PHYSICS

CHEMISTRY
BIOLOGY

ENGINEERING

LD DIDACTIC

CASSY

THE SOLUTION

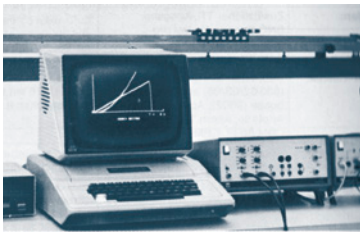
LEYBOLD®

25 YEARS CASSY®

For over two decades CASSY has stood for computer-assisted experimenting at all levels of education, from secondary schools to university.

Twenty five years ago our idea of sensor boxes and sensors was pioneering. Since then CASSY has been developed into the modular and flexible system that it is today and, with its software CASSY Lab has been one of the most successful and popular solutions for data acquisition and analysis.

The didactic concept, the intuitive handling as well as high technical standards have convinced not only the many users around the world, but also the international jury of the Worlddidac Association, who awarded the current Sensor-CASSY 2 and the software CASSY Lab 2 the prestigious Worlddidac Award. Another reason to celebrate the 25-year success story of the CASSY system.



1982

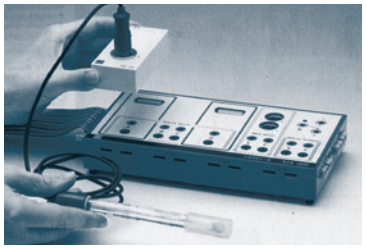
CAP, our first Inferface for Apple II, BBC-, CBM computer, followed by CAP-CS2 for C64 and CAP 3

1988

Idea of universal sensor boxes and sensors for CASSY

1990

Presentation of first CASSY-E



THE SOLUTION

worlddidac
15th AWARD 2012

2003

Extension of the CASSY range by Mobile-CASSY and Pocket-CASSY

2012

Sensor-CASSY 2 and CASSY Lab 2 have been awarded with the Worlddidac Award.

With Pocket-CASSY 2 Bluetooth experimenting is easier and more flexible than ever before.

1999

Presentation of Sensor-CASSY with CASSY Lab, Power-CASSY and CASSY-Display

2010

Sensor-CASSY 2 and CASSY Lab 2 replace Sensor-CASSY and CASSY Lab.

2013

We celebrate 25 years computer-assisted experimenting with CASSY.

LEYBOLD®

THE SUITABLE SOLUTION FOR EACH TEACHING SITUATION

BENEFITS AT A GLANCE

DEMONSTRATION EXPERIMENT

with computer

- Reliable measurement and analysis
- Possible operation with whiteboard
- Plug & Play

DEMONSTRATION EXPERIMENT

without computer

- Simple set-up
- Easy operation
- Plug & Play

STUDENT EXPERIMENT

- Stable and economically priced
- Easy operation
- Plug & Play

FLEXIBLE MEASUREMENTS

without cable

- For outdoor experiments
- Wirelessly
- Plug & Play

TYPICAL MEASURING CAPABILITIES WITH CASSY

PHYSICS

Voltage, current, power factor, power, resistance, level, pulse, count rate, frequency, time, time-of-flight (sound), time-of-flight (light), path, angle, amplitude, oscillation period, rotary frequency, force, acceleration, pressure, temperature, humidity, air temperature, illuminance, atmospheric pressure, height, magnetic flux density, electric field strength, energy spectra α, β, γ, X-ray

32 MEAS. QUANTITIES

Voltage, current, resistance, pulse, count rate, frequency, time, time-of-flight (sound), time-of-flight (light), path, angle, amplitude, oscillation period, rotary frequency, force, acceleration, pressure, temperature, humidity, air temperature, illuminance, atmospheric pressure, height, magnetic flux density, electric field strength

25 MEAS. QUANTITIES

Voltage, current, resistance, level, pulse, count rate, frequency, time, time-of-flight (sound), path, angle, amplitude, oscillation period, rotary frequency, force, acceleration, pressure, temperature, humidity, air temperature, illuminance, atmospheric pressure, height, magnetic flux density

24 MEAS. QUANTITIES

Voltage, current, resistance, path, angle, amplitude, oscillation period, rotary frequency, force, acceleration, pressure, temperature, humidity, air temperature, illuminance, atmospheric pressure, height, magnetic flux density, electric field strength

19 MEAS. QUANTITIES

CHEMISTRY

Temperature, differential temperature, pH value, potential, conductivity, transmission, extinction, concentration, voltage, current, pressure, oxygen concentration, oxygen saturation, CO_2 concentration

14 MEAS. QUANTITIES

Temperature, differential temperature, pH value, potential, conductivity, transmission, extinction, voltage, current, pressure, oxygen concentration, oxygen saturation, CO_2 concentration

13 MEAS. QUANTITIES

Temperature, differential temperature, pH value, potential, conductivity, transmission, extinction, concentration, voltage, current, pressure

11 MEAS. QUANTITIES

Temperature, differential temperature, pH value, potential, conductivity, transmission, extinction, voltage, current, pressure, oxygen concentration, oxygen saturation, CO_2 concentration

13 MEAS. QUANTITIES

BIOLOGY

Pulse, skin resistance, ECG, EMG, blood pressure, respiration volume flow, reaction time, hearing threshold, temperature, differential temperature, pH value, conductivity, transmission, extinction, concentration, oxygen concentration, oxygen saturation, CO_2 concentration, humidity, air temperature, illuminance, atmospheric pressure, height

23 MEAS. QUANTITIES

Pulse, skin resistance, blood pressure, respiration volume flow, reaction time, hearing threshold, temperature, differential temperature, pH value, conductivity, oxygen concentration, oxygen saturation, CO_2 concentration, humidity, air temperature, illuminance, atmospheric pressure, height

18 MEAS. QUANTITIES

Pulse, skin resistance, reaction time, hearing threshold, temperature, differential temperature, pH value, conductivity, transmission, extinction, concentration, humidity, air temperature, illuminance, atmospheric pressure, height

16 MEAS. QUANTITIES

Pulse, skin resistance, respiration volume flow, hearing threshold, temperature, differential temperature, pH value, conductivity, tansmission, extinction, concentration, oxygen concentration, oxygen saturation, CO_2 concentration, humidity, air temperature, illuminance, atmospheric pressure, height

19 MEAS. QUANTITIES

AN OVERVIEW OF ALL MEASURING AND CONNECTION CAPABILITIES IS AVAILABLE ON PAGE 16

CASSY-THE SYSTEM

COMPUTER-ASSISTED EXPERIMENTING

- modular and flexible
- for all level of education and requirements – from secondary school to university

Extensive offer of sensors for determing many measurements in Physics, Chemistry and Biology

BASIC UNITS

USABLE WITH OR WITHOUT COMPUTER

1.

SENSO

FOR ALL MEASURING TASKS

BENEFITS AT A GLANCE

- many measurements are possible due to our extensive offer of sensors
- for demonstration and student experiments
- easy and intuitive operation

DETAILED PRODUCT INFORMATION IS AVAILABLE FROM PAGE 20.

CASSY Lab 2:
The suitable software
for all units and sensors.

RS

G

2.

TEACHWARE

DATA ACQUISITION,
ANALYSING AND
EXPERIMENTAL LITERATURE

3.

SENSOR-CASSY 2

worlddidac
15th AWARD 2012

INTERFACE FOR DATA ACQUISITION

- for connection to the USB port of a computer, another CASSY module or to the CASSY-Display
- simultaneous measurements of voltage, current and two additional sensors are possible
- automatic sensor detection
- can be set up as a benchtop, console or demonstration unit (also suitable for CPS/TPS panel frames)

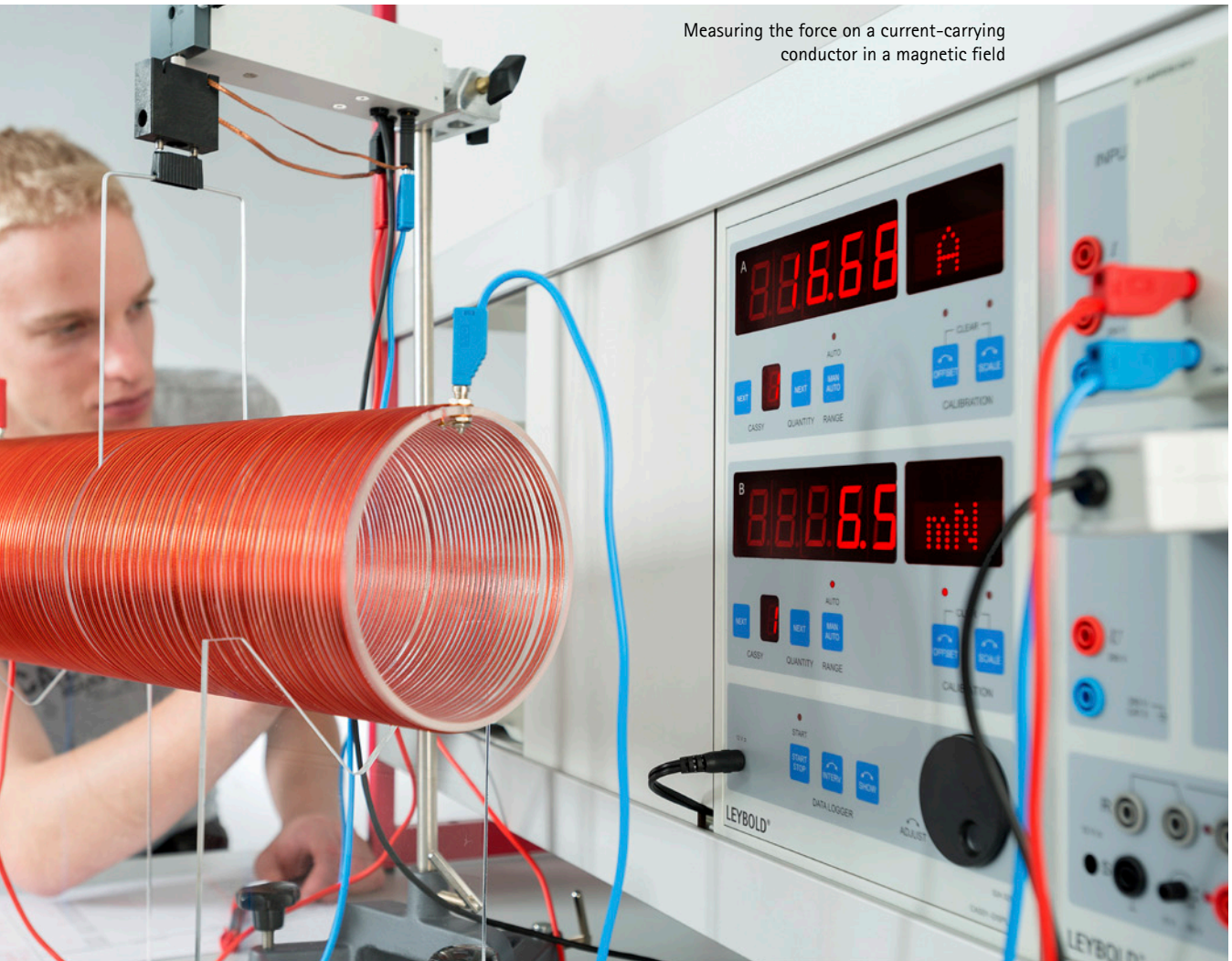
PLUG & PLAY

automatic detection and set-up of CASSY and sensor boxes

COMPATIBLE

to all CASSY sensor boxes and sensors

Sensor-CASSY 2 (524 013) provides two electrically isolated voltage inputs, an alternative current input and parallel two sensor box inputs. All inputs have switchable measurement ranges.



Measuring the force on a current-carrying conductor in a magnetic field

POWER-CASSY

PROGRAMMABLE CURRENT OR VOLTAGE SOURCE

- with integrated current or voltage measurement
- can be set up as a benchtop, console or demonstration unit (also suitable for CPS/TPS panel frames)
- for connection to the USB port of a computer, another CASSY module or to the CASSY-Display
- CASSYs with USB port and CASSYs with serial interface can be mixed cascadable

FLEXIBLE

The design allows versatile use in the classroom. Different inclinations for desktop use and the use in the panel frame is possible.

Power-CASSY (524 011USB) can replace a power function generator. By the integrated current measurement when operating as voltage source no further input for a second CASSY module for measurements is required. Therefore, for example, a single Power-CASSY is sufficient for recording of characteristics of a two terminal network.

CASSY-DISPLAY

2-CHANNEL DISPLAY FOR DISPLAYED MEASURED VALUES WITHOUT A COMPUTER

- can be set up as a benchtop, console or demonstration unit (also suitable for CPS/TPS panel frames)
- supports up to 8 Sensor-CASSYs (equivalent to 16 measuring channels)
- measurements are carried out using Sensor-CASSY or a sensor box connected there (see specifications of respective device for measurement quantities and ranges)
- measured values can be switched and calibrated individually. The measuring range and unit are matched automatically when plugging and swapping sensor boxes

The CASSY-Display (524 020USB) indicates the current measured values of the connected Sensor-CASSYs. The suitable measurement of the attached sensor box is automatically chosen. Thus, it replaces during simple measurement tasks, both the computer and with a Sensor-CASSY commercial demonstration units (e.g. voltmeter, ammeter, tesla meter, newton meter, barometer). Furthermore it provides a measured value memory, which can be read and analysed later by CASSY Lab at the computer.

UNIVERSAL MEASURING INSTRUMENTS

- measurements of many different quantities due to exchangeable sensors
- connectable via USB port to a computer
- easy handling
- automatic sensor detection (plug & play)
- large display

Ideal for measurements not requiring a computer. Through the optional connection to a computer graphic measurements and analysis are also easily possible.

PHYSICS SENSORS

(not included in the scope of delivery):

- Force sensor S, ±50 N
- Force sensor S, ±1 N
- Force plate S
- Pressure sensor S, ±2000 hPa
- Pressure sensor S, ±70 hPa
- Absolute pressure sensor S, 1500 hPa
- Laser motion sensor S
- Rotary motion sensor S
- 3D acceleration sensor S
- Centrifugal force apparatus S
- Temperature sensor S, NTC
- NiCr-Ni adapter S
- UIP sensor S
- Electric field meter S
- Axiale B sensor S, ±0.3 mT
- Axiale B sensor S, ±1000 mT
- Combi B sensor S
- Geiger-Müller counter tube S
- Climate sensor S

Universal measuring instrument Physics (531 835)

Universal measuring instrument Chemistry (531 836)

Universal measuring instrume Biology (531 837)

PHYSICS CHEMISTRY BIOLOGY

CHEMISTRY SENSORS

(not included in the scope of delivery):

- pH adapter S
- Conductivity adapter S
- Pressure sensors S, ±2000 hPa, ±70 hPa and 1500 hPa
- Temperature sensor S, NTC
- NiCr-Ni adapter S
- O_2 adapter S
- CO_2 sensor S
- Immersion photometer S
- UIP sensor S
- Lux adapter S
- Humidity sensor S

BIOLOGY SENSORS

(not included in the scope of delivery):

- Reaction test adapter S
- Pulse sensor S
- Skin resistance sensor S
- Blood pressure sensor S
- Spirometer box
- pH adapter S
- Pressure sensors S, ±2000 hPa, ±70 hPa and 1500 hPa
- Temperature sensor S, NTC
- NiCr-Ni adapter S
- O_2 adapter S
- CO_2 sensor S
- UIP sensor S
- Lux adapter S
- Climate sensor S
- Humidity sensor S
- Hearing threshold adapter S

LEYBOLD®

Monitoring of the pH value during a titration with Mobile-CASSY

MOBILE-CASSY

Mobile-CASSY
(524 009A)

NEW

HAND-HELD MEASURING INSTRUMENT FOR NATURAL SCIENCE PURPOSES

- used in conjunction with sensors from the CASSY family, Mobile-CASSY can perform varied measurements in the fields of physics, chemistry and biology, e.g. measurement of temperature, conductivity, pH value, pressure, force, heart rate and many other quantities
- up to four measured values can be displayed at the device, which offers several font sizes to be selected from
- if Mobile-CASSY is used in conjunction with CASSY Lab (524 220), the computer can be employed for large-screen displays and for recording measured values
- data memory for up to 16,000 measured values is preserved after switching off and can thus be read by CASSY Lab via the USB port later on
- **NEW: Simplified charging by built-in rechargeable battery**

QUICK AND EASY

THE RECHARGEABLE BATTERY FOR POCKET-CASSY 2 BLUETOOTH

NEW

After measuring in the classroom all Pocket-CASSY batteries (524 019) can be nested (cascaded) within seconds and then be recharged by only one power supply. The battery cascade always gives information about the recharging progress.

IP REGISTRATION

Wireless measurements of acceleration, velocity and path on a inclined plane using the Pocket-CASSY 2 Bluetooth (524 018) and 3D acceleration sensor (524 0424).

POCKET-CASSY 2

STUDENT INTERFACE FOR DATA RECORDING

- ideal solution for computer-assisted measuring with the advanced science kits system
- supports all sensors and sensor boxes of the CASSY range
- data transfer optionally via USB or Bluetooth (wireless)
- power supply optionally via USB, plug-in supply unit (wireless to computer) or optional rechargeable battery (completely wireless)
- sampling rate up to 100 kHz (also wireless)

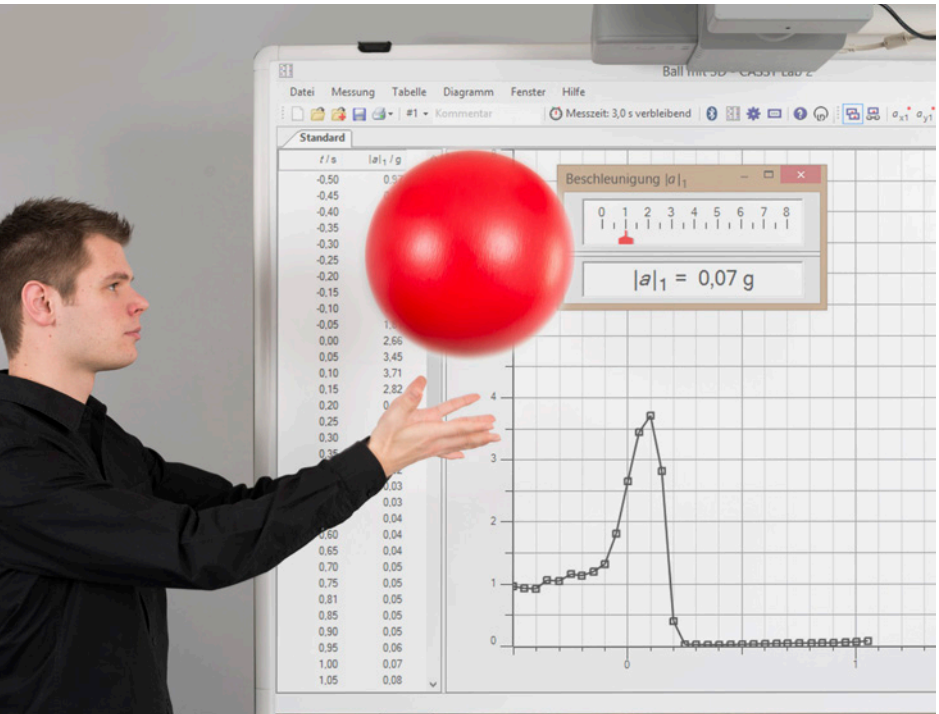
On YouTube you can see how easy it is to measure with POCKET-CASSY 2!

WWW.YOUTUBE.COM/USER/LDDIDACTIC

NEW

WIRELESS MEASURING

With Pocket-CASSY experimenting is easier and more flexible than ever before!



IP REGISTRATION

Pocket-CASSY 2 (524 018) measures with the 3D acceleration sensor (524 0424) the acting g-forces. During the throw there is zero gravity inside the ball.

2 IN 1

MICRO-CASSY

SIMPLE DATA ACQUISITION FOR STUDENT EXPERIMENTS WITH SCIENCE KITS

The new LEYBOLD Micro-CASSY is an economically priced data acqusition system in a practical USB flash drive format. The robust Micro-CASSYs are interface and sensor in one and therefore easy to use - ideal for student experiments in Physics, Chemistry and Biology for secondary schools.
Micro-CASSY is specially designed for the easy implementation of standard measurements as for example the determination of tensions or pH values in primary schools, secondary school and colleges.

Using Micro-CASSY is easy and intuitively:

1. Starting the software CASSY Lab 2.
2. Connecting the sensors to the USB ports of the computer.
3. CASSY Lab 2 provides measurement data and charts.

MICRO-CASSY AT A GLANCE

- sensors for voltage, current, temperature and pH value
- robust, simple, economically priced
- with USB port, no additional interface required
- also suitable for mobile use with netbooks and Laptops (entire Micro-CASSY equipment)
- automatic detection of sensors (Plug & Play)
- multi-channel use with different Micro-CASSYs or Pocket-CASSYs is possible

SENSORS

Micro-CASSY Voltage
528 11

Micro-CASSY Current
528 12

Micro-CASSY Temperature
528 15

Micro-CASSY pH value
528 18

On YouTube you can see how easy it is to measure with Micro-CASSY!

WWW.YOUTUBE.COM/USER/LDDIDACTIC

SENSORS

THE EXTENSIVE SENSORS OFFER FOR ALL MEASUREMENTS IN PHYSICS, CHEMISTRY AND BIOLOGY LESSONS

CO_2 sensor S

Chemistry box

Force sensor S

Blood pressure sensor S

Universal microphone

MORE THAN 50 SENSORS

OVER 100 MEAS. QUANTITIES

Absolute pressure sensor S

Laser motion sensor S

Immersion photometer S

OVERVIEW OF SENSORS

MEASUREMENT AND CONNECTIVITY CAPABILITIES FOR CASSY AND UNIVERSAL MEASURING INSTRUMENTS

Measurement quantities	Name	Cat. No.	DEMONSTRATION EXPERIMENTS WITH COMPUTER Sensor-CASSY 2
Voltage	Micro-CASSY voltage	528 11	
Current	Micro-CASSY current	528 12	
Temperature	Micro-CASSY temperature	528 15	
pH value	Micro-CASSY pH value	528 18	
Resistance, path	Current supply box	524 031	X
Pulse, counter rate	Geiger-Müller box	524 033	X
Pulse, counter rate	Geiger-Müller counter tube S	524 0331	X
Level, pulse, counter rate, frequency, times, path, angle, velocity	Timer box	524 034	X
Magnetic flux density	Combi B sensor S	524 0381	X
Magnetic flux density	Axial B sensor, ±1000 mT	524 0382	X
Magnetic flux density	Axial B sensor, ±0.3 mT	524 0383	X
Voltage	µV box	524 040	X
Force, acceleration	Force sensor S, ±50 N	524 042	X
Force	Force plate S	524 0421	X
3 x acceleration, magnitude of acceleration	3D acceleration sensor S	524 0424	X
Current	30 A box	524 043	X
Temperature	Temperature sensor S, NTC	524 044	X
2 x temperature, differential temperature	Temperature box NiCr-Ni/NTC	524 045	X
Reaction time	Reaction test adapter	524 0461	X
Pulse	Pulse sensor S	524 0471	X
Skin resistance	Skin resistance sensor S	524 0481	X
3 x ECG, EMG	ECG/EMG box	524 049	X
1 x ECG, EMG	ECG/EMG sensor S	524 0491	X
Blood pressure	Blood pressure sensor S	524 0501	X
Illuminance	Lux adapter S	524 0511	X
Oxygen concentration, oxygen saturation	Oxygen adapter S	524 0521	X
Voltage	Electrometer box	524 054	X
Respiration volume flow	Spirometer box	524 056	X
Humidity, 2 x temperature, illuminance, atmospheric pressure	Climate box	524 057	X
Humidity, air temperature	Humidity sensor S	524 0572	X
Humidity, air temperature, illuminance, atmospheric pressure, height	Climate sensor S	524 0573	X
Energy spectra α, β, γ, X-ray	MCA box	524 058	X
Voltage, frequency, time-of-flight, sound level	Mikrophone S	524 059	X
Force	Force sensor S, ±1 N	524 060	X
Current, voltage, power factor	UIP sensor S	524 0621	integrated
Pressure	Pressure sensor S, ±2000 hPa	524 064	X
Pressure	Absolute pressure sensor S, 1500 hPa	524 065	X
Pressure	Pressure sensor S, ±70 hPa	524 066	X
pH, conductivity, 3 x temperature, potential	Chemistry box	524 067	X
Conductivity, temperature	Conductivity adapter S	524 0671	X
pH, potential	pH adapter S	524 0672	X
2 x temperature, differential temperature	NiCr-Ni adapter	524 0673	X
Force	Centrifugal force apparatus S	524 068	X
Transmission, extinction, concentration	Immersion photometer S	524 069	X
Path, air temperature	Ultrasonic motion sensor	524 070	X
Path, time-of-flight (sound)	Ultrasonic motion sensor S	524 0701	X
Path, time-of-flight (light)	Laser motion sensor S	524 073	X
Level, pulse, frequency, times, path, angle, velocity	Timer S	524 074	X
Electric field strength, voltage	Electric field meter S	524 080	X
Angle, path, amplitude, oscillation period, rotary frequency	Rotary motion sensor S	524 082	X
CO_2 concentration	CO_2 sensor S	524 083	X
Hearing threshold	Hearing threshold adapter S	524 085	X

DEMONSTRATION EXPERIMENTS WITHOUT COMPUTER				STUDENT EXPERIMENTS		FLEXIBLE MEASURING		ADDITIONAL SENSOR REQUIRED
Universal Measuring Instruments Physics	Chemistry	Biology	Sensor-CASSY 2 in combination with CASSY-Display	Micro-CASSY	Pocket-CASSY 2 Bluetooth	Pocket-CASSY 2 Bluetooth	Mobile-CASSY	
				X				
				X				
				X				
				X				
			X		X	X	X	
			X		X	X	X	X
X			X		X	X	X	
			X		X	X		X
X			X		X	X	X	
X			X		X	X	X	
X			X		X	X	X	
			X		X	X	X	
X			X		X	X	X	
X			X		X	X	X	
X			X		X	X	X	
			X		X	X	X	
X	X	X	X		X	X	X	
			X		X	X	X	X
		X	X		X	X		X
		X	X		X	X	X	
		X	X		X	X	X	
					X	X		
					X	X		
		X	X		X	X		
	X	X	X		X	X	X	X
	X	X	X		X	X	X	X
			X		X	X	X	
			X		X	X	X	
			X		X	X	X	X
	X	X	X		X	X	X	
X		X	X		X	X	X	
					X	X		X
			X		X	X	X	
X			X		X	X	X	
X	X	X	X		X	X	X	
X	X	X	X		X	X	X	
X	X	X	X		X	X	X	
X	X	X	X		X	X	X	
			X		X	X	X	X
	X		X		X	X	X	X
	X	X	X		X	X	X	X
X	X	X	X		X	X	X	X
X			X		X	X	X	
	X		X		X	X	X	
			X		X	X		
X			X		X	X		
X			X		X	X	X	
			X		X	X		X
X			X		X	X	X	
X			X		X	X		
	X	X	X		X	X	X	
		X	X		X	X	X	

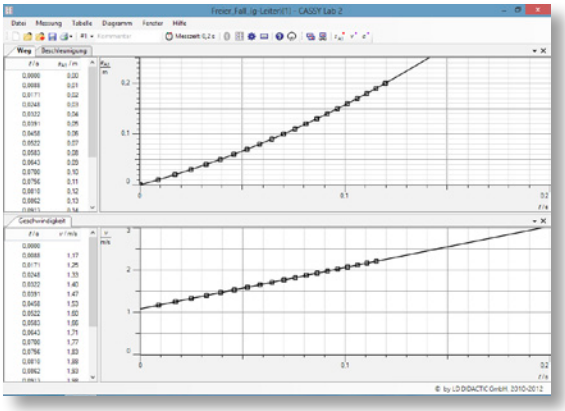
CASSY LAB 2

worlddidac 15th AWARD 2012

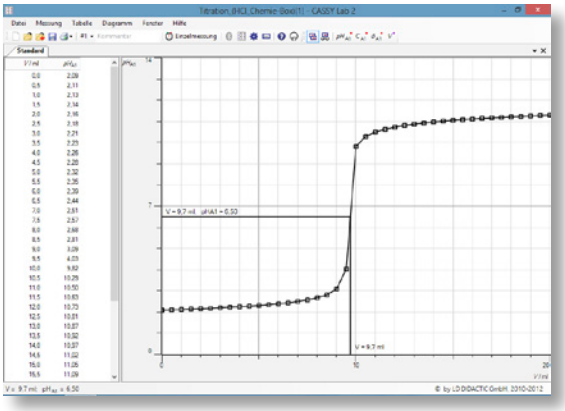
SOFTWARE FOR DATA ACQUISITION AND ANALYSING

Software for data acquisition and analysing of all CASSY units with detailed integrated overview and many carefully arranged experimental examples.

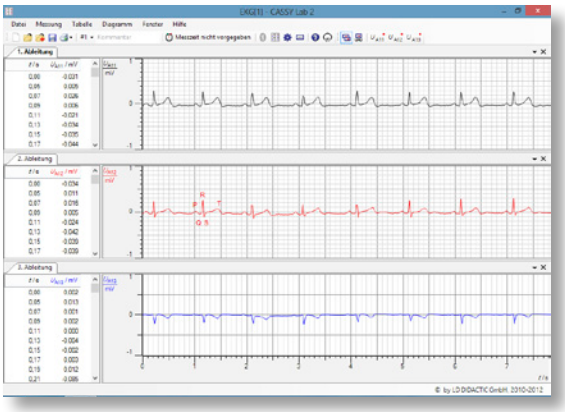
- it supports
  - up to 8 Sensor-CASSYs 2, Sensor-CASSYs and Power-CASSYs at one USB-port respectively at one serial interface
  - Pocket-CASSY 2 via Bluetooth or USB
  - Pocket-CASSYs or Mobile-CASSYs at different USB ports
  - Joule and Wattmeter and the universal measuring instruments Physics, Chemistry and Biology
  - all CASSY sensor boxes
  - additionally numerous devices via the serial interface (e.g. VideoCom, IRPD, balance)
- „Plug and play" enabled for easy use: the software automatically detects the connected CASSYs and sensor boxes and displays these graphically, inputs and outputs are activated simply by pointing and clicking and typical experiment parameters are automatically loaded (depending on the connected sensor box)
- measurement data can be displayed in the form of analog/ digital instruments, tables and/or diagrams (also simultaneously, with user-definable axis assignment)
- measured values can be recorded manually (at keystroke) or automatically (choice of time interval, measured time, lead time, trigger or additional measurement condition)
- evaluation functions including various fits (straight line, parabola, hyperbola, exponential function, free fit), integrals, diagram labeling, calculation of user-definable formulas, differentiation, integration, Fourier transforms
- convenient exporting of measurement data and diagrams via the clipboard
- complete with more than 150 experiment examples from Physics, Chemistry and Biology with detailed descriptions
- graphical display of CASSY, sensor box and connector allocation when the experiment file is loaded



Path and velocity of a free fall

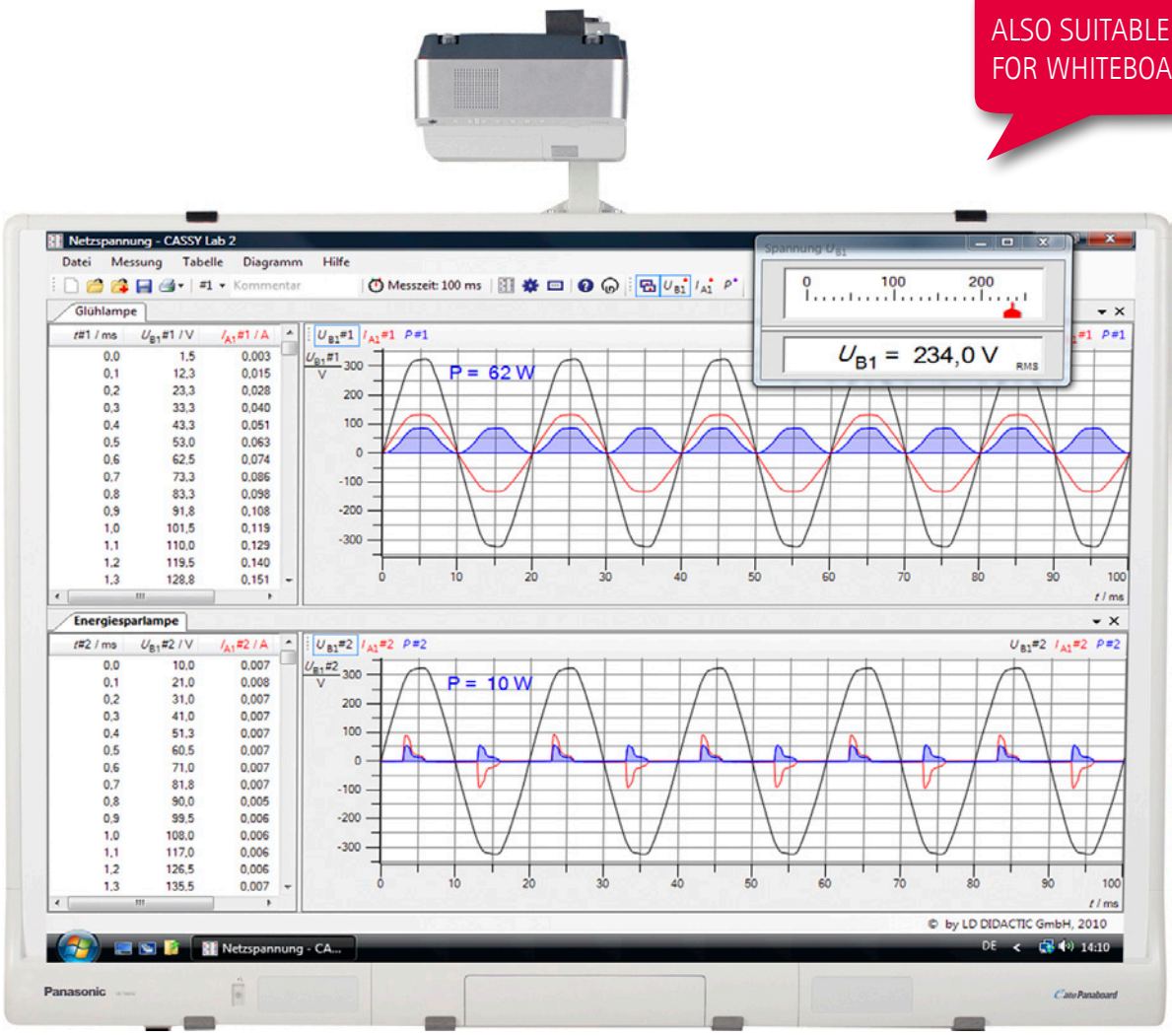


Recording and analyse of a titration curve



Recording of an ECG

ALSO SUITABLE
FOR WHITEBOARDS



CASSY Lab 2 (524 220) is also usable with a whiteboard. There you have a large display for your measurements and you can analyse the charts with your finger.

ALL-ROUND CAREFREE-SOFTWARE

- for all basic units
- for all sensors
- for all workstations in your school
  (Individual workstation licence = school licence)
- with experimental literature

CASSY Lab 2 (524 220)
Software on a CD.
Free of charge updates and demo versions are available under www.ld-didactic.com.

CASSY

1 Basic equipment

Sensor-CASSY 2

Cascadable interface device for recording measurement data

- For connection to the USB port of a computer, another CASSY module or the CASSY display (524 020USB)
- Sensor CASSY (524 010), Sensor CASSY 2 and Power CASSY (524 011USB) can be mixed cascadable
- 3-fold electrical isolation (4-mm inputs A and B, relay R)
- Measurement possible parallel at 4-mm inputs and sensor box connector sites (4 channels)
- Cascading of up to 8 CASSY modules possible (to expand the inputs and outputs)
- Up to 8 analog inputs per Sensor-CASSY retrofittable using sensor boxes
- Automatic sensor box detection (plug and play) by CASSY Lab 2 (524 220)
- Microprocessor-controlled with CASSY operating system (easily updatable via software for function enhancements)
- For use as a benchtop, console or demonstration unit (also in CPS/TPS panel frames)
- Voltage supply 12 V AC/DC via cannon plug or adjacent CASSY module
- Developper Information and LabVIEW™ driver available through our internet homepage

Technical data:

- **5 analog inputs**
  2 analog voltage inputs A and B on 4-mm safety sockets (electrically isolated)
  Resolution: 12 bits
  Measuring ranges: ±0.1/±0.3/±1/±3/±10/±30/±100/±250 V
  Measurement error: ±1 % plus 0.5 % of range end value
  Input resistance: 1 MΩ
  Scanning rate: up to 1 MHz per input
  Amount of measured values: nearly unlimited (dependent on PC) up to 10,000 values/s, at higher measuring rate max. 200,000 values
  Pretrigger: up to 50,000 values per input
  1 analog current input A on 4-mm safety sockets (alternatively to voltage input A)
  Measuring ranges: ±0.03/±0.1/±0.3/±1/±3 A
  Measurement error: voltage error plus 1 %
  Input resistance: < 0.5 Ω
  Scanning rate: up to 1 MHz per input
  See voltage inputs for further data
  2 analog inputs at sensor box connector sites A and B
  (All CASSY sensor boxes and sensors can be connected)
  Measuring ranges: ±0.003/±0.01/±0.03/±0.1/±0.3/±1 V
  Input resistance: 10 kΩ
  Scanning rate: up to 500 kHz per input
  See voltage inputs for further data
  The technical data will change depending on a connected sensor box. In this case CASSY Lab 2 automatically detects the possible measurement quantities and ranges when a sensor box is attached.
- **4 timer inputs** with 32-bit counters at sensor box sites A and B (e.g. for GM box, timer box or Timer S)
  Counting frequency: max. 1 MHz
  Time resolution: 20 ns
- **5 LED status indicators** for analog inputs and USB port
  Colours: red and green, according to status
  Light intensity: adjustable
- **1 changeover relay** (switching indication via LED)
  Range: max. 250 V/2 A
- **1 analog output** (LED switching state indicator, e.g. for holding magnet or supplying experiment)
  Variable voltage range: max. 16 V/200 mA (load ≥ 80 Ω)
- **12 digital inputs** (TTL) on sensor box sites A and B (at present only used for automatic sensor box detection)
- **6 digital outputs** (TTL) on sensor box sites A and B (at present only used for automatic switching of a sensor box measuring range)
- **1 USB port** for connection to a computer
- **1 CASSY bus** for connecting additional CASSY modules
- Dimensions (W x H x D): 115 mm x 295 mm x 45 mm
- Weight: 1.0 kg

Scope of delivery:

- Sensor-CASSY 2
- CASSY Lab 2 software, without activation code, with comprehensive help function (16 full-functionality sessions free, then usable as demo version)
- USB cable
- Plug-in supply unit 230 V, 12 V/1.6 A

524 013	Sensor-CASSY 2

Sensor-CASSY 2 Starter

Voltage and current input are already integrated in the Sensor-CASSY. Therefore following experiments are realizable **without additional sensors**:

- Voltage and current measurement
- Ohm's law
- Electric oscillations
- Characteristic curves
- AC circuit
- Active power

Scope of delivery:

Count	Cat. No.	Name
1	524 013	Sensor-CASSY 2
1	524 220	CASSY Lab 2

524 013S	Sensor-CASSY 2 Starter

Power-CASSY USB

Cascadable interface device as programmable current or voltage source (power function generator) with integrated current or voltage measurement.

- For connection to the USB port of a computer, another CASSY module or the CASSY Display
- Electrically isolated
- Microprocessor-controlled via the CASSY operating system (complete with software update functionality for fast, easy performance enhancements)
- Can be set up as a benchtop, console or demonstration unit (also suitable for CPS/TPS panel frames)
- Voltage supply 12 V AC via cannon plug

Technical data:

- **1 programmable voltage source** with simultaneous current measurement (e.g. for recording characteristic curves)
  Resolution: 12 bit
  Output range: ±10 V
  Measuring range: ±0.1/±0.3/±1 A
  Error: ±1 % plus 0.5 % maximum range value
  Sampling rate: 200,000 values/s (= 100,000 values/s voltage and current)
  Number of measured values: nearly unlimited (depends on PC) upto 100 values/s, at higher measuring rate max. 32,000 values (= 16,000 values per input)
- **1 programmable current source** with simultaneous voltage measurement
  (can be activated alternatively to voltage source)
  Output range: ±1 A
  Measuring range: ±1/±3/±10 V
  See voltage source for additional data
- **1 USB port** for connection to a computer
- **1 CASSY bus** for connecting additional CASSY modules
- Dimensions: 115 mm x 295 mm x 45 mm
- Weight: approx. 1 kg

Scope of delivery:

- Power-CASSY
- CASSY Lab 2 software, without activation code, with comprehensive help function (16 full-functionality sessions free, then usable as demo version)
- Installation manual
- USB cable
- Plug-in supply unit 230 V, 12 V/1.6 A

524 011USB	Power-CASSY USB

Pocket-CASSY 2 Bluetooth

Interface for data recording

- Connects to the USB port of a computer or connection via Bluetooth (wireless)
- With button to start and stop data recording directly on the device
- Supports all sensors and sensor boxes of the CASSY family

Technical data:

- Analog input at sensor box connector
  Resolution: 12 Bit
  Sampling rate: max. 100,000 values/s
  Number of measurement quantities: max. 8 simultaneously (depending on the sensor box) per Pocket-CASSY
  Measurement quantities and measuring ranges change automatically when a sensor box has been attached (automatic sensor box detection). For further details regarding the possible measuring ranges see sensors.
- 2 timer inputs at sensor connector site (e. g. for GM box or timer S)
  Counting frequency: max. 1 MHz
  Timer resolution: 20 ns
- Pushbutton: for starting and stopping measured value recording
- Connections:
  CASSY sensor connector site (15-pole)
  Bluetooth range: 20 m in free space
  USB connection: Micro-USB
- 3 LEDs:
  green (USB-connection)
  blue (Bluetooth-connection)
  red (battery warning)
- Power supply: via USB port (500 mA) or included plug-in supply unit
- Dimensions: 50 mm x 25 mm x 60 mm
- Weight: 0.1 kg

Scope of delivery:

- Pocket-CASSY 2 Bluetooth
- USB cable
- Plug-in supply unit
- CASSY Lab 2 software, without activation code, with comprehensive help function (16 full-functionality sessions free, then usable as demo version)

524 018	Pocket-CASSY 2 Bluetooth

Pocket-CASSY 2 Bluetooth Starter

Bundle consisting of Pocket-CASSY 2 Bluetooth with UIP sensor S, software CASSY Lab and Bluetooth dongle serving as an introduction into data recording with CASSY (USB and Bluetooth). The UIP sensor S offers a voltage and a current input. Therefore, the following experiments are possible without additional sensors:

- Voltage and current measurement
- Ohm's law
- Electric oscillations
- Characteristic curves
- Alternating current circuit
- Active power

Scope of delivery:

Count	Cat. No.	Name
1	524 0031	Bluetooth Dongle
1	524 018	Pocket-CASSY 2 Bluetooth
1	524 0621	UIP sensor S
1	524 220	CASSY Lab 2

524 018S	Pocket-CASSY 2 Bluetooth Starter

Rechargeable battery for Pocket-CASSY 2 Bluetooth

Cascadable battery for mobile power supply of Pocket-CASSY 2 Bluetooth (524 018). AC adapter for charging the battery is included in the scope of delivery of Pocket-CASSY 2 Bluetooth.

Technical data:

- Input: Micro-USB, 5 V/500 mA (for mains adapter or further rechargeable battery)
- Output: Micro-USB, 5 V/500 mA (for Pocket-CASSY 2 or further rechargeable battery)
- Cascadeability: Rechargeable batteries can be charged or discharged in series
- Capacity: 4 Wh
- 2 LEDs: yellow (charging process), green (totally charged)

524 019	Rechargeable battery for Pocket-CASSY 2 Bluetooth

Bluetooth Dongle

USB Bluetooth Dongle for PC.

Technical data:

- Range: 20 m in free space
- Supports Windows XP/Vista/7

524 0031	Bluetooth Dongle

Pocket-CASSY

Interface for recording measurement data.

- For connection to the USB port of a computer.
- Supports all sensors and sensor boxes of the CASSY family.
- Up to 8 Pocket-CASSYs can be used simultaneously at a computer via USB hubs.

Technical data:

- Analog input at sensor connector site
  Resolution: 12 bit
  Scanning rate: max. 7,800 values/s
  Number of measurement quantities: max. 8 simultaneously (depending on the sensor box) per Pocket-CASSY
  Measurement quantities and measuring ranges change automatically when a sensor box has been attached (automatic sensor box detection). For further details regarding the possible measuring ranges see sensors.
- 2 timer inputs at sensor connector site (e. g. for GM box or timer S)
  Counting frequency: max. 10 kHz
  Time resolution: 1 µs
- Connections:
  CASSY sensor connector site (15-pole)
  USB port (compatible with USB 1.x and 2.0, full speed)
- Power supply: via USB port (500 mA)
- Dimensions: 50 mm x 25 mm x 60 mm
- Weight: 0.1 kg

Scope of delivery:

- Pocket-CASSY
- USB cable
- CASSY Lab 2 software, without activation code, with comprehensive help function (16 full-functionality sessions free, then usable as demo version)

524 006	Pocket-CASSY

Mobile-CASSY

Universal hand-held measuring instrument for science purposes.

- Used in conjunction with sensors from the CASSY family, Mobile-CASSY can perform varied measurements in the fields of physics, chemistry, and biology, e.g. measurement of temperature, conductivity, pH value, pressure, force, heart rate and many other quantities.
- Up to four measured values can be displayed at the device, which offers several type sizes to be selected from.
- If Mobile-CASSY is used in conjunction with CASSY Lab (524 220), the computer can be employed for large-screen displays and for recording measured values.
- With integrated real-time clock and data logger.
  Data memory for up to 16,000 measured values is preserved after switching off and can thus be read by CASSY Lab via the USB port later on.
- The performance can be expanded by updating via CASSY Lab at any time.
- Simplified charging by built-in rechargeable battery.

Technical data:

- Sensor connector site: most CASSY sensors can be connected
  Resolution: 12 bit
  Scanning rate: max. 5 values/s
  Number of measurement quantities: max. 8 (depending on sensor) per Mobile-CASSY
  Measurement quantities and ranges are changed automatically after connected a sensor box (automatic recognition of sensor box).
  For more details regarding the available measurement ranges see at the sensors.
- Datalogger: max. 16.000 measured values
  Scanning interval: adjustable from 5 values/s to 1 value/h
- Connections:
  CASSY sensor connector site (15-pole)
  USB (compatible with 1.x and 2.0, isolated)
  Cannon plug for plug-in power supply 12 V AC/DC
- Built-in rechargeable battery
  Capacity: 9 Wh
- Dimensions: 87 mm x 215 mm x 30 mm
- Weight: 350 g

Scope of delivery:

- Mobile-CASSY
- Plug-in power supply (230 V)
- USB cable
- CASSY Lab 2 software, without activation code, with comprehensive help function (16 full-functionality sessions free, then usable as demo version)

524 009A	Mobile-CASSY

Holder for Mobile-CASSY

Positions a Mobile-CASSY (524 009A) in two different angles to keep it dry and to facilitate measurements.

Technical data:

- Dimensions: 150 mmm x 100 mm x 160 mm
- Weight: 350 g

524 0038	Holder for Mobile-CASSY

Storage case for Mobile-CASSYs

With 2 parts of preformed foam inlays for safe transport and storage of up to 3 Mobile-CASSYs with their plug-in power supplies 12 V AC/DC, 5 sensors with adapters and 1 USB cable.

Technical data:

- Color: grey
- Dimensions (W x H x D): 445 x 150 x 360 mm
- Mass: 1.5 kg

666 388	Storage case for Mobile-CASSYs

CASSY-Display USB

2-channel display for displaying measured values for Sensor-CASSY (524 013) without a computer.

- Microprocessor-controlled via the CASSY operating system (complete with software update functionality for fast, easy performance enhancements)
- Can be set up as a benchtop, console or demonstration unit (also suitable for CPS/TPS panel frames)
- Supports up to 8 Sensor-CASSYs (equivalent to 16 measuring channels)
- Measurements are carried out using Sensor-CASSY or a sensor box connected there (see specifications of respective device for measurement quantities and ranges)
- Measured values can be switched and calibrated individually. The measuring range and unit are matched automatically when plugging and swapping sensor boxes
- With integrated real-time clock and data logger. The data memory for up to 32,000 measured values retains its contents even when the device is switched off so that it can be subsequently read out via CASSY Lab (524 220) via the USB port.
- Voltage supply 12 V AC/DC via cannon plug
- Measured value recording also possible independently of mains with portable power supply unit (12 V)

Technical data:

- Dimensions (W x H x D): 215 mm x 295 mm x 45 mm
- Weight: approx. 1.8 kg

524 020USB	CASSY-Display USB

CASSY Lab 2

Improved development of the successful CASSY Lab software for recording and evaluating measurement data acquired using the CASSY family, with comprehensive integrated help functionality and many operable experiment examples.

- Supports up to 8 Sensor-CASSYs 2, Sensor-CASSYs and Power-CASSYs at a USB port respectively at one serial interface
- Supports Pocket-CASSYs or Mobile-CASSYs at different USB ports
- Supports Joule and Wattmeter and Universal Measuring Instruments Physics, Chemistry and Biology
- Supports all CASSY sensor boxes
- Additionally supports numerous devices via the serial interface (e.g. VideoCom, IRPD, balance)
- „Plug and play" enabled for easy use: the software automatically detects the connected CASSYs and sensor boxes and displays these graphically, inputs and outputs are activated simply by pointing and clicking and typical experiment parameters are automatically loaded (depending on the connected sensor box)
- Measurement data can be displayed in the form of analog/digital instruments, tables and/or diagrams (also simultaneously, with user-definable axis assignment)
- Measured values can be recorded manually (at keystroke) or automatically (choice of time interval, measured time, lead time, trigger or additional measurement condition)
- Powerful evaluation functions including various fits (straight line, parabola, hyperbola, exponential function, free fitting), integrals, diagram labeling, calculation of user-definable formulas, differentiation, integration, Fourier transforms
- Experiment files in XML-data format (can also import experiment files which are prepared with CASSY Lab 1)
- Convenient exporting of measurement data and diagrams via the clipboard
- „Logbook" function lets you briefly document other experiment information in the experiment file
- Complete with more than 150 experiment examples from physics, chemistry and biology with detailed descriptions
- Graphical display of CASSY, sensor box and connector allocation when the experiment file is loaded
- Free updates and demo version available through our internet homepage
- PC Requirements: Windows XP/Vista/7/8 (32+64 bits), free USB port (USB apparatus) resp. free serial interface (serial apparatus), supports multicore processor

524 220	CASSY Lab 2

CASSY Lab 2 Home

Three year license of the successful CASSY Lab software for recording and evaluating measurement data acquired using the CASSY family, with comprehensive integrated help functionality and many operable experiment examples. For the pure **evaluation** of the data in students PCs the free of charge demo version of CASSY Lab is sufficient. But the Home version is required for **measurements** with PCs, which are not belonging to the school.

- 3 year license for students PCs not belonging to the school
- Supports up to 8 Sensor-CASSYs 2, Sensor-CASSYs and Power-CASSYs at a USB port respectively at one serial interface
- Supports Pocket-CASSYs or Mobile-CASSYs at different USB ports
- Supports Joule and Wattmeter and Universal Measuring Instruments Physics, Chemistry and Biology
- Supports all CASSY sensor boxes
- Additionally supports numerous devices via the serial interface (e.g. VideoCom, IRPD, balance)
- „Plug and play" enabled for easy use: the software automatically detects the connected CASSYs and sensor boxes and displays these graphically, inputs and outputs are activated simply by pointing and clicking and typical experiment parameters are automatically loaded (depending on the connected sensor box)
- Measurement data can be displayed in the form of analog/digital instruments, tables and/or diagrams (also simultaneously, with user-definable axis assignment)
- Measured values can be recorded manually (at keystroke) or automatically (choice of time interval, measured time, lead time, trigger or additional measurement condition)
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- Complete with more than 150 experiment examples from physics, chemistry and biology with detailed descriptions
- Graphical display of CASSY, sensor box and connector allocation when the experiment file is loaded
- Free updates and demo version available through our internet homepage
- PC Requirements: Windows XP/Vista/7/8 (32+64 bits), free USB port (USB apparatus) resp. free serial interface (serial apparatus), supports multicore processor

524 220H	CASSY Lab 2 Home

Universal Measuring Instrument Physics

Changeable CASSY sensors make it possible to measure many different physical quantities, e.g.

- Force
- Acceleration
- Angle
- Pressure
- Temperature
- Voltage
- Current
- Electrical field strength
- Magnetic flux density
- Pulses
- Rates

Sensors are detected automatically and the respective measurement quantity is automatically presented in the large digital display. The instrument can also be connected to a computer via its USB port. Includes software to record and evaluate measurements.

Technical data:

- Measurement ranges: see sensors
- Measurement range selection: automatic or manual
- Display: 5-digit, 7-segment display for numeric values and 7x15 LEDs for displaying units-of-measure
- Height of digits: 25 mm
- Acoustic signal for measurement in counting rates
- USB port: compatible with USB 1.1 and 2.0, full speed, electrically isolated (USB cable included)
- Supply: 230 V, 50/60 Hz
- Dimensions: 20 cm x 21 cm x 23 cm
- Updates: available free in internet

531 835	Universal Measuring Instrument Physics

Additionally recommended:

Count	Cat. No.	Name
1	524 0331	Geiger-Müller counter tube S
1	524 0381	Combi B sensor S
1	524 0382	Axial B sensor S, ±1000 mT
1	524 0383	Axial B sensor S, ±0.3 mT
1	524 042	Force sensor S, ±50 N
1	524 0421	Force plate S
1	524 0422	3D acceleration sensor S
1	524 0424	3D acceleration sensor S
1	524 044	Temperature sensor S, NTC
1	524 060	Force sensor S, ±1N
1	524 0621	UIP sensor S
1	524 064	Pressure sensor S, ±2000 hPa
1	524 065	Absolute pressure sensor S, 0...1500 hPa
1	524 066	Pressure sensor S, ±70 hPa
1	524 0673	NiCr-Ni adapter S, Type K
1	524 068	Centrifugal force apparatus S
1	524 073	Laser motion sensor S
1	524 080	Electric field meter S
1	524 082	Rotary motion sensor S

Universal Measuring Instrument Chemistry

For measurement of many different chemical quantities through exchangeable sensors, e.g.

- pH
- Conductivity
- Pressure
- Temperature
- Transmission
- Illuninance
- Voltage
- Current
- O_2 and CO_2 concentration
- Relative humidity

The sensors are detected automatically and the corresponding measuring range is displayed automatically in the large digital display. The connection of a Temperature probe NiCr-Ni (Type K) is addidional possible. The calibration of pH, conductivity, O_2 and CO_2 concentration is internally saved and needs to be checked only from time to time. Additionally it is possible to connect the measuring instrument via the USB port to a computer. Including software for recording and evaluation of measurements.

Technical data:

- Measuring ranges: dependent on sensor
- Measuring range selection: automatic or manual
- Type K socket: for the connection of an additional Temperature probe NiCr-Ni (not included in the scope of delivery)
- Calibration: 1 or 2 point (pH, conductivity, O_2 and CO_2 concentration automatically saved)
- Display: 5-digit, 7-segment display for numerical values and 7x25 LEDs for displaying units-of-measure
- Height of digits: 25 mm
- USB port: compatible to USB 1.1 and 2.0, full speed, electrically isolated (USB cable included in scope of delivery)
- Supply: 230 V, 50/60 Hz
- Dimensions: 20 cm x 21 cm x 23 cm
- Updates: available free in internet

531 836	Universal Measuring Instrument Chemistry

Additionally recommended:

Count	Cat. No.	Name
1	524 044	Temperature sensor S, NTC
1	524 0511	Lux adapter S
1	524 0521	Oxygen adapter S
1	524 0572	Humidity sensor S
1	524 0621	UIP sensor S
1	524 064	Pressure sensor S, ±2000 hPa
1	524 065	Absolute pressure sensor S, 0...1500 hPa
1	524 066	Pressure sensor S, ±70 hPa
1	524 0671	Conductivity adapter S
1	524 0672	pH adapter S
1	524 0673	NiCr-Ni adapter S, Type K
1	524 069	Immersion photometer S
1	524 083	CO_2 sensor S

Universal Measuring Instrument Biology

For measurement of many different quantities through exchangeable sensors, e.g.

- Pulse
- Skin resistance
- Blood pressure
- Reaction time
- Hearing threshold
- pH value
- Temperature
- O_2 and CO_2 concentration
- Voltage
- Current

The sensors are detected automatically and the corresponding measuring range is displayed automatically in the large digital display. With integrated loudspeaker, e.g. for measurement of the auditory threshold or to give an audible sound while pulse or blood pressure measurements.
The calibration of pH, O_2 and CO_2 concentration is internally saved and needs to be checked only from time to time. Additionally it is possible to connect the measuring instrument via the USB port to a computer. Including software for recording and evaluation of measurements.

Technical data:

- Measuring ranges: dependent on sensor
- Measuring range selection: automatic or manual
- Calibration: 1 or 2 point (pH, O_2 and CO_2 concentration automatically saved)
- Display: 5-digit, 7-segment display for numerical values and 7x25 LEDs for displaying units-of-measure
- Height of digits: 25 mm
- USB port: compatible to USB 1.1 and 2.0, full speed, electrically isolated (USB cable included in scope of delivery)
- Supply: 230 V, 50/60 Hz
- Dimensions: 20 cm x 21 cm x 23 cm
- Updates: available free in internet

531 837	Universal Measuring Instrument Biology

Additionally recommended:

Count	Cat. No.	Name
1	524 044	Temperature sensor S, NTC
1	524 0461	Reaction test adapter S
1	524 0471	Pulse sensor S
1	524 0481	Skin resistance sensor S
1	524 0501	Blood pressure sensor S
1	524 0511	Lux adapter S
1	524 0521	Oxygen adapter S
1	524 0572	Humidity sensor S
1	524 0621	UIP sensor S
1	524 064	Pressure sensor S, ±2000 hPa
1	524 065	Absolute pressure sensor S, 0...1500 hPa
1	524 066	Pressure sensor S, ±70 hPa
1	524 0672	pH adapter S
1	524 0673	NiCr-Ni adapter S, Type K
1	524 083	CO_2 sensor S
1	524 085	Hearing threshold adapter S

Micro-CASSY voltage

Inexpensive, robust and compact measurement interface for voltage measurement. Connects to PC, laptop or netbook via USB port. For use with the software CASSY Lab 2 (524 220).

Technical data:

- Measurement input: Sockets for 4-mm safety plug
- Measurement ranges: ±3/±30 V
- Sampling rate: 100 kHz
- Input: Differential
- Input resistance: 2 MΩ
- Resistance from input to USB earth: 1 MΩ
- Housing color: Blue
- Housing dimensions: 85 mm x 22 mm x 14 mm
- Length of the connection cable: 15 cm

528 11	Micro-CASSY voltage

Micro-CASSY current

Inexpensive, robust and compact measurement interface for current measurement. Connects to PC, laptop or netbook via USB port. For use with the software CASSY Lab 2 (524 220).

Technical data:

- Measurement input: Sockets for 4-mm safety plug
- Measurement ranges: ±0.3/±3 A
- Surge protection: Built-in self-resetting fuse
- Sampling rate: 10 kHz
- Input: Differential
- Input resistance: 0.1 Ω
- Resistance from input to USB earth: 1 MΩ
- Housing color: Red
- Housing dimensions: 85 mm x 22 mm x 14 mm
- Length of the connection cable: 15 cm

528 12	Micro-CASSY current

Micro-CASSY temperature

Inexpensive, robust and compact measurement interface with fixed NiCr-Ni sensor for temperature measurement. Connects to PC, laptop or netbook via USB port. For use with the software CASSY Lab 2 (524 220).

Technical data:

- Measurement range: -50 ... 1100 °C
- Housing color: Yellow
- Housing dimensions: 85 mm x 22 mm x 14 mm
- Length of the connection cable: 70 cm
- Measurement tips diameter: 1.5 mm

528 15	Micro-CASSY temperature

Micro-CASSY pH value

Inexpensive, robust and compact measurement interface including replaceable electrode (BNC) for pH value measurement. Connects to PC, laptop or netbook via USB port. For use with the software CASSY Lab 2 (524 220).

Technical data:

- Measurement range: 0 ... 14 pH
- Housing color: Grey
- Housing dimensions: 85 mm x 22 mm x 14 mm
- Connection: BNC socket
- Length of the connection cable: 10 cm
- Length of the electrode cable: At least 50 cm

528 18	Micro-CASSY pH value

2 Sensor boxes / sensors

2.1 Physics

UIP sensor S

For simultaneous and potential-free measurement of voltage *U* and current *I* as well as their effective values with Pocket-CASSY (524 006, 524 018), Mobile-CASSY (524 009A), Universal Measuring Instrument Physics (531 835) or Universal Measuring Instrument Chemistry (531 836). It can therefore also be used for power and resistance measurement and determination of characteristics. Pocket-CASSY additionally determines in a.c. voltage circuits the cosφ between voltage *U* and current *I*, and thus allows the measurement of active power.

Technical data:

- Voltage measurement:
  Measuring ranges: ±0.1/±0.3/±1/±3/±10/±30 V
  Measurement error: ±1 % plus 0.5 % of the range limit value
  Input resistance: 0.8 MΩ
- Current measurement:
  Measuring ranges: ±0.1/±0.3/±1/±3 A
  Measurement error: ±2 % plus 0.5 % of the range limit value
  Input resistance: < 0.5 Ω (except by overload)
- Overload protection: automatically put back fuse
- Potential difference: 40 V max. (between U and I)
- Scanning frequency:
  with Pocket-CASSY:
  approx. 8000 values/s (single-channel),
  approx. 2000 values/s per channel (two-channel)
  with Mobile-CASSY:
  approx. 5 values/s
- Dimensions (W x H x D): 50 mm x 25 mm x 60 mm
- Weight: 0.1 kg

524 0621	UIP sensor S

Timer S

Enables connection of two light barriers (337 46, 337 462, 337 468, 337 4681) or of a combination light barrier with a combination spoked wheel (337 462 with 337 464) to CASSY.

Technical data:

- Time resolution: 1 µs (if light barriers are used)
- Path resolution: 1 cm or ±1 mm with detection of rotational direction (if the combination spoked wheel is used)
- Electrical connections: two 6-pole sockets (for 501 16)
- Dimensions: 50 mm x 25 mm x 60 mm
- Weight: 0.1 kg

524 074	Timer S

Timer box

Sensor box with two TTL and light barrier inputs for CASSY.

- Input E can be used as a counter, timer and frequency input
- Both inputs E and F can be used as timer inputs for measuring the time between selected edges (e.g. measuring the transit time from E to F, measuring the obscuration time at E and/or F)

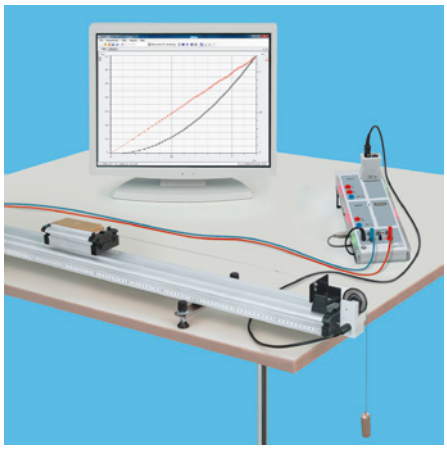
Technical data:

- Time resolution: 1 µs
- Connections: two 6-pole sockets (for 501 16) and three 4-mm sockets
- Dimensions: 42 mm x 92 mm x 30 mm
- Weight: 0.1 kg

524 034	Timer box

Path-time diagram of straight motion – Recording and evaluating with CASSY

The experiment P1.3.2.2 looks at motion events which can be transmitted to the combination spoked wheel by means of a thin thread on Fletcher's trolley. The combination spoked wheel serves as an easy-running deflection pulley. The signals of the combination light barrier are recorded by the computer-assisted measuring system CASSY and converted to a path-time diagram. As this diagram is generated in real time while the experiment is running, the relationship between the motion and the diagram is extremely clear.



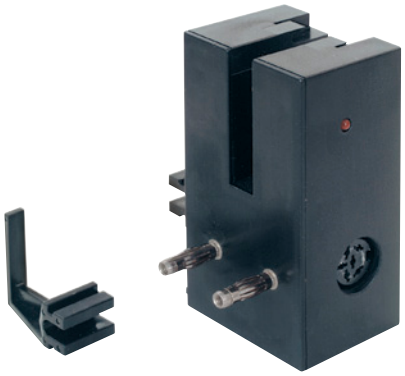
Combination light barrier

The combination light barrier can be used either with standard interrupter flags or with the combination spoked wheel (337 464) as a motion transducer. It is ideal for use with the track (337 130) and fits the grooved rail on the track side. It can alternatively be used in free-standing setups when mounted on a rod. Connection via Timer box (524 034) or Timer S (524 074).

Technical data:

- Mechanical connections:
  4-mm plug pins, 19 mm spacing
  Thread: M6
- Connections: 6-pole socket (for 501 16)
- Interruter flags, width: 5 mm
- Dimensions 4 cm x 3 cm x 7.5 cm
- Weight: 150 g

337 462	Combination light barrier



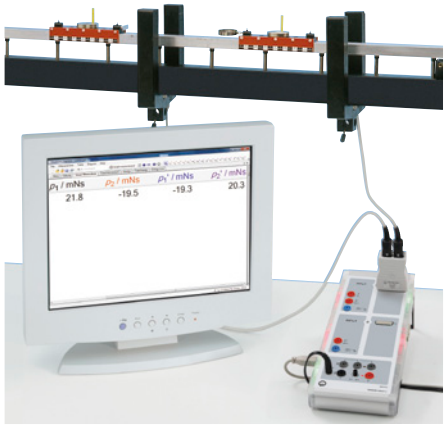
Combination spoked wheel

The ball bearing-mounted combination spoked wheel is used with the holder (337 463) as a deflection pulley or with the combination light barrier (337 462) as a deflection pulley and motion transducer.

Technical data:

- Path resolution:
  Timer box (524 034): 1 cm
  Timer S (524 074): 1 cm or ±1 mm with detection of rotational direction
- Diameter: 52 mm
- Internal division: 16 slits
- External division: 40 slits
- Maximum load capacity: 20 N (≈2 kg)

337 464	Combination spoked wheel



Energy and momenturm in elastic collision – Measuring with two forked light barriers

In the experiments P1.3.4.1 and P1.3.4.2, the obscuration times Δt_i of two light barriers are measured, e.g. for two bodies on a linear track before and after elastic and inelastic collision. These experiments investigate collisions between a moving body and a body at rest, as well as collisions between two bodies in motion. The evaluation program calculates and, when selected, compares the velocities

$$v_i = \frac{d}{\Delta t_i}$$

d: width of interrupter flags

the momentum values

$$p_i = m_i \cdot v_i$$

m_i: masses of bodies

and the energies

$$E_i = \frac{1}{2} \cdot m_i \cdot v_i^2$$

of the bodies before and after collision.

Forked light barrier

Precision light barrier, with infrared light source, for the control of electronic timing equipment in experiments with moving or oscillating bodies, e.g. experiments on tracks, pendulum oscillations, free fall, oscillations of strings or leaf springs. Connection to CASSY via the timer box (524 034) or the Timer S (524 074). Mounted by means of a clamp or holding magnet. Equipped with a stopper for perpendicular attachment to square profile sections. Operation display (LED).

Technical data:

- Measuring accuracy (resolution): 0.1 mm
- Switching rate: max. 5 kHz
- Signal output and voltage supply: via multiple socket
- Inner fork width: 110 mm
- Effective fork depth: 160 mm
- Connection:
  9 ... 25 V DC or
  6 ... 15 V AC
  via multiple socket (for 501 16)
- Current consumption: 110 mA

337 46	Forked light barrier

Additionally required:

Count	Cat. No.	Name
1	501 16	Multi-core cable, 6-pole, 1.5 m

Free fall: multiple measurements with the g ladder

In the experiment P1.3.5.3, a ladder with several rungs falls through a forked light barrier, which is connected to the CASSY computer interface device to measure the obscuration times. This measurement is equivalent to a measurement in which a body falls through multiple equidistant light barriers. The height of the falling body corresponds to the rung width. The measurement data are recorded and evaluated using CASSY Lab. The instantaneous velocities are calculated from the obscuration times and the rung width and displayed in a velocity-time diagram $v(t)$. The measurement points can be described by a straight line

$$v(t) = v_0 + g \cdot t$$

g: gravitational acceleration

whereby v_0 is the initial velocity of the ladder when the first rung passes the light barrier.

g ladder

Falling body for determining gravitational acceleration g through measurement of the falling times of all ladder rungs through a light barrier in a single measuring run. With two holes for attaching additional weights for proving that gravitational acceleration is independent of mass.

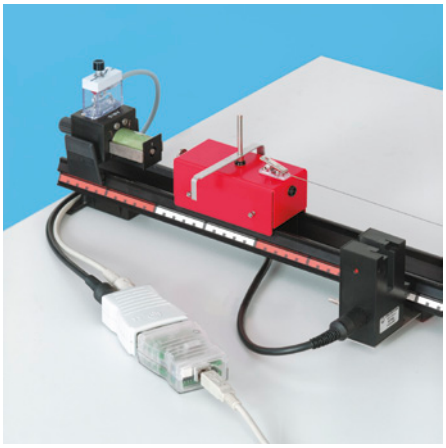
Technical data:

- Number of rungs: 21
- Rung spacing: 1 cm
- Dimensions: 75 mm x 205 mm

529 034	g ladder

Recording path-time diagrams of linear motion – recording with a light barrier

In experiment P1.3.1.2 the time between the start of the trolley by release of the holding magnet and the stop by interrupting a light barrier is measured. The driven distance is varied by moving the light barrier. The time measuring is carried out with Pocket-CASSY. Therefore, a *s*(*t*)-diagram is directly generated on the monitor. From this, the *v*(*t*)- and *a*(*t*)-diagrams can be calculated.



Holding magnet adapter with a release mechanism

Adapter cable for the supply and release of a Holding magnet (336 21, 336 201, 683 41) on Counter S (575 471), Counter P (575 451) or Timer S (524 074, with CASSY).

Technical data:

- Power supply: by means of a counter or CASSY
- Intermediate resistance: 100 Ω
- Release: switch
- Retention force: approx. 1 N with holding magnet
- Connection: 6-pole DIN

336 25	Holding magnet adapter with a release mechanism

Adapter for combination light barrier

Adapter for using the combination light barrier (337 462) with combination spoked wheel (337 464) on the precision metal rail (student track). The adapter can be attached on one side of the student track (460 81) and fixed in place. It has sockets into which the combination light barrier can be plugged.

337 465	Adapter for combination light barrier

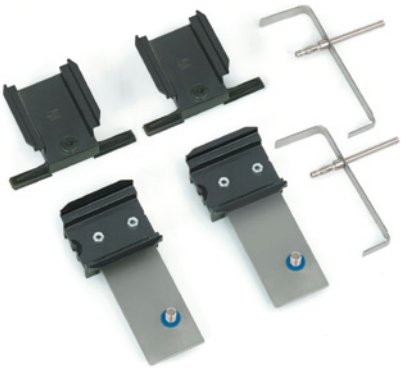
Accessories for electronic time measurement

On the precision metal rail (460 81) with the trolley (337 00) and the combination light barrier (337 462).

Scope of delivery:

1 Pair of feet for metal rail (460□88)
2 Rider for combination light barrier
2 Interrupter for trolley

337 466	Accessories for electronic time measurement



Reflection light barrier

For use with counters, CASSY (524 013, 524 006, 524 018) or the Universal Measuring Instrument Physics (531 835). With adjoined light transmitter and receiver. A white or reflecting object is detected in front of the light barrier. Independent to ambient light due to modulated light. Can be used e.g. for measurements of rotary frequencies, for example at a gyroscope, also in experiments in which a forked light barrier can be mounted badly.

Technical data:

- Diameter: 12 mm
- Length: 10 cm
- Connections: DIN 6-pole
- Maximum counting rate: > 1000/s
- Detection distance: 5 ... 40 mm

337 468	Reflection light barrier

Additionally required:

Count	Cat. No.	Name
1	524 034	Timer box
1	524 074*	Timer S

* alternative

3D acceleration sensor S

Sensor for measuring g-forces acting on the sensor (acceleration and earth's gravity) with Sensor-CASSY 2, Mobile-CASSY, Pocket-CASSY 2 (524 013, 524 009A, 524 018) or the Universal Measuring Instrument Physics (531 835).

Technical data:

- Measuring quantities: Acceleration in g or in m/s²
- Measuring ranges: ±2/±4/±8 g or ±20/±40/±80 m/s²
- Resolution: 0.00025 g or 0.0025 m/s² in the smallest measuring range (14 bit)
- Axes: 3 (x, y, z)
- Dimensions: 70 mm x 50 mm x 25 mm
- Weight: 50 g

Scope of delivery:

- Dual Lock Velcro tape for fixation of Pocket-CASSY 2 e.g. to a trolley or to a rotational system.

524 0424	3D acceleration sensor S

3D acceleration sensor S

Very small and light sensor for measuring the operative forces g (acceleration and gravitation of the earth) on the sensor with CASSY (524 013, 524 006, 524 009A, 524 018) or the Universal Measuring Instrument Physics (531 835), with 4 mm socket for adapter (529 422) for the torsional safe mounting on the trolley (e.g. 337 110 or 337 00).

Technical data:

- Measuring range: ±3/±10 g
- Connecting cable: 2 m
- Limit frequency: 20 Hz
- Mass of the moving sensor: 9 g
- Dimensions: 12 mm x 12 mm x 45 mm

524 0422	3D acceleration sensor S

Acceleration sensor fixture

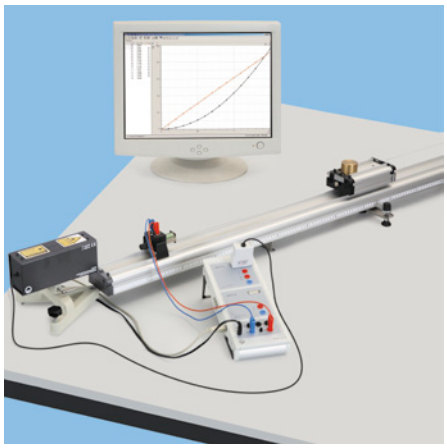
To attach the 3D acceleration sensor S (524 0422) to a trolley (337 110) from the large track (337 130) or a trolley 1 (337 00) from STM MEC 3 (588 813S) or STM MEC 4 (588 814S). Plastic clamp with 4 mm pins.

Technical data:

- Dimensions: 56 mm x 41 mm x 20 mm
- Weight: 17 g

529 422	Acceleration sensor fixture

Definition of the Newton as a unit of force – Recording and evaluating with CASSY



In the experiment P1.3.2.3, a calibrated weight exercises an accelerating force of 1 N on a trolley with the mass 1 kg. As one might expect, CASSY shows the value

$$a = 1\ \frac{m}{s^2}$$

for the acceleration. At the same time, this experiment verifies that the trolley is accelerated to the velocity

$$v = 1\ \frac{m}{s}$$

in the time 1 s.

Laser motion sensor S

For high-resolution, contactless recording of distance and light's time of flight with CASSY (524 013, 524 006, 524 009A, 524 018) or universal measuring instrument physics (531 835). The time-dependent measurement of distance allows the high-resolution and non-contact recording of motion (such as on a track or in a free fall). The time delay measurement between laser motion sensor S and reflector can determine the speed of light in different media (air, glass, etc.). As a reflector a piece of retroreflective sheeting supplied is glued to an object (eg, trolley and rider).

Technical data:

- Laser: Class 2, modulated (6.0 or 60.0 MHz), optical power limited to 0.2 mW
- Measuring ranges (distance): 1/2/10/20 m
  Resolution: 0.5 mm in the smallest measuring range
- Measuring ranges (running time): 5/10/50/100 ns
  Resolution: 3.3 ps in the smallest measuring range
- Retroreflecting foil: DIN A5
- Dimensions: 50 mm x 70 mm x 150 mm
- Weight: 0.5 kg

524 073	Laser motion sensor S

Ultrasonic motion sensor S

For measuring distances with CASSY. A distance is determined from the propagation time of an impulse of ultrasound. Velocities can also be measured by way of differentiation. Collisions on the track can be investigated if two ultrasound sensors are connected to one Sensor-CASSY. Synchronized start of data logging is possible thanks to a mechanical trigger. The sensor can be used as a desktop device or it can be mounted in stand material.

Technical data:

- Measurable distances: 0.15 ... 10 m
- Measuring ranges: 1/2/5/10 m (Δt = 20/40/100/200 ms)
- Resolution: ±1 mm
- System-related sudden changes in values measured (jitter): ±1 wavelength (8 mm)
- Display LEDs for narrow or wide field of vision and "reflection detected"
- Maximum load of the trigger: 1 kg
- Connection: cable approx. 1.5 m long with SubD15 plug
- Dimensions: 120 mm x 100 mm x 60 mm
- Weight: 0.3 kg

524 070	Ultrasonic motion sensor S

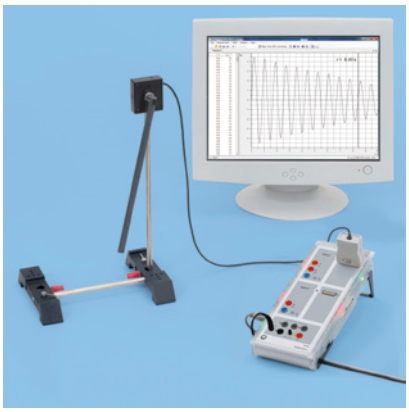
Ultrasonic motion sensor S

For measuring distances and sound travel times with CASSY (524 006, 524 018, 524 013). A distance is determined from the time-of-flight of an impulse of ultrasound. Derivations enable velocity and acceleration measurements.

Technical data:

- Distance measurement
  Measurable distance: 0.25 ... 10 m
  Measuring ranges: 1/2/5/10 m (Δt = 20/40/100/200 ms)
  Resolution: 0.1 mm in small measuring ranges
- Sound travel time
  Measuring range: 2 ... 60 ms
  Resolution: 1 µs in small measuring ranges
- Dimensions: 65 mm x 51 mm x 27 mm
- Weight: 0.1 kg

524 0701	Ultrasonic motion sensor S



Oscillations of a rod pendulum

In the experiment P1.5.1.3, the oscillation of a rod pendulum, i.e. an simple physical pendulum is investigated. Using the rotary motion sensor S the oscillation of the pendulum is recorded as a function of time. Angle $\alpha(t)$, velocity $\omega(t)$ and acceleration $a(t)$ are compared. In addition, the effective length of the pendulum is determined from the measured oscillation period T.

Rotary motion sensor S

For frictionless measurement of rotational motions, linear displacements, amplitudes, periods and rotary frequencies with Sensor-CASSY (524 013), Pocket-CASSY (524 006, 524 018) or Universal Measuring Instrument Physics (531 835).

Technical data:

- Measuring quantities: angle, path, oscillation amplitude and period, rotary frequency
- Derived quantities: velocity, acceleration (with CASSY Lab)
- Measuring range: without mechanical stop (incremental encoder)
- Angular resolution: 0.18°
- Path resolution: 0.08 mm
- Time resolution: 0.001 s
- Frequency resolution: 0.001 Hz
- Axis: double ball-bearing

Scope of delivery:

- Rotational sensor S
- Wheel for measuring linear displacements and for mounting the physical pendulum
- Stand rod for fixing the sensor with stand material
- Coupling plug for mounting on rastered socket panel or at hot-air engine

524 082	Rotary motion sensor S

Centrifugal force of an orbiting body – Measuring with the central force apparatus and CASSY

In the experiment P1.4.3.3, the relationship

$F \propto \omega^2$

is derived directly from the parabolic shape of the recorded curve $F(\omega)$. To verify the proportionalities

$F \propto r$, $F \propto m$

curves are recorded and evaluated for different orbit radii r and various masses m.

Centrifugal force apparatus S

For investigating the radial force of a rotating body as a function of mass, orbit radius and angular velocity with CASSY (524 013, 524 006, 524 009A, 524 018) or Universal Measuring Instrument Physics (531 835). The force is transmitted via an angular lever and needle bearing along the vertical axis to a leaf spring with a wire resistance strain gauge. The gear ratio of the lever system is so designed that changes in the distance of the rotating body do not significantly influence the force measurement. Complete with electric drive motor, friction gear, on stand rod, with connection for CASSY.

Technical data:

- Rotating arm (orbit radius): length: max. 250 mm, graduations: 50 mm
- Masses of the test bodies: 50 g, 75 g and 100 g
- Motor connection: 12 V- via 4-mm sockets
- Gear ration: approx. 1 : 15
- Measuring ranges: ±5/±15/±50 N
- Resolution: 0.1 % of range
- Cable length: 1.5 m
- Stand rod: 20 cm x 12 mm Ø
- Total dimensions: 37 cm x 32 cm x 8 cm
- Weight: approx. 0.8 kg

524 068	Centrifugal force apparatus S

Rotable centrifugal force arm

It is qualified, together with the force sensor S, ±50 N (524 042), to aquire the centrifugal force as a function of angular velocity, mass and the distance between mass and pivot. So it allows one of the seldom experiments for aquiring a law with three parameters. Including 3 balance weights (2 x 100 g, 1 x 50 g). They can be fixed in anyone variation of distance to the pivot.

Technical data:

- Length: 40 cm
- Width: 3 cm
- Weight: 350 g

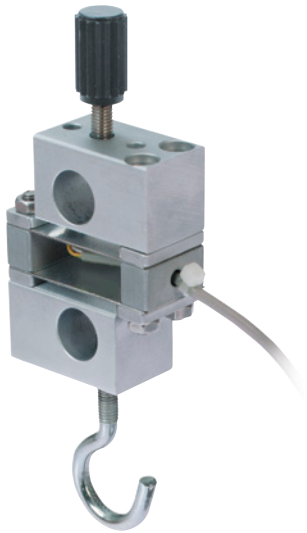
347 211	Rotable centrifugal force arm

Additionally required:

Count	Cat. No.	Name
1	300 01	Stand base V-shape, large
1	300 40	Stand rod 10 cm, 12 mm Ø
1	524 013	Sensor-CASSY 2
1	524 042	Force sensor S, ±50 N
1	524 220	CASSY Lab 2

Force sensor S, ±50 N

For direct connection to CASSY (524 013, 524 006, 524 009A, 524 018) or the Universal Measuring Instrument Physics (531 835) to measure force components up to ±50 N (e.g. spring pendulum or central force components) or accelerations up to 1000 m/s². The force sensor S consists of a parallelogram with two bending elements, one of which is provided with a strain gauge full bridge. This results in a rigid construction with the possibility of measuring the force components in any position. Several orthogonally positioned force sensors thus measure, for example, the force vector of a rigid rotary pendulum or of a circularly oscillating thread pendulum.



Technical data:

- Measuring ranges force: ±0.5/±1.5/±5/±15/±50 N
- Measuring ranges acceleration: ±10/±30/±100/±300/±1000 m/s²
- Resolution: 0.1 % of the measuring range
- Compensation (tare): ±50 N in each measuring range
- Mounting: with locking screw on stand equipment
- Connection: SubD15-plug
- Length of cable: 2 m
- Dimensions: 58 mm x 43 mm x 20 mm
- Weight: 130 g

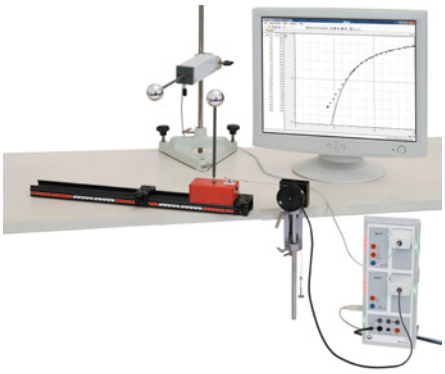
524 042	Force sensor S, ±50 N

Confirming Coulomb's law – Recording and evaluating with CASSY

This experiment utilizes the software CASSY Lab to record the values and evaluate them. The coulomb force is measured for different charges Q_1 and Q_2 as a function of the distance r. The charges of the spheres are measured using an electrometer amplifier connected as a coulomb meter. The aim of the evaluation is to verify the proportionality

$$F \propto \frac{1}{r^2}$$

and to calculate of the permittivity ε_0.



Force sensor S, ±1N

For measuring forces (e.g. electrostatics) up to ±1 N with CASSY (524 013, 524 006, 524 009A, 524 018) or Universal Measuring Instrument Physics (531 835). Two flection elements arranged in parallel with four strain gauges in bridge configuration.

Technical data:

- Measuring ranges: ±10/±30/±100/±300 mN, ±1 N
- Compensation: ±2.5 N in each measuring range
- Resolution: 0.1 % of the measuring range (dependent on place of setting up)
- Connection: SubD15-plug
- Length of cable: 1 m
- Dimensions: 14.4 cm x 4 xcm x 4 cm
- Weight: 360 g

524 060	Force sensor S, ±1N

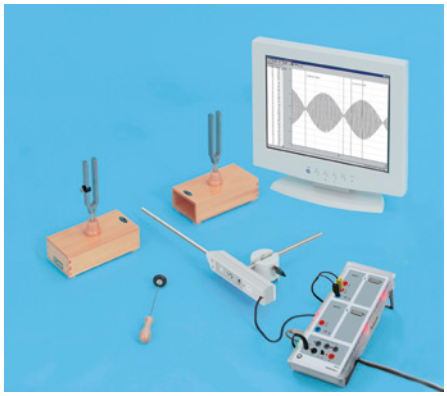
Force plate S

Stable force plate to measure the forces which appear by jumps on the plate. To use in general as a robust force sensor. Use with CASSY (524 013, 524 006, 524 009A, 524 018) or the Universal Measuring Instrument Physics (531 835).

Technical data:

- Area: 30 cm x 30 cm
- Measuring range: +10 kN (= weight of 1 ton)
- Limit frequency: 1 kHz
- Measuring accuracy: 10 % of the final value
- Dimensions: 30 cm x 30 cm x 7 cm
- Weight: 4 kg

524 0421	Force plate S

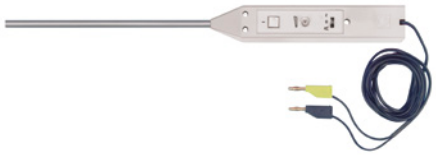


Acoustic beats – Recording with CASSY

In the experiment P1.7.1.3, the acoustic beats are recorded and evaluated via the CASSY computer interface device. The individual frequencies f_1 and f_2, the oscillation frequency f and the beat frequency f_S are determined automatically and compared with the calculated values

$$f = \frac{f_1 + f_2}{2}$$

$$f_s = f_2 - f_1$$



Multi-purpose microphone

For all acoustic experiments in the audible frequency and ultrasonic ranges. With built-in amplifier, switchable rectifiers (analogous, level, TTL) and automatic battery switch-off. Includes stand rod (can be removed) and battery.

Technical data:

- Frequency range:
  30 ... 20,000 Hz,
  15 ... 40,000 Hz (at reduced sensitivity)
- Amplification: up to 16-fold
- Output signal: „signal", „level", „trigger"
- Connection cable with 4-mm sockets: l = 2 m
- Probe dimensions: 25 cm x 8 mm Ø
- Stand rod: 10 mm Ø
- Overall length (without cable): 45 cm
- Weight: 250 g

586 26	Multi-purpose microphone

Microphone S

With integrated, very sensitive electret microphone capsule with omnidirectional characteristic for direct connection to CASSY. With switch jack to connect standard microphones with 3.5-mm minijack.

Technical data:

- Frequency range: 50 ... 20,000 Hz
- Measured quantities:
  Voltage: internal/external microphone
  Frequency: internal/external microphone
  Run time: from external to internal microfone
  Sound level: internal microphone (not calibrated)
- Dimensions: 70 mm x 50 mm x 25 mm
- Weight: 75 g

524 059	Microphone S

Extension cable, 15 pole

For connecting sensors S with CASSY.

Technical data:

- Length: 2 m

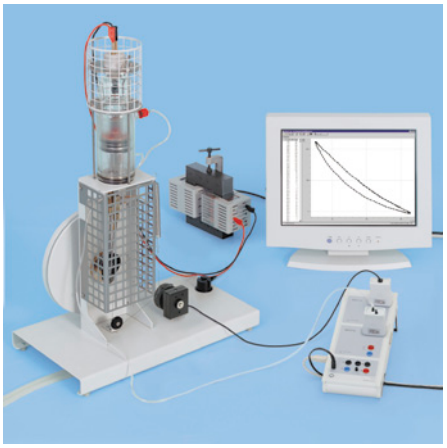
501 11	Extension cable, 15 pole

PC microphone, simple

Multi-purpose microphone for using with microphone S (524 059) or for the connection on the digital counter (575 48).

586 281	PC microphone, simple

pV diagram of the hot-air engine as a heat engine – Recording and evaluating with CASSY



In the experiment P2.6.2.4, the *pV* diagram of the hot air engine as a heat engine is recorded using the computer-assisted measured value recording system CASSY. The pressure sensor measures the pressure *p* in the cylinder and a displacement sensor measures the position *s*, from which the volume is calculated, as a function of the time *t*. The measured values are displayed on the screen directly in a *pV* diagram. In the further evaluation, the mechanical work performed as piston friction per cycle

$$W = -\int p \cdot dV$$

and from this the mechanical power

$$P = W \cdot f$$

f: no-load speed

are calculated and plotted in a graph as a function of the no-load speed.

Pressure sensor S, ±2000 hPa

For relative pressure measurements with CASSY (524 013, 524 006, 524 009A, 524 018)) or the universal measuring instruments (531 835, 531 836, 531 837). Connection to the experiment via two hose nozzles (4 mm Ø). Incl. PVC tubing (667 192) and two connectors with nipple (604 520).

Technical data:

- Measuring ranges: ±20/±60/±200/±600/±2000 hPa
- Resolution: 0.05 % of the measuring range
- Dimensions: 70 mm x 50 mm x 25 mm
- Weight: 75 g

524 064	Pressure sensor S, ±2000 hPa

Pressure sensor S, ±70 hPa

For measuring very small pressure differences with CASSY (524 013, 524 006, 524 018, 524 009A) or the Universal Measuring Instruments (531 835, 531 836, 531 837), e.g. at flow experiments in the wind tunnel (373 12) or the Venturi tube (from 373 091). Connection to the experiment via two hose nozzles (4 mm Ø). Incl. PVC tubing (667 192) and two connectors with nipple (604 520).

Technical data:

- Measuring ranges: ±0.7/±2.1/±7/±21/±70 hPa
- Resolution: 0.05 % of the measuring range
- Dimensions: 70 mm x 50 mm x 25 mm
- Weight: 75 g

524 066	Pressure sensor S, ±70 hPa

Absolute pressure sensor S, 0...1500 hPa

For absolute pressure measurements with CASSY (524 013, 524 006, 524 009A, 524 018) or the universal measuring instruments (531 835, 531 836, 531 837). Thus, it can be used for recording the air pressure or the low pressure in a vacuum apparatus. Connection via small flange DN 16 KF.

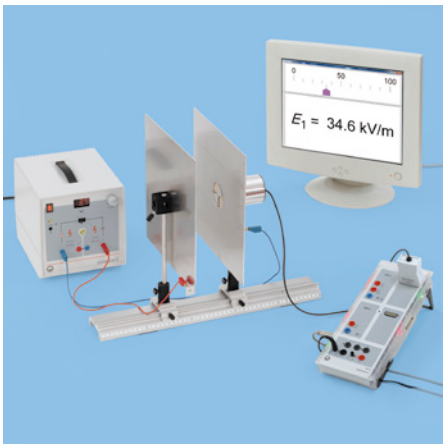
Technical data:

- Measuring ranges: 15/45/150/450/1500 hPa
- Resolution: 0.05 % of the measuring range
- Dimensions: 85 mm x 50 mm x 35 mm
- Weight: 90 g

524 065	Absolute pressure sensor S, 0...1500 hPa

Additionally recommended:

Count	Cat. No.	Name
1	501 11	Extension cable, 15 pole



Measuring the electric field strength inside a plate capacitor

In the experiment P3.1.7.4 the dependance of the electric field strength *E* on the applied voltage *U* and the plate spacing *d* is determined. First, keeping the distance of the plates constant, the value of the applied voltage *U* is varied and the electric field strength is measured. Then, the voltage *U* is kept constant and the dependance of the electric field strength *E* on the plate spacing *d* is determined.

Electric field meter S

For measurement of static electric fields with CASSY (524 013, 524 006, 524 009A, 524 018) or universal measuring instrument physics (531 835). The field is recorded with the correct polarity. To be used for example in experiments for field strength in capacitor, also with dielectric, or for field strength of charged bodies. For investigation of the earth electric field of the Ionosphere (approx. +100 V/m) and the electric charge of clouds (some kV/m). With the voltage measuring plate 1 cm (included in scope of delivery) it can be used as extreme high-impedance voltmeter, e.g. for potential measurement in a free space by potential probe or at the Faraday's cup.

Technical data:

- Measuring ranges:
  Field strength: ±1/±10/±100 kV/m, ±1 MV/m
  Voltage: ±10/±100 V, ±1/±10 kV
- Limiting frequency: 10 Hz
- Input resistance: 10^{15} Ω (under normal conditions)
- Input capacitance: 4 pF
- Voltage supply: ±12 V from CASSY
- Diameter:
  Receptacle for capacitor: 58.3 mm
  Back: 60 mm
- Length: 96 mm
- Length of the stand rod: 190 mm without thread

Scope of delivery:

1 Electric field meter S
1 Stand rod with thread
1 Voltage measuring plate, 1 cm distance

524 080	Electric field meter S

Additionally recommended:

Count	Cat. No.	Name
1	540 540	Accessories for electric field meter S

Current source box

For operating any sensor in which the resistance changes as a function of the physical quantitiy, e.g. LDR, NTC, PTC resistors.

Technical data:

- Measuring ranges: 100 Ω, 1/10/100 kΩ, 1 MΩ
- Saturation voltage: 10 V
- Connections: 4-mm sockets

524 031	Current source box

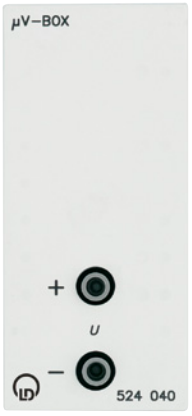
µV box

For measuring very low voltages (e.g. thermocouples, induction coils) using CASSY.

Technical data:

- Measuring ranges: ±1/±3/±10/±30/±100 mV
- Measuring accuracy: 2 %
- Offset error: < 0.5 %
- Input resistance: 100 kΩ
- Cutoff frequency: approx. 1 Hz
- Max. overvoltage: 100 V
- Connection: 4-mm sockets
- Dimensions: 42 mm x 92 mm x 30 mm
- Weight: 100 g

524 040	µV box



30 A box

For electrically isolated current measurement in extra-low voltage circuits with CASSY.

Technical data:

- Contact resistance: < 0.01 Ω
- Measuring ranges: ±1/±3/±10/±30 A
- Measurement error: ±1.5 %
- Connection: 4-mm sockets
- Dimensions: 42 mm x 92 mm x 30 mm
- Weight: 100 g

524 043	30 A box

Electrometer box

Used in electrostatic experiments for measurements of high resistance voltages with respect to earth; can be connected to capacitors and resistors.

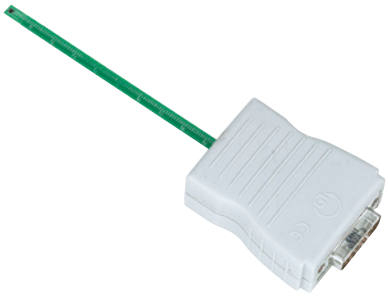
Technical data:

- Max. input voltage: 8 V
- Overvoltage: ≤ 300 V
- Input impedance: ≥ 10^{11} Ω
- Measurement error: ±1.5 %
- Frequency range: 0 Hz ... 1 kHz
- Connection: 4-mm sockets
- Dimensions: 42 mm x 92 mm x 30 mm
- Weight: 100 g

524 054	Electrometer box

Measuring the magnetic field of a pair of coils in the Helmholtz configuration

The experiment P3.3.4.3 examines the homogeneity of the magnetic field in a pair of Helmholtz coils. The magnetic field along the axis through the coil centers is recorded in several measurement series; the spacing *a* between the coils is varied from measurement series to measurement series. When *a* is equal to the coil radius, the magnetic field is essentially independent of the location *x* on the coil axis.



Combi B sensor S

For measuring the tangential or axial magnetic flux density with CASSY (524 013, 524 006, 524 009A, 524 018) or universal measuring instrument physics (531 835). Including stand rod with thread.

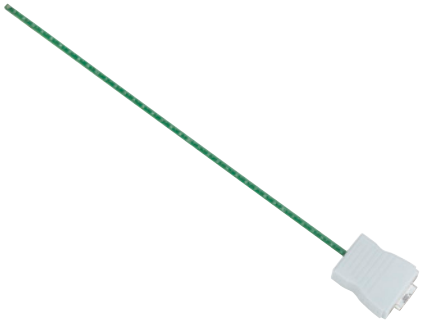
Technical data:

- Measuring ranges: ±10/±30/±100/±300/±1000 mT
- Measuring direction: switchable
- Measurement error: ±2 % plus 0.5 % of the range limit value
- Compensation: up to 1000 mT in each measuring range
- Dimensions: 50 mm x 25 mm x 190 mm
- Weight: 0.15 kg

524 0381	Combi B sensor S

Additionally recommended:

Count	Cat. No.	Name
1	501 11	Extension cable, 15 pole



Axial B sensor S, ±1000 mT

For measuring the axial magnetic flux density with CASSY (524 013, 524 006, 524 009A, 524 018) or universal measuring instrument physics (531 835). Including stand rod with thread.

Technical data:

- Measuring ranges: ±10/±30/±100/±300/±1000 mT
- Measurement error: ±2 % plus 0.5 % of the range limit value
- Compensation: up to 1000 mT in each measuring range
- Dimensions: 50 mm x 25 mm x 420 mm
- Weight: 0.15 kg

524 0382	Axial B sensor S, ±1000 mT

Additionally recommended:

Count	Cat. No.	Name
1	501 11	Extension cable, 15 pole

Axial B sensor S, ±0.3 mT

For measuring magnetic flux density of small fields in the axial direction with CASSY (524 013, 524 006, 524 009A, 524 018) or universal measuring instrument physics (531 835). For example, useful in measuring the earth's magnetic field (40 ... 60 µT) or for measuring a field surrounding a current-carrying conductor for direct and alternating currents (Biot-Savart). Including a nonmagnetic stand rod with thread.

Technical data:

- Measurement ranges: ±30/±100/±300 µT
- Compensation: up to 300 µT in each measurement range
- Frequency limit: 100 Hz in the 300-µT measuring range

524 0383	Axial B sensor S, ±0.3 mT

Additionally recommended:

Count	Cat. No.	Name
1	501 11	Extension cable, 15 pole

Determining the luminous intensity as a function of the distance from the light source – Recording and evaluating with CASSY

The experiment P5.5.1.2 demonstrates that the luminous intensity is proportional to the square of the distance between a point-type light source and the illuminated surface

Lux adapter S

Enables the illuminance to be measured with CASSY (524 013, 524 006, 524 009A, 524 018) or universal measuring instrument chemistry (531 836). Depending on the sensor, the illuminance can be measured in lux or the irradiance in W/m² in various spectral ranges (UV-A, UV-B, UV-C, Vis, IR, IR-CO_2).

Technical data:

- Measuring ranges:
  100/300 lx, 1/3/10/30/100 klx
  10/30/100/300/1000 W/m²
- Connection: DIN socket
- Dimensions: 50 mm x 25 mm x 60 mm
- Weight: 0.1 kg

524 0511	Lux adapter S

Sensors for lux adapter S

Cat. No.	Designation	Measuring range
666 243	Lux sensor	400 ... 750 nm
666 244	UV-A sensor	320 ... 400 nm
666 245	UV-B sensor	280 ... 320 nm
666 246	UV-C sensor	220 ... 280 nm
666 247	IR sensor	750 ... 1700 nm
666 248	IR-CO_2 sensor	4100 ... 4300 nm

Optical power sensor S

Sensor for putting on CASSY (524 013, 524 006, 524 009A, 524 018). The optical achievement sensor S allows the measurement of the absolute and relative optical achievement in dBm/dB.

Technical data:

- Sensor: Si (7 mm²)
- Connections: FSMA, unmanufactured fibers PMMA (2.2 mms) about provided adaptor
- Wavelengths: 665 nm, 820 nm
- Measuring area absolutely:-5 ... -55 dBm
- Measuring area relatively: +50 ... -50 dB
- Resolution: 0.1 dB
- Absolute exactness: 1 dB
- Dimensions: 50 mm x 25 mm x 60 mm
- Weight: 0.1 kg

524 0512	Optical power sensor S

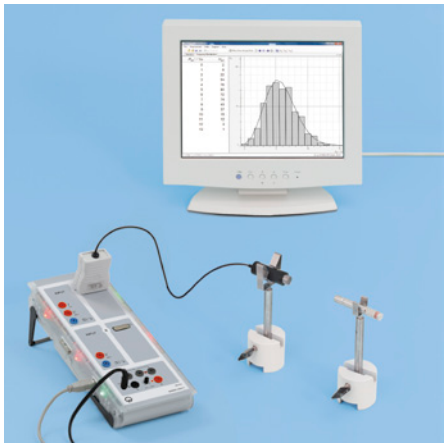
Climate sensor S

Sensor allows simultaneous recording of up to 5 climate-related parameters with Sensor-CASSY 2, Mobile-CASSY, Pocket-CASSY 2 (524 013, 524 009A, 524 018) or the Universal Measuring Instruments Physics and Biology (531 835, 531 837).

Technical data:

- Relative humidity:
  Measuring range: 0 ... 100 %
  Resolution: 0.1 %
  Accuracy: ±3 % (range 20 ... 80 %)
- Air temperature:
  Measuring range: -40 ... 85 °C
  Resolution: 0.1 °C
  Accuracy: ±0.5 °C (range 0 ... 70 °C)
- Illuminance:
  Measuring range: 200 lx, 2/20/180 klx
  Comparison: Full moon-light (0.25 lx), bright sunny day (100 klx)
  Resolution: 0.1 lx in the smallest measuring range
  Wavelength range: 400 ... 700 nm (adapted to the spectral sensitivity of the eye)
- Atmospheric pressure:
  Measuring range: 50 ... 1100 hPa
  Resolution: 0.01 hPa
  Accuracy: ±2 hPa
- Height:
  Calculated by the Barometric Formula using the atmospheric pressure
  Reference height or zero settable
  Resolution: 0.1 m
- Dimensions: 70 mm x 50 mm x 25 mm
- Weight: 50 g

524 0573	Climate sensor S



Statistical variations in determining counting rates

Using a computer-assisted measuring system, the experiment P6.4.2.1 determines multiple pulse counts n triggered in a Geiger-Müller counter tube by radioactive radiation over a selectable gate time Δt. After a total of N counting runs, the frequencies $h(n)$ are determined at which precisely n pulses were counted, and displayed as histograms. For comparision, the evaluation program calculates the mean value μ and the standard deviation

$\sigma = \sqrt{\mu}$

of the measured intensity distribution $h(n)$ as well as the Poisson distribution $w_\mu(N)$.

Geiger-Müller counter tube S

Self-quenching Geiger-Müller counter tube with very thin mica end-window for measuring radioactive radiation with CASSY (524 013, 524 006, 524 009A, 524 018) or universal measuring instrument physics (531 835).

Technical data:

- Gas filling: neon, argon, halogen
- Avarage operating voltage: 500 V
- Dead time: approx. 100 µs
- Service Life: > 10^{10} pulses
- Background in plateau: approx. 0.2 pulses/s
  (with 50 mm Pb and 3 mm Al shielding)
- Responsivity to γ radiation: approx. 1 %
- End-window: 9 mm Ø
- Mass per unit area: 1.5 ... 2 mg/cm²
- Dimensions of counter tube: 75 mm x 24 mm Ø
- Cable length: approx. 50 cm between counter tube and CASSY-Adapter

524 0331	Geiger-Müller counter tube S

GM box

For measuring radioactive radiation using a Geiger-Müller counter tube (559 01). The high voltage for the counter is generated and the counter-tube pulses are converted into suitable signals in the sensor-box.

Technical data:

- Counter tube voltage: 500 V above 1 MΩ
- Connection: coaxial socket
- Dimensions: 42 mm x 92 mm x 30 mm
- Weight: 130 g

524 033	GM box

End-window counter with cable for α, β, γ and X-rays

Self-quenching Geiger-Müller counter tube, in a plastic housing, with a very thin mica end-window which also allows the registration of soft β radiation. With a permanently attached cable. Complete with a protective cap for the mica window.

Technical data:

- Gas filling: neon, argon, halogen
- Mean operating voltage: 450 V
- Connection: screened cable, 55 cm long, with coaxial plug (Amphenol-Tuchel T 3162/1)
- Plateau length: 200 V
- Relative plateau slope: < 0.05 %/V
- Dead time: approx. 100 µs
- Service life: > 10^{10} pulses
- Background in plateau: approx. 0.2 pulses/s (with 50 mm Pb and 3 mm Al shielding)
- Responsivity to γ radiation: approx. 1 %
- End-window: 9 mm Ø
- Mass per unit area 1.5 ... 2 mg/cm²
- Dimensions: 75 mm x 24 mm Ø

559 01	End-window counter with cable for α, β, γ and X-rays

Additionally required: Rate meter with integrated high-voltage supply.

Pancake GM counter tube

Large area Geiger-Müller counter tube for highly sensitive registering of very weak radioactive sources, particularly for use in student experiments with weak sources.

Technical data:

- Operating voltage: 500 V
- Effective diameter: 44 mm
- Connection: BNC with adapter on coaxial plug
- Mass per unit area: 1.5 ... 2 mg/cm²

559 012	Pancake GM counter tube

Additionally required:

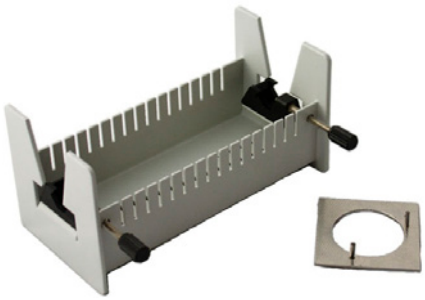
Count	Cat. No.	Name
1	575 471	Counter S
1	524 018*	Pocket-CASSY 2 Bluetooth
1	524 033*	GM box
1	524 220*	CASSY Lab 2

* alternative

Additionally recommended:

Count	Cat. No.	Name
1	559 013	Counter tube holder

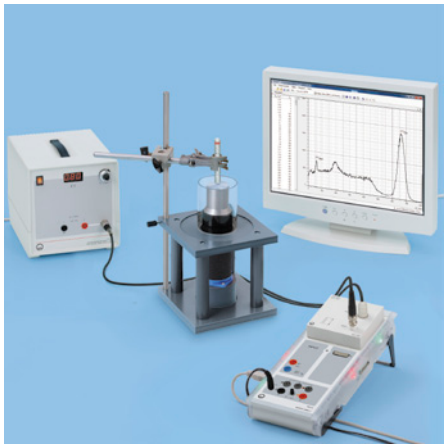
Counter tube holder



Mounting for Pancake GM counter tube (559 012).

559 013	Counter tube holder

Detecting γ radiation with a scintillation counter



In the experiment P6.5.5.1, the output pulses of the scintillation counter are investigated using the oscilloscope and the MCA-Box with CASSY. The total absorption peak and the Compton distribution are identified in the pulse-amplitude distribution generated with monoenergetic γ radiation.

MCA Box

The MCA box is part of the CASSY-S system and together with suitable detectors (e.g. NaJ(Tl) scintillation counters, Si-semiconductor detectors) and in combination with Sensor CASSY (524 013) or Pocket-CASSY (524 006, 524 018), CASSY Lab (524 220) and a computer, it constitutes a multi-channel pulse-amplitude analyzer for a fast and easy recording of the spectra of radioactive decay products. The interaction mechanism in the detectors generates electrical pulses of various amplitudes which are proportional to the energy loss in the detector, unlike Geiger-Müller counter tubes. These pulses are converted to equivalent numerical values, and the Sensor CASSY adds these values together in channels which correspond to the numerical values. The resulting energy spectrum represents the probability distribution of the detected radioactive radiation in dependence on the energy. Consequently, an MCA is significantly different from a single-channel analyzer, which consecutively sweeps the entire spectrum using a small window (channel), and is thus less suitable for low activities. The MCA box contains a BNC input which allows the connection of external detectors, e.g. an NaJ scintillation counter (559 901) with detector output stage (559 912) or a semiconductor detector (559 921) or from (559 56) with discriminator-preamplifier (559 931). Additionally, their analog output signal can be observed by an oscilloscope using a BNC-T-adapter (501 091). The polarity of input signals and the amplitudes of different detectors can be adapted accordingly. The voltage supply for the discriminator pre-amplifier (559 931) and the detector output stage (559 912) can be obtained from the MCA box via a multi-pin socket. The detector output stage (559 912) allows the measurement of high voltage supply at the detector.
NaJ scintillation counters are particularly suitable for γ and β radiation, while Si-semiconductor detectors are appropriate for α and β radiation. For measurements with extremely weak radioactive sources (e.g. radioactively contaminated mushrooms, 137 Cs) the (lead) scintillator screening (559 89) with socket (559 891) can protect the scintillation counter (559 901) against the natural radioactivity of the environment.
The former detector output stages (559 91) and (559 911) can be placed at the MCA box, but they do not allow measurement of high voltage and mechanically they do not suit to the socket for the scintillator screening (559 891).
The software CASSY Lab (524 220) permits the recording of measured values (including high-voltage measurement), the display and evaluation of any spectra in parallel. Energy calibration occurs with one or two known energies and can be realized for each curve individually or for many spectra simultaneously. Integration of any spectrum sections (e.g. of photopeak), fit of Gaussian distribution, addition and substraction of spectra are possible for the evaluation.

Technical data:

- Resolution: 256 ... 2048 channels (8 ... 11 bits) per spectrum
- Storage depth: $2 \cdot 10^9$ events per channel (31 bit)
- Dead time: approx. 60 µs
- Energy linearity: < 3 % of final value
- Coincidence window: 4 µs
- Operating limit for external sensors: 0.5 ... 5 V according to the adjustment of the attenuator, positive or negative. Internal attenuator and polarity adjustable via software.
- High-voltage measurement up to 1.5 kV in connection with detector output stage (559 912)
- Dimensions: 92 mm x 92 mm x 30 mm

524 058	MCA Box

2.2 Chemistry

Temperature sensor S, NTC

For direct connection to CASSY (524 013, 524 006, 524 009A, 524 018) or the Universal Measuring Instruments Physics, Chemistry, Biology (531 835, 531 836, 531 837), incl. NTC-sensor in the stainless steel tube.

Technical data:

- Measuring range: -20 ... 120 °C
- Resolution: 0.1 °C
- Dimensions (without sensor): 70 mm x 50 mm x 25 mm
- Weight: 100 g

524 044	Temperature sensor S, NTC

NiCr-Ni adapter S, Type K

Enables connection of two NiCr-Ni (type K - miniature flat connector) thermocouples for temperature and differential temperature measurements with CASSY (524 013, 524 006, 524 009A, 524 018) or the Universal Measuring Instruments (531 835, 531 836, 531 837).

Technical data:

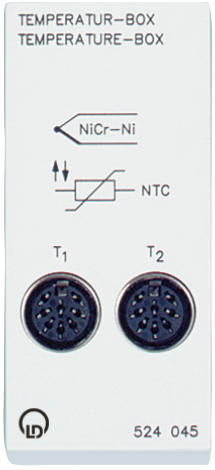
- Max. measuring ranges (dependent on sensor):
  -200 ... +200 °C / -200 ... +1200 °C
- Resolution: 0.1 K / 1 K
- Differential temperature measuring ranges:
  -20 ... +20 °C / -200 ... +200 °C
- Resolution: 0.01 K / 0.1 K
- Dimensions: 50 mm x 25 mm x 60 mm
- Weight: 0.1 kg

524 0673	NiCr-Ni adapter S, Type K

Temperature sensors for NiCr-Ni adapter S

Cat. No.	Designation	Measuring range	Response time
529 676	Temperature probe NiCr-Ni, 1.5 mm, Type K	-50 ... +1100 °C	0.9 s
666 1261	Temperature probe NiCr-Ni, fast, Type K	-50 ... +400 °C	0.3 s
666 1262	Temperature probe NiCr-Ni, for insertion, Type K	-50 ... +1000 °C	3.0 s
666 1263	Temperature probe NiCr-Ni, 3 mm, Type K	-50 ... +1150 °C	5.0 s
666 1264	Temperature probe NiCr-Ni, for surface measurement, Type K	-50 ... +650 °C	8.0 s
666 1265	Temperature probe NiCr-Ni, extra long, Type K	-50 ... +250 °C	10 s

Temperature box NiCr-Ni/NTC



For temperature measurement with up to two NiCr-Ni or NTC temperature sensors with CASSY.

Technical data:

- Measurement ranges:
  NiCr-Ni: -200 ... +1100 °C
  NTC: -20 ... +120 °C
- Connections: DIN plugs
- Dimensions: 42 mm x 92 mm x 30 mm
- Weight: 0.1 kg

524 045	Temperature box NiCr-Ni/NTC

Temperature sensors for temperature box

Cat. No.	Designation	Measuring range
666 193	Temperature probe NiCr-Ni, 1.5 mm	-200 ... +1100 °C
666 212	Temperature probe NTC, 3 mm	-20 ... +120 °C
666 2121	Temperature probe NTC, 3 mm, long	-20 ... +120 °C
666 213	Temperature probe NiCr-Ni, for surface measurement	-200 ... +600 °C
666 217	Temperature probe NiCr-Ni, paddle	-40 ... +400 °C

Micro-CASSY temperature

Inexpensive, robust and compact measurement interface with fixed NiCr-Ni sensor for temperature measurement. Connects to PC, laptop or netbook via USB port. For use with the software CASSY Lab 2 (524 220).

Technical data:

- Measurement range: -50 ... 1100 °C
- Housing color: Yellow
- Housing dimensions: 85 mm x 22 mm x 14 mm
- Length of the connection cable: 70 cm
- Measurement tips diameter: 1.5 mm

528 15	Micro-CASSY temperature

Chemistry box

For measuring pH/potential, conductivity and a maximum of 4 temperatures with CASSY. Measurement of differences in temperatures with high resolution possible.

Technical data:

- pH/Potential:
  Measuring range: 0 ... 14 pH / -2 ... +2 V
  Resolution: 0.01 pH / 1 mV
  Input resistance: > 10^{13} Ω
  Connetion: BNC
- Conductivity (with sensor 529 670):
  Measuring ranges: 10/30/100/300 µS/cm, 1/3/10/30/100/300 mS/cm, 1 S/cm
  Resolution: 0.005 µS/cm
  Temperature: -25 ... +100 °C
  Connection: 6-pin DIN
- Temperature:
  Measuring ranges: -200 ... +200 °C / -200 ... +1200 °C
  Resulution: 0.1 K/ 1 K
  Connection: Type K
- Difference temperature:
  Measuring ranges: -20 ... +20 °C / -200 ... +200 °C
  Resulution: 0.01 K/0.1 K
  Connection: Type K
- Dimensions: 91 mm x 91 mm x 60 mm
- Weigth: 100 g

524 067	Chemistry box

pH adapter S

Enables a pH electrode to be connected to CASSY (524 013, 524 006, 524 009A, 524 018) or the Universal Measuring Instrument Chemistry (531 836). Moreover, the voltage at the BNC socket can be measured at a very high resistance, e.g. for measuring electrochemical potentials.

Technical data:

- Measuring ranges pH: 0 ... 14 pH
- Resolution pH: 0.01 pH
- Measuring ranges potential: ±1/±2 V
- Input resistance: > 10^{13} Ω
- Connection: BNC socket
- Dimensions: 50 mm x 25 mm x 60 mm
- Weight: 0.1 kg

524 0672	pH adapter S

pH probes with BNC connection

- Measuring range: 0 ... 14 pH
- Resolution: 0.01 pH
- Suitable for: 524 067 and 524 0672

Cat. No.	Designation
529 672	pH sensor, BNC
667 4172	pH sensor with plastic shaft, BNC
667 4182	pH probe with conical diaphragm,BNC
667 4192	pH probe with flat diaphraagm, BNC
667 4242	pH probe with glass shaft, BNC

Conductivity adapter S

Used in conjunction with the conductivity sensor (529 670), this adapter enables conductivity and temperature to be measured with CASSY (524 013, 524 006, 524 009A, 524 018) or the Universal Measuring Instrument Chemistry (531 836).

Technical data:

- Measuring ranges:
  Conductivity (with sensor 529 670):
  10/30/100/300 µS/cm, 1/3/10/30/100/300 mS/cm, 1 S/cm
- Resolution 0.005 µS/cm in the smallest measuring range
- Temperature measurement and compensation: -25 ... +100 °C
- Connections: 6-pole DIN socket for conductivity sensor with temperature measurement
- Dimensions: 50 mm x 25 mm x 60 mm
- Weight: 0.1 kg

524 0671	Conductivity adapter S

Conductivity sensor

Conductivity sensor in four-wire technology with integrated Pt temperature sensor; for use with the Chemistry Box (524 067) or Conductivity Adapter S (524 0671) and CASSY (524 013, 524 006, 524 009A, 524 018) or the Universal Measuring Instrument Chemistry (531 836). Open design for rapid response by conductivity modulation. A minimum distance from the tank side of 1 cm, as well as a minimum immersion depth of 2 cm are keep by measurements.

Technical data:

- Cell constant 0.58 cm^{-1}
- Measuring range: 0 ... 1 S/cm
- Temperature range: -25 ... +100 °C
- Connections: 6-pole DIN socket
- Dimensions: 160 mm x 16 mm Ø
- Weight: 75 g

529 670	Conductivity sensor

Immersion photometer S

In conjunction with CASSY (524 013, 524 006, 524 009A, 524 018) or the Universal Measuring Instrument Chemistry (531 836) and appropriate reagents (666 2600, 666 2601, 666 2603, 666 2604), pollutants and turbidity can be measured on water samples. In the software, the determination of 17 pollutants is already programmed. Moreover, you can do an arbitrary number of determinations of your own and store them. Apart from direct transmission, extinction and concentration measurements, the evolution of these quantities in the course of time can also be followed (kinetic measurement). The device can also be employed for long-term measurements (e.g. measurement of the turbidity in a bioreactor).

Technical data:

- Measurement quantities: transmission, extinction and concentration
- Wavelength: LEDs 455, 520, 558, 612, 696 nm
- Detector: silicon photoelement
- Measurable pollutants: ammonium, free chlorine, total chlorine, chloride, iron, hardness, potassium, silicic acid, copper, manganese, nickel, nitrate, nitrite, phosphate, sulphate, sulphite, turbidity, zinc (own determinations possible)
- Cable length: 1 m
- Material: DURAN glass
- Volume of sample: 10 ml
- Dimensions: 200 mm x 26 mm Ø
- Weight: 200 g

524 069	Immersion photometer S

Holder for immersion photometer S

Replaces a stand in carrying out calibrations and measurements. Holder made of plastic with base of lacquered sheet metal.

Technical data:

- Dimensions: 80 mm x 80 mm x 140 mm
- Weight: 0.15 kg

666 2605	Holder for immersion photometer S

Drop counter

Drop counter for use with CASSY (524 013, 524 006, 524 018) or the Universal Measuring Instrument Physics (531 835). Very sensitive reflection light barrier with light transmitter and receiver are lied side by side. Daylight independent by modulated light. Simple set up in an experiment, because it is necessary only one-sided access to the buret.

Technical data:

- Diameter: 12 mm
- Length: 10 cm
- Connection: 6-pole DIN

337 4681	Drop counter

Additionally required:

Count	Cat. No.	Name
1	524 034	Timer box
1	524 074*	Timer S

* alternative

Oxygen adapter S

Used in conjunction with the oxygen electrode (667 458), this adapter enables the oxygen content and the temperature of liquids and air to be measured with CASSY (524 013, 524 006, 524 009A, 524 018) or the Universal Measuring Instrument Chemistry (531 836).

Technical data:

- Measuring ranges:
  Oxygen concentration: 0 ... 20 mg/l
  Relative oxygen saturation: 0 ... 200 %
  Temperature: 0 ... 50 °C
- Connection: DIN socket
- Dimensions: 50 mm x 25 mm x 60 mm
- Weight: 0.1 kg

524 0521	Oxygen adapter S

Oxygen electrode

The oxygen electrode after Clark is used for measuring the oxygen content of liquids and air. The temperature sensor integrated in the electrode also allows temerature measurements.

Technical data:

- Measuring ranges:
  Oxygen concentration in H_2O: 0 ... 60 mg/l
  Temperature: 0 ... 45 °C
- Cable length: 1.5 m (with 8-pole DIN plug)
- Dimensions: 140 mm x 12 mm Ø

Scope of delivery:

1 Spare cap with membrane for the O_2 electrode
1 Ampoule zero point solution
50 ml Solution of electrolytes for the O_2 electrode

667 458	Oxygen electrode

Accessory set for the oxygen electrode

Scope of delivery:

5 Spare covers with membranes
50 ml Oxygen electrolyte
6 Double lance ampoules zero point solution

667 451	Accessory set for the oxygen electrode

2.3 Biology

Lux adapter S

Enables the illuminance to be measured with CASSY (524 013, 524 006, 524 009A, 524 018) or universal measuring instrument chemistry (531 836). Depending on the sensor, the illuminance can be measured in lux or the irradiance in W/m² in various spectral ranges (UV-A, UV-B, UV-C, Vis, IR, IR-CO_2).

Technical data:

- Measuring ranges:
  100/300 lx, 1/3/10/30/100 klx
  10/30/100/300/1000 W/m²
- Connection: DIN socket
- Dimensions: 50 mm x 25 mm x 60 mm
- Weight: 0.1 kg

524 0511	Lux adapter S

Sensors for lux adapter S

Cat. No.	Designation	Measuring range
666 243	Lux sensor	400 ... 750 nm
666 244	UV-A sensor	320 ... 400 nm
666 245	UV-B sensor	280 ... 320 nm
666 246	UV-C sensor	220 ... 280 nm
666 247	IR sensor	750 ... 1700 nm
666 248	IR-CO_2 sensor	4100 ... 4300 nm

Climate sensor S

Sensor allows simultaneous recording of up to 5 climate-related parameters with Sensor-CASSY 2, Mobile-CASSY, Pocket-CASSY 2 (524 013, 524 009A, 524 018) or the Universal Measuring Instruments Physics and Biology (531 835, 531 837).

Technical data:

- Relative humidity:
  Measuring range: 0 ... 100 %
  Resolution: 0.1 %
  Accuracy: ±3 % (range 20 ... 80 %)
- Air temperature:
  Measuring range: -40 ... 85 °C
  Resolution: 0.1 °C
  Accuracy: ±0.5 °C (range 0 ... 70 °C)
- Illuminance:
  Measuring range: 200 lx, 2/20/180 klx
  Comparison: Full moon-light (0.25 lx), bright sunny day (100 klx)
  Resolution: 0.1 lx in the smallest measuring range
  Wavelength range: 400 ... 700 nm (adapted to the spectral sensitivity of the eye)
- Atmospheric pressure:
  Measuring range: 50 ... 1100 hPa
  Resolution: 0.01 hPa
  Accuracy: ±2 hPa
- Height:
  Calculated by the Barometric Formula using the atmospheric pressure
  Reference height or zero settable
  Resolution: 0.1 m
- Dimensions: 70 mm x 50 mm x 25 mm
- Weight: 50 g

524 0573	Climate sensor S

Climate box

For measuring humidity, temperature, illuminance and barometric pressure in conjunction with CASSY (524 013, 524 006, 524 009A, 524 018). The pressure sensor is integrated in the climate box; external sensors are required for measuring all other quantities.

Technical data:

- Measuring ranges:
  with humidity sensor (529 057):
  relative humidity: 0 ... 100 %
  Temperature: -40 ... +80 °C
  with NTC sensor (666 212):
  Temperature: -20 ... +120 °C
  with lux sensor (666 243):
  Illuminance: 0 ... 200 klx
  Internal:
  Barometric pressure: 400 ... 1600 hPa
- Hose nozzle: 5 mm Ø
- Connections: DIN sockets
- Dimensions: 42 mm x 92 mm x 30 mm
- Weight: 100 g

524 057	Climate box

Sensors for climate box

Cat. No.	Designation	Measuring range
529 057	Humidity sensor	0 ... 100 % / -40 ... 80 °C
666 212	Temperature probe NTC, 3 mm	-20 ... 120 °C
666 2121	Temperature probe NTC, 3 mm, long	-20 ... 120 °C
666 243	Lux sensor	0 lx ... 200 klx

Humidity sensor S

For measuring relative humidity and air temperature with CASSY (524 013, 524 006, 524 009A, 524 018) or the Universal Measuring Instrument Chemistry (531 836).

Technical data:

- Measuring ranges:
  Relative humidity: 0 ... 100 %
  Air temperature: -40 ... +80 °C

524 0572	Humidity sensor S

CO_2 sensor S

For measuring of carbon diaxide concetration in the air or in other gases, f.i. for photosynthesis and respiration with CASSY (524 013, 524 006, 524 009A, 524 018) or the universal measuring instrument chemistry (531 836). Also suitable for measuring the airquality in a class-room.

524 083	CO_2 sensor S

Additionally recommended:

Count	Cat. No.	Name
1	501 11	Extension cable, 15 pole

Pulse sensor S

For measurement of the pulse frequency with the aid of an infrared sensor which is attached to the ear lobe or finger tip, whereby the sensitivity is adjusted automatically. The individual pulse beats are indicated by a LED. The pulse sensor is electrically isolated from CASSY.

524 0471	Pulse sensor S

Skin resistance sensor S

For measurement of the electrical conductance of the skin with CASSY. The degree of skin conductance provides information as to the level of „emotional excitement" (stress) of the test person and provides information on the stereotype mechanisms of the stress reaction in general.
The electrodes are attached to the finger tips by way of Velcro fastening bands and are electrically isolated from the measurement input of the CASSY.

524 0481	Skin resistance sensor S

Blood pressure sensor S

For blood pressure measurements according to the oscillatory method with Sensor-CASSY (524 013) or Pocket-CASSY (524 006, 524 018) without stethoscope and microphone. The pressure variations which are caused by the pulse waves are transmitted by the arm collar and measured together with the falling pressure in the arm collar. Alternative for use with the Mobile-CASSY (524 009A) after the auscultatoric method (after Korotkow). The characteristic noise phenomenons are listened with a stethoscope (additionally required).
The Universal Measuring Instrument Biology (531 837) gives an audible sound for the pressure variations.

Technical data:

- Pressure range: 375 mm Hg (500 hPa)

524 0501	Blood pressure sensor S

ECG/EMG box

For measurement of the electrical processes at the heart muscle (ECG, electrocardiogramm) or skeletal muscles (EMG, electromyogramm) with Sensor-CASSY or Pocket-CASSY. The tension of the muscles is recorded with self-adhesive silver/silver chloride electrodes. In case of the ECG measurement all three standard measurements after EINTHOVEN can be run. The sensors are electrically isolated from CASSY.

Technical data:

- Cable length: each 1 m (screened)
- Dimensions: 92 mm x 92 mm x 30 mm
- Weight: 0.3 kg

Scope of delivery:

Count	Cat. No.	Name
1	524 049	ECG/EMG box
1	529 492	ECG/EMG single use electrodes, 30 pieces

524 049	ECG/EMG box

Additionally recommended:

Count	Cat. No.	Name
1	529 492	ECG/EMG single use electrodes, 30 pieces
1	529 493*	ECG/EMG permanent electrodes
1	662 112*	Electrode gel
1	662 113*	Desinfectant spray

* alternative

ECG/EMG adapter S

For the single channel measurement of the electric processes at the heart muscle (ECG, electrocardiogram) or at the skeleton muscular system (EMG, electromyogram) with Sensor-CASSY or Pocket-CASSY. The muscle tensions are recorded with self-adhesive silver/silver chloride electrodes. The sensors are electrically isolated from CASSY. Connection for Reflex hammer with release (529 491).

Scope of delivery:

Count	Cat. No.	Name
1	524 0491	ECG/EMG adapter S
1	529 492	ECG/EMG single use electrodes, 30 pieces

524 0491	ECG/EMG adapter S

Additionally recommended:

Count	Cat. No.	Name
1	529 492	ECG/EMG single use electrodes, 30 pieces
1	529 493*	ECG/EMG permanent electrodes
1	662 112*	Electrode gel
1	662 113*	Desinfectant spray

* alternative

Reflex hammer with release

Reflex hammer for the triggering of reflex reactions. With built-in transmitter to mark the start time.
Usage with ECG/EMG Adapter S (524 0491).

529 491	Reflex hammer with release

ECG/EMG single use electrodes, 30 pieces

Self-adhesive single use electrodes for ECG and EMG examination.

Technical data:

- Ag/AgCl contact

529 492	ECG/EMG single use electrodes, 30 pieces

ECG/EMG permanent electrodes

Permanent electrodes for ECG/EMG box (524 049) and ECG/EMG Adapter S (524 0491), single channel.

Scope of delivery:

4 Permanent electrodes
4 Rubber bands

529 493	ECG/EMG permanent electrodes

Electrode gel

For improving the conductance of the skin during ECG, EMG and skin resistance measurements.

Technical data:

- Tube: 250 g

662 112	Electrode gel

Desinfectant spray

For the hygienic cleanup of the sensors. Can with spray nozzle.

Technical data:

- Content: 200 ml

662 113	Desinfectant spray

Spirometer box

For pneumotachographic measurement of various tidal volumes, the flow-volume curve and the forced expriatory volume per second with CASSY.

Technical data:

- Measuring range: -14.0 ... +14.0 l/s
- Accuracy of measurement: ±2.5 %

Scope of delivery:

1 Spirometer-Box
1 Reducer
30 Bacteria filter
30 Mouth pieces

524 056	Spirometer box

Mouthpiece for the spirometer, 40 items

The mouthpiece is put onto the bacteria filter which is used for spirometer box (524 056) or for the accessories to the spirometer (662 383).

662 3812	Mouthpiece for the spirometer, 40 items

Bacteria filter for spirometer, 30 items

For hygienic connection between the mouthpiece and spirometer box (524 056) or the accessories to the spirometer (662 383).

662 3813	Bacteria filter for spirometer, 30 items

Accessories for spirometer

Used for examining the oxygen consumption in conjunction with the spirometer-box (524 056), the oxygen box (524 052) and the oxygen electrode (667 458).

Scope of delivery:

- 2-way breathing valve
- Tube
- Bacteria filter
- Mouthpiece

662 383	Accessories for spirometer

Reaction test adapter S

For measuring reaction times, controlled by a hand or foot key, and for determining nerve conductor speed. Signaling accomplished as selected; either via three-color LEDs (hand key) or acoustic signal (foot key) or software.

524 0461	Reaction test adapter S

Additionally required:

Count	Cat. No.	Name
1	662 148	Push-button
1	662 149	Foot switch

Push-button

For reaction time measuring in connection with three buttons of different colours, for connection to the Reaction box (524 046) or the Reaction test adapter S (524 0461).

Technical data:

- Dimensions: 65 mm x 50 mm x 25 mm
- Weight: 100 g

662 148	Push-button

Foot switch

For connection to the Reaction box (524 046) or the Reaction test adapter S (524 0461) to determine the approximate speed of the nerve impulses travelling along the nerves.

Technical data:

- Dimensions: 110 mm x 65 mm x 60 mm
- Weight: 0.13 kg

662 149	Foot switch

Hearing threshold adapter S

Technical data:

- Frequency: 21 ... 29,834 Hz
- Audibility: -64 ... 0 dB

524 085	Hearing threshold adapter S

Additionally recommended:

Count	Cat. No.	Name
1	529 085	Headphones

Headphones

Closed earcup design to supress outside noise, can be used with Threshold of hearing adapter S (524 085).

Technical data:

- Connector: 3.5 mm Minijack (1/8")

529 085	Headphones

Artificial head

For the demonstration of the binaural listening and of running time differences. Provided with 2 electret microphones in the ears, cables leaded out.

529 0591	Artificial head

Additionally required:

Count	Cat. No.	Name
1	524 013	Sensor-CASSY 2
2	524 059	Microphone S

3 Sets

Sensor-CASSY 2 Starter

Voltage and current input are already integrated in the Sensor-CASSY. Therefore following experiments are realizable **without additional sensors**:

- Voltage and current measurement
- Ohm's law
- Electric oscillations
- Characteristic curves
- AC circuit
- Active power

Scope of delivery:

Count	Cat. No.	Name
1	524 013	Sensor-CASSY 2
1	524 220	CASSY Lab 2

524 013S	Sensor-CASSY 2 Starter

Pocket-CASSY 2 Bluetooth Starter

Bundle consisting of Pocket-CASSY 2 Bluetooth with UIP sensor S, software CASSY Lab and Bluetooth dongle serving as an introduction into data recording with CASSY (USB and Bluetooth). The UIP sensor S offers a voltage and a current input. Therefore, the following experiments are possible without additional sensors:

- Voltage and current measurement
- Ohm's law
- Electric oscillations
- Characteristic curves
- Alternating current circuit
- Active power

Scope of delivery:

Count	Cat. No.	Name
1	524 0031	Bluetooth Dongle
1	524 018	Pocket-CASSY 2 Bluetooth
1	524 0621	UIP sensor S
1	524 220	CASSY Lab 2

524 018S	Pocket-CASSY 2 Bluetooth Starter

Physics Sensors Basic Equipment

With the Sensor Equipment 524 010P1 additonal workable experiments:
- Uniformly and accelerated motion
- Mechanical oscillations and forces

Scope of delivery:

Count	Cat. No.	Name
1	337 462	Combination light barrier
1	337 464	Combination spoked wheel
1	501 16	Multi-core cable, 6-pole, 1.5 m
1	524 042	Force sensor S, ±50 N
1	524 074	Timer S

524 010P1	Physics Sensors Basic Equipment

Additionally required:

Count	Cat. No.	Name
1	524 013S	Sensor-CASSY 2 Starter
1	524 018S*	Pocket-CASSY 2 Bluetooth Starter

* alternative

Physics Sensors Supplementary Equipment

If the Sensor Equipment 524 010P1 are extended with the Sensor Supplementary Equipment 524 010P2 the following experiments are additional workable:
- Free fall
- Rate Measurement
- Poisson distribution
- Inverse-square law of distance radioactivity and light
- Velocity of sound
- Acoustic frequency
- Sound analysis
- Hydrostatic pressure
- Temperature measurement
- Axial and tangential magnetic field

Scope of delivery:

Count	Cat. No.	Name
1	337 46	Forked light barrier
1	501 11	Extension cable, 15 pole
1	524 0331	Geiger-Müller counter tube S
1	524 0381	Combi B sensor S
1	524 044	Temperature sensor S, NTC
1	524 0511	Lux adapter S
1	524 059	Microphone S
1	524 064	Pressure sensor S, ±2000 hPa
1	529 034	g ladder
1	586 281	PC microphone, simple
1	666 243	Lux sensor

524 010P2	Physics Sensors Supplementary Equipment

Additionally required:

Count	Cat. No.	Name
1	524 010P1	Physics Sensors Basic Equipment
1	524 013S	Sensor-CASSY 2 Starter
1	524 018S*	Pocket-CASSY 2 Bluetooth Starter

* alternative

Class sets of 4 pcs.

Delivery of sensors in a storage drawer.

Cat. No.	Designation
524 006B4	Pocket-CASSY (4x)
524 009AB4	Mobile-CASSY (4x)
524 0621B4	UIP sensor S (4x)
524 074B4	Timer S (4x)
524 059B4	Microphone S (4x)
524 0673B4	NiCr-Ni adapter S, Type K (4x)
524 044B4	Temperature sensor S, NTC (4x)
524 042B4	Force sensor S, ±50 N (4x)
524 082B4	Rotary motion sensor S (4x)
524 0672B4	pH adapter S (4x)
524 0671B4	Conductivity adapter S (4x)

Class sets of 8 pcs.

Delivery of sensors in a storage drawer.

Cat. No.	Designation
524 006B8	Pocket-CASSY (8x)
524 009AB8	Mobile-CASSY (8x)
524 0621B8	UIP sensor S (8x)
524 074B8	Timer S (8x)
524 059B8	Microphone S (8x)
524 0673B8	NiCr-Ni adapter S, Type K (8x)
524 044B8	Temperature sensor S, NTC (8x)
524 042B8	Force sensor S, ±50 N (8x)
524 082B8	Rotary motion sensor S (8x)
524 0672B8	pH adapter S (8x)
524 0671B8	Conductivity adapter S (8x)
528 11B8	Micro-CASSY voltage (8x)
528 12B8	Micro-CASSY current (8x)
528 15B8	Micro-CASSY temperature (8x)
528 18B8	Micro-CASSY pH value (8x)

Case for CASSY and sensors

All-purpose storage case fitting the shape of one Sensor-CASSY and/or Pocket-CASSY and up to 10 sensors.

Technical data:

- Dimensions: 45 cm x 35 cm x 12 cm
- Weight: 1.5 kg

524 0035	Case for CASSY and sensors

Sensor-CASSY 2 Physics Kit

Contains a Sensor-CASSY 2, the software CASSY Lab 2 and sensors for force, magnetic field, and temperature. In a storage case fitting the shape of components with room for more sensors.

Technical data:

- Dimensions: 45 cm x 35 cm x 12 cm
- Weight: 3 kg

Scope of delivery:

Count	Cat. No.	Name
1	501 11	Extension cable, 15 pole
1	524 0035	Case for CASSY and sensors
1	524 013	Sensor-CASSY 2
1	524 0381	Combi B sensor S
1	524 042	Force sensor S, ±50 N
1	524 0673	NiCr-Ni adapter S, Type K
1	524 220	CASSY Lab 2
1	529 676	Temperature probe NiCr-Ni, 1.5 mm, Type K

524 013P	Sensor-CASSY 2 Physics Kit

Pocket-CASSY 2 Physics Kit

Contains a Pocket-CASSY 2 Bluetooth with a Bluetooth dongle, a Rechargeable Battery for Pocket-CASSY 2 Bluetooth, the software CASSY Lab 2, and sensors for 3D acceleration, magnetic field, voltage, current, and power. In a storage case fitting the shape of components with space for more sensors.

Technical data:

- Dimensions: 45 cm x 35 cm x 12 cm
- Weight: 2 kg

Scope of delivery:

Count	Cat. No.	Name
1	524 0031	Bluetooth Dongle
1	524 0035	Case for CASSY and sensors
1	524 018	Pocket-CASSY 2 Bluetooth
1	524 019	Rechargeable battery for Pocket-CASSY 2 Bluetooth
1	524 0381	Combi B sensor S
1	524 0424	3D acceleration sensor S
1	524 0621	UIP sensor S
1	524 220	CASSY Lab 2

524 018P	Pocket-CASSY 2 Physics Kit

Sensor-CASSY 2 Chemistry Kit

Contains a Sensor-CASSY 2, the software CASSY Lab 2 and sensors for temperature, conductivity, and pH value. In a storage case fitting the shape of components with room for more sensors.

Technical data:

- Dimensions: 45 cm x 35 cm x 12 cm
- Weight: 3 kg

Scope of delivery:

Count	Cat. No.	Name
1	524 0035	Case for CASSY and sensors
1	524 013	Sensor-CASSY 2
1	524 0671	Conductivity adapter S
1	524 0672	pH adapter S
1	524 0673	NiCr-Ni adapter S, Type K
1	524 220	CASSY Lab 2
1	529 670	Conductivity sensor
1	529 672	pH sensor, BNC
1	529 676	Temperature probe NiCr-Ni, 1.5 mm, Type K

524 013C	Sensor-CASSY 2 Chemistry Kit

Pocket-CASSY 2 Chemistry Kit

Contains a Pocket-CASSY 2 Bluetooth with a Bluetooth dongle, a Rechargeable Battery for Pocket-CASSY 2 Bluetooth, the software CASSY LAB 2, and sensors for temperature, conductivity, and pH value. In a storage case fitting the shape of components with space for more sensors.

Technical data:

- Dimensions: 45 cm x 35 cm x 12 cm
- Weight: 2 kg

Scope of delivery:

Count	Cat. No.	Name
1	524 0031	Bluetooth Dongle
1	524 0035	Case for CASSY and sensors
1	524 018	Pocket-CASSY 2 Bluetooth
1	524 019	Rechargeable battery for Pocket-CASSY 2 Bluetooth
1	524 0671	Conductivity adapter S
1	524 0672	pH adapter S
1	524 0673	NiCr-Ni adapter S, Type K
1	524 220	CASSY Lab 2
1	529 670	Conductivity sensor
1	529 672	pH sensor, BNC
1	529 676	Temperature probe NiCr-Ni, 1.5 mm, Type K

524 018C	Pocket-CASSY 2 Chemistry Kit

Sensor-CASSY 2 Biology Kit

Contains a Sensor-CASSY 2, the software CASSY Lab 2 and sensors for pulse and skin resistance. In a storage case fitting the shape of components with room for more sensors.

Technical data:

- Dimensions: 45 cm x 35 cm x 12 cm
- Weight: 3 kg

Scope of delivery:

Count	Cat. No.	Name
1	524 0035	Case for CASSY and sensors
1	524 013	Sensor-CASSY 2
1	524 0471	Pulse sensor S
1	524 0481	Skin resistance sensor S
1	524 220	CASSY Lab 2

524 013B	Sensor-CASSY 2 Biology Kit

Pocket-CASSY 2 Biology Kit

Contains a Pocket-CASSY 2 Bluetooth with a Bluetooth dongle, a Rechargeable Battery for Pocket-CASSY 2 Bluetooth, the software CASSY LAB 2, and sensors for pulse and skin resistance. In a storage case fitting the shape of components with space for more sensors.

Technical data:

- Dimensions: 45 cm x 35 cm x 12 cm
- Weight: 2 kg

Scope of delivery:

Count	Cat. No.	Name
1	524 0031	Bluetooth Dongle
1	524 0035	Case for CASSY and sensors
1	524 018	Pocket-CASSY 2 Bluetooth
1	524 019	Rechargeable battery for Pocket-CASSY 2 Bluetooth
1	524 0471	Pulse sensor S
1	524 0481	Skin resistance sensor S
1	524 220	CASSY Lab 2

524 018B	Pocket-CASSY 2 Biology Kit

4 Manuals

LIT: CASSY Lab 2 manual

All information on using CASSY Lab, plus all experiment examples, in a single ring binder, in English.

524 221EN	LIT: CASSY Lab 2 manual

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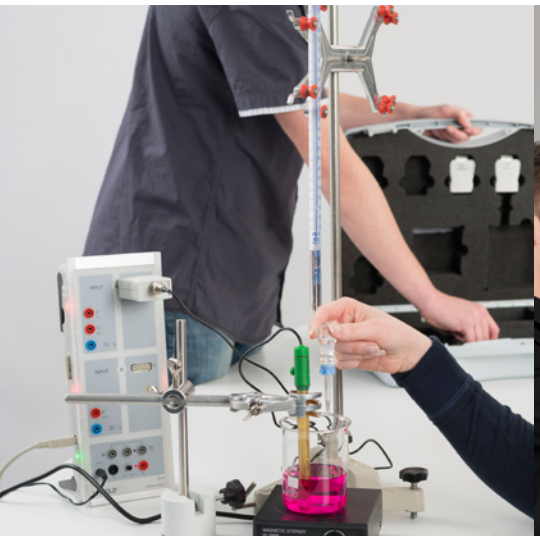

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