as a table

Multi-lingual

German, English, Ukrainian, Hungarian, Russian, Polish, Arabic, Turkish, French, Portuguese, Kazakh, Italian, Spanish, Vietnamese, Czech, Croatian, Korean, Latvian, Chinese, Lithuanian, Swedish, Dutch, Rumanian, Greek

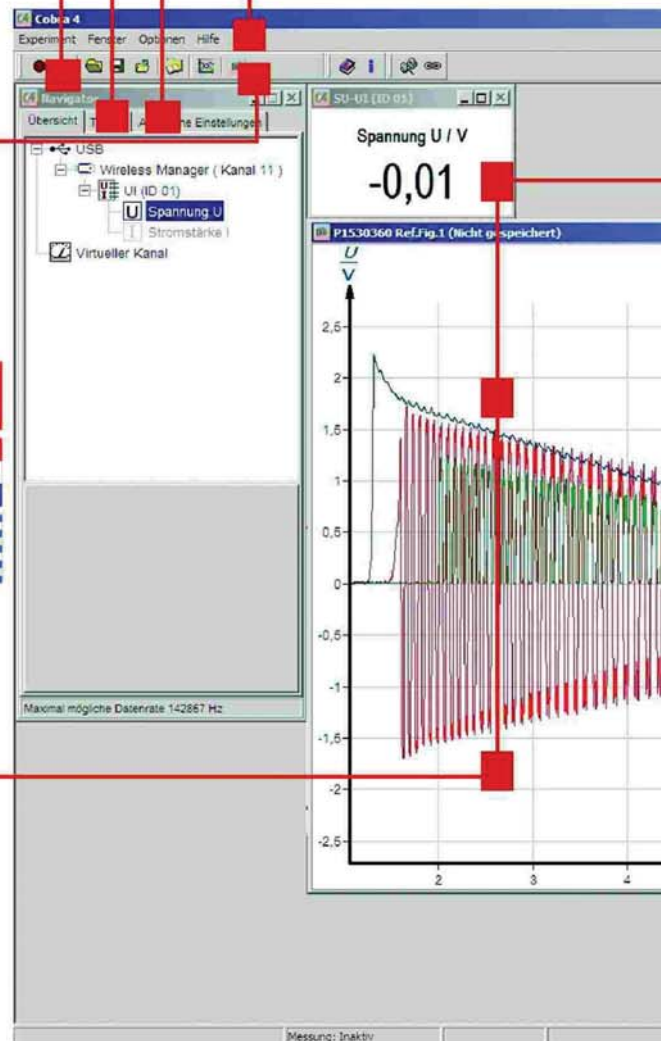
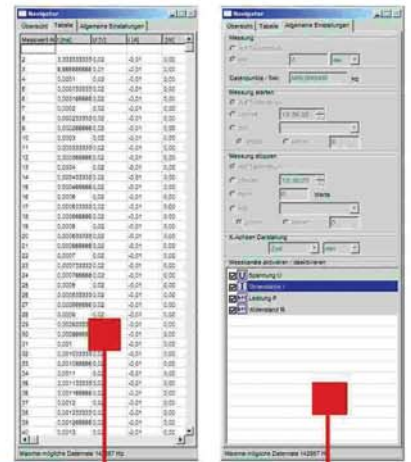


Measurement window

All of the measurements are immediately displayed. Select from the following options for displaying your measurement channel:

- digital measurement window
- analog measurement window
- additional graphs with free scale assignment (multigraph)

Changes can also be performed **during the measurements**.





measure Cobra4 software
Single and school licence
Product no. 14550-61

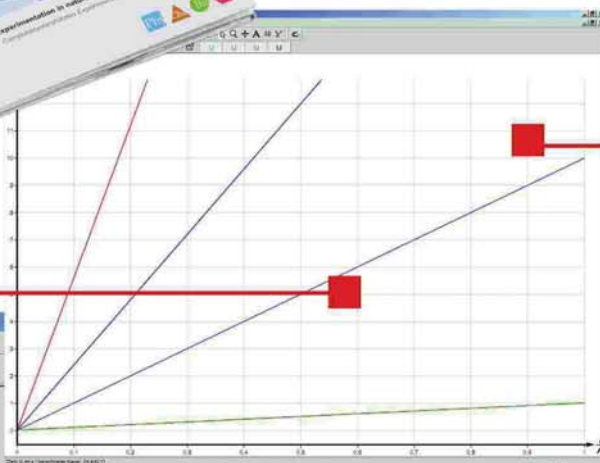
System requirements:
PC with at least Pentium 3, 512 MB RAM,
1 GB of memory, DVD drive,
USB 2.0,
Microsoft® Windows XP or higher.

measure main program

You can always switch back and forth between the measurement window with your measurements and the measure main program for data evaluation. This means that you can simultaneously perform measurements and edit the measurement values of another measurement. You can:

- save and print the measurement values
- analyse measurements (peak analysis, etc.)
- offset two measurement curves against one another
- export data to, or import data from, other programs, e.g. Excel or Word, via the clipboard
- and much more

Try it. Download the trial version of the measure program for free from www.phywe.com.



Cobra4 **Wozu braucht man ein Netzteil bei Handy, Laptop & Co?** 4.4.1

Unter Wechselspannung versteht man eine Spannung, deren Polarität sich periodisch ändert. Das Stromnetz in Deutschland liefert eine sinusförmige Wechselspannung von 230 Volt mit einer Frequenz von 50 Hertz. Sehr viele Haushaltsgeräte, mit denen wir täglich arbeiten und umgehen, benötigen jedoch Gleichspannung zum Betrieb, von Laptop oder PC, über Handy-Ladegeräte, bis hin zu Halogen- oder LED-Lampen. Um die Wechselspannung in Gleichspannung umzuwandeln benötigt man einen Gleichrichter, der entweder direkt im Gerät integriert ist oder in einem externen Netzteil. In der Technik wird die Umwandlung von Wechsel- in Gleichspannung auch bei der Hochspannungs-Gleichstrom-Übertragung zum Stromtransport auf langen Strecken angewendet.

In diesem Versuch werden die Erzeugung von Wechselspannung und die Umwandlung in Gleichspannung mittels Gleichrichtung und Glättung nachvollzogen.

Material

1	Cobra4 Wireless-Manager	12600,00
1	Cobra4 Wireless-Link	12620,00
1	Cobra4-Netz-Strom / Spannung	12645,00
2	Strom 400 Watt	07520,01
1	Überspanner, gelackert	07530,00
1	Zenerdiode	07536,00
1	Leuchtdiode	07537,00
1	Magnet, ≈ 72 mm, stabförmig	07623,00
2	Leuchtdioden, 1-farbig, 5mm	08621,03
1	Leuchtdioden, gerade, 5mm	08621,01
1	Leuchtdioden, gerade mit Buchse	08621,11
1	Widerstand 1k Ω , 5W	08614,10
1	Stromzange THACO7, 20A	08619,00
1	Kondensator (ELN) 470 μ F, 50V	08648,47
1	Kondensator (ELN) 100 μ F, 50V	08648,10
1	Kondensator (ELN) 470 μ F, 50V	08648,47
1	Vermessungswertung = 50 ohm, rot	07261,01
1	Vermessungswertung = 25 ohm, rot	07261,04
1	Vermessungswertung = 25 ohm, rot	07260,01
1	Vermessungswertung = 25 ohm, blau	07360,04
1	Vermessungswertung = 10 ohm, gelb	07360,02
1	Software-Messung für Cobra4	14550,61

Zusätzlich wird benötigt:
PC mit USB-Controller, Windows XP oder höher

Abbildung 1: Versuchsaufbau

Loading experiments

Simply load the perfect settings for your experiments from an extensive digital library of Cobra4 experiments which can be downloaded free of charge from our website.

Apart from the correct settings, you will also find the associated PDF file with the experiment description and an example measurement

Keywords in the example experiments

The keywords that are associated with an experiment are always displayed together with the example experiments. Clicking a keyword opens a help text with detailed explanations. As a result, the experiments can be performed in a particularly easy, quick, and safe manner.

All of the experiment descriptions, configuration files, and example measurements are included FREE OF CHARGE on the measure Cobra4 DVD.

Didactic literature

experiment descriptions for students and teachers

An important part of Cobra4 is the extensive experiment literature (more than 200 experiments). There are highly detailed experiments for virtually any topic, including the experiment instructions, evaluation methods, and much more. They have been devised especially for demonstration (Demo) and student experiments (TESS).

Advantages:

- detailed set-up and evaluation description – school and university students (TESS) can work autonomously and independently
- experiments from all fields, including an extensive theoretical background – saves time for teachers and lecturers
- identical structure and layout of all of the experiment descriptions



5.3.2.1
Generation of an AC-voltage,rectification and smoothing

An alternating voltage is induced in a coil in the (alternating) field of a periodically moving magnet. The characteristic of a diode to allow electric current only to pass in one direction is used to rectify the induced alternating voltage. A capacitor that is switched in parallel to the load (resistance) smoothes the rectified alternating voltage.

Material		
1	Cobra4 Wireless Manager	12600.00
1	Cobra4 Wireless-Link	12644.00
1	Cobra4 Sensor-Unit Electricity, ± 6 A, ± 30 V	07829.01
2	Coil, 400 turns	07832.00
1	U-core	07837.00
1	Rotating stem	07833.00
1	Bearing plate	05601.03
1	Bar magnet, l = 73mm	05601.01
4	T-shaped connector module, SB	05601.11
1	Straight connector module with socket, SB	05614.10
4	Straight connector module, SB	05651.00
1	Resistor module 1 kOhm, SB	05645.47
1	Silicon-diode module 1N4207, SB	05646.47
1	Capacitor module 47 µF non-polar electrolytic, SB	07361.01
1	Capacitor module 100 µF non-polar electrolytic, SB	07361.04
1	Capacitor module 470 µF non-polar electrolytic, SB	07360.01
1	Connecting cord, 32 A, 500 mm, blue	07360.04
1	Connecting cord, 32 A, 250 mm, red	07359.02
1	Connecting cord, 32 A, 250 mm, blue	14550.81
1	Connecting cord, l = 10 cm, gelb	
1	Software Cobra4 - Single user and school licence	

Additional material

- 1 PC with USB port, Windows XP or higher

Equipment list for a quick overview of what is required

5.3.2.1
Generation of an AC-voltage,rectification and smoothing

Fig. 2: Measured data acquisition

Results and Evaluation

- The experimental set-up represents a simple alternating current generator in which mechanical energy (energy of rotation of the magnet) is converted to electrical energy. In other processes common in engineering, it is not the field-generating magnet that rotates but the induction coil, i.e. the magnet is at rest.
- The signal in Fig. 3 (top left) shows mainly a sinusoidal but the amplitude of the voltage, the amplitude of which decreases with time as the rotation of the magnet proceeds.
- The "waist" of the voltage on proceeding through the plane spreading of the poles of the magnetic pole. The moment when a magnetic pole is directly above the front face of the coil, as that is where the change in the magnetic field is at its maximum.
- When, apart from the load resistance, only the diode is in the circuit, only the positive half-cycles of the alternating voltage are allowed to pass. The signal form of the resulting voltage (Fig. 3, top right).
- With increasing capacity parallel to the load resistance, the relative ripple in the smoothed voltage (Fig. 3 below left and below right). Alternating voltage can be converted to direct voltage in this way.

Software screenshots to facilitate the use of the software

Picture showing an overview of the experiment set-up to ensure the easy execution of the experiment

Detailed evaluation with text, tables, and graphs

Topic-specific handbooks for all school subjects with suitable experiments





Basic Units

2.1	Cable Free - Wireless	14
2.2	Outdoors - Mobile	16
2.3	Fast or Easy Measurements - USB	18
2.4	Signal-Link	19
2.5	Digital Function Generator	20

2 Basic Units

2.1 Cable Free - Wireless

HOW do you want to measure? Wireless

Cobra4 | PHYWE

Cobra4 Wireless-Link



Function and Applications

Interface module for the radio-based transmission of sensor measuring values in conjunction with the Cobra4 wireless Manager.

Benefits

- All Cobra4 Sensor-Units can be quickly connected using a secure and reliable plug-in / lockable connection.
- All Cobra4 measuring sensors are easy to plug in and automatically detected.
- The radio network with the Cobra4 Wireless Manager is established automatically and is extremely stable, as it uses its own radio protocol.
- Up to 99 Cobra4 Wireless-Links can be connected to one Cobra4 Wireless Manager. No more cable mess, thanks to radio measuring.
- With radio transmission, moving sensors offer completely new experimentation options, e.g. the measurement of acceleration of a student on a bicycle etc. .
- The use of high performance batteries means that no external power supplies required.

Cobra4 Wireless is particularly suitable for:

- Computer aided student's experiments using only one teacher's computer (max. 99 sensors on one computer)
- Convenient experimentation without annoying cables
- Experiments with moving sensors, e.g. freefall acceleration etc.

Equipment and technical data

- Voltage supply: 2 x Mignon batteries; Power consumption: < 300 mA
- Radio output power: 1 mW; max. data rate (burst): 125.000 values/s; Range with no obstacles: 20 m; Dimensions L x B x H: 125 x 65 x 35 mm
- Weight: 200 g; 2 high performance 2,700 mAh batteries; Operating manual

12601-00

Cobra4 Wireless Manager



Function and Applications

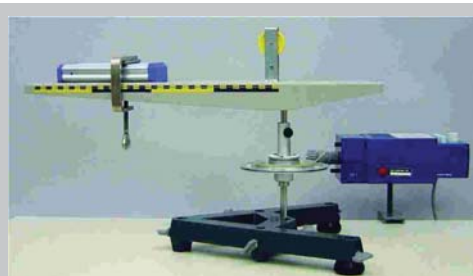
USB device for radio-based communication with the Cobra4 Wireless-Link.

Benefits

Simply connect the device to the computer's USB port.

12600-00

Centripetal acceleration with Cobra4



Principle

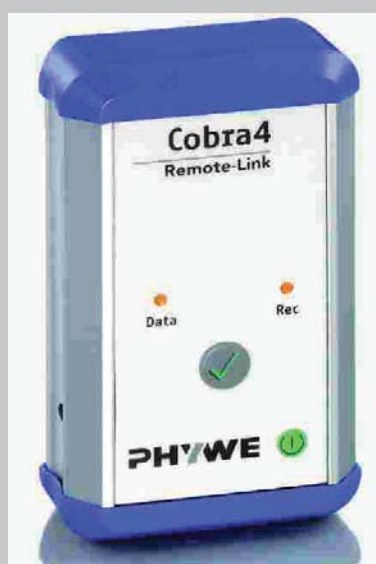
Two-dimensional movements make it apparent that force, acceleration and velocity are vectorial quantities. The movement of a body on a path is an important special case of such movement. In this case it is beneficial to look at the quantities in their components tangentially and radially to the circular path, since the amount of acceleration in the tangential direction determines the change in speed.

The amount of acceleration in radial direction - called centripetal acceleration - is responsible that the body does not move along a straight line, but that the direction of the velocity changes.

Since the acceleration measures three spatial directions at the same time, tangential and radial acceleration can be examined as well. Through the measurements of acceleration the dependencies on centripetal acceleration can be examined directly.

P6000560

Cobra4 Remote-Link



Function and Applications

The Cobra4 Remote-Link is used to control the measuring value recording of an experiment constructed using a radiobased Cobra4 network.

Benefits

- The measuring value recording start and stop command is transmitted by radio to the Cobra4 Wireless Manager on the PC.
- Optimum application, e.g. in student experiments, free fall with an acceleration sensor etc. .

Equipment and technical data

- Voltage supply: 2 x Mignon batteries
- Power consumption < 200 mA
- Radio output power: 1 mW
- Range with no obstacles: 20 m
- Dimensions L x B x H: 125 x 65 x 35 mm
- Weight: 200 g
- 2 high performance batteries
- Operating manual

12602-00



Free fall with air friction with Cobra4



Principle

The radio transmission between the acceleration sensor and the computer makes a simple, interferencefree analysis of movements possible, also over longer distances. This allows movement to be evaluated under the influence of air friction and therefore examination of the dependency of air friction force on speed.

The experiment on "weightlessness in free fall" could already show that the acceleration decreases during the fall. If you let an object fall long enough, the acceleration also nears zero and therefore falls at a constant speed. The principles of parachuting are based on this effect. However, air friction also plays a major role in other aspects of everyday life. Since the air friction force is dependent on the speed movements under the influence of air friction can only be solved numerically, for example, with the help of so-called model creation programs. Such a movement is recorded and evaluated. Through the measurement of acceleration.

P6000460

HOW do you want to measure?

Handheld with the Mobile-Link

Cobra4 Mobile-Link



Function and Applications

The Cobra4 Mobile-Link is a modern, high performance hand measuring device for mobile data recording to which all Cobra4 Sensor-Units can be connected via a secure plug-in/lockable connection.

Benefits

The Cobra4 Mobile-Link particularly stands out for the following features

- Up to 1,000 measuring values/sec
- Data can be saved on an SD memory card
- Automatic detection of all Cobra4 Sensor-Units
- Foolproof navigation with central navigation cross
- "measure" evaluation software can be used for FREE
- Water-resistant and reliable for outdoor work

The Cobra4 Mobile-Link is ideal for use in:

- Students experiments with no computer (as a digital multi-meter for numerous measuring parameters)
- Outdoor experiments with student groups
- Project days, trips, school hiking days etc.

Equipment and technical data

- Power supply: 2 x Mignon batteries
- Power consumption: < 300 mA
- Data storage: Max. 2 GB SD card
- Data rate: 1,000 values/s
- Dimensions: L x B x H: 155 x 65 x 35 mm
- Weight: 200 g
- Delivery incl. operating manual plus CD-ROM with drivers and demo version of the "measure Cobra4" measuring software incl. FREE evaluation software, experiments descriptions and configuration settings for experiments.
- Delivery without batteries and memory card.

12620-00

Changes of the light conditions in a deciduous forest



Principle

Why are there only a few different kinds of plants in a deciduous forest? Except for having trees that are all approximately of the same height, hardly any other plants grow in a deciduous forest, except for young plants of the same type of trees. This experiment shows how the light intensity in a mixed forest of oaks and beeches changes in the spring during the foliation of the trees. It also demonstrates the effects on the vegetation.

Literature for this experiment as follows:

TESS and Demo advanced Manual Cobra4 Physics, Chemistry, Biology, Everyday Science
01330-02 English

TESS advanced Applied Sciences manual Cobra4 environment and outdoors
12622-02 English

P1520762



Overview Cobra4 Mobile-Link

Cobra4 Mobile-Link set, incl. rechargeable batteries, SD memory card, USB cable and software "measure"
12620-55

Cobra4 Mobile-Link
12620-00

SD memory card for Cobra4-Mobile-Link, 2 GB, 20MB/sec
12620-01

SD card reader
12620-03

g-forces in the rollercoaster

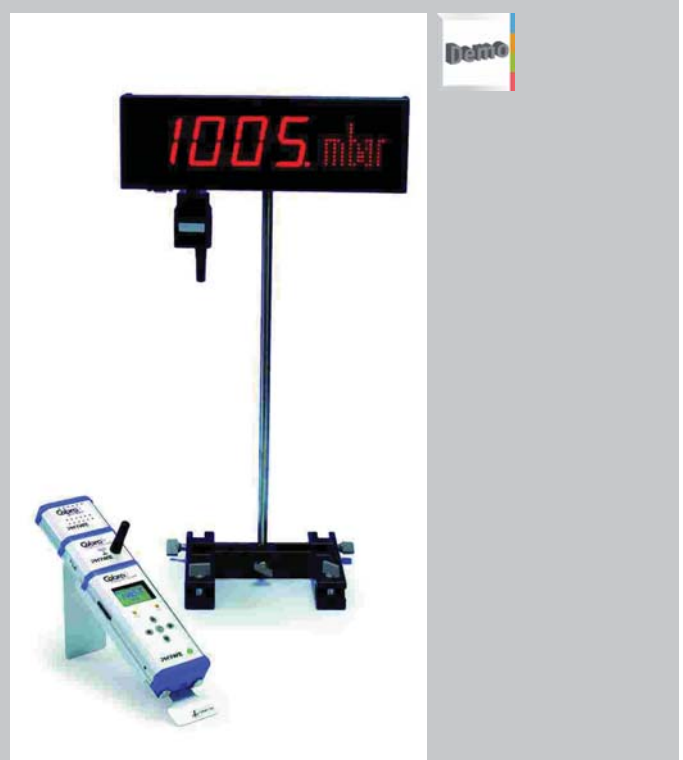


Principle

Riding a roller coaster is fun and thrilling. The appeal of such a ride lies in the applied acceleration, which we experience as the force pushing us in the seat or turning our stomach. The Cobra4 Mobile-Link is a device, which you can comfortably put into the pocket and take along on such a ride. The accelerations, i. e. the occurring g-forces, are analyzed first hand and associated with the course of the ride and the various sensations.

P1530660

Cobra4 Display-Connect



Function and Applications

Device combination from a sender and a receiver for the radio-based communication between a Cobra4 Mobile-Link and up to 2 digital large displays.

Benefits

- The system works with 5 switchable send channels at a carrier frequency of 433 MHz.
- With this set it is possible to represent the measured values well readable for a big auditory in a classroom or lecture hall.
- For this purpose, the transmitting unit is inserted between an any Cobra4 Sensor Unit and the Cobra4 Mobile-Link.
- The receiver unit is plugged into the input socket of the digital large display.
- The power supply of the sender and receiver: by the connected devices.
- A parallel write-out of a series of measurements to the SD-Card of the Mobile-Link is possible.

Cobra4 Display-Connect, Set of transmitter and receiver
12623-88

2 Basic Units

2.3 Fast or Easy Measurements - USB

HOW do you want to measure? With USB connection

Cobra4 | PHYWE

Cobra4 USB-Link



Function and Applications

The Cobra4 USB-Link is a highly efficient interface module for the transmission of sensor measuring values to a PC via a USB connection.

Benefits

- All Cobra4 Sensor-Units can be connected to the Cobra4 USB-Link using a stable plug-in / lockable connection.
- Up to 400,000 measuring values/sec.
- Several Cobra4 USB links can be connected to one PC (via USB ports on the PC or by USB hub).
- Automatic detection of all Cobra4 Sensor-Units.
- Power supply from USB connection, no additional external power supply required.

Ideally suitable for the following applications:

- Particularly fast measurements (acoustic, electrical etc.)
- Demonstration experiments
- Student's experiments (if one PC is available for each work group)

Equipment and technical data

- Power supply via PC: < 300 mA
- Max. data rate (burst): 400,000 values/sec
- Dimensions L x B x H: 125 x 65 x 35 mm
- Weight: 100 g
- Delivery incl. USB cable
- Operating manual and CD-ROM with drivers and demover-sion of the "measure Cobra4" measuring software
- Incl. FREE evaluation software, experiments descriptions and configuration settings for experiments

12610-00

Cobra4 Junior-Link



Function and Applications

Interface module to capture data at the students workstations. The Cobra4 Junior-Link offers an easy and cost-effective lead-in to record measurement data.

Benefits

- Compatible with all the sensors of the Cobra4 product range
- Transfer of sensor data to the PC via a USB port
- Easy handling without any superfluous extras - exact one Junior-Link can be connected to one PC
- The high data rate of 10 kHz enables all of the common applications in student experiments in physics, chemistry and biology

Equipment and technical data

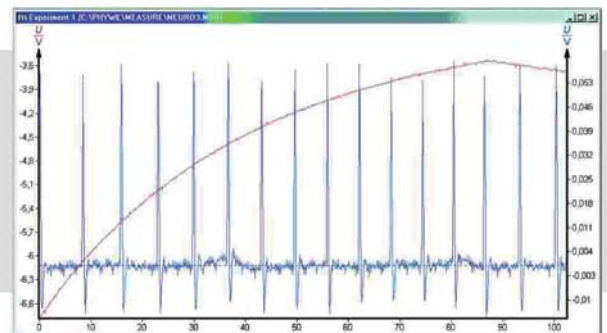
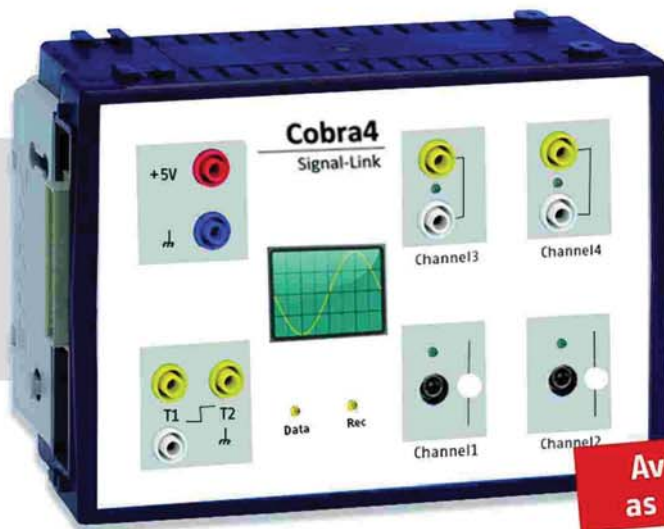
- Power supply via the USB port of the PC
- Current consumption: < 300 mA
- Max. data rate: 10 kHz
- Dimensions L x B x H: 125 x 65 x 35 mm
- Weight: 100 g
- Including a USB cable, operating instructions and a demo version of the "measure Cobra4" software

12615-00

Signal-Link – precise and quick



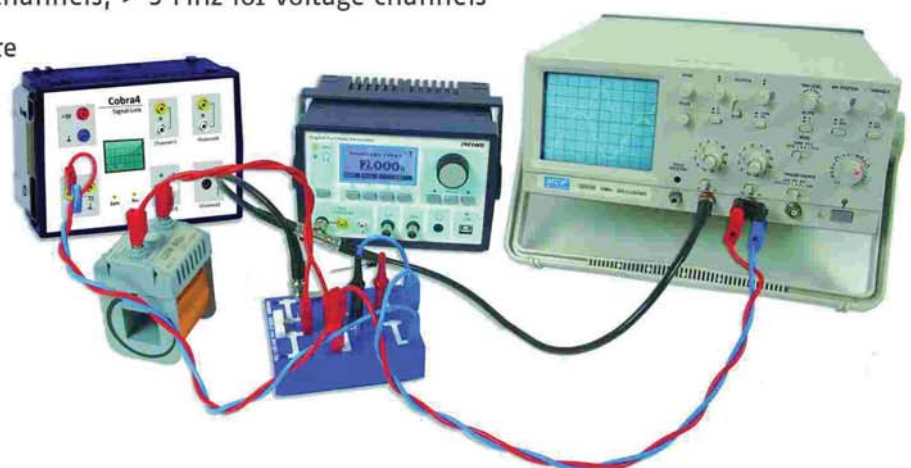
The Signal-Link is a highly precise USB interface. As such, it is particularly suitable for high data rates.



Available
as of 2013

Features

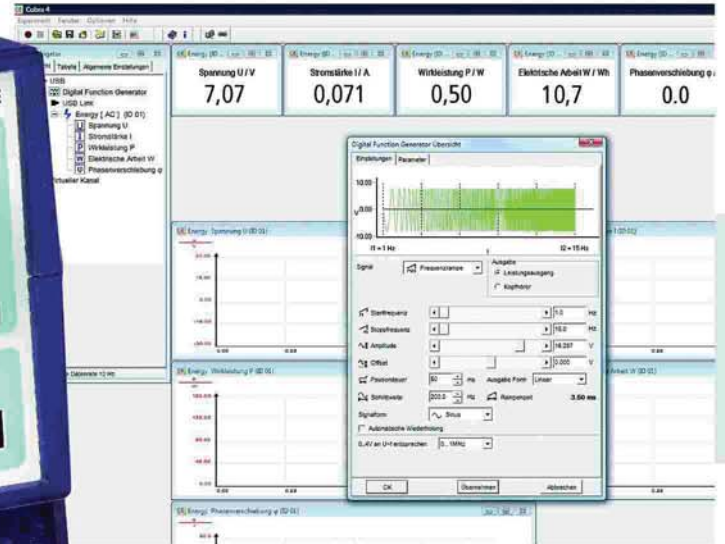
- combined sensor and USB interface: for the direct connection to a USB port
- 4 channels (2x current, 2x voltage), electrically isolated
- true RMS converter for all channels
- high resolution: up to 5 microvolts and 1 microampere
- scanning rate: > 1 MHz for current channels, > 5 MHz for voltage channels
- pretrigger and RAM memory for more than 1 million data points
- separate voltage output 5 V+, 50 mA
- can be used as a recorder or USB oscilloscope in a free combination with other devices of the Cobra4 range of products



Digital function generator –
universal and intuitive

Cobra4
compatible

NEW



Features

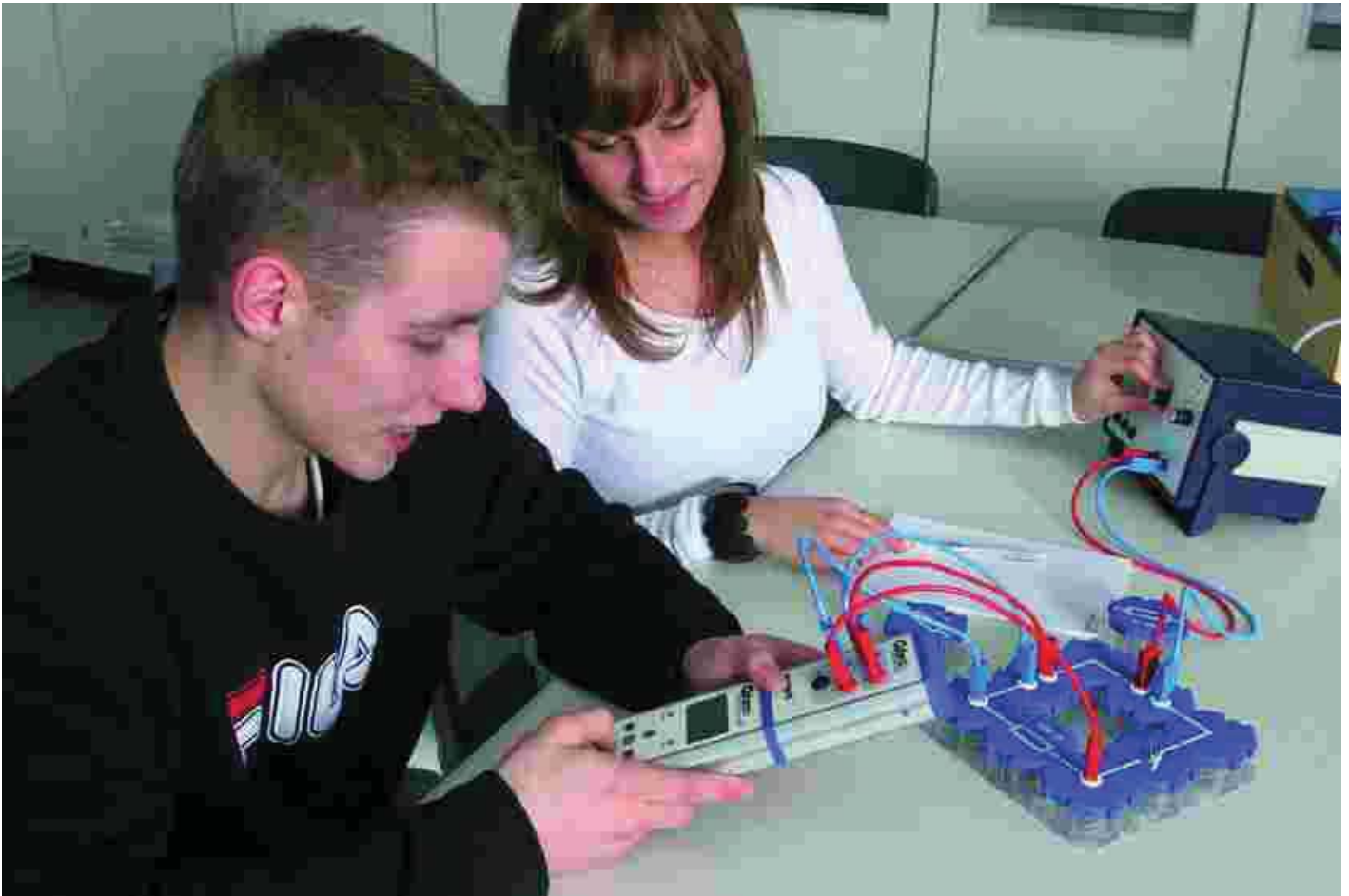
- Universal, programmable voltage source with a bandwidth of 1 MHz and an output current of 1 A
- Can be used with Cobra4 or as a stand-alone device
- Intuitive operation via function keys and a rotary control knob
- Illuminated display for optimum visibility
- Low distortion factor and high signal-to-noise ratio for brilliant signals (acoustics/hearing)
- $U = U(f)$ output for a particularly easy pick-up of the frequency – ideal for analysing circuits with frequency ramps
- Part of more than 25 TESS experiments



Faraday effect (P2260106)



Chladni's figures (P2150702)



Physics

3.1	Experiments and Sensor-Units Physics	22
3.1.1	Motion	24
3.1.2	Force, Mass	26
3.1.3	Pressure	27
3.1.4	Electricity, Charge	28
3.1.5	Temperature	31
3.1.6	Light	33
3.1.7	Sound	34
3.1.8	Radioactivity	35
3.1.9	Magnetism	36
3.2	Sets and Literature Physics	37

3 Physics

3.1 Experiments and Sensor-Units Physics

Find Cobra4 Sensors According to your curriculum

Curriculum	Sensors / Sets																	
	Motion (12649-00)	Acceleration (12650-00)	Timer Counter (12651-00)	Force, Force plate (12661-00)	Pressure (12647-00)	Thermodynamics (12638-00)	Energy (12656-00)	Electricity (12644-00)	Digital Function Generator (13654-00)	Temperature (12643-00)	Sound Level (12669-00)	Photodetector (07937-00) + 30 Electricity (12644-00)	Radioactivity (12665-00)	Tesla (12652-88)	Cobra4 Junior-Link Set, Physics (12616-89)	Cobra4 Basic-Set Physics (12604-89)	Physik Set linear motion (12651-88)	Cobra4 Extension Set for TESS (12604-88)
INTRODUCTION TO PHYSICS																		
Light												✓						
Electric current and magnets							✓	✓						✓	✓	✓		
Motion	✓	✓	✓												✓	✓	✓	
Heat						✓				✓					✓	✓		✓
GENERAL PHYSICS																		
Measurement techniques	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
NEWTONIAN MECHANICS																		
Kinematics	✓	✓	✓												✓	✓	✓	
Dynamics	✓	✓	✓												✓	✓	✓	
Forces			✓	✓											✓	✓		✓
Work, energy, power							✓								✓			
Physics of fluids					✓	✓									✓			
Gravitational field		✓														✓		
MATTER																		
Phases of matter						✓				✓					✓	✓		✓
Deformation of solids				✓											✓	✓		✓
Ideal gases					✓	✓									✓			
Temperature						✓				✓					✓	✓		✓
Thermal properties of materials						✓									✓	✓		✓
OSCILLATIONS AND WAVES																		
Oscillations			✓						✓									✓
Light propagation, colours												✓						
Waves			✓						✓									✓
Superposition			✓						✓									✓
Sound			✓				✓		✓		✓							
ELECTRICITY AND MAGNETISM																		
Electric fields							✓	✓							✓	✓		✓
Current of electricity							✓	✓							✓	✓		✓
D.C. circuits							✓	✓							✓	✓		✓
Magnetic fields														✓				
Electromagnetism							✓	✓						✓	✓	✓		✓
Electromagnetic induction							✓	✓						✓	✓	✓		✓
Alternating currents							✓	✓	✓						✓	✓		✓
Electric motors / generators							✓	✓							✓			✓
Introductory electronics							✓	✓							✓	✓		✓
Capacitance							✓	✓							✓	✓		✓
Electronic systems							✓	✓							✓	✓		✓
MODERN PHYSICS																		
Quantum physics													✓					
Nuclear physics												✓						
ENERGY: CONVERSION, STORAGE & SUSTAINABLE USE																		
Energy from ambient heat							✓								✓			
Heat and electrical energy from solar energy							✓			✓					✓			
Wind energy and hydro power							✓								✓			
Hydrogen technology							✓								✓			
Energy conversion and storage							✓								✓			

*+ microphone 03543-00 or 03542-00

Physics with Cobra4

more than 50 Experiments

NEWTONIAN MECHANICS	
Kinematics	
Uniformly accelerated motion on an inclined plane	P1198860
Uniformly accelerated motion	P6000260
Uniformly accelerated motion caused by an accelerating mass	P6000360
Dynamics	
Newton's law with Cobra4 and Timer-Counter sense	P1351360
Impulse and momentum / demonstration track	P6000860
Conservation of momentum during central elastic collision	P1199560
Centripetal acceleration	P1199660
Centripetal force	P6000560
Forces	
Weight	P0999060
Bending of a leaf spring	P0999260
Friction	P1000360
Dynamic friction	P6000060
Rolling friction	P6000160
Work, Energy, Power	
Electrical power and work	P1373360
See chapter renewable energy in Applied Sciences	
Physics of Fluids	
Floating and sinking	P1424560
Evaporation	P1297260
Properties of the atmospheric pressure	P1500460
Gravitational Field	
Free fall with air friction	P6000460
Free Fall: determination of the acceleration of earth	P6000760
Zero gravity during free fall	P1500160
MATTER	
Phases of Matter	
Melting and freezing curve of sodium thiosulphate	P1044660
Evaporation	P1045160
Specific evaporation heat of water	P1349260
Cooling by evacuation	P1500060
Deformation of Solids	
Bending of a leaf spring	P0999260
Ideal Gases	
Charles' law	P1350060
Amontons law	P1350160
Boyle's law	P1350260
Temperature	
Thermal equilibrium	P1042260
Thermal insulation	P1043660
Thermal Properties of Materials	
Heating of water	P1043760
Heating of various liquids	P1043860
Specific heat capacity of water	P1043960
Temperature of mixtures and heat capacity of the calorimeter	P1044160
Specific heat capacity of metals	P1044260
Calorimetric temperature measurement	P1044360
Conversion of mechanical energy into internal energy	P1044460
Specific heat capacity of water	P1349160
Specific heat capacity of liquids	P1349360
OSCILLATIONS AND WAVES	
Oscillations	
Helical spring pendulum	P1002760
Frequency of a spring pendulum (on the magnetic board)	P1500260
Acceleration of a spring pendulum	P1500560
Dependence of the frequency of a spring pendulum	P1500360

OSCILLATIONS AND WAVES	
Parallel and series connection of helical springs	P1337860
Coupled pendula on the magnetic board	P0515760
Light propagation, colours	
Coming soon with SU Colorimetry	12634-00
Sound	
Coming soon with SU Sound Level	12669-00
ELECTRICITY AND MAGNETISM	
Electric Fields	
Charging and discharging a capacitor	P1373560
Switch-on behaviour of a capacitance	P1331060
Current of Electricity	
Ohm's law	P1330360
Current and resistance in a parallel connection	P1372860
Current and resistance in a series connection	P1372960
Resistance of wires - dependence on the length and cross-section	P1372560
The potentiometer	P1373160
D.C. Circuits	
Generation of an alternating voltage, rectification and smoothing	P1331360
Magnetic Fields / Electromagnetism / Electromagnetic Induction	
Definition of the magnetic flux density	P1219460
Self-induction	P1500860
Magnetic induction	P2440260
Alternating Currents	
Generation of an alternating voltage, rectification and smoothing	P1331360
Capacitor in the alternating current circuit	P6007060
A coil in an alternating current circuit	P6007160
RC high-pass filter	P1501160
RC low-pass filter	P1501260
Resonant circuit	P1501360
Parallel resonant circuit	P1501460
Series resonant circuit	P1501560
Electric Motors / Generators	
The permanent magnet DC motor	P1376260
The series motor	P1376360
Introductory Electronics / Electronic Systems	
Warm-up time of an energy-saving lamp	P1520160
Inrush current of a light bulb	P1330860
Bridge rectifiers	P1378360
Diodes as electrical valves	P1373760
Diodes as rectifiers	P1373860
MODERN PHYSICS	
Quantum Physics / Nuclear Physics	
Law of distance	P6020160
Determination of count rates	P6020060
ENERGY	
Conversion, Storage & sustainable use	
See chapter Applied Sciences	

Sensor-Units



WHAT do you want to measure?

Cobra4 Sensor-Unit Motion, Ultrasound Motion Detector



Function and Applications

The Cobra4 Sensor-Unit motion measures path, velocity and acceleration of an object moving in one dimension, e.g. a cart on a demonstration track. The measurement is performed via an ultrasound sensor.

Benefits

- Contact-free measurement of path, velocity and acceleration
- Direct display and calculation of the measured values
- The movement of different objects can be analyzed, e.g. carts on a demonstration track, students in the classroom, bouncing balls etc.

Equipment and technical data

- The Sensor-unit has 2 measurement modes:

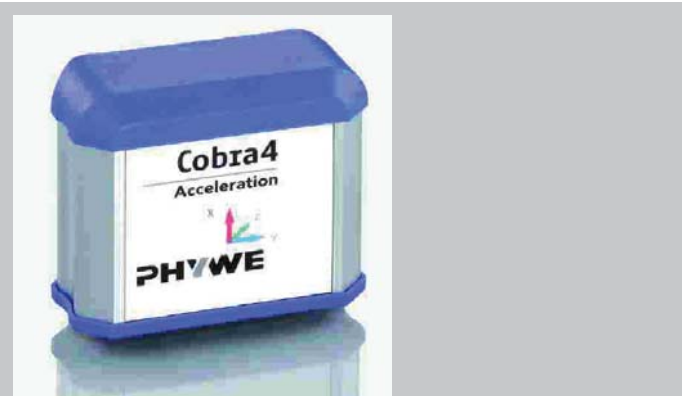
Distance 0,25 ... 10 m
Velocity ± 10 m/s
Acceleration ± 100 m/s²
Maximum data rate 10 Hz
Resolution (distance) 5 mm

Distance 0,15 ... 2 m
Velocity ± 10 m/s
Acceleration ± 100 m/s²
Maximum data rate 50 Hz
Resolution (distance) 1 mm

- Weight: app. 120 g
Dimensions: app. 70 x 114 x 32 mm

12649-00

Cobra4 Sensor-Unit 3D-Acceleration, ± 2 g, ± 6 g



Function and Applications

With the Sensor-Unit 3D-Acceleration, ± 2 g, ± 6 g you can measure the acceleration in your experiment in three dimensions simultaneously. Explore acceleration in everyday life situations such as driving in a car or even in a rollercoaster.

Benefits

- Specifically with this sensor, the use of Cobra4 Wireless enables completely new experimentation possibilities.
- As such, it is possible to investigate e.g. the acceleration of the sensor in free fall or the acceleration of a schoolchild on a bicycle etc..

Equipment and technical data

- Measuring ranges: $-2g...+2g$ or $-6g...+6g$
- Resolution: 1 mg or 5 mg
- Presentable channels: x, y and z
- Max. data rate: 160 Hz per channel
- Weight: 80 g

12650-00



Cobra4 Sensor-Unit Timer/Counter



Function and Application

Sensor-Unit of the Cobra4 family. Interface-module with timer and counter functionality for up to four light barriers, one measuring microphone, movement sensor, falling sphere apparatus or other devices with TTL compatible signals. Optionally an external trigger device can be used (switch, starter system for motion track, ...). All Cobra4 sensor-units are quickly connectable through a secure and reliable plug-in / lockable connection.

Some applications:

- linear Motion incl. laws of collision with motion and air track
- free fall with picket fences or falling ball apparatus
- oscillations
- rotational motion
- frequency of acoustical signals

Benefits

- With the aid of the intuitive software measure for Cobra4 the single application scenarios can be started comfortably with 10 preset modes
- All relevant attempts with time measurement and counting are covered
- The simultaneous observation of the signal level facilitates the understanding of the measured values of light barriers
- Investigation of complex contexts through combination with other sensors from the Cobra4 family

Equipment and technical data

- Power supply: by the Cobra4 Wireless-Link or another Cobra4 basic device, from 3 light barriers with enclosed external power supply
- Current consumption: < 300 mA
- Resolution: 1 μ s
- Dimensions: (L x B x H) 125 x 65 x 35 mm
- Weight: 200 g
- Accessories (included): adapter for light barriers, external power supply

Accessories

- Light barrier, compact (up to 4 lightbarriers), 11207-20
- Cobra4 adapter for Sensor-Unit Timer/Counter to connect a light barrier, 12651-01
- Measuring microphone, 03542-00
- Movement sensor with cable, 12044-10

12651-00

Accessories for Cobra4 Sensor-Unit Timer/Counter



Function and Applications

Universal fork-type light barrier to measure short and long shadowing periods.

Benefits

- An incremental wheel with a string groove which can be attached to the fork of the light barrier allows to measure paths by counting the ribs of the incremental wheel.
- Areas of application: track experiments, free fall, pendulum experiments, leaf spring oscillations, drop counters, volumetric measurements concerning the gas laws.

Equipment and technical data

- Dimensions: 40 x 40 mm
- Supply voltage: 5 V

Light barrier, compact 11207-20

Cobra4 adapter for Sensor-Unit Timer/Counter to connect one light barrier 12651-01

Movement sensor with cable 12004-10

3.1 Experiments and Sensor-Units Physics

3.1.2 Force, Mass

Cobra4 Sensor-Unit Force ± 4 N and ± 40 N



Function and Applications

The Cobra4 Sensor-Unit Force ± 4 N and ± 40 N contains a bending beam (DMS technology), which converts the mechanical load into an electrical signal.

Benefits

- On the bottom of the device, there is a hook on which weights may be hung.
- The Cobra4 Sensor-Unit Force can be mechanically fixed using a drop rod.

Equipment and technical data

- 100 mm rod with M6 thread
- weight plate, weight hook
- operating manual
- Measuring range: $-4...+4$ N ($-40...+40$ N Sensor-Unit Force ± 40 N)
- Maximum sampling rate: 16 Hz
- Measuring accuracy: 0.2 mN (2mN Sensor Unit Force ± 40 N)
- Dimensions (L x B x H): 64 x 70 x 35 mm
- Weight: 100 g

Cobra4 Sensor-Unit Force ± 4 N
12642-00

Cobra4 Sensor-Unit Force ± 40 N
12643-00

How can ships made of steel float on water?



Principle

Everyone has at one time or another wondered how comes that ships made of steel can float on water but a steel ball simply sinks. Expanded bodies have the property of having less weight in water than in air, as one notices when one swims, for example. In this experiment, buoyancy and hydrostatic pressure are dealt with using Archimedes' principle to find out what determines whether a body will sink or swim.

Literature for this experiment as follows:

TESS and Demo advanced manual Cobra4 Physics, Chemistry, Biology, Everyday Science
01330-02 English

P1530460

Cobra4 Sensor-Unit Forceplate



COMING - SOON:

Cobra4 Sensor-Unit Forceplate

Article-Nr.: 12661-00

Cobra4 Sensor-Unit Pressure, 7 bar absolute



Function and Applications

The Cobra4 Sensor-Unit Pressure is a measuring recorder for pressure measurements, which is controlled by micro-controller.

Benefits

With the sturdy metal connector (outer diameter: 8 mm) the pressure sensor can be connected to all kinds of devices and instruments via a suitable connection tube.

Equipment and technical data

Pressure:

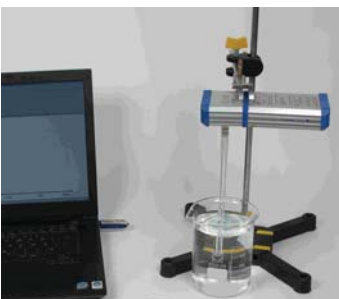
- Measuring range 1: 0...2000 hPa @ Resolution 0.1 hPa
- Measuring range 2: 0...7000 hPa @ Resolution 0.3 hPa
- Overall accuracy: $\pm 2.5\%$

General:

- Data flow rate: max. 200 Hz
- Dimensions: approx. 62mm x 63mm x 35mm
- Weight: approx. 120 g

12647-00

Hydrostatic pressure with Cobra4



P1001860

Cobra4 Sensor-Unit Thermodynamics, pressure abs. 2 bar and 2 temperature NiCr-Ni



Function and Applications

The Cobra4 Sensor-Unit Thermodynamics is a measuring recorder for pressure and temperature measurements, which is controlled by micro-controller.

Benefits

- It can be fitted with two NiCr-Ni thermoelements (type K), in order to measure up to two temperatures and one absolute pressure value simultaneously. With the sturdy metal connector (outer diameter: 8 mm) the sensor can be connected to all kinds of devices and instruments via a suitable connection tube.
- A high resolution of the pressure sensor enables precise measurements.

Equipment and technical data

Temperature:

- Measuring range: $-200..+1200^{\circ}\text{C}$
- Resolution: 0.1 K
- Measuring accuracy: equal to the accuracy of the gauges used

Pressure:

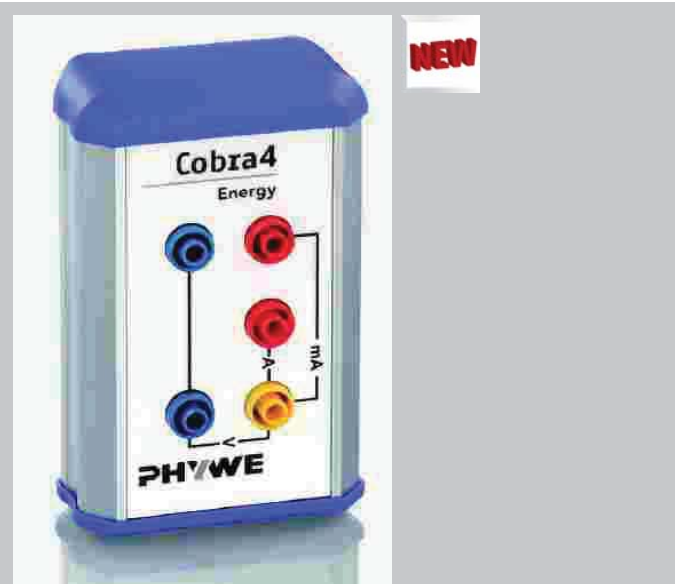
- Measuring range: 0...2000 hPa
- Resolution 0.1 hPa
- Measuring accuracy: $\pm 0,5\%$
- Data flow rate: max. 5 Hz
- Dimensions: approx. 62mm x 63mm x 35mm
- Weight: approx. 190 g

12638-00

3.1 Experiments and Sensor-Units Physics

3.1.4 Electricity, Charge

Cobra4 Sensor-Unit Energy current, voltage, power, energy



Function and Applications

The Cobra4 Sensor Unit Energy is used for the measurement and direct indication of measurement variables of the electrical power and energy in direct-current and alternating current circuits (current, voltage, effective and apparent power, angular phase shift, frequency, electric work).

Benefits

This sensor measures directly the values for alternating current and direct-current. This allows numerous basic as well as application-oriented experiments, e.g. the determination of the characteristics of alternating current resistances or the investigation of the energy demand of consumers.

Equipment and technical data

- Operating modes:
 - "u(t), i(t)": instantaneous values, max. sample rate 2000 Hz
 - "Energy DC": direct current circuit, max. measuring rate 4 Hz
 - "Energy AC": alternating current circuit, max. measuring rate 4 Hz, up to 6000 Hz signal frequency, trueRMS
- Voltage:
 - Range 30 V: -30...30 V, resolution: 0,01 V, internal resistance: > 5 MΩ
 - Range 1000 mV: -1000...1000 mV, resolution: 0,1 mV, internal resistance: > 200 kΩ
 - Accuracy: 1,5 % of upper range value
 - Damping: +/- 2 dB (at 6000 Hz)
 - Overvoltage protection: up to 50 V
- Current:

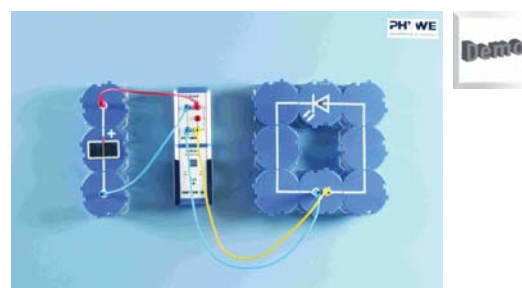
- Range 6 A: -6...6 A (6 A for 3 min until overcurrent protection is active), resolution: 0.001 A, internal resistance: 33 mΩ, overcurrent protection: max. 10 A self reset after approx. 5 min
- Range 600 mA: -600...600 mA, resolution: 0.1 mA, internal resistance: 2 Ω, overcurrent protection: max. 2 A self reset after approx. 5 min
- Accuracy: 1.5 % of upper range value
- Damping: +/- 2 dB (at 6000 Hz)
- Active power: 0... max. 180 W, max. resolution 0.01 mW
- Apparent power: 0... max. 180 VA, max. resolution 0.01 mVA
- Reactive power: 0... max. 180 var, max. resolution 0.01 mvar
- Electrical work: 0... max. 100000 Wh, max. resolution 0.1 Ws
- Phase shift: -90...90°, resolution: 0.1°
- Frequency: 10...6000 Hz, resolution: 0.1 Hz (< 1000 Hz), 1 Hz (> 1000 Hz)
- Operating temperature range: 5...40° C
- Relative humidity: < 80%
- Current consumption: 100 mA
- Dimensions L x W x H (mm): 110 x 70 x 30
- Weight: 110 g

Necessary Accessories

- Basic device:
Cobra4 Wireless-Link 12601-00, and Wireless Manager 12600-00 and Software measure Cobra4 14550-61
or Cobra4 USB-Link 12610-00 and Software measure Cobra4 14550-61
or Cobra4 Mobile-Link 12620-55

12656-00

Operate a LED with solar power ENT 2.3



P9502360

Cobra4 Sensor-Unit Electricity, Current ± 6 A / Voltage ± 30 V



Function and Applications

The Cobra4 Sensor-Unit Electricity is a secured measuring sensor, which can be connected to the Cobra4 Wireless-Link, the Cobra4 Mobile-Link or the Cobra4 USB-Link using a secure and reliable plug-in / lockable connection.

Benefits

- The sensor has a voltage difference input.
- Simultaneous measurement of current and voltage is possible.

Equipment and technical data

Measuring range:

- Voltage: $-30 \dots 30$ V
- Current: $-6 \dots 6$ A

Resolution:

- Voltage: 15 mV
- Current: 3 mA

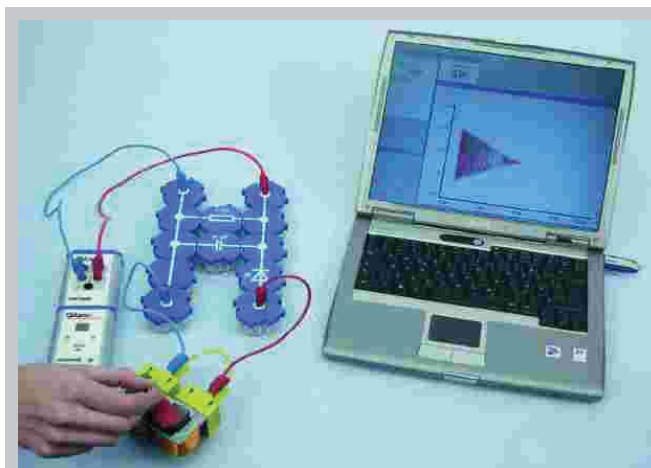
Internal resistances:

- Voltage: 1 M Ω
- Current: 33 m Ω
- Weight: 100 g

12644-00



Why do mobile phones or laptops need a charger/adapter?



Principle

In this experiment, the generation of alternating voltage and the conversion of it to direct voltage by means of rectifying and smoothing are presented.

An alternating voltage changes polarity periodically. The electricity network supplies a sinusoidal alternating voltage (in Germany: 230 Volt with a frequency of 50 Hertz). Many household devices that we daily use and handle need a direct voltage for their operation, however. Examples of these reach from Laptops und PCs to mobilephone chargers and on to halogen and LED lamps. A rectifier is needed to convert the alternating voltage to direct voltage. It can be directly built in the device or in an external power supply. In engineering, the conversion of alternating to direct voltage is also used for high voltage direct current conveyance in the transport of electricity over long stretches.

Literature for this experiment as follows:

TESS and Demo advanced Manual Cobra4 Physics, Chemistry, Biology, Everyday Science
01330-02 English

P1530360

3.1 Experiments and Sensor-Units Physics

3.1.4 Electricity, Charge

Digital Function Generator, USB, incl. Cobra4 Software



Function and Applications

Digital signal generator for use as a programmable voltage source in practical or demonstration experiments, particularly in the disciplines of acoustics, electrical engineering and electronics

Benefits

- Can be used as universal stand-alone device or controlled via a USB interface
- Universally applicable thanks to broad, continually adjustable frequency range
- Usable as programmable voltage source via amplifier output
- Intuitive, menu-driven operation using control knob and function buttons, with help capability
- Illuminated monochrome graphic display for maximum visibility and readability
- Simple setting of voltage and frequency ramps in stand-alone mode
- Features $V = f(f)$ output for easy reading of frequency in the form of a voltage - ideal for measuring circuit response to frequency ramps using an oscilloscope
- Low distortion and signal-to-noise ratio for brilliantly clear signals - ideal for acoustics/audio experiments

Equipment and technical data

- Frequency range: 0.1 Hz...1 Mhz
- Steps: 0.1 Hz
- Distortion factor: <0.5%
- Signal forms: Sine, triangle, square, frequency ramp, voltage ramp
- Amplifier output, short-circuit-proof, via BNC and 4-mm connectors:
 - Output voltage: 0 ... 20 Vpp for $R_{out} > 40 \Omega$
 - DC offset: ± 10 V (steps 5 mV)
 - Power output: 5 W (for up to 1 A) where $R_{out} = 20 \Omega$
- Headphone output via 3.5 mm jack socket:
 - Switch for selecting standard headphones or speakers
 - Output voltage: 0 ... 1 Vpp for $R_{out} = 400 \Omega$
- Sync (trigger) output via BNC:
 - Output resistance: 50 Ω

- Logic level: CMOS (5 V)
- $V=f(f)$ output via BNC, short-circuit-proof:
 - For outputting frequency in the form of a proportional voltage 0 ... 10 V (0...1 MHz)
- Sweep function for frequency ramp
- Monochrome graphic display with continuous setting for background illumination: 128 x 64 pixels
- USB 2.0 port
- Settings via buttons and knob or software-assisted via USB
- Power supply 100 V~ - 240 V~ at 50/60 Hz
- Impact-resistant plastic case with carrying handle
- Dimensions (mm): 194 x 140 x 130
- incl. software

13654-99

Electrometer Amplifier



Function and Applications

Operational amplifier with high resistance input for quasi-static voltage measurement respectively charge measurement in fail-safe plastic housing.

Benefits

- Suited for experiments with electrostatics e.g. charge measurement, capacity measurement of sphere-capacitor, measurement of direct voltages, quasistatic measurements and measurement of small currents.

Electrometer Amplifier
13621-00

Power supply 12V AC/500 mA
11074-93

Cobra4 Sensor-Unit Temperature, semiconductor -20...110 °C



Function and Applications

Semiconductor sensor to measure temperature in the range of -20...110° C.

Benefits

- Can be connected directly to the Cobra4 Wireless-Link, the Cobra4 Mobile-Link or the Cobra4 USB-Link.

Equipment and technical data

- Sensor jacket: stainless steel; Measuring range: -20...+110° C
- Absolute accuracy: $\pm 0.5^\circ$ C; Resolution: 0.05° C; Time constant: 7 s
- Data flow rate: 200 Hz; Connecting port: sub-D-15-pole; Sensor length / diameter: 200 mm, 6 mm; Cable length: 120 cm; Weight: 125 g

12640-00

Melting and freezing curve of sodium thiosulphate



Principle

How does a temperature curve express the change of state of a substance that occurs when it is heated or cooled?

P1044660

Cobra4 Sensor-Unit 2 x Temperature, NiCr-Ni



Function and Applications

The Cobra4 Sensor-Unit 2 x Temperature NiCr-Ni is a temperature probe, which is controlled by a micro-controller.

Benefits

- It can be fitted with two NiCr-Ni thermoelements (type K), in order to measure up to two temperatures simultaneously or to measure a temperature difference.

Equipment and technical data

- Temperature measuring range: -200..+1200 °C
- Resolution: 0.1 K
- Measuring accuracy: equal to the accuracy of the gauges used
- Data flow rate: 5 Hz
- Dimensions: approx. 62 mm x 63 mm
- Weight: 85 g

Accessories

For the measurement of temperature the following accessories are needed:

Thermocouple NiCr-Ni -40...+500° C single type, 13615-02
 or Thermocouple NiCr-Ni -50...+1100° C microsheath, 13615-01
 or Immersion probe NiCr-Ni -50...+1000° C stainless steel, 13615-03
 or Immersion probe NiCr-Ni -50...+300° C Teflon, 13615-05
 or Surface probe NiCr-Ni up to +1000° C stainless steel, 13615-04

12641-00

3.1 Experiments and Sensor-Units Physics

3.1.5 Temperature

Further sensors for temperature measuring

Cobra4 Sensor-Unit Chemistry, pH and 2 x Temperature NiCr-Ni
12630-00

Cobra4 Sensor-Unit Thermodynamics, pressure abs. 2 bar and 2 temperature NiCr-Ni
12638-00

Cobra4 Sensor-Unit Weather: Humidity, Air pressure, Temperature, Light intensity, Altitude
12670-00

Thermoelemente NiCr-Ni (Typ K)



Different NiCr-Ni-Thermocouple with standard type-K 2-pin flat plug which makes no contribution to the thermovoltage. All of these thermoelements can be connected with the Cobra4 Sensor-Units 2x Temperature, Thermodynamics and Chemistry.

Thermocouple NiCr-Ni, sheathed
13615-01

Immersion probe NiCr-Ni, steel, -50...400° C
13615-03

Surface probe NiCr-Ni
13615-04

Immersion probe NiCr-Ni, teflon, 200° C
13615-05

Thermocouple NiCr-Ni, -50...500° C
13615-02

Specific heat capacity of water



Principle

In households, a great amount of energy is used to heat up water - for showers, for washing clothes, for cooking. Exactly how much is necessary for each degree that each millilitre of water is warmed up? How are amount of heat, heat capacity and change in temperature related?

Literature for this experiment as follows:

TESS and Demo advanced Manual Cobra4 Physics, Chemistry, Biology, Everyday Science
01330-02 English

TESS advanced Physics manual Cobra4 Mechanics, Heat, Electricity/ Electronics
01332-02 English

P1043960

Conversion of thermal energy into electrical energy and motion



Principle

The thermogenerator (or thermoelectric generator) consists of a block with numerous thermocouples. These thermocouples are electrically connected in series and thermally in parallel so that their thermoelectric voltages are added.

Literature for this experiment as follows:

Demo advanced Applied Sciences Manual Renewable Energy on the magnetic board, incl CD ROM, second edition
01157-02 English

P9501260

Measuring of the light intensity with a Photodetector and Control Unit



The Cobra4 Sensor-Unit Electricity connected with a photodetector and a control unit can be used for measuring the light intensity. The current is directly proportional to the intensity of incident light.

Cobra4 Sensor-Unit Electricity, current ± 6 A / voltage ± 30 V
12644-00

Si-Photodetector with Amplifier
08735-00

Control Unit for Si-Photodetector
08735-99

Adapter, BNC-plug/socket 4 mm
07542-26

Connecting cord, 32 A, 500 mm, black
07361-05

Measuring of light intensity with photoelement



The Cobra4 Sensor-Unit Electricity connected with a photodetector and an amplifier can be used for measuring the light intensity. The current is directly proportional to the intensity of incident light.

Cobra4 Sensor-Unit Electricity, Current ± 6 A / Voltage ± 30 V
12644-00

Photocell, silicon
07937-00

Photoelement for optical base plate
08734-00

Universal measuring amplifier
13626-93

Cobra4 Sensor-Unit Sound



COMING SOON

Cobra4 Sensor-Unit Sound, Sound level

Measure the sound level of various noise sources in dB(A) such to determine the noise impact.

Article-Nr. 12669-00

Measuring the sound frequency



The frequency of a tone can be measured directly by connecting a measuring microphone of the Sensor Unit Timer / Counter.

Measuring microphone 03542-00

Cobra4 Sensor-Unit Timer/Counter
12651-00

Measuring the sound signal



For measuring the sound signal a measuring microphone can be connected with the Sensor-Unit Energy. From the course of the measured voltage e.g. the frequency of the sound wave can be determined.

Cobra4 Sensor-Unit Energy current, voltage, power, energy 12656-00

Measuring microphone with amplifier
03543-00



Cobra4 Sensor-Unit Radioactivity



Function and Applications

The Cobra4 Sensor-Unit Radioactivity allows the measurement of radioactive radiation (alpha, beta and gamma) with the aid of a Geiger-Mueller counter tube. The Sensor-Unit also supplies the counter tube with the necessary supply voltage and is controlled by a micro-controller.

Benefits

- It can be fitted with 3 different counter tubes
- Variable counter voltage to investigate the characteristics of the counter tube
- Integrated speaker for acoustic signal of the counted pulses

Equipment and technical data

- Measurement mode: pulses per minute, pulses per second, pulses absolute
- Measurement ranges:
 - 0 ... 64 000 #/s
 - 0 ... 999 999 #/min
 - 0 ... 64 000 #
- Gate time (adjustable): 1 ... 100 s, adjustable tube voltage (300 - 600 V, in steps of 1 V)
- Maximum data rate: 1 Hz
- BNC-plug for connection with standard Geiger-Mueller counters
- Dimensions (mm): 110 x 63 x 35; Weight: 120 g

Necessary Accessories

- GM counter 45 mm 09007-00 and shielded cable, BNC, l=750 mm 07542-11
- GM counter type A 09025-11 and shielded cable, BNC, l=750 mm 07542-11
- GM counter type B 09005-00

12665-00

Accessories Cobra4 Sensor-Unit Radioactivity

Geiger-Mueller Counter tube, 45 mm
09007-00

Geiger-Mueller Counter tube, type A, BNC
09025-11

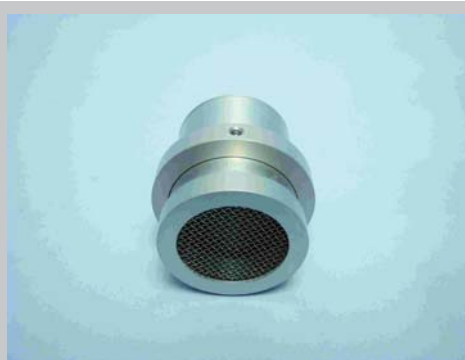
Geiger-Mueller Counter tube, type B
09005-00

Screened cable, BNC, l 750 mm
07542-11

Counter tube holder on fix.magn.
09201-00

Holder for counter tube large
09206-00

Geiger-Mueller Counter tube, 45 mm



Purpose and description

The Geiger-Mueller Counter tube, 45 mm is a self-extinguishing halogen counting tube for the detection of alpha, beta and gamma radiation. A long plateau (approx. 425...650 V) with only a slight slope renders the selection of the operating point uncritical. The actual counting tube, which is mounted in a metal cylinder with a permanent BNC connecting cable, has a thinwalled metal sheath that is permeable to alpha radiation.

09007-00

3.1 Experiments and Sensor-Units Physics

3.1.9 Magnetism

Cobra4 Sensor-Unit Tesla



Function and Applications

Sensor out of the Cobra4 family to measure the magnetic field strength in DC and AC fields. This Sensor is suitable for the connection of the Hall probes.

Benefits

- Connection of two different Hall probes possible: tangential and axial; Exceptionally good resolution
- Measurement of the earth's magnetic field possible.

Equipment and technical data

Measuring Ranges DC field: ± 1000 mT: Resolution ± 1 mT; ± 100 mT: Resolution $\pm 0,1$ mT; ± 10 mT: Resolution $\pm 0,01$ mT

Accuracy approx. ± 2 % of the maximum value of the measuring range; every range can be compensated up to the maximum value of the measuring range

Measuring Ranges AC field: Frequency: 15 Hz ... 1 kHz

± 1000 mT: resolution ± 1 mT; ± 100 mT: resolution $\pm 0,1$ mT, ± 10 mT: resolution $\pm 0,01$ mT; Accuracy approx. ± 3 % of the maximum value of the measuring range; AC fields measurements are of RMS type- no compensation

Accessories

A Hall probe is needed for the measurement of magnetic fields (not contained in the scope of delivery):

- Hall probe, axial (13610-01)
- Hall probe, tangential (13610-02)

Cobra4 Sensor Tesla, Set with 2 hall probes
12652-88

Cobra4 Sensor Tesla, magnetic field strength,
resolution max. ± 0.01 mT
12652-00

Hall probe



Function and Applications

In conjunction with the Teslameter or COBRA interface for the measurements of magnetic fields in coils or on conductors.

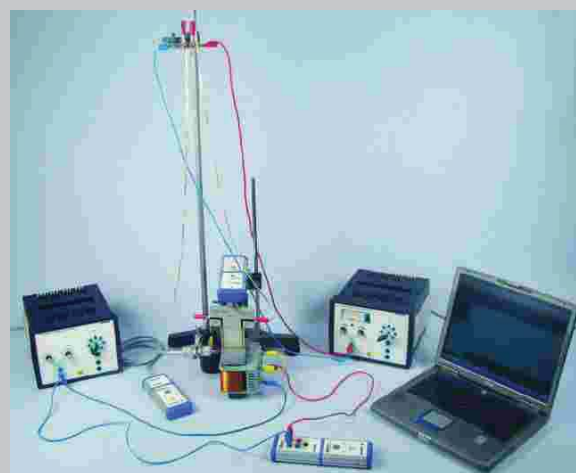
Equipment and technical data

- Probe length without handle, 300 mm
- Probe tube, diameter 6 mm

Hall probe, axial
13610-01

Hall probe, tangential, protection cap
13610-02

Definition of the magnetic flux density with Cobra4



Principle

Magnetism is a phenomenon that can be attributed to electromagnetic interaction. It manifests itself through the force that acts on magnetisable material and moving electric charges. The force is hereby conveyed via a magnetic field. Measurement is made of the force that deflects electrons in a current-carrying conductor of length l that is situated in the field of a permanent magnet.

P1219460

Sets

Complete solutions

Cobra4 JUNIOR-Link, Basic Set Physics for 5 groups



Function and Applications

This attractive device set is ideally suited to computer-aided experiments in the field of physics. The set contains sensor-units to measure force, motion, pressure, energy, and temperature. Experimental options: motion, hydrostatic pressure, energy consumption

Benefits

The Junior-Link Basis-Set Physics is designed for 5 groups working simultaneously.

12616-89

Cobra4 Wireless, Basic Set Physics



Function and Applications

This attractive device set is ideally suited to computer-aided experiments in the field of physics.

Benefits

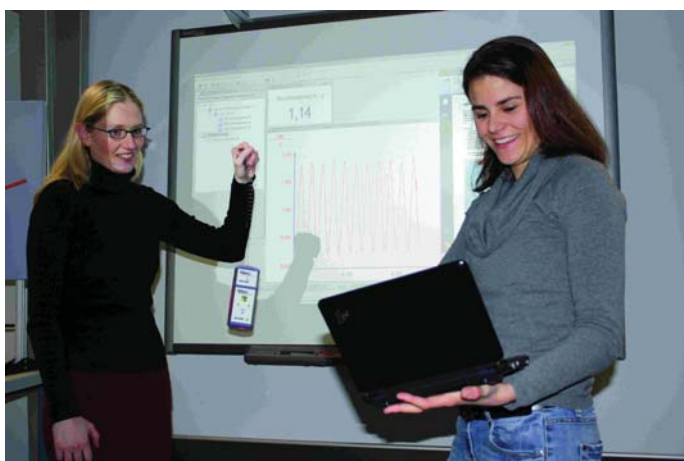
With the radiobased recording of measured values, experiments can conveniently be carried out with no annoying cables. The optimum use of this device set is in the area of demonstration experiments. Furthermore, with modern radio transmission, moving sensors offer completely new experimentation options, e.g. the measurement of acceleration of a school child on a bicycle, measuring the acceleration of a body in free fall, etc. .

Equipment and technical data

1 x Cobra4 Wireless Manager, 1 x Cobra4 Wireless-Link, 1 x Cobra4 Sensor-Unit Temperature Semiconductor, 20...110° C, 1 x Cobra4 Sensor-Unit Current/ Voltage, 1 x Cobra4 3D Sensor-Unit Acceleration, ± 6 g, 1 x Cobra4 Sensor-Unit Force, 40 N. Delivery incl. CD-ROM with all drivers and the full version of the "measure Cobra4" measuring software incl. experiment descriptions and configuration settings for experiments plus 2 high performance batteries for the Cobra4 Wireless-Link and an operating manual.

Cobra4 Wireless, Basic Set Physics 12605-89

TESS and Demo advanced manual Cobra4 Physics,
Chemistry, Biology, Everyday Science
01330-02



3 Physics

3.2 Sets and Literature Physics

TESS advanced Physics set Cobra4 Wireless, Extension Set for Mechanics, Heat, Electricity



Function and Applications

This attractive device set is ideally suited to perform computer assisted student experiments from the PHYWE TESS experiment sets Mechanics ME 1/2, Electric building blocks system EB 1/2 and Heat WE 1/2.

Benefits

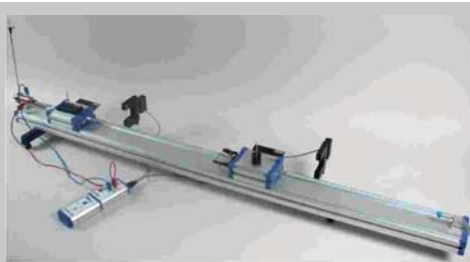
- This enables the easy and convenient execution of more than 20 experiments (for a list, see handbook 01332-02).

Required accessories

- 1 x "measure Cobra4" measuring software incl. data analysis software "measure", experimental descriptions and configuration settings for experiments (14550-61)

12604-88

Conservation of momentum during central elastic collision with Cobra4



Principle

An impulse is a change in momentum caused by a force F in a short amount of time. The momentum p is defined here as the product of force F and time t and is conserved if no friction loss occurs and the collision is elastic. This means that in a closed system of different bodies the latter can transfer or receive momentum, however the total momentum of the system remains temporally and quantitatively constant and the energy is therefore a conserved quantity.

P1199660

Cobra4 Set linear motion with Sensor-Unit Timer/Counter



Function and Applications

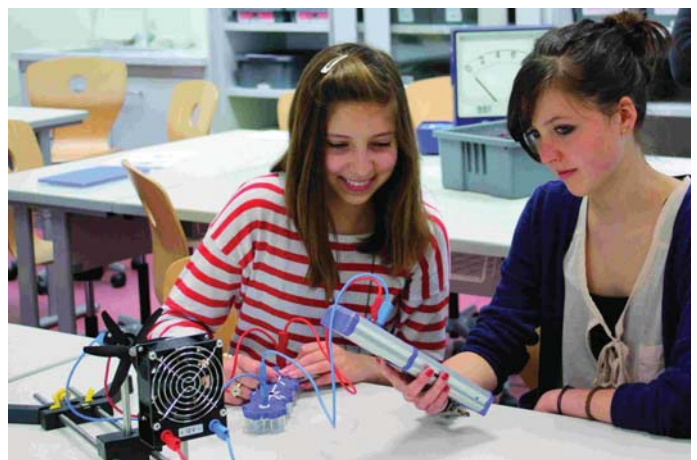
The Cobra4 "Timer/Counter" Sensor-Unit is used for the time measurement of switching signals and signal levels of up to four fork-type light barriers or one measuring microphone, motion sensor, falling sphere apparatus, or other devices with TTL-compatible signals. Moreover, a device for external triggering can be connected (switch, starting device for the demonstration track). The input (TC1) enables the counting of pulses as well as the measurement of frequencies.

Accessories

- Demonstration track, basic set 11305-77

DEMO Physics set Linear Motion/ Cobra4
12651-88

Demonstration Track, basic bundle
11305-77





Chemistry

4.1	Experiments and Sensor-Units Chemistry	40
4.1.1	pH-Value, Redox Potential	42
4.1.2	Conductivity	44
4.1.3	Titration and Colorimetry	45
4.2	Sets and Literature Chemistry	46

4 Chemistry

4.1 Experiments and Sensor-Units Chemistry

Find Cobra4 Sensors

According to your curriculum

Sensors / Sets	Curriculum											
	Chemistry (12630-00)	pH/Potential (12631-00)	Conductivity (12633-00)	Conductivity and Temperature (12632-00)	Drop Counter (12636-00)	Thermodynamics (12638-00)	Oxygen (12676-00)	Carbon dioxide (12671-00)	Weather (12670-00)	Basic Sets Chemistry Wireless (12606-89)	Set Gas laws with glass jacket (43020-00)	Junior-Link-Set Chemistry (12617-89)
INTRODUCTION TO CHEMISTRY												
Water	✓	✓	✓	✓						✓		✓
Heat	✓			✓						✓	✓	✓
GENERAL CHEMISTRY												
Methods of purification and analysis	✓	✓	✓	✓	✓	✓	✓			✓		✓
Identification of ions and gases							✓	✓			✓	
Structure and properties of materials	✓	✓								✓	✓	✓
Kinetic particle theory						✓					✓	✓
The liquid and the solid state	✓			✓						✓		✓
Bonding and physical properties			✓	✓								
Ionic and covalent bonding	✓		✓	✓						✓		✓
Intermolecular forces, including hydrogen bonding	✓		✓	✓						✓		✓
Chemical reaction - difference to physical process	✓	✓								✓		✓
Redox reactions	✓									✓		✓
INORGANIC CHEMISTRY												
Properties and reactivity of metals	✓	✓								✓		✓
Air - properties and analysis						✓	✓	✓	✓		✓	✓
Gases: Oxygen, Nitrogen, Carbon dioxide							✓	✓				
Water - components, use and purification	✓	✓	✓	✓						✓		✓
Acids and bases	✓	✓			✓					✓		✓
Preparation of salts	✓	✓								✓		✓
Properties and uses of ammonia, hydrochloric Acid and sulfuric acid	✓	✓			✓					✓		✓
ORGANIC CHEMISTRY												
Test reactions of elements in organic compounds					✓	✓	✓	✓				
Alcohols, phenols						✓						
Carboxylic acids, esters	✓	✓	✓		✓					✓		✓
PHYSICAL CHEMISTRY												
Redox processes	✓	✓								✓		✓
Electrode potentials	✓	✓								✓		✓
Electrolysis	✓	✓								✓		✓
ATMOSPHERE AND ENVIRONMENT												
Air							✓	✓	✓			
Water	✓	✓	✓	✓			✓			✓		✓
Environment and energy									✓			

Chemistry with Cobra4

more than 40 Experiments

GENERAL CHEMISTRY

Methods of purification and analysis

Volumetric redox titration: Cerimetry	P1268660
Precipitation titration: Determination of chloride and iodid	P1268760

Assimilation and chloroplasts

Photosynthesis (O ₂ pressure measurement)	P1351360
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Identification of ions and gases

Coming soon with SU Oxygen	12676-00
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Structure and properties of materials

Melting and crystallization diagram of a pure substance.	P1282060
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Kinetic particle theory

Charles' law	P1350060
Amontons law	P1350160
Boyle's law	P1350260
Pressure-Volume-Work	P7200160

The liquid and the solid state

Melting and crystallization diagram of a pure substance.	P1282060
Heat of fusion of sodium thiosulphate	P1273460
Conductivity of crystalline salts, molten salts and salt solutions.	P1282560

Ionic and covalent bonding

Conductivity of crystalline salts, molten salts and salt solutions	P1282560
Model experiments of hand warmers (Principle of latent heat storage tanks)	P7200460

Intermolecular forces, including hydrogen bonding

Determination of the solubility product of silver chloride	P1268460
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Chemical reaction – difference to physical process

Briggs-Rauscher-Reaction	P7201060
Model experiments of hand warmers (Principle of latent heat storage tanks)	P7200460

Redox reactions

Volumetric redox titration: Cerimetry	P1268660
Ionic permeability of the cell membrane	P1369760

INORGANIC CHEMISTRY

Properties and reactivity of metals

Specific heat capacity of metals	P1044260
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Air - properties and analysis

Temperature change when a gas is liquefied by compression	P7200560
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Gases: Oxygen, Nitrogen, Carbon dioxide

Photosynthesis	P8000060
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Water – components, use and purification

Heating of water	P1043760
Specific heat capacity of water	P1043960
Water quality - contamination with heavy metals	P0990162

Acids and bases / ammonia, hydrochloric acid and sulfuric acid

Determination of pH values and calibration of pH-electrodes Basic principles of pH measurement	P1270060
Titration of a polyvalent acid with a strong base	P7200660
Titration of a weak organic acid with sodium hydroxide	P7200760
Titration of a weak base (ammonia) with a strong acid	P7200860

Preparation of salts

Precipitation titration: Determination of chloride and iodid	P1268760
Conductivity of crystalline salts, molten salts and salt solutions	P1282560

ORGANIC CHEMISTRY

Alcohols, phenols

Determination of the boiling point of ethanol	P1272660
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Carboxylic acids, esters

Conductometric measurement of the saponification of an ester	P1271860
Specific conductivity of acetic acid	P1271560

PHYSICAL CHEMISTRY

Redox processes

Briggs-Rauscher-Reaction	P7201060
Volumetric redox titration: Cerimetry	P1268660

Electrode potentials

The electrochemical series of metals	P1282360
Voltage of a concentration cell	P1268360

Electrolysis

Electrolysis	P7105160
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ATMOSPHERE AND ENVIRONMENT

Air

The origin of acid rain	P4100760
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Water

Water quality - contamination with heavy metals	P0990162
Acidity changes of a watercourse	P1520862

Environment and energy

Impact of the forest type on humidity, temperature and brightness	P1521762
Electrical energy from wind power - influence of wind speed	P9505160
Model experiments of hand warmers (Principle of latent heat storage tanks)	P7200460

Sensor-Units

WHAT do you want to measure?

Cobra4 | PHYWE

Cobra4 Sensor-Unit Chemistry, pH and 2 x Temperature NiCr-Ni



Function and Applications

The Cobra4 Sensor-Unit pH and 2 x temperature NiCr-Ni is a measuring recorder for pH, potential and temperature measurements, which is controlled by micro-controller.

Benefits

- It can be fitted with two NiCr-Ni thermoelements (Type K) and a pH probe or redox measuring chain.
- Measure up to two temperatures and one pH or potential value simultaneously.
- Values of the calibration are saved in the sensor - no need for new calibration after changing the basic unit.
- The sensor is not restricted to the measurement of pH values: Connect the redox electrode 46267-10 to measure redox potentials.

Accessories

For the measurement of temperature, pH-value and potential the following accessories are needed:

Temperature:

Thermocouple NiCr-Ni -40...+500° C single type, 13615-02
or Thermocouple NiCr-Ni -50...+1100° C microsheath, 13615-01
or Immersion probe NiCr-Ni -50...+1000° C, 13615-03
or Immersion probe NiCr-Ni -50...+300° C Teflon, 13615-05
or Surface probe NiCr-Ni up to +1000° C, 13615-04

pH/potential:

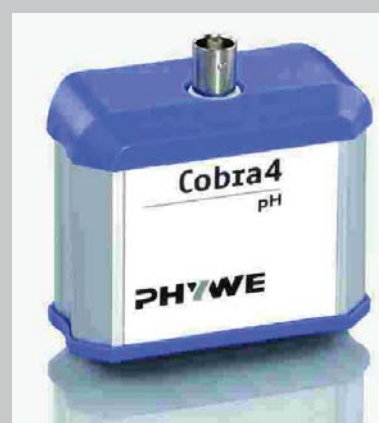
pH electrode, plastic, gel-filled, 46265-15
or pH electrode, plastic, refillable, 46266-10
or pH electrode, plastic, refillable, 46266-15
or pH electrode, glass, refillable, 46268-10

Potential:

Platinum redox electrode, plastic, gel-filled, 46267-10

12630-00

Cobra4 Sensor-Unit pH, BNC connector



Function and Applications

The Cobra4 Sensor-Unit pH, BNC connection is a measuring recorder for pH measurements, which is controlled by micro-controller.

Benefits

- It can be fitted with a pH probe, in order to measure pH values.
- Values of the calibration are saved in the sensor - no need for new calibration after changing the basic unit.
- The sensor is not restricted to the measurement of pH values: Connect the redox electrode 46267-10 to measure redox potentials.

Accessories

For the measurement of the pH-value the following accessories are needed:

pH electrode, plastic, gel-filled, 46265-15
or pH electrode, plastic, refillable, 46266-10
or pH electrode, plastic, refillable, 46266-15
or pH electrode, glass, refillable, 46268-10

Potential:

Platinum redox electrode, plastic, gel-filled, 46267-10

12631-00

Thermocouples NiCr-Ni (Typ K)

Different NiCr-Ni-thermocouple with standard type-K 2-pin flat plug which makes no contribution to the thermovoltage. All of these thermoelements can be connected with the Cobra4 Sensor-Units 2x Temperature, Thermodynamics and Chemistry.

Thermocouple NiCr-Ni, sheathed, -50...1100° C
13615-01

Immersion probe NiCr-Ni, steel, -50...400° C
13615-03

Surface probe NiCr-Ni, -50...300° C
13615-04

Immersion probe NiCr-Ni, teflon, 200° C
13615-05

Thermocouple NiCr-Ni, -50...500° C
13615-02

pH-Electrode with BNC-plug



The Sensor-Units Chemistry and pH can be used with all pH- and Redox-Electrodes that are equipped with BNC-plug. Corresponding to the probe, the units pH-value or mV are available. Calibration of the sensor is possible with one or two points.

pH-electrode, plastic body, gel, BNC
46265-15

pH-electrode, plastic, refill., BNC
46266-15

Redox electrode, BNC
46267-10

pH-electrode, glass, refill., BNC
46268-10

Cobra4 Sensor-Unit Thermodynamics, pressure abs. 2 bar and 2 temperature NiCr-Ni



Function and Applications

The Cobra4 Sensor-Unit Thermodynamics is a measuring recorder for pressure and temperature measurements, which is controlled by micro-controller.

Benefits

- It can be fitted with two NiCr-Ni thermoelements (type K), in order to measure up to two temperatures and one absolute pressure value simultaneously.

12638-00

Charles' law with Cobra4



P1350060

4.1 Experiments and Sensor-Units Chemistry

4.1.2 Conductivity

Cobra4 | PHYWE

Cobra4 Sensor-Unit Conductivity, with stainless steel electrodes



Function and Applications

The Cobra4 Sensor-Unit Conductivity is equipped with a firmly connected conductivity probe. A temperature probe is integrated to compensate the influence of temperature on the conductivity.

Benefits

- Particularly good application for school and outdoor experimentation, as the measuring probe is already firmly connected.

Equipment and technical data

Conductivity:

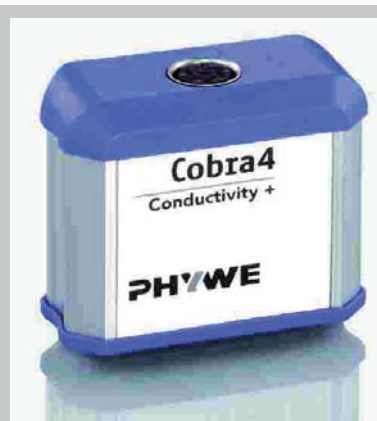
- Measuring range: 0.2 $\mu\text{S}/\text{cm}$...200 mS/cm
- Measuring accuracy: 6% of the measuring value $\pm 0,2 \mu\text{S}/\text{cm}$
- Resolution: 0.1 $\mu\text{S}/\text{cm}$, 1 $\mu\text{S}/\text{cm}$, 10 $\mu\text{S}/\text{cm}$, 100 $\mu\text{S}/\text{cm}$

Temperature:

- Measuring range: 0 to 100° C
- Measuring accuracy: $\pm 0.8^\circ \text{C}$
- Resolution: 0.1° C
- Data flow rate: 1 Hz
- Connecting port: sub-D-15 pole
- Measuring electrode length, diameter, electrode spacing: 7 mm, 1 mm, 2 mm
- Cable length: 60 cm
- Weight: 85 g

12633-00

Cobra4 Sensor-Unit Conductivity+, Conductivity / Temperature Pt1000



Function and Applications

The Cobra4 Sensor-Unit Conductivity/Temperature (Pt1000), is a microcontroller-based measuring recorder with a 5-pin diode socket for connecting conductance measuring sensors with a cell constant of $K = 1.00/\text{cm}$ or Pt1000 thermocouples.

Benefits

- Measure conductivity or temperature - multipurpose-sensor

Equipment and technical data

Conductivity:

- Measuring range 1: 0.0 ... 2500.0 $\mu\text{S}/\text{cm}$ approx.; Measuring accuracy: 4% of the measuring value $\pm 0.15 \mu\text{S}/\text{cm}$
- Measuring range 2: 0 ... 45.000 $\mu\text{S}/\text{cm}$ approx.; Measuring accuracy: 4% of the measuring value $\pm 3 \mu\text{S}/\text{cm}$
- Measuring range 3: 0.00 ... 1100 mS/cm approx.; Measuring accuracy: 4% of the measuring value $\pm 0.05 \text{mS}/\text{cm}$

Temperature:

- Measuring accuracy: -20.0° C...150.0° C; Resolution: 0.1 K
- Measuring accuracy: $\pm 0.5 \text{K}$ (in the range 0...100° C)

Cobra4 Sensor-Unit Conductivity+, Conductivity/ Temperature (Pt1000) 12632-00

Temp. probe, imm. type, Pt1000
12123-00

Conductivity temperature probe Pt1000
13701-01

Cobra4 Sensor-Unit Drop Counter



Function and Applications

The Cobra4 Drop Counter serves to count the number of drops that fall from a burette and so, indirectly, to quantitatively determine the volume of a liquid that flows from the burette.

Benefits

- Automatic performance of titration measurements
- Each single drop reliably measured
- Easy calculation of the volume in the software
- Easy to mount

Equipment and technical data

- Length: 185 mm
- Width: 50 mm
- Height: 30 mm
- Length of the holding rod: 90 mm
- Diameter of the holding rod: 10 mm
- Diameter of the two electrode pick-ups: 13 mm
- Dimensions of the elongated hole: 25 mm x 15 mm
- Length of the connecting cable: 90 cm
- Connector: 3.5 mm jack plug
- Maximum counting rate 5 / s
- Weight: 145 g

12636-00

You need more information? **WEB@** 
Just click www.phywe.com



Titration of a polyvalent acid with a strong base



Principle

Phosphoric acid and sodium hydroxide are to be used to give an example of a titration of a polyvalent acid with a strong base.

P7200660

Cobra4 Sensor-Unit Colorimeter



COMING SOON

Cobra4 Sensor-Unit Colorimeter

Article-No.: 12634-00

Sets

Complete solutions



Cobra4 JUNIOR-Link, Basic Set Chemistry for 5 groups

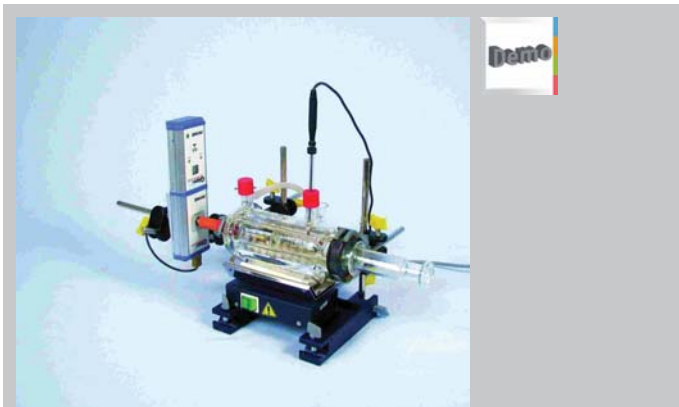


Function and Applications

The set contains sensor-units to measure pH-values, conductivity, pressure, and temperature. Experimental options: temperature, titration, conductivity of different water samples, gas laws.

12617-89

Set Gas laws with glass jacket system and Cobra4

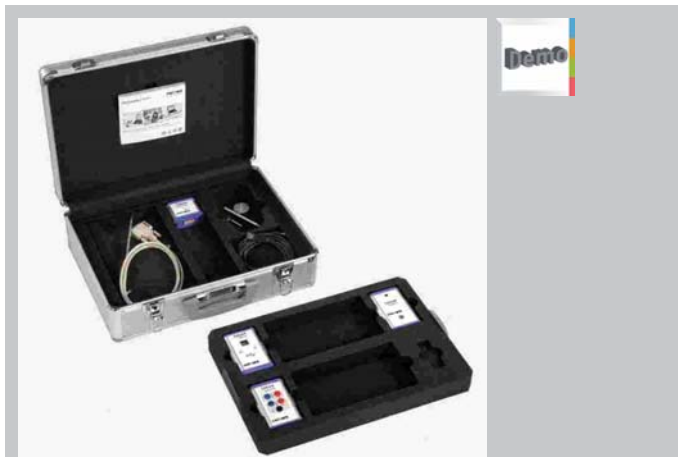


Function and Applications

Complete device compilation for a comfortable way to derive the ideal gas laws experimentally with help of the Cobra4 Sensor-Unit Thermodynamics and the glass jacket system.

43020-00

Cobra4 Wireless, Basic Set Chemistry



Function and Applications

This attractive device set is ideally suited to computer-aided experiments in the field of chemistry. With the radio based recording of measured values, experiments can conveniently be carried out with no annoying cables. The optimum use of this device set is in the area of demonstration experiments.

Furthermore, with modern radio transmission, moving sensors offer completely new experimentation options. With this system it is possible now, that experiments can be carried out far away from the PC. Therewith it is surely set that the PC is not endangered by liquids or similar things.

Cobra4 Wireless, Basic Set Chemistry, incl. software and english handbook
12606-89





Biology

5.1	Experiments and Sensor-Units Biology	48
5.1.1	Environment: Light Intensity, Humidity, Temperature, Air Pressure, Altitude	50
5.1.2	Wind	51
5.1.3	Salinity	52
5.1.4	Carbon Dioxide and Oxygen	53
5.1.5	Pulse Measurement, ECG, and Blood Pressure	54
5.1.6	Respiration and Skin	55
5.2	Sets and Literature Biology	56

5 Biology

5.1 Experiments and Sensor-Units Biology

Find Cobra4 Sensors

According to your curriculum

Curriculum	Sensors / Sets																
	Weather (12670-00)	Spitometry (12675-00)	Conductivity (12635-00)	CO ₂ Carbon Dioxide (12671-00)	O ₂ Oxygen (12676-00)	Pulse (12672-00)	Skinresistance (12677-00)	Temperature (12640-00)	Electrophysiology (12673-00)	Acceleration (12650-00)	pH (12631-00)	Sound Level (12669-00)	Thermodynamics (12638-00)	Cobra4 Junior-Link Set, biology (12618-89)	Cobra4 Set environment and outdoors (12622-77)	Biochemistry and Plant Physiology (65982-88)	Electrophysiology (12673-89)
INTRODUCTION TO BIOLOGY																	
Light, Air, Soil	✓		✓	✓	✓						✓			✓	✓	✓	
Senses							✓		✓								✓
Movement										✓							
Heat								✓				✓	✓	✓	✓	✓	
Water			✓		✓						✓			✓	✓	✓	
PLANTS - GROWTH, DEVELOPMENT, METABOLISM																	
Photosynthesis and carbon dioxide				✓	✓						✓			✓	✓	✓	
Assimilation and Chloroplasts				✓	✓							✓				✓	
Leaf structure and epidermis of plants												✓				✓	
Mineral nutrition			✓											✓	✓	✓	
Water and ion uptake			✓								✓			✓	✓	✓	
Transpiration, translocation and active transport				✓	✓							✓	✓			✓	
Diffusion and osmosis											✓			✓	✓	✓	
RESPIRATION AND BLOOD CIRCULATION																	
Aerobic respiration		✓		✓	✓									✓			
Breathing and effects of tobacco smoke								✓						✓			
Respiratory rate and heart rate		✓				✓			✓			✓	✓				✓
Heart frequency and electrocardiography (ECG)									✓								✓
BONES AND MUSCLES																	
Muscles and electromyography									✓								✓
SENSES, NERVES																	
Senses: touch, temperature, smell, taste, visual							✓	✓	✓					✓			✓
Acuesthesia									✓		✓						✓
Electrooculography and electronystagmography									✓								✓
Reflex action							✓		✓								✓
ENVIRONMENT, ECOLOGY, METEOROLOGY																	
Soil - constitution, function, pH, water and salt content			✓								✓			✓	✓	✓	
Weather and climate	✓	✓						✓						✓	✓		
Drinking water, pH, oxygen content, salt content, pollution			✓		✓						✓			✓	✓	✓	
Air pollution, ozone, exhaust gases by cars				✓	✓												
Effects of humans on the ecosystem and ground water pollution	✓		✓								✓			✓	✓	✓	
BIOCHEMISTRY																	
Enzyme kinetics			✓									✓					✓

Biology with Cobra4

more than 50 Experiments

PLANTS - GROWTH, DEVELOPMENT, METABOLISM

Photosynthesis and carbon dioxide	
Photosynthesis (O ₂ pressure measurement) (with Cobra4)	P1351360
Photosynthesis (bubble-counting-method)	P1360860
Photosynthesis	P8000060
Glycolysis (pressure measurement)	P1360960
Glycolysis (temperature measurement)	P1351460
Assimilation and chloroplasts	
Photosynthesis (O ₂ pressure measurement) (with Cobra4)	P1351360
Leaf structure and epidermis of plants	
Transpiration of leaves	P1351260
Mineral nutrition / Water and ion uptake	
Ionic permeability of the cell membrane	P1369760
Transpiration, translocation and active transport	
Transpiration of leaves	P1351260
Diffusion and osmosis	
Ionic permeability of the cell membrane	P1369760

RESPIRATION AND BLOOD CIRCULATION

Aerobic respiration	
How much air can our lungs contain?	P8001060
Direct determination of lung volume from a spirogram	P8001160
Does the lung volume depend on how tall you are?	P8001260
Which method enables lung illnesses to be diagnosed?	P8001360
Breathing and effects of tobacco smoke	
Changes in the blood flow during smoking (with Cobra4)	P4020460
Respiratory rate and heart rate	
Measurement of the respiratory rate	P4090260
We determine our heart frequency EP2	P1522060
Heart frequency and electrocardiography (ECG)	
We investigate our heartbeat - electrocardiography	P1332760
Blood pressure measurement (with Cobra4)	P4020360
We determine our heart frequency EP2	P1522060
Pulse at rest and during exercise	P8000160

BONES AND MUSCLES

Muscles and electromyography	
We investigate our physical fitness - the heart under stress EP3	P1522160
We investigate our muscular power - electromyography	P1350360

SENSES, NERVES

Senses: touch, temperature, smell, taste, visual	
We measure our eye movements - electrooculography	P1350460
We measure our reading speed - measuring reading skills EP6	P1522260
Regulation of human body temperature (with Cobra4)	P4060360
The Bergmann rule: heat loss as a function of the body surface area and volume	P1351060
Acuesthesia	
Coming soon with SU Sound level	12669-00
Electrooculography and electronystagmography	
Electronystagmography	P0873560
We measure our eye movements - electrooculography	P1350460
Reflex action	
We measure our reading speed - measuring reading skills EP6	P1522260

ENVIRONMENT, ECOLOGY, METEOROLOGY

Soil - constitution, function, pH, water and salt content	
The pH value of various soils	P1521062
Salinity of soils and plant substrates	P1521162
Insulating effect of body coverage	P4100360
Learning stations using the experimentation case Cobra4 Mobile, Environment and outdoors	P1521562
Raised bog and fen	P1521262
Drinking water, pH, oxygen content, salt content, pollution P1360960	
Conductivity of various water samples	P1520060
We examine our drinking water	P1520062
Water quality - contamination with heavy metals	P0990162
Acidity changes of a watercourse	P1520862
Salinity changes of a watercourse	P1521462
We visit a wastewater treatment plant	P1521662
Weather and climate	
24-hour weather observation	P1520461
Relative humidity	P1520560
Changes of the light conditions in a deciduous forest	P1520762
Comparison of the heat capacities of water and soil	P1350960
Comparison of soil and air temperatures in the course of a day	P1520962
Air pollution, ozone, exhaust gases by cars	
Weather observation with the Cobra4 Mobile-Link	P1520462
Impact of the forest type on humidity, temperature and brightness	P1521762
The origin of acid rain	P4100760
Effects of humans on the ecosystem and ground water pollution	
We examine our drinking water	P1520062
Water quality - contamination with heavy metals	P0990162

BIOCHEMISTRY

Enzyme kinetics	
Enzyme inhibition (poisoning of enzymes)	P1370060
Substrate inhibition of enzymes	P1369960
The enzymatic activity of catalase	P1360760
Determination of the Michaelis constant	P1369860

5.1 Experiments and Sensor-Units Biology

5.1.1 Environment: Light Intensity, Humidity, Temperature, Air Pressure, Altitude

Sensor-Units

WHAT do you want to measure?

Cobra4 | PHYWE

Cobra4 Sensor-Unit Weather: Humidity, Air Pressure, Temperature, Light Intensity, Altitude



Function and Applications

Use this multi-purpose Sensor-Unit to measure air pressure, relative humidity, air temperature, brightness, and height. The compact Cobra4 Weather multisensor makes for fitting out your own weatherstation with little means.

Benefits

Measure 5 parameters simultaneously: air pressure, relative humidity, air temperature, brightness, and height. Investigate the relations between air pressure, humidity and temperature, and also brightness. Ideal for use in outdoor experiments, on class trips or for project or school hiking days. Depending on application type, the Cobra4 Sensor-Unit Weather can be connected to the Cobra4 Wireless-Link, the Cobra4 Mobile-Link, the Cobra4 USB-Link or the Cobra4 Junior-Link using a secure and reliable plug-in/ lockable connection.

Equipment and technical data

Relative Humidity:

Measurement range 0 ... 100 %, resolution: 0.1 %, accuracy ± 5 %

Air Pressure:

Measurement range 10 ... 1100 hPa, resolution: 0.1 hPa, accuracy ± 5 %

Air Temperature:

Measurement range -40 ... $+125$ °C, resolution: 0.1 K, accuracy ± 0.5 °C

Brightness:

Measurement range 0 ... 100,000 lx, resolution: 1 lx, accuracy ± 5 %

Altitude:

Calculation using air pressure, resolution: 1 m

General:

Data transfer rate for each sensor: 1 Hz, Dimensions (L x W x H): 64 x 70 x 31 mm, Weight: 60 g

12670-00

Weather observation with the Cobra4 Mobile-Link



Literature for this experiment as follows:

TESS and Demo advanced manual Cobra4 Physics, Chemistry, Biology, Everyday Science

01330-02 English

TESS advanced Applied Sciences manual Cobra4 environment and outdoors

12622-02 English

P1520462



Cup anemometer



Function and Applications

The cup anemometer can be used together with the Cobra4 Sensor-Unit Timer/Counter to measure the wind speed.

Benefits

- precise measurement
- independent measurement
- connect the cup anemometer to the Sensor-Unit Timer/Counter using the cables

Equipment and technical data

Cup anemometer:

- Operating temperature: 0...+70° C
- Measuring range: 1...40 m/s resp. 4...140 km/h
- max. switching capacity: 0.6 V
- Weight: 0.3 kg
- Dimensions (L x B x H): 112 x 162 x 140 mm

Sensor-Unit Timer/Counter:

- Power supply: by the Cobra4 Wireless Link or another Cobra4 basic device
- Current consumption: < 300 mA
- Resolution: 1 μ s
- Dimensions: (L x B x H) 125 x 65 x 35 mm
- Weight: 200 g
- Accessories (included): adapter for light barriers, external power supply

Cup anemometer
12124-00

Cobra4 Sensor-Unit Timer/Counter
12651-00

Cobra4 Sensor-Unit Spirometry, Pulmonary volume and wind speed



Function and Applications

The Cobra4 Sensor Unit Spirometry is used for the measurement of the breath-dependent pulmonary volume. A measurement of wind speed is also possible.

Benefits

- Through the possibility of the recording of measurement one receives a diagram by means of which different function variables of the breath volume can be determined. The velocity of the exhaled air is also displayed, therefore the Sensor-Unit Spirometry can be used to measure the wind speed.
- The data can be measured and displayed in student or demonstration experiments with or without PC.

Equipment and technical data

- Measurement of total volume, flow rate, maximum flow rate, wind speed
- Max. data rate: 5 Hz; Volume: -15, ..., + 15 l; Volumetric flow rate: -10, ..., + 10 l/s; Wind speed: 0.2, ..., 20 m/s
- Incl. accessories: 2 disposable turbines with cardboard-mouthpieces

Cobra4 Sensor-Unit Spirometry, Pulmonary volume and wind speed
12675-00

Disposable turbine with cardboard-mouthpiece, set of 10 (for Cobra4 Sensor-Unit Spirometry)
12675-10

Disposable turbine with cardboard-mouthpiece, set of 50 (for Cobra4 Sensor-Unit Spirometry)
12675-11

5.1 Experiments and Sensor-Units Biology

5.1.3 Salinity

Cobra4 Sensor-Unit Conductivity, with stainless steel electrodes



Function and Applications

The Cobra4 Sensor-Unit Conductivity is equipped with a firmly connected conductivity probe. A temperature probe is integrated to compensate the influence of temperature on the conductivity.

Benefits

Particularly good application for school and outdoor experimentation, as the measuring probe is already firmly connected.

Equipment and technical data

Conductivity:

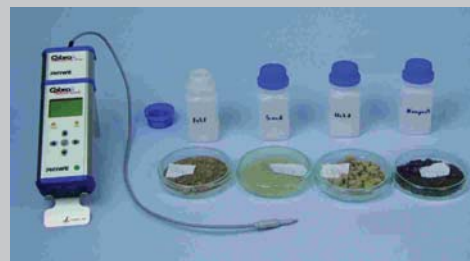
Measuring range: 0.2 $\mu\text{S}/\text{cm}$...200 mS/cm , Measuring accuracy: 6% of the measuring value $\pm 0,2 \mu\text{S}/\text{cm}$, Resolution: 0.1 $\mu\text{S}/\text{cm}$, 1 $\mu\text{S}/\text{cm}$, 10 $\mu\text{S}/\text{cm}$, 100 $\mu\text{S}/\text{cm}$

Temperature:

Measuring range: 0 to 100° C, Measuring accuracy: $\pm 0.8^\circ \text{C}$, Resolution: 0.1° C, Data flow rate: 1 Hz, Connecting port: sub-D-15 pole, Measuring electrode length, diameter, electrode spacing: 7 mm, 1 mm, 2 mm, Cable length: 60 cm, Weight: 85 g

12633-00

Salinity of soils and plant substrates



Principle

How suitable are certain soils and plant substrates for the nutrition of plants? This experiment is about measuring the conductivity, which in turn provides information as to which of the examined soils and plant substrates already contain nutrient salts for plant growth and to which of them nutrients should be added in the form of fertilisers.

Plants obtain their nutrients in the form of ions from the salts in the soil. The most important nutrients of a total of 16 nutrients that a plant needs for its growth are nitrogen in the form of nitrates and ammonium, phosphor in the form of phosphates, and potassium in the form of potassium salts. In addition, the soils also require lime (calcium carbonate) in order to avoid acidification (decrease of the pH). For agricultural production, these nutrients are added to the soil via inorganic fertilisers, while potting compost with fertilisers is used for house plants.

Literature for this experiment as follows:

TESS and Demo advanced manual Cobra4 Physics, Chemistry, Biology, Everyday Science

01330-02 English

TESS advanced Applied Sciences manual Cobra4 environment and outdoors

12622-02 English

P1521162

Cobra4 Sensor-Unit CO₂



Function and Applications

Sensor of the Cobra4 family for the measurement of the CO₂ concentration in the air. The measured data of the sensor can be transferred with the Cobra4 Wireless Link by radio to the PC in connection with the Cobra4 Wireless Manager. All Cobra4 Sensor Units are quickly connectable through a secure and reliable plug-in / lockable connection.

Equipment and technical data

measuring range: 0... 6000 ppm, resolution: 50 ppm, data transfer rate: 1 Hz, dimensions (L x W x H): 60 mm x 70 mm x 30 mm, Weight: 60 g

Accessories

Cobra4 Wireless Link (12601-00) and Cobra4 Wireless Manager (12600-00) and/or alternative: Cobra4 USB Link (12610-00) to the connection to a PC, Software measure Cobra4, individual position and school license (14550-61) for the realization, representation and evaluation of the measurements, Cobra4 Mobile Link (12620-00) for the measuring without PC

12671-00

You need more information? **WEB@** 
Just click www.phywe.com



Cobra 4 Sensor Unit O₂, Oxygen concentration



COMING SOON

Cobra4 Sensor-Unit Oxygen

For measuring dissolved and gaseous oxygen.

Article-No. 12676-00

Photosynthesis



Principle

This experiment shows that carbon dioxide is consumed during photosynthesis, whereas it is produced through cellular respiration.

P800060

5.1 Experiments and Sensor-Units Biology

5.1.5 Pulse Measurement, ECG, and Blood Pressure

Cobra4 Sensor-Unit Pulse, Pulse measurement



Function and Applications

Sensor of the Cobra4 family for measuring the heart rate on the ear or finger.

Benefits

- Measurement of the signal amplitude and the heart rate

Equipment and technical data

- Range 40...240 pulses/minute; Accuracy 2%
- Including ear clip (cable length: 1 m)
- Digital and graphical display of the heart rate
- Size: 60 x 70 x 35 mm; Weight: 100 g

Cobra4 Sensor-Unit Pulse, Heart rate, incl. ear clip
12672-00

Blood pressure measurement (with Cobra4)



Principle

Didactical blood pressure measurement system for wireless data transfer of measurement data from test person to computer, thereby permitting flexible and mobile experimental setup.

P4020360

Cobra4 Sensor-Unit Thermodynamics, pressure abs. 2 bar and 2 temperature NiCr-Ni



Details concerning the Sensor-Unit Thermodynamics:

See page 29

12638-00

Cobra4 Sensor-Unit Electrophysiology: ECG, EMG, EOG



Function and Applications

To perform electrophysiological, noninvasive measurements of heart-, eye-, and muscle activities using the Cobra4 Wireless-Link or the Cobra4 USB-Link. This Sensor can not be used with Cobra4 Mobile-Link.

Benefits

- Multipurpose-sensor: Measure ECG, EMG or EOG.
- self-explanatory pictogram on the sensor yields intuitive handling of the device.

Details concerning the Sensor-Unit Electrophysiology:

See page 62

12673-00

Cobra4 Sensor-Unit Spirometry, Pulmonary volume and windspeed



Function and Applications

The Cobra4 Sensor Unit Spirometry is used for the measurement of the breath-dependent pulmonary volume. A measurement of wind speed is also possible.

Benefits

Through the possibility of the recording of measurement one receives a diagram by means of which different function variables of the breath volume can be determined.

The velocity of the exhaled air is also displayed, therefore the Sensor-Unit Spirometry can be used to measure the wind speed. The data can be measured and displayed in student or demonstration experiments with or without PC.

Equipment and technical data

- Measurement of total volume, flow rate, maximum flow rate, wind speed
- Max. data rate: 5 Hz; Volume: -15, ..., + 15 l
Volumetric flow rate: -10, ... , + 10 l/s; Wind speed: 0.2, ..., 20 m/s; Incl. accessories: 2 disposable turbines with cardboard-mouthpieces.

Cobra4 Sensor-Unit Spirometry, Pulmonary volume and wind speed 12675-00

Disposable turbine with cardboard-mouthpiece, set of 10 (for Cobra4 Sensor-Unit Spirometry) 12675-10

Disposable turbine with cardboard-mouthpiece, set of 50 (for Cobra4 Sensor-Unit Spirometry) 12675-11

Cobra4 Sensor-Unit Skin resistance



COMING SOON

Cobra4 Sensor-Unit Skin resistance

Article-No.: 12677-00

Diagnosis of lung illnesses



Principle

The forced expiratory volume (FEV) in one second is used in the diagnosis of lung illnesses. For the measurement of this here, the student carrying out the test breathes normally a few times, presses out all the air he or she can, takes a deep breath and holds it for a moment before (at the beginning of measurement) force breathing out as much air as he or she can right from the start of measurement.

P8001360

Sets

Complete solutions



Cobra4 JUNIOR-Link, Basic Set Biology for 5 groups



Function and Applications

This attractive device set is ideally suited to computer-aided experiments in the field of biology. The set contains sensor-units to measure pH-values, conductivity, spirometry, weather, pulse, and temperature. Experimental options: temperature, weather observation, conductivity of different water samples, lung diseases.

12618-89

Cobra4 Environment and outdoors



Function and Applications

This device set is ideally suited to shared-work experiments with schoolgroups.

Benefits

- Whether in the classroom, outdoors or on project days: in this robust aluminium case, you will always find the right device for carrying out fascinating experiments with schoolgroups.
- Up to 4 work groups can work on and investigate interesting topics in parallel.
- All data are saved on SDmemory cards.
- Evaluation of the data can be carried out e.g. at home, as homework.

- The measure evaluation software is included for FREE and may, of course, be used privately by each pupil.

Cobra4 Environment and outdoors, for 4 workgroups 12622-77

TESS Cobra4 Environment and outdoors, with 1 measurement instrument and english handbook 12619-77

TESS advanced Applied Sciences manual Cobra4 environment and outdoors 12622-02

Basic set Cobra4 Biochemistry and Plant Physiology



Function and Applications

Instrument set with the wireless computer interface Cobra4 to perform the following experiments:

- Photosynthesis (2 methods); Transpiration of leaves
- Glycolysis (2 methods)
- Ionic permeability of the cell membrane
- Determination of the Michaelis constant; Enzyme inhibition
- Substrate inhibition of enzymes; Enzymatic activity of catalase

Benefits

- Ten experiments in one set
- Uniform computer interface
- Flexible experimenting thanks to wireless data transmission
- Compact setup
- Reliable and reproducible results

Basic set Cobra4 Biochemistry and Plant Physiology 65982-89

Standard labware set for Biochemistry & Plant Physiology 65980-77

Chemicals set Biochemistry & Plant Physiology 65980-10



Applied Sciences

6.1	Experiments and Sensor-Units Applied Sciences	58
6.1.1	Energy	59
6.1.2	Human Physiology	60
6.2	Sets and Literature Applied Sciences	62

Everyday phenomena with Cobra4 45 Experiments

Renewable energy (17 experiments)

Energy conversions

Conversion of light in motion with a solar cell	P9501160
Conversion of thermal energy into electrical energy and motion	P9501260
Conversion of electric energy into heat energy	P9501360

Electrical energy from solar energy

Voltage and current of a solar cell - Influence of surface and illumination	P9502160
Voltage and current in series and parallel connection of solar cells	P9502260
Operation of a solar-powered LED	P9502360
The solar cell diode	P9502460
Storage of the electrical energy of a Solar cell with a battery	P9502560

Thermal energy from solar energy

Influence of the surface to the absorption of solar energy	P9503160
The greenhouse effect	P9503260
Heating water in a solar collector	P9503360

Wind energy

Electrical energy from wind power - Influence of wind speed	P9505160
Influence of the number of rotor blades	P9505260
Storage of the electrical energy from wind power with a battery	P9505360

Energy from ambient heat

Peltier effect: cooling machine	P9507160
Peltier effect heat pump	P9507260
Learning stations using the experimentation case „Cobra4 Mobile, Environment and outdoors“	P9507360

Physiology (18 experiments)

Human physiology

Electrocardiography	P1332760
Blood pressure measurement	P4020360
Pulse measurement	P1522060
Resting and exercise heart rate	P8000160
Perfusion in tobacco	P4020460
Regulation of body temperature	P4060360
Body covering	P4100360
Respiration rate	P4090260
Heart rate	P1522060
Physical fitness	P1522160
Electromyography	P1350360
Electrooculography	P1350460
Read speed	P1522260
Electronystagmography	P0873560
Lung volume	P8001060
Spirogram	P8001160
Relationship between change body size and lung volume	P8001260
Lung diseases	P8001360

Everyday Phenomena (10 experiments)

Household

Why do energy-saving lamps need some time brightness?	P9000060
Why bulbs usually go when switching broken?	P9000160
Floating and sinking	P9000260

Outdoors

Height measurement on a path	P9000362
Measuring the height of a tower	P9000462
Field mapping	P9000562

Hobby

What happens during the flash recycling time of a camera?	P9000660
Acceleration in roller coaster	P1530660

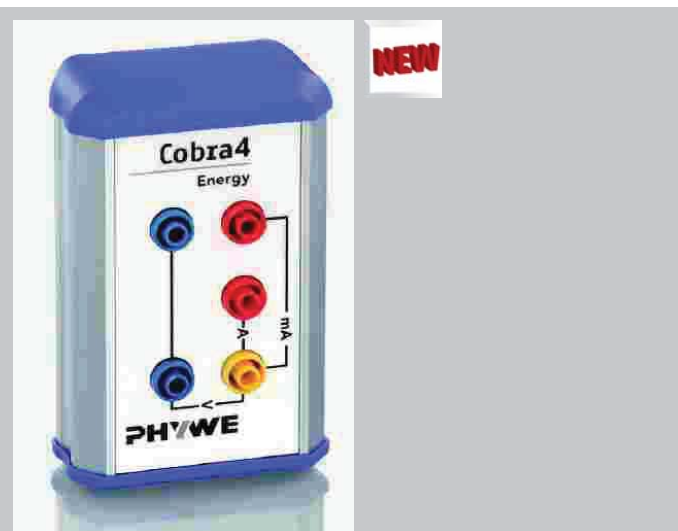
Technology

Why do you need a power supply for Mobile phone, laptop, etc.?	
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Traffic

How can ships made of steel float on water?	P9000860
Air pressure and relative humidity in an aircraft	P9000962

Cobra4 Sensor-Unit Energy, current, voltage, power, energy



Function and Applications

The Cobra4 Sensor-Unit Energy is used for the measurement and direct indication of measurement variables of the electrical power and energy in direct current and alternating current circuits (current, voltage, effective and apparent power, angular phase shift, frequency, electric work).

Benefits

This sensor measures directly the values for alternating current and direct-current. This allows numerous basic as well as application-oriented experiments, e.g. the determination of the characteristics of alternating current resistances or the investigation of the energy demand of consumers.

Equipment and technical data

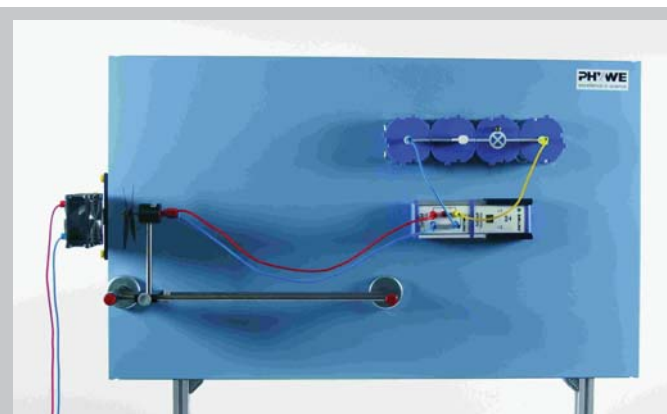
- Operating modes:
 - "u(t), i(t)": instantaneous values, max. sample rate 2000 Hz
 - "Energy DC": direct current circuit, max. measuring rate 4 Hz
 - "Energy AC": alternating current circuit, max. measuring rate 4 Hz, up to 6000 Hz signal frequency, trueRMS
- Voltage:
 - Range 30 V: -30...30 V, resolution: 0.01 V, internal resistance: > 5 MΩ
 - Range 1000 mV: -1000...1000 mV, resolution: 0.1 mV, internal resistance: > 200 kΩ
 - Accuracy: 1.5 % of upper range value
 - Damping: ±2 dB (at 6000 Hz)
 - Overvoltage protection: up to 50 V
- Current:
 - Range 6 A: -6...6 A (6 A for 3 min until overcurrent protection is active), resolution: 0.001 A, internal resist-

ance: 33 mΩ, overcurrent protection: max. 10 A self reset after approx. 5 min

- Range 600 mA: -600...600 mA, resolution: 0.1 mA, internal resistance: 2 Ω, overcurrent protection: max. 2 A self reset after approx. 5 min
- Accuracy: 1.5 % of upper range value
- Damping: ±2 dB (at 6000 Hz)
- Active power: 0... max. 180 W, max. resolution 0.01 mW
- Apparent power: 0... max. 180 VA, max. resolution 0.01 mVA
- Reactive power: 0... max. 180 var, max. resolution 0.01 mvar
- Electrical work: 0... max. 100.000 Wh, max. resolution 0.1 Ws
- Phase shift: -90...90 °, resolution: 0.1 °
- Frequency: 10...6000 Hz, resolution: 0.1 Hz (< 1000 Hz), 1 Hz (> 1000 Hz)

12656-00

Electrical energy from wind energy - influence of wind speed and load



Principle

Wind turbines convert the energy that is contained in the wind into electrical energy. Driven by the wind, the rotors rotate, thereby driving a generator. This generator, which is located inside the rotor cabin, converts the mechanical energy into electrical energy. The aim of this experiment is to examine how a wind turbine behaves at different wind speeds, loads, and wind directions, and how these changes affect the electric power.

P9505160

Cobra4 Sensor-Unit Electrophysiology: ECG, EMG, EOG



Function and Applications

To perform electrophysiological, noninvasive measurements of heart, eye, and muscle activities using the Cobra4 Wireless-Link, the Cobra4 USB-Link or the Cobra4 Junior-Link.

Benefits

- Multipurpose-sensor: measure ECG, EMG or EOG.
- Self-explanatory pictogram on the sensor yields intuitive handling of the device.

Equipment and technical data

- this Cobra4 Sensor-Unit can be connected to one of the following measurement recording instruments for the transmittance of measured values to it:
 - to Cobra4 Wireless-Link (12601-00) for wireless transmittance of data to a computer.
 - to Cobra4 USB-Link (12610-00) for data transmittance to a computer via a USB-cable.
 - to Cobra4 Junior-Link (12615-00) for data transmittance between Sensor-Unit and a computer.
- Measurement mode: permanent measurement
- Requires measurement cords and ECG and/or EMG/EOG electrodes.
- Operation with three separate and shielded measurement cords.
- Signal filter:
 1. ECG filter: 0.03 Hz to 20 Hz with 450-fold magnification
 2. EMG filter: 80 Hz to 5000 Hz with 1600-fold magnification
 3. EOG filter: 0.03 Hz to 10 Hz with 800-fold magnification

Cobra4 Sensor-Unit Electrophysiology, set incl. cords and ECG electrodes
12673-77

Cobra4 Sensor-Unit Electrophysiology: ECG, EMG, EOG
12673-00

ECG electrodes, 3/pkg
65981-01

EMG electrodes, 3 off
65981-02

Electrode Gel, tube
65981-06

Electrodes for ECG Sensor, 100 pcs.
12559-01

Shielded leads for electrophysiology, color-coded, 3/pkg
12673-01

Crocodile clips for disposable electrodes, 3/pkg
12673-02

We measure our eye movements - electrooculography



Principle

With this experiment, you can find evidence of the electrical activity that is generated during the movement of your eyes. Several electrodes attached to the skin of the face measure all the changes of the electrical voltage that are caused by the movement of the eyes. This method is referred to as electrooculography (EOG).

Literature for this experiment as follows:

TESS and Demo advanced manual Cobra4 Physics, Chemistry, Biology, Everyday Science
01330-02 English

TESS advanced Biology manual Cobra4 Electrophysiology: ECG, EMG, EOG
12673-12 English

P1350460

Cobra4 Sensor-Unit Pulse, Pulse measurement



Function and Applications

Sensor of the Cobra4 family for measuring the heart rate on the ear or finger.

Benefits

- Measurement of the signal amplitude and the heart rate

Equipment and technical data

- Range 40...240 pulses/minute; Accuracy 2%
- Including ear clip (cable length: 1 m)
- Digital and graphical display of the heart rate
- Size: 60 x 70 x 35 mm; Weight: 100 g

**Cobra4 Sensor-Unit Pulse, Heart rate, incl. ear clip
12672-00**

Cobra4 Sensor-Unit Skin resistance



COMING SOON

Cobra4 Sensor-Unit Skin resistance

Article-No.: 12677-00

Cobra4 Sensor-Unit Spirometry, Pulmonary volume and windspeed



Function and Applications

The Cobra4 Sensor Unit Spirometry is used for the measurement of the breath-dependent pulmonary volume. A measurement of wind speed is also possible.

Benefits

Through the possibility of the recording of measurement one receives a diagram by means of which different function variables of the breath volume can be determined.

The velocity of the exhaled air is also displayed, therefore the Sensor-Unit Spirometry can be used to measure the wind speed. The data can be measured and displayed in student or demonstration experiments with or without PC.

Equipment and technical data

- Measurement of total volume, flow rate, maximum flow rate, wind speed
- Max. data rate: 5 Hz; Volume: -15, ..., + 15 l
Volumetric flow rate: -10, ... , + 10 l/s; Wind speed: 0.2, ..., 20 m/s; Incl. accessories: 2 disposable turbines with cardboard-mouthpieces.

**Cobra4 Sensor-Unit Spirometry, Pulmonary volume and wind speed
12675-00**

**Disposable turbine with cardboard-mouthpiece, set of 10 (for Cobra4 Sensor-Unit Spirometry)
12675-10**

**Disposable turbine with cardboard-mouthpiece, set of 50 (for Cobra4 Sensor-Unit Spirometry)
12675-11**

Sets

Complete solutions

Cobra4 wireless, extension set for renewable energy: electric parameters, temperature



Function and Applications

This attractive device set is ideally suited to computer-aided demonstration experiments in the field of renewable energy. It is optimally adjusted to experiments with the experimentation set Demo Renewable Energy ENT1 (09492-88) and ENT2 (09493-88).

Benefits

- Complete set
- With the radiobased recording of measured values, experiments can conveniently be carried out with no annoying cables.
- Direct measuring of electrical parameters such as power and energy.
- Experimentation on magnetic boards due to magnetic adhesive device holders.
- Thanks to embedded experiments ideally suited for demonstration purposes.

Equipment and technical data

- 1 x Cobra4 Wireless Manager
- 2 x Cobra4 Wireless-Link
- 2 x Holder for Cobra4, magn.
- 1 x Cobra4 Sensor-Unit Energy
- 1 x Cobra4 Sensor-Unit 2 x Temperature, NiCr-Ni

- 2 x Immersion probe NiCr-Ni, steel, -50...400° C
- 1 x Fast Charging System for up to 4 MeH accumulators

Delivery in a robust aluminium case incl. DVD-ROM with all drivers and the full version of the "measureCobra4" measuring software incl. experiments descriptions and configuration settings for experiments plus 4x2 high performance rechargeable batteries for the Cobra4 Wireless-Link and an operating manual.

12608-88

TESS Set Electrophysiology



Function and applications

Complete instrument set and accessories to perform computer-assisted experiments in human and animal physiology:

- The heart/ ECG (3 exp.)
- Muscles/ EMG (1 exp.)
- The eye/ EOG (3 exp.)

Benefits

- Wireless transmitter and receiver units to connect to the electrophysiology sensor and to a PC, can also be used for others sensors to measure parameters common in physics, chemistry, biology and medical education.

TESS advanced Applied Sciences set Electrophysiology, EP with english manual
12673-89

**TESS advanced Biology manual Cobra4
Electrophysiology: ECG, EMG, EOG**
12673-12

General sets

Cobra4 | PHYWE

Cobra4 Mobile, for 8 work groups



Function and Applications

This attractive device set serves excellently for use as a digital multimeter set for numerous measurement dimensions.

Benefits

This set is ideal for use in:

- Student experiments without PC
- Outdoor experimentation
- Project days, school hiking days, trips etc.
- With this set, simply choose your desired Cobra4 Sensor-Units and therefore compile your own personal set of equipment.
- Sufficient extra space has been left in the case for storing the sensors.
- The "measure" evaluation software can also be used at home, by any schoolchild, for FREE.

Equipment and technical data

- 8 x Cobra4 Mobile-Link
- 8 x SD memory card
- 4 x spare Mignon 1.2 V 2700 mAh batteries, set of 4;
- 1 x 7.5 Ah battery charger
- Operating manual plus CD-ROM with drivers and demo version of the "measure Cobra4" measuring software
- Incl. FREE evaluation software, experimental descriptions and configuration settings for experiments

Cobra4 Mobile, for 8 work groups
12621-88

Cobra4 Mobile, for 4 work groups
12621-44

Cobra4 Display-Connect, Basic Set with digital large-scale display, Mobile-Link, weather sensor and english handbook, in case, 230 V



Function and Applications

Complete set in the attractive suitcase.

Equipment and technical data

The set consists of each one:

- Cobra4 Display-Connect
- Set of sender and receiver for the use of the Cobra4 Mobile-Link with a digital large-scale display
- Cobra4 Mobile-Link, incl. accumulators
- SD memory card
- Fast charging system for up to 4 MeH Accumulators, 110...240 V
- Digital large display with RS 232-Interface
- Cobra4 Sensor-Unit Weather: air pressure, air humidity, temperature, light intensity, altitude measure
- Software, CD-ROM in Jewelcase
- Manual Cobra4: Physics, Chemistry, Biology, everyday life Phenomena
- Suitcase for storage

Cobra4 Display-Connect, Basic Set with digital large-scale display, Mobile-Link, weather sensor and english handbook, in case, 230 V

12607-89

TESS and Demo advanced manual Cobra4 Physics, Chemistry, Biology, Everyday Science
01330-02

Cobra4 Demo-Set Physics Chemistry - Biology incl. PC



Function and Application

Multi-purpose Set for many sensors used in physics, chemistry, biology und applied sciences. A PC (different languages available) including required software is included. Additional accessories enable basic experiments in the field of electrics and renewable energy.

Benefits

- One set for all topics
- All important sensors in one case
- Computer is included (Cobra4 Data Unit)
- Additional accessories for basic experiments is also included
- Safe storage in aluminium case
- Accessories for 2 experiments:
 - Generation of an alternating voltage, rectification and smoothing (P1331360)
 - Helical spring pendulum (P1002760)

Please contact us if you need other languages than german for the system software and keyboard.

Equipment and technical data

The following devices are placed in the stable aluminium case:

- 1x Cobra4 Wireless Manager
- 1x Cobra4 Wireless-Link
- 1x Cobra4 Data Unit (PC)
- 1x TESS and Demo advanced handbook Cobra4
- 1x Fast Charging System for up to 4 MeH accumulators
- 1x Ni-MH Accu., Mignon, 1.2 V, 2000 mAh, Eneloop Type
- 1x Cobra4 Sensor-Unit Energy
- 1x Cobra4 Junior-Link
- 1x Cobra4 Sensor-Unit Electricity, ± 6 A, ± 30 V
- 1x Cobra4 Sensor-Unit Motion

- 1x Cobra4 Sensor-Unit Radioactivity
- 1x Geiger-Mueller Counter tube, 45 mm
- 1x Screened cable BNC, l = 750 mm
- 1x Cobra4 Sensor-Unit Acceleration
- 1x Cobra4 Sensor-Unit Chemistry, pH and 2 x Temperature NiCr-Ni
- 2x Immersion probe NiCr-Ni, steel, -50...400° C
- 1x pH-Electrode, BNC-Plug
- 1x Protection sleeve for electrode with a diameter of 12 mm
- 1x Cobra4 Sensor-Unit Conductivity
- 1x Cobra4 Sensor-Unit Force ± 4 N
- 1x Cobra4 Sensor-Unit Spirometry,
- 1x Cobra4 Sensor-Unit Temperature- semiconductor
- 1x Software measure Cobra4
- Accessories for 2 experiments
 - Generation of an alternating voltage, rectification and smoothing (P1331360)
 - Helical spring pendulum (P1002760)

Techn. Data Computer:

- HDMI-port
- USB-port
- VGA-port
- incl. Webcam (270° Rotation)
- Rotating screen
- Touchscreen
- Windows7 ®
- e-Book Reader
- 2GB RAM
- System type: 32 Bit

Optional Accessories:

Cobra4 Display-Connect, set of transmitter and receiver for using the Cobra4 Mobile-Link with large-scale displays, 12623-88.

12609-88



Accessories

Fast Charging System for up to 4 MeH Accumulators



Function and Applications

For 1-4 Mignon AA or Micro AAA.

Benefits

- Adjustable charging current by a switch "Fast charge/ Standardcharge" (2100 mA/ 850 mA for Mignon AA cells and 850 mA/ 350 mA for Micro AAA cells).
- Multiple over charging protection by deltaV detection, temperature control and safety timer
- Trickle charging, faulty cell and alkaline detection
- Reverse polarity protection
- Cooling of the batteries by a fan
- Battery status is displayed by LED per charging slot

Equipment and technical data

- External power supply with wide range input 100-240 VAC and 12 V car adapter.

07930-99

Ni-MH accu, Mignon, 1.2 V, 2000 mAh, Eneloop Type, 4 pcs.



Function and applications

4-pack of 2,000 mAh rechargeable AA batteries for digital cameras, remotes, etc.

Benefits

Pre-charged and ready to use right out of the pack, preserves charge for long periods of time, extremely low self-discharge rate (maintains 85 percent of capacity after 1 year of storage).

Combines best features of AA alkaline (ready for use) and rechargeable (reusable) batteries; Can be charged up to 1,000 times (including partially) without experiencing memory effect

Equipment and technical data

Size: AA (Mignon; HR 6); Electrochemical system: nickel hydride (Ni-MH), Capacity: 2,000 mAh, Voltage: 1.20 V

07930-03

Holder for Cobra4 with support rod



Function and application

To fix e.g. the Cobra4 Wireless-Link or Cobra4 USB-Link to support rods.

Benefits

Safe fixation of the equipment, incl. reusable touch fastener

Equipment and technical data

Plate: Aluminium anodized, Support rod d = 10 mm, Incl. self adhesive touch fastener

12680-00

Stand for Cobra4



Function and Applications

Supporting stand of aluminum with a tiltangle of about 30° to place Cobra4 Mobile-links and Cobra4 USB-Links on desks.

Equipment and technical data

The devices are fixed by a specific hook and loop fastener on the stand. A 50 cm long stripe of this selfadhesive hook and loop fastener is delivered together with the stand. To attach the devices to the stand, a correspondingly suitable small piece of the self-adhesive hook and loop fastener is stuck onto the back of this devices.

12681-00

Touch fastener, selfadhesive, 100 cm

Function and Applications

Self-adhesive, flexible touch fastener for joining or fastening of devices, small hardware items etc. .

Benefits

- This touch fastener with interlocking mushroom-shaped necks of polypropylene allows a controllable, externally invisible and reversible connection for fixing of parts together.
- These parts can be quickly and simply unfastened and fastened again for mounting, maintenance and in case of repairs.
- The connection shows an excellent tensile strength and is not unfastened also by shaking motions.

Equipment and technical data

- Transparent self-adhesive tape; Length: 100 cm; Width: 26 mm

12680-01

Holder for Cobra4, magn.



Function and Applications

Mounting Cobra4 Devices incl. sensors on the physics demo board.

Equipment and technical date

- Metal mount, varnished
- Magnet foil on the back side

02161-10

SD card reader

Function and Applications

USB 2.0 single slot card reader for SD- und MMC-cards up to 2 GB.

Benefits

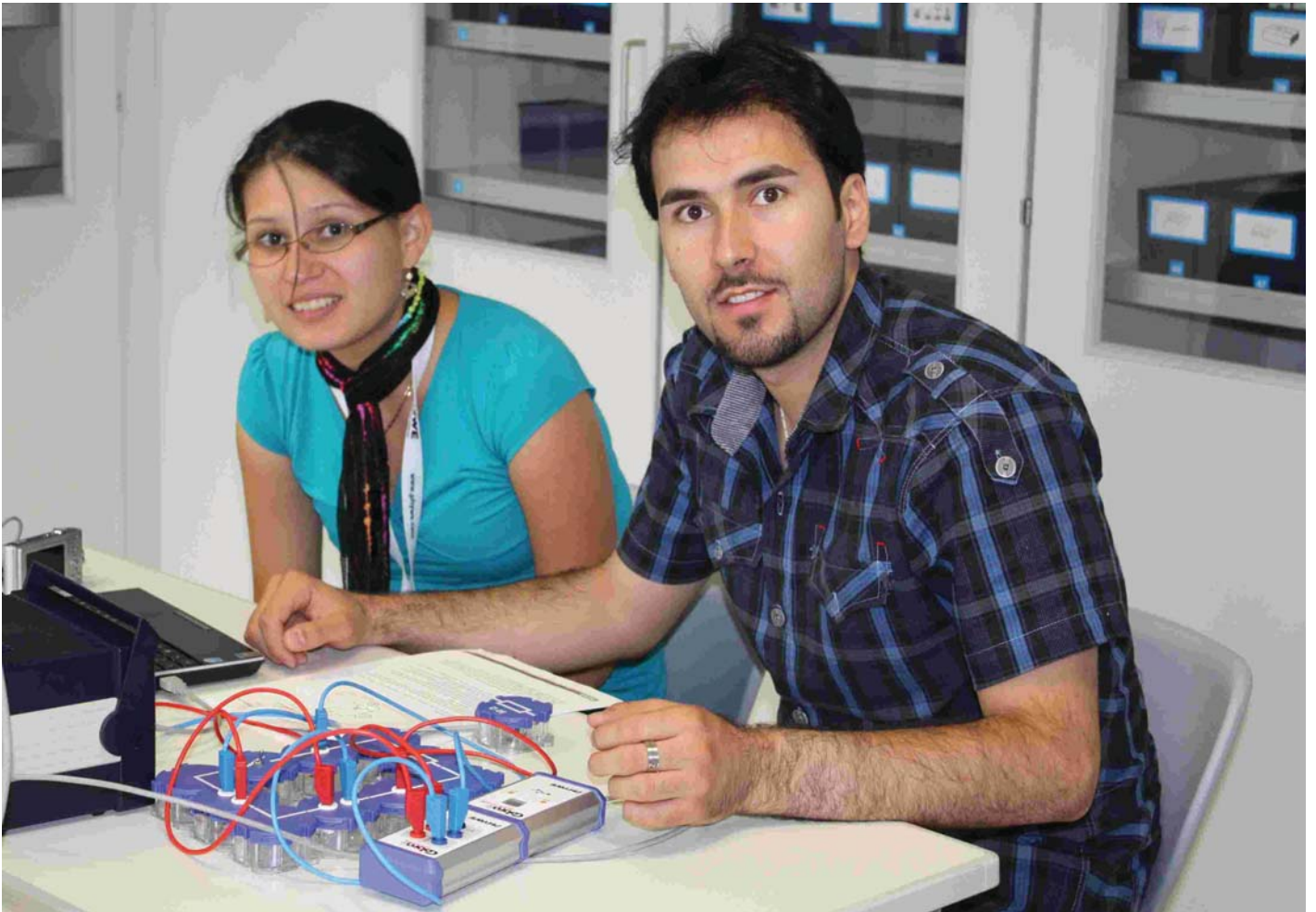
Read and write SecureDigital and MultiMedia-Cards.

Equipment and technical data

Data transfer rate:

- Up to 18,5 MB/s for SD cards
- Up to 11 MB/s for MM Card
- Can be used without driver with Windows ME ®, 2000 ®, XP ®, Vista ® and Mac OS 9.1 ®, OS X ®

12620-03



Ordering Overview

8.1	Sets	68
8.2	Literature	71

Content of Cobra4 Sets

TESS advanced 12604-88 Physics set Cobra4 Wireless, extension set for Mechanics, Heat, Electricity

Cobra4 Wireless-Link	12601-00	1
Cobra4 Sensor-Unit Force ± 4 N	12642-00	1
Cobra4 Sensor-Unit Electricity, current ± 6 A / voltage ± 30 V	12644-00	1
Cobra4 Wireless Manager	12600-00	1
Cobra4 Sensor-Unit Temperature, semiconductor -20...110 °C	12640-00	2
Storage case, h=130 mm	13269-00	1
Connecting cord, 32 A, 250 mm, blue	07360-04	1
Connecting cord, 32 A, 250 mm, red	07360-01	1
Rubber stopper 26/32, 2 holes 7 mm + 6 mm	39258-16	1
Rubber stopper 26/32, 1 hole 6 mm	39258-06	1

Cobra4 Wireless, 12605-89 Basic Set Physics, incl. software

Software Cobra4 - multi-user licence	14550-61	1
Cobra4 Wireless-Link	12601-00	1
Cobra4 Sensor-Unit Force ± 4 N	12642-00	1
Cobra4 Sensor-Unit Electricity, Current ± 6 A / Voltage ± 30 V	12644-00	1
Cobra4 Sensor-Unit 3D-Acceleration, ± 2 g, ± 6 g	12650-00	1
Cobra4 Wireless Manager	12600-00	1
Cobra4 Sensor-Unit Temperature, semiconductor -20...110 °C	12640-00	1
TESS and Demo advanced Manual Cobra4 Physics, Chemistry, Biology, Everyday Science	01330-02	1

Cobra4 JUNIOR- 12616-89 Link, Basic Set Physics for 5 groups

Software Cobra4 - multi-user licence	14550-61	1
Cobra4 Sensor-Unit Energy, current, voltage, power, energy	12656-00	1
Cobra4 Sensor-Unit Pressure, 7 bar absolute	12647-00	1
Cobra4 Sensor-Unit Force ± 40 N	12643-00	1
Cobra4 Junior-Link	12615-00	5
Cobra4 Sensor-Unit Motion, ultrasound motion detector	12649-00	1
Cobra4 Sensor-Unit Temperature, semiconductor -20...110 °C	12640-00	2
TESS and Demo advanced manual Cobra4 Physics, Chemistry, Biology, Everyday Science	01330-02	1
Foam for Cobra4 Junior-Link Set Physics	12616-25	1

DEMO Physics set 12651-88 Linear Motion/ Cobra4

Software Cobra4 - multi-user licence	14550-61	1
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Cobra4 Wireless-Link	12601-00	1
Cobra4 Sensor-Unit Timer/Counter	12651-00	1
Cobra4 Remote-Link	12602-00	1
Cobra4 Wireless Manager	12600-00	1
Light barrier, compact	11207-20	4
Cobra4 adapter for Sensor-Unit Timer/Counter to connect one light barrier	12651-01	3

Demonstration 11305-77 Track, basic bundle

Demonstration Track, Aluminium, Length: 1.5 m	11305-00	1
Cart, low friction sapphire bearings	11306-00	2
Weight for low friction cart, 400 g	11306-10	2
End holder for demonstration track	11305-12	1
Holder for pulley	11305-11	1
Pulley for demonstration track	11305-10	1
Shutter plate for low friction cart, width: 100 mm	11308-00	2
Plate with plug	11202-10	1
Fork with plug	11202-08	1

Cobra4 Wireless, 12606-89 Basic Set Chemistry

Software Cobra4 - multi-user licence	14550-61	1
Cobra4 Wireless-Link	12601-00	1
Cobra4 Sensor-Unit Chemistry, pH and 2 x Temperature NiCr-Ni	12630-00	1
Cobra4 Sensor-Unit Conductivity+, Conductivity/ Temperature (Pt1000)	12632-00	1
Conductivity temperature probe Pt1000	13701-01	1
Cobra4 Wireless Manager	12600-00	1
Immers. probe NiCr-Ni, teflon, 200° C	13615-05	1
TESS and Demo advanced manual Cobra4 Physics, Chemistry, Biology, Everyday Science	01330-02	1
pH-electrode, plastic, refill., BNC	46266-15	1
Protection sleeve for electrode with a diameter of 12 mm	37651-15	2

Set Gas laws with 43020-00 glass jacket system and Cobra4

Software Cobra4 - multi-user licence	14550-61	1
Cobra4 Sensor-Unit Thermodynamics, pressure abs. 2 bar and 2 temperature NiCr-Ni	12638-00	1
Cobra4 Wireless-Link	12601-00	1
Glass jacket	02615-00	1
Heating apparatus for glass jacket system	32246-93	1
Cobra4 Wireless Manager	12600-00	1
H-base PHYWE, with 5 fixing points	02009-55	1
Immersion probe NiCr-Ni, steel, -50...400° C	13615-03	1
Holder for Cobra4 with support rod	12680-00	1
Gas syringe, 100 ml	02614-00	1
Magnet, d = 10mm, l = 200mm	06311-00	1
Universal clamp	37715-00	2
Boss head	02043-00	6
Support rod, stainless steel, 500 mm	02032-00	1
Rubber tubing, vacuum, i.d. 6mm	39286-00	1

Support rod, stainless steel, l = 250 mm, d = 10 mm	02031-00	3
Rubber caps, pack of 20	02615-03	1
Glass tube, straight, l=80 mm, 10/pkg.	36701-65	1
Erlenmeyer flask, narrow n., 250 ml	36124-00	1
Hose clamp for 10-17 mm diameter	40998-00	2
Silicone tubing i.d. 7mm	39296-00	1
Magnetic stirring bar 30 mm, cylindrical	46299-02	1
Filter funnel, PP, d = 75 mm	46895-00	1

Cobra4 JUNIOR- 12617-89 Link, Basic Set Chemistry for 5 groups

Software Cobra4 - multi-user licence	14550-61	1
Cobra4 Sensor-Unit Chemistry, pH and 2 x Temperature NiCr-Ni	12630-00	1
Cobra4 Sensor-Unit Conductivity, with stainless steel electrodes	12633-00	2
Cobra4 Sensor-Unit Pressure, 7 bar absolute	12647-00	1
Cobra4 Junior-Link	12615-00	5
Cobra4 Sensor-Unit pH, BNC connector	12631-00	1
TESS and Demo advanced manual Cobra4 Physics, Chemistry, Biology, Everyday Science	01330-02	1
pH-electrode, plastic, refill., BNC	46266-15	2
Immersion probe NiCr-Ni, steel, -50...400° C	13615-03	2

TESS Cobra4 12619-77 Environment and outdoors, with 1 measurement instrument

Cobra4 Mobile-Link	12620-00	1
Cobra4 Sensor-Unit Weather: Humidity, Air pressure, Temperature, Light Intensity, Altitude	12670-00	1
Cobra4 Sensor-Unit Conductivity, with stainless steel electrodes	12633-00	1
Cobra4 Sensor-Unit pH, BNC connector	12631-00	1
Cobra4 Sensor-Unit Temperature, semiconductor -20...110 °C	12640-00	1
pH-electrode, plastic body, gel, BNC	46265-15	1
TESS advanced Applied Sciences manual Cobra4 environment and outdoors	12622-02	1
Foam insert for Cobra4 Environmental Experimentation case	12622-25	1
Fast Charging System for up to 4 MeH Accumulators	07930-99	1
SD memory card for Cobra4-Mobile-Link, 2 GB, 20 MB/sec	12620-01	1
Buffer solution tablets pH4, 100 pcs.	30281-10	1
Buffer solution tablets pH10, 100 pcs.	30283-10	1
Protection sleeve for electrode with a diameter of 12 mm	37651-15	1
Ni-MH accu, Mignon, 1.2 V, 2000 mAh, Eneloop Type, 4 pcs.	07930-03	0
Stand. solu. 1413 μ S/cm (25 °C), 460 ml	47070-02	1
Labels for microscopic slides, 120/pkg	64703-00	1
Wash bottle, plastic, 500 ml	33931-00	1
Beaker, 250 ml, low form, plastic	36013-01	2
Measurement software "measure Cobra4", CD-ROM	14501-00	1
Bottle, square, HDPE, 100ml	47417-00	4

Cobra4 12622-77 Environment and outdoors, for 4 workgroups

Cobra4 Mobile-Link	12620-00	4
Cobra4 Sensor-Unit Weather: Humidity, Air pressure, Temperature, Light Intensity, Altitude	12670-00	1
Cobra4 Sensor-Unit Conductivity, with stainless steel electrodes	12633-00	1
Cobra4 Sensor-Unit pH, BNC connector	12631-00	1
Cobra4 Sensor-Unit Temperature, semiconductor -20...110 °C	12640-00	1
pH-electrode, plastic body, gel, BNC	46265-15	1
TESS advanced Applied Sciences manual		
Cobra4 environment and outdoors	12622-02	1
Foam insert for Cobra4 Environmental Experimentation case	12622-25	1
Fast Charging System for up to 4 MeH accumulators	07930-99	1
SD memory card for Cobra4-Mobile-Link, 2 GB, 20 MB/sec	12620-01	4
Buffer solution tablets pH4, 100 pcs.	30281-10	1
Buffer solution tablets pH10, 100 pcs.	30283-10	1
Protection sleeve for electrode with a diameter of 12 mm	37651-15	1
Ni-MH accu, Mignon, 1.2 V, 2000 mAh, Eneloop Type, 4 pcs.	07930-03	1
Stand. solu. 1413 μ S/cm (25 α C), 460 ml	47070-02	1
Labels for microscopic slides, 120/pkg	64703-00	1
Wash bottle, plastic, 500 ml	33931-00	1
Beaker, 250 ml, low form, plastic	36013-01	2
Measurement Software "measure Cobra4", CD-ROM	14501-00	1
Bottle, square, HDPE, 100ml	47417-00	4

Basic set Cobra4 65982-89 Biochemistry and Plant physiology

Cobra4 Sensor-Unit Thermodynamics, pressure abs. 2 bar and 2 temperature NiCr-Ni	12638-00	1
Cobra4 Wireless-Link	12601-00	1
Cobra4 Sensor-Unit Weather: Humidity, Air pressure, Temperature, Light Intensity, Altitude	12670-00	1
Cobra4 Sensor-Unit Conductivity+, Conductivity/ Temperature (Pt1000)	12632-00	1
Conductivity temperature probe Pt1000	13701-01	1
Ceramic lamp socket E27 with reflector, switch, safety plug	06751-01	1
Cobra4 Sensor-Unit pH, BNC connector	12631-00	1
Cobra4 Wireless Manager	12600-00	1
pH-electrode, plastic body, gel, BNC	46265-15	1
Hot/cold air blower, 1800 W	04030-93	1
Immersion probe NiCr-Ni, steel, -50...400° C	13615-03	2
Holder for Cobra4 with support rod	12680-00	1
Support base variable	02001-00	2
Demo advanced Biology manual Cobra4 Biochemistry & plant physiology	01331-02	1
Dialysis clips, 2 pcs.	64209-00	2
Universal clamp with joint	37716-00	1
Filament lamp, 220 V/120 W, w.refl.	06759-93	1
Thermos flask	64841-00	2
Test tube, 200 x 30 mm, side arm, PN29	36331-00	1
Universal clamp	37715-00	2
Boss head	02043-00	2
Dialysis tubing 24 A, diam. 44 mm, 1m	64208-00	1
Test tube, 200 x 30 mm, DURAN, PN29	36294-00	1
Support rod, stainless steel, l = 500 mm	02032-00	3
Support rod, stainless steel, l = 250 mm, d = 10 mm	02031-00	1
Rubber stopper, d = 41/34 mm, 2 holes	39261-02	2

Rubber stopper 26/32, 1 hole 1,5 mm	39258-09	1
Rubber stopper 26/32, 1 hole 7 mm	39258-01	1

Standard labware 65980-77 set for biochemistry & plant physiology

Magnetic stirrer Mini / MST	47334-93	1
Micro-l syringe, 100 μ l	02606-00	1
Lab jack, 160 x 130 mm	02074-00	1
Retort stand, h = 750 mm	37694-00	1
Bunsen burner, nat.gas	32165-05	1
Test tubes 100 x 12 mm, FIOLEX, 100 pcs.	36307-10	1
Erlenmeyer flask, narrow neck, 100 ml, PN 19	36418-00	7
Separator for magnetic bars	35680-03	1
Erlenmeyer flask, narrow neck, PN 29	36424-00	1
Disposable gloves, 100 pcs., medium	46359-00	1
Pipettor	36592-00	1
Mortar with pestle, 150 ml, porcelain	32604-00	1
Glass beaker DURAN®, tall, 1000 ml	36008-00	1
Glass beaker DURAN®, short, 1000 ml	36017-00	1
Pasteur pipettes, 250 pcs.	36590-00	1
Tripod, ring-d = 100 mm, h = 180 mm	33299-00	1
Safety gas tubing, DVGW, sold by metre	39281-10	1
Volumetric pipette, 50 ml	36581-00	1
Plasticine, 10 sticks	03935-03	1
Lab thermom.-10...+100° C, w/o Hg	47040-00	1
Graduated cylinder 25 ml	36627-00	1
Rubber caps, 10 pcs.	39275-03	1
Graduated cylinder 100 ml	36629-00	2
Beaker, low, BORO 3.3, 1000 ml	46057-00	1
Glass beaker DURAN®, tall, 50 ml	36001-00	2
Glass beaker DURAN®, tall, 100 ml	36002-00	8
Glass beaker DURAN®, tall, 250 ml	36004-00	2
Glass tube, straight, l = 80 mm, 10/pkg.	36701-65	1
Glass beaker DURAN®, short, 250 ml	36013-00	1
Volumetric pipette, 20 ml	36579-00	1
Magn.stirring bar 50 mm, cyl.	46299-03	1
Microspoon, steel	33393-00	1
Funnel, glass, top dia. 55 mm	34457-00	1
Sieve, fine mesh, d = 60 mm	40968-00	1
Magnetic stirring bar 30 mm, cylindrical	46299-02	1
Wash bottle, plastic, 500 ml	33931-00	1
Wire gauze 120 x 120mm, ceramic cen.	33287-03	1
Volumetric pipette, 1 ml	36575-00	1
Beaker, high, BORO 3.3, 250 ml	46027-00	2
Graduated pipette 10 ml	36600-00	2
Graduated pipette, 1 ml	36595-00	1
Rubber bands, 50 pieces	03920-00	1
Beaker, 250 ml, low form, plastic	36013-01	1
Rubber tubing, i.d. 6 mm	39282-00	1
Hose clip, diam. 8-12 mm	40996-01	2
Rubber stopper 26/32, 1 hole 7 mm	39258-01	1
Dropping bottle, plastic, 50 ml	33920-00	1
Glass rod, boro 3.3, l = 200 mm, d = 3 mm	40485-01	1
Rubber stopper, d = 2 2/17 mm, without hole	39255-00	7

Chemicals set 65980-10 Biochemistry & plant physiology

Natriumhydrogencarbonat, 250 g	1
Tartrazin, 25 g	1
Patentblau-V, 25 g	1
Pufferlösung pH 4, 01, 460 ml	1
Pufferlösung pH 10, 01, 1000 ml	1
Salzsäure, 1,0 mol / l, 1000 ml	1
Natriumhydroxidlösung, 1,0 M, 1000 ml	1
Harnstoff, reinst, 250 g	1
Ureaselösung in 50% Glycerin, 10 ml	1

Silbernitrat, reinst, 15 g/Wasser, destilliert, 5 l	1
Glycerin, 99%, 100 ml	1
Wasserstoffperoxid, 30%, 250 ml	1

Cobra4 JUNIOR- 12618-89 Link, Basic Set Biology for 5 groups

Software Cobra4 - multi-user licence	14550-61	1
Cobra4 Sensor-Unit Weather: Humidity, Air pressure, Temperature, Light Intensity, Altitude	12670-00	1
Cobra4 Junior-Unit Spirometry, Pulmonary volume and wind speed	12675-00	1
Cobra4 Sensor-Unit Conductivity, with stainless steel electrodes	12633-00	1
Cobra4 Sensor-Unit Pulse, Heart rate, incl. ear clip	12672-00	1
Cobra4 Junior-Link	12615-00	5
Cobra4 Sensor-Unit pH, BNC connector	12631-00	1
Cobra4 Sensor-Unit Temperature, semiconductor -20...110 °C	12640-00	2
TESS and Demo advanced manual		
Cobra4 Physics, Chemistry, Biology, Everyday Science	01330-02	1
pH-electrode, plastic, refill., BNC	46266-15	1

Cobra4 wireless, 12608-88 extension set for renewable energy: electric parameters, temperature

Software Cobra4 - multi-user licence	14550-61	1
Cobra4 Sensor-Unit Energy, current, voltage, power, energy	12656-00	1
Cobra4 Wireless-Link	12601-00	2
Cobra4 Sensor-Unit 2 x Temperature, NiCr-Ni	12641-00	1
Cobra4 Wireless Manager	12600-00	1
Immersion probe NiCr-Ni, steel, -50...400° C	13615-03	2
Fast Charging System for up to 4 MeH Accumulators	07930-99	1
Holder for Cobra4, magn.	02161-10	2
Ni-MH accu, Mignon, 1.2 V, 2000 mAh, Eneloop Type, 4 pcs.	07930-03	1

TESS advanced 12673-89 Applied Sciences set Electrophysiology

Software Cobra4 - multi-user licence	14550-61	1
Cobra4 Sensor-Unit Electrophysiology: ECG, EMG, EOG	12673-00	1
Cobra4 Wireless-Link	12601-00	1
Cobra4 Wireless Manager	12600-00	1
ECG electrodes, 3/pkg.	65981-01	1
Shielded leads for electrophysiology, color-coded, 3/pkg.	12673-01	1
EMG electrodes, 3 off	65981-02	1
TESS advanced Biology manual Cobra4 Electrophysiology: ECG, EMG, EOG	12673-12	1
Foam insert for Cobra4		
Electrophysiology Set	12673-25	1
Electrodes for ECG Sensor, 100 pcs.	12559-01	1
Electrode Gel, tube	65981-06	1
Crocodile clips for disposable electrodes, 3/pkg.	12673-02	1

8 Ordering Overview

8.1 Sets

Cobra4 Display-Connect, Basic Set with digital large-scale display, Mobile Link, weather sensor 12607-89

Large-scale display, digital, RS-232 port	07157-93	1
Cobra4 Display-Connect, Set of transmitter and receiver for using the Cobra4 Mobile-Link with large-scale displays	12623-88	1
Cobra4 Mobile-Link set, incl. rechargeable batteries, SD memory card, USB cable and software "measure"	12620-55	1
Cobra4 Sensor-Unit Weather: Humidity, Air pressure, Temperature, Light intensity, Altitude	12670-00	1
Case Aluminum with foam insert 54 x 41 x 19 cm	12611-01	1
TESS and Demo advanced manual		
Cobra4 Physics, Chemistry, Biology, Everyday Science	01330-02	1
Fast Charging System for up to 4 MeH accumulators	07930-99	1
Stand for Cobra4	12681-00	1

Cobra4 Mobile, for 4 work groups 12621-44

Cobra4 Mobile-Link	12620-00	4
Fast Charging System for up to 4 MeH accumulators	07930-99	1
SD memory card for Cobra4-Mobile-Link, 2 GB, 20 MB/sec	12620-01	4
Ni-MH accu, Mignon, 1.2 V, 2000 mAh, Eneloop Type, 4 pcs.	07930-03	1
SD card reader	12620-03	1
Measurement Software "measure Cobra4", CD-ROM	14501-00	1

Cobra4 Mobile, for 8 work groups 12621-88

Cobra4 Mobile-Link	12620-00	8
Fast Charging System for up to 4 MeH accumulators	07930-99	1
SD memory card for Cobra4-Mobile-Link, 2 GB, 20MB/sec	12620-01	8
Ni-MH accu, Mignon, 1.2 V, 2000 mAh, Eneloop Type, 4 pcs.	07930-03	3
SD card reader	12620-03	1
Measurement Software "measure Cobra4", CD-ROM	14501-00	1

Cobra4 Demo-Set Physics Chemistry - Biology incl. PC 12609-88

Software Cobra4 - multi-user licence	14550-61	1
Geiger-Mueller Counter tube, 45 mm	09007-00	1
Cobra4 Sensor-Unit Energy, current, voltage, power, energy	12656-00	1
Cobra4 Wireless-Link	12601-00	1
Cobra4 Sensor-Unit Force ± 4 N	12642-00	1
Cobra4 Sensor-Unit Chemistry, pH and 2 x Temperature NiCr-Ni	12630-00	1

Cobra4 Sensor-Unit Conductivity, with stainless steel electrodes	12633-00	1
Cobra4 Sensor-Unit Spirometry, Pulmonary volume and wind speed	12675-00	1
Cobra4 Sensor-Unit Radioactivity	12665-00	1
Cobra4 Sensor-Unit Electricity, current ± 6 A/ voltage ± 30 V	12644-00	1
Cobra4 Sensor-Unit 3D-Acceleration, ± 2 g, ± 6 g	12650-00	1
Cobra4 Junior-Link	12615-00	1
Cobra4 Wireless Manager	12600-00	1
Cobra4 Sensor-Unit Motion, ultrasound motion detector	12649-00	1
Cobra4 Sensor-Unit Temperature, semiconductor -20...110 °C	12640-00	1
U-core	07832-00	1
pH-electrode, plastic, refill., BNC	46266-15	1
Immersion probe NiCr-Ni, steel, -50...400° C	13615-03	2
Coil, 400 turns	07829-01	2
Fast Charging System for up to 4 MeH accumulators	07930-99	1
Bar magnet, l = 72mm	07823-00	1
Junction module, SB	05601-10	4
Silicon-diode module 1N4007, SB	05651-00	1
Resistor module 1 kOhm, SB	05614-10	1
Capacitor module 47 μ F non-polar electrolytic, SB	05645-47	1
Capacitor module 100 μ F non-polar electrolytic, SB	05646-10	1
Capacitor module 470 μ F non-polar electrolytic, SB	05646-47	1
Protection sleeve for electrode with a diameter of 12 mm	37651-15	1
Ni-MH accu, Mignon, 1.2 V, 2000 mAh, Eneloop Type, 4 pcs.	07930-03	1
Screened cable, BNC, l = 750 mm	07542-11	1
T-shaped connector module, SB	05601-03	4
Straight connector module, SB	05601-01	1
Rotating stem	07836-00	1
Weight holder for slotted weights	02204-00	1
Slotted weight, 50 g, black	02206-01	2
Plastic sack, flat, DIN A4, 100 pcs.	46444-02	0.1
Bearing plate	07837-00	1
Helical spring, 3 N/m	02220-00	1
Slotted weight, 10 g, black	02205-01	2
Connecting cord, 32 A, 500 mm, red	07361-01	1
Connecting cord, 32 A, 500 mm, blue	07361-04	1
Helical spring, 20 N/m	02222-00	1
Connecting cord, 32 A, 250 mm, red	07360-01	1
Connecting cord, 32 A, 250 mm, blue	07360-04	1
Connecting cord, 100 mm, yellow	07359-02	1
Rubber rings, 5 pieces	02673-00	1

Literature

TESS and Demo advanced Manual Cobra4 Physics, Chemistry, Biology, Everyday Science



Topics

- Physics: Mechanics, Thermodynamics, Electricity
- Chemistry: Chemical equilibrium, Electrochemistry
- Biology: Ecology, Physiology, Biochemistry and Plant physiology
- Everyday science: Home, Outdoors, Hobby, Technics, Transportation

01330-02

Demo advanced Biology Manual Cobra4 Biochemistry & Plant Physiology



Topics

- Photosynthesis (2 different methods)
- Transpiration of leaves
- Glycolysis (2 different methods)
- The ionic permeability of the cell membrane
- Determination of the Michaelis constant; Enzyme inhibition
- Substrate inhibition of enzymes

01331-02

TESS advanced Applied Sciences Manual Cobra4 environment and outdoors



Topics

- Learning stations using the experimentation case "Environment and Outdoors"
- We examine our drinking water
- Acidity changes of a watercourse
- Salinity changes of a watercourse
- Water quality - heavy metal pollution
- Salinity of soils and plant substrates
- Acidity of soils

12622-02

TESS advanced Physics Manual Cobra4 Mechanics, Heat, Electricity/ Electronics

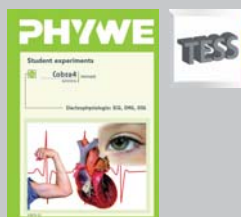


Topics

- Mechanics: Forces, Oscillations (3 experiments)
- Heat: Thermal equilibrium, Heat transfer, Thermal energy, Change of state (11 experiments)
- Electricity / Electronics: Electrical resistance, Electric power and work, The capacitor, The diode, Electrochemistry, Electric motors, Special components and circuits (13 experiments)

01332-02

TESS advanced Biology Manual Cobra4 Electrophysiology: ECG, EMG, EOG



Topics

- We investigate our heartbeat (Electrocardiography)
- We determine our heart frequency
- We investigate our physical fitness (the heart under strain)
- We investigate our muscular power (Electromyography)
- We investigate our eye movements (Electrooculography)
- We measure our reading speed; Electronystagmography

12673-12

Demo advanced Applied Sciences Manual Renewable Energy on the magnetic board, incl CD ROM, second edition



Topics

- Conversion of energy; Storage of energy
- Solar energy (thermal, photovoltaics)
- Water power (only set 2); Wind power
- Geothermal Energy; Ambient Heat
- Hydrogen technology / Fuel cells (only set 2)

01157-02

Cobra4 in a nutshell

Which sensor is the right one for your application?

Parameter	Sensor-Unit	Article No.	Accessories	Article No.
Motion	Motion	12649-00	-*	
	Acceleration	12650-00	-*	
	Timer Counter	12651-00	Light barrier	11207-00
			Adapter	12651-01
Movement sensor with cable			12004-10	
Forces	Force 40 N	12643-00	-*	
	Force 4 N	12642-00	-*	
	Force plate	12661-00	-*	
Electricity	Electricity	12644-00	-*	
	Energy	12656-00	-*	
Magnetic Field	Tesla	12652-00	Hall probe axial / Hall probe tangential	13610-01, 13610-02
Radioactivity	Radioactivity	12665-00	Geiger-Mueller Counter tube, 45 mm	09007-00
			or Counter tube Type B	09025-11
			or Counter tube Type A	09005-00
			+ Screened cable, BNC, l 750 mm	07542-11
Sound Level	Sound Level	12669-00	-*	
	Energy	12656-00	Measuring microphone with amplifier	03543-00
or Measuring microphone			03542-00	
Sound Frequency	Timer Counter	12651-00	Measuring microphone	03542-00
			or Measuring microphone with amplifier	03543-00
Light	Electricity	12644-00	Photocell, silicon	07937-00
	Weather	12670-00	Universal measuring amplifier	13626-93
Temperature	Temperature-semiconductor	12640-00	-*	
	2 x Temperature	12641-00	Thermoelement NiCr-Ni	13615-02, 13615-01
			or Immersion probe NiCr-Ni, steel, -50...400°C	13615-03, 12615-05
			or Surface probe NiCr-Ni	13615-04
	Thermodynamics	12638-00	NiCr-Ni probes, see above	
	Conductivity +	12632-00	Temp. probe, imm. type, Pt1000	12123-00
Chemistry	12630-00	NiCr-Ni probes, see above		
Pressure	Pressure	12647-00	-*	
	Thermodynamics	12638-00	-*	
Air Pressure	Weather	12670-00	-*	
pH-Value	pH	12631-00	pH-electrode, plastic body, gel, BNC	46265-15
			or pH-electrode, plastic, refill., BNC	46266-15
			or pH-electrode, glass, refill., BNC	46268-10
	Chemistry	12630-00	see "pH-Value, SU pH"	
Redox-Potential	pH	12631-00	Redox electrode, BNC	46267-10
	Chemistry	12630-00		
Temperature + Pressure	Thermodynamics	12638-00	Thermoelement NiCr-Ni	13615-02, 13615-01
			or Immersion probe NiCr-Ni, steel, -50...400°C	13615-03, 12615-05
			or Surface probe NiCr-Ni	13615-04
pH-Value + Temperature	Chemistry	12630-00	NiCr-Ni probes, see "Temperature"	
			pH-electrode, see "pH-value"	
Conductivity	Conductivity	12633-00	-*	
	Conductivity +	12632-00	Conductivity temperature probe Pt1000	13701-01
Colours	Colorimeter	12634-00	Cuvettes (Coming soon)	
Humidity	Weather	12670-00	-*	
Ambient Temperature	Weather	12670-00	-*	
Oxygen	Oxygen	12676-00	Oxygen probe (Coming soon)	
Carbon Dioxide	Carbon dioxide	12671-00	-*	
Wind	Spizometry	12675-00	Disposable turbine, set of 10	12675-10
Skin Resistance	Skin resistance	12677-00	Accessories (Coming soon)	
Heart Rate	Pulse	12672-00	-* (ear clip included)	
	Electrophysiology	12673-00	Electrodes for ECG Sensor, 100 pcs.	12559-01
			Shielded leads for electrophysiology, color-coded, 3/pkg	12673-01
			Crocodile clips for disposable electrodes, 3/pkg	12673-02
Respiratory Rate and Lung Volume	Spizometry	12675-00	Disposable turbine with cardboard-mouthpiece, set of 10	12675-10

*In these cases no further accessories are necessary to measure the parameter.

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