

PHYSICS

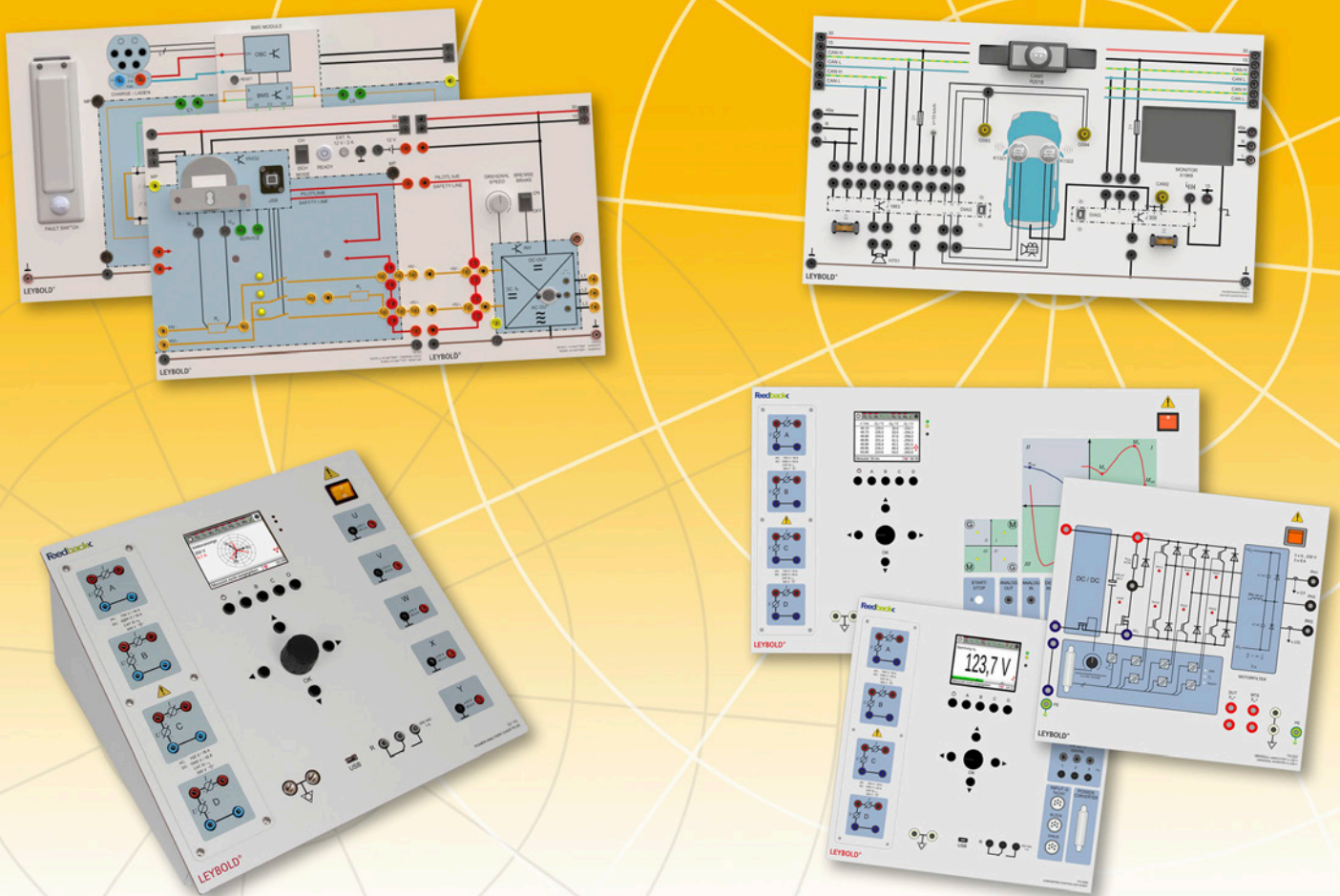
CHEMISTRY  
BIOLOGY

ENGINEERING



LD DIDACTIC

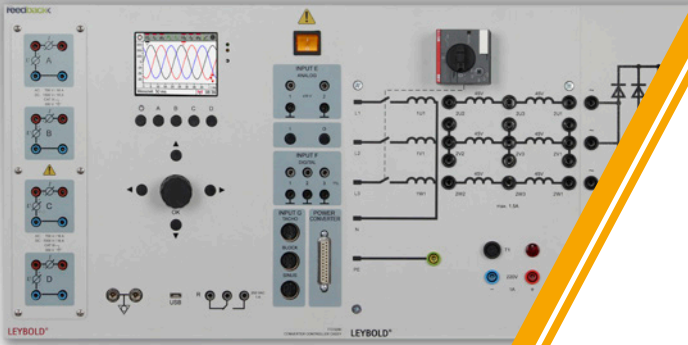
# INNOVATIONS IN VOCATIONAL TRAINING 2019



- POWER ELECTRONICS & DRIVE TECHNOLOGY
- ANALYSIS OF ENERGY SUPPLY GRIDS
- MACHINE TEST SYSTEM
- COM3LAB SENSOR TECHNOLOGY
- BATTERY TRAINER & SIDE ASSIST

**LEYBOLD®**

## NEW EQUIPMENT FOR POWER ELECTRONICS RECTIFIERS



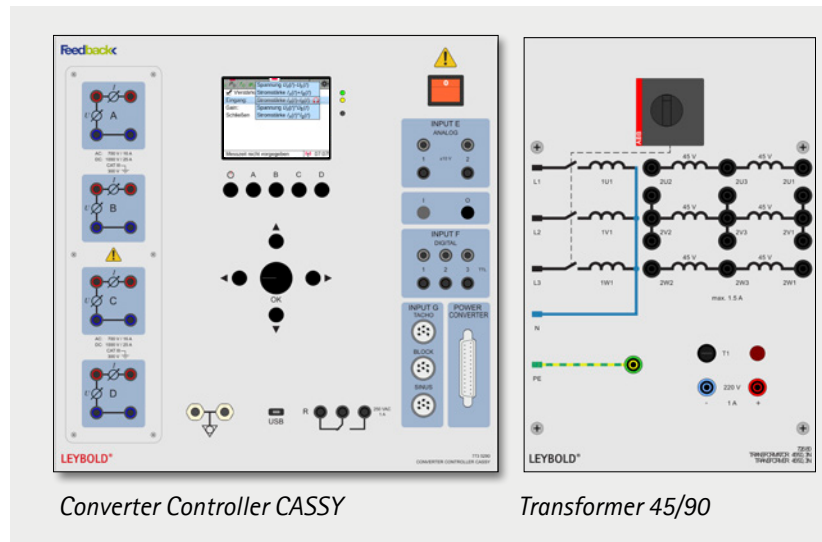
The Converter Controller CASSY is the ultimate universal measuring and control unit in power electronics.

On the one hand, it controls the didactic frequency inverter, and on the other hand, it is able to record variables in power electronics via the eight measuring inputs.

The measured values are displayed both in the display and in the CASSY Lab 2 software.

Possible experiments:

- Diagrams of current and voltage curves in power electronic circuits
- Measurements of power loss and efficiency
- Transmission behaviour of PWM modulation
- Measuring in circuits with frequency converters



Converter Controller CASSY

Transformer 45/90

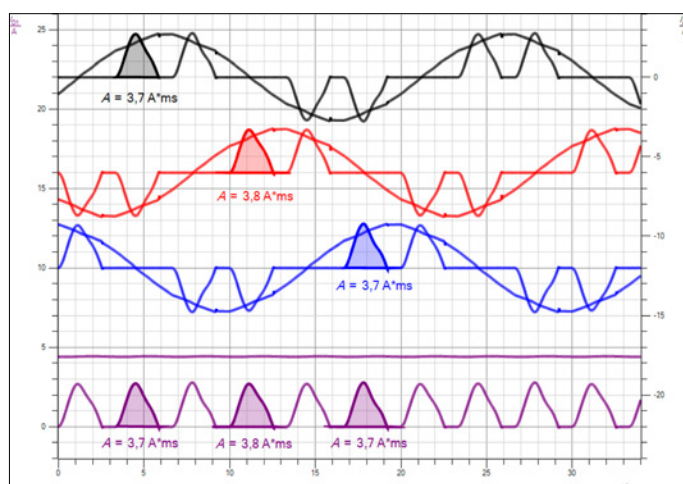
### PRODUCT HIGHLIGHTS

- ★ Simultaneous surveying of all phases
- ★ Analysis of the characteristics in real time
- ★ Fault-tolerant measuring directly at the rectifier
- ★ compatible with CASSY Lab 2, MATLAB® and LabView™
- ★ Digital experiment manuals "Lab Docs"

### TRAINING OBJECTIVES

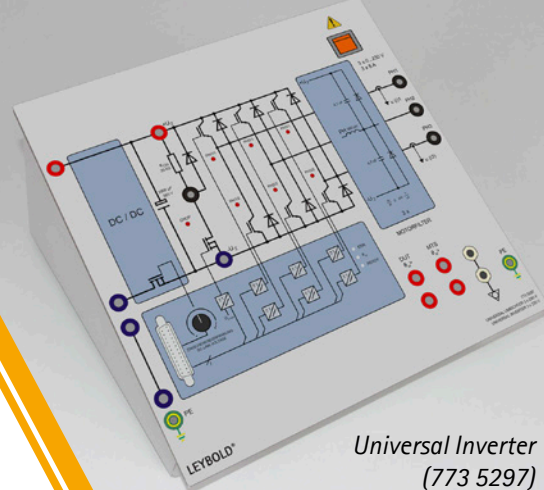
Examples for operation:

- Ensuring the function of a power supply and safety of the equipment
- Analysing systems and verifying safety
- Installation and maintenance of power systems

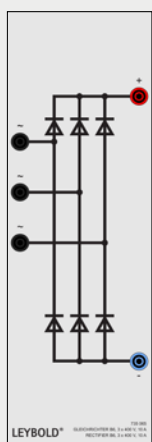


Measurements on a B6 rectifier bridge while feeding into the intermediate circuit of a frequency converter

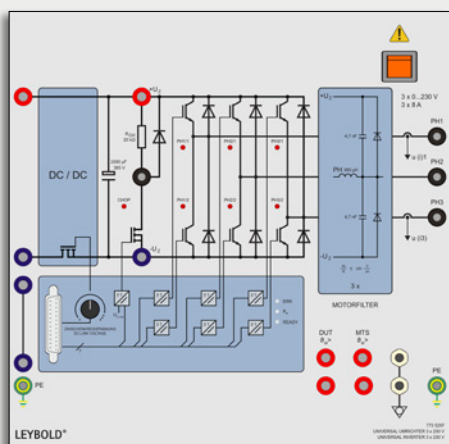
## NEW EQUIPMENT FOR DRIVE TECHNOLOGY FREQUENCY INVERTERS



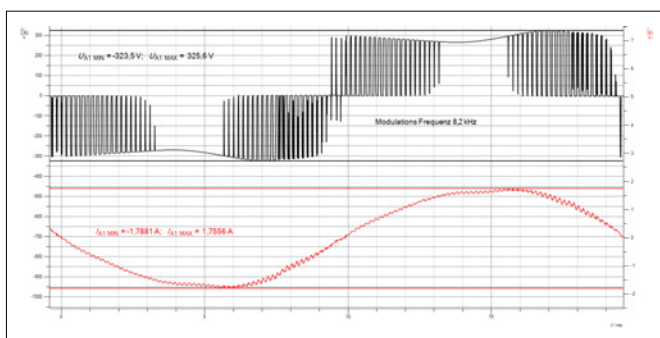
Universal Inverter  
(773 5297)



Rectifier B6



Universal Inverter



Behaviour of the output voltage and the output current of a frequency converter

### PRODUCT HIGHLIGHTS

- ★ Digital filter can be switched on and off at runtime for analysing switched signals (e.g. PWM)
- ★ The output frequency of the frequency inverter can be set from 0 to 120 Hz
- ★ Flank and pulse width analysis accurate to 20 µs
- ★ Harmonic analysis and leakage current measurement possible even in 3-phase systems

E2.5.3.2	Basics of Frequency Converters
E2.5.3.3	Drives with Educational Frequency Converter
773 5290	Converter Controller CASSY
773 5297	Universal Inverter
726 80	Transformer, 45/90, 3N
735 065	Rectifier B6, 3 x 400 V/10 A

As a result of the increasing importance of frequency converters in the technical and educational environment, LD DIDACTIC has developed a didactic frequency converter to combine fundamental understanding with modern technology.

With the measuring unit integrated into the Converter Controller CASSY, it is easy to measure the voltage between the phases of a frequency converter. Using the integrated digital filter high-resolution power measurements can also be done with a high sampling rate.

The analysis of the didactic frequency converter with different loads, such as grids or motors, is done in real time and therefore particularly facilitates the understanding of the fundamentals.

### TRAINING OBJECTIVES

#### Examples for operation:

- Ensuring the function of a power supply and safety of the equipment
- Analysis of the operational behavior of electrical machines
- Installation and maintenance of power systems



## NEW EQUIPMENT FOR GRID ANALYSIS POWER ANALYSER CASSY

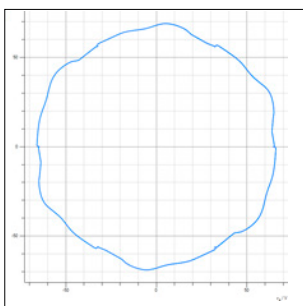


In TN or TT grids with a grounded neutral point, all load characteristics can be measured directly or via a 3-phase transformer. The relationships between the phases, the effect of different impedances, taking into account symmetrical and asymmetrical loads as well as the behaviour in case of an error (e.g. neutral conductor break), can be investigated for common voltages in power grids.

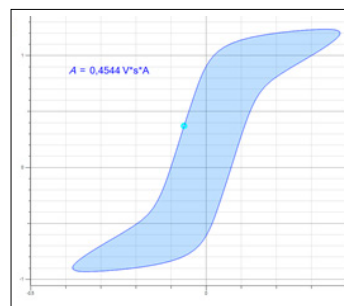
Measurements of active, reactive, and apparent power can be didactically prepared for various grids, such as star, delta, and zigzag circuits, and can be represented in different diagrams, e.g. as a vector diagram.

### PRODUCT HIGHLIGHTS

- ★ Interactive experiments using the digital experiment manuals "Lab Docs", and various possibilities of diagrams in real time
- ★ Complex evaluations with CASSY Lab 2 software (harmonic analyses, load behaviour, etc.)
- ★ Measurements of all currents and voltages as well as all phases in the grid in high-resolution and variable up to 1 MHz sampling rate



Positive component of a 3-phase power line with symmetrical load with harmonics



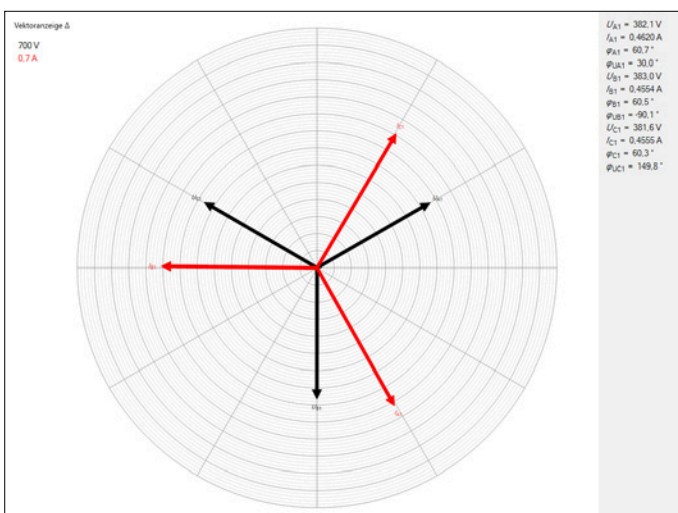
Hysteresis of transformer core

E3.1.7	Resistors in DC, AC and three-phase networks
67-142-230	Switched three-phase Resistive Load
67-212-230	Switched three-phase Capacitive Load
67-312-230	Switched three-phase Inductive Load

### TRAINING OBJECTIVES

#### Examples for operation:

- Analysis of electro-technical systems and checking their functions
- Ensuring the function of a power supply and safety of the equipment
- Analysing systems and verifying safety
- Installation and maintenance of power systems



Vector diagram for measurement in a triangle with a resistive load

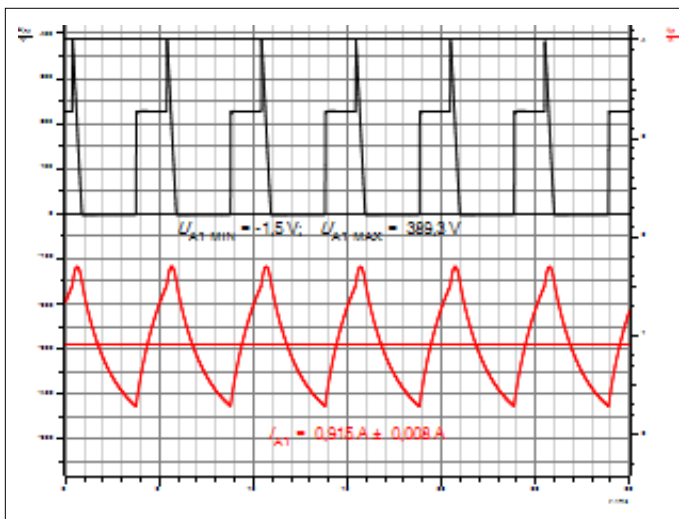
## POWER ANALYSER CASSY, POWER ANALYSER CASSY PLUS & CASSY LAB 2

The Power Analyser CASSY is equipped with the basic functions for measuring  $U$ ,  $I$ ,  $\varphi$ ,  $P$ ,  $f$  and  $\varphi_{UA-B}$ .

The Power Analyser CASSY Plus allows additionally the connection of oscilloscopes and the control of other devices.

With the new version of the CASSY Lab 2 software, additional parameters can now be derived, displayed, and shared online in real time. With the new distribution function of CASSY Lab 2, students observe the measurements on their tablet/smartphone and can track everything from their workstation. Distribution is done via a QR code, which can be generated in the CASSY Lab 2 software.

- Apparent power, reactive power
- AC resistance:  
impedance, reactance, resistance
- AC conductance:  
admittance, susceptance, conductance
- Symmetrical components of the 3-phase system:  
positive sequence, negative sequence, zero system
- Time integral and hysteresis functions
- Frequency spectrum and histogram



Measurement of the pulse width modulation of a buck converter on a resistive load

Power Analyser CASSY (727 100)



Power Analyser CASSY Plus (727 110)

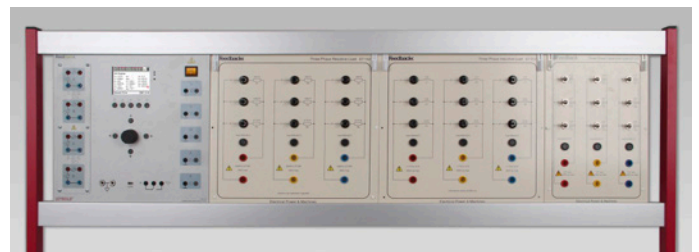
Download the student and demo version of CASSY Lab 2 for free at: [www.ld-didactic.de/service/softwaredownload/cassy-s.html](http://www.ld-didactic.de/service/softwaredownload/cassy-s.html)



### PRODUCT HIGHLIGHTS

- ★ Universal use as multimeter, oscilloscope, plotter, and data recorder
- ★ Measure with or without a computer
- ★ Data transfer via USB-C or WLAN
- ★ 4 main channels with 6 measured variables per channel
- ★ Reliable measurement and experimentation with CAT III
- ★ Additional 5 analogue outputs with mathematical functions and integrated function generator in the Power Analyser CASSY Plus

727 100	Power Analyser CASSY
727 110	Power Analyser CASSY Plus
524 220	CASSY Lab 2



## ELECTRICAL MACHINES ROTOR KITS



An insight into the construction and mode of operation of electrical machines forms the fundamental idea for our Rotor Kits.

Building a ready-to-use 300 W electrical machine requires assembling the rotor and stator assembly. The stator housing is mounted on an aluminium base and thus fully compatible with our 300 W classes of industrial machinery.

A reliable connection of the stator and rotor is ensured by star grip pull bolts, allowing a quick exchange of the rotor. The rotors are equipped with a B-end bearing shield, a fan wheel, and a cover hood, as well as slip rings, brushes, etc., as required.

The assembled specimen can now be electrically connected and analysed with the Machine Test System. This allows the characteristic lines to be attributed to the properties of the respective rotor. By individually exchanging the rotors, a direct comparison of different construction types is easily accomplished.

It is particularly impressive to prove the savings potential of efficiency machines and establish the relation to the extra cost required by the copper cage of the efficiency runner.

### PRODUCT HIGHLIGHTS

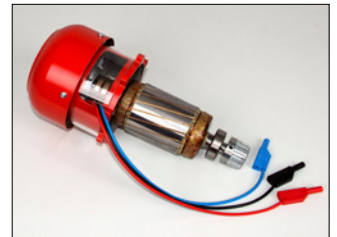
- ★ Compatible with the 300 W class
- ★ 7 different rotor types
- ★ 2 different stator types
- ★ Didactic connection panel
- ★ Electrically connectable

E2.1.3.4

Machines with Rotor Kits



774 7721  
*Squirrel Cage Rotor 0.3*



774 7722  
*Slip-ring rotor 0.3*



774 7723  
*Salient pole rotor 0.3*



774 7724  
*Smooth core rotor 0.3*



774 7725  
*Reluctance rotor 0.3*



774 7726  
*DC shunt stator 0.3 (with rotor)*



774 7728  
*DC rotor 0.3  
(mounted in stator)*



774 7729  
*Squirrel Cage Rotor  
high Efficiency 0.3*

## INNOVATIVE MACHINE TEST SYSTEM



The new Machine Test System is used for recording characteristic lines of electrical machines of the 300 W class in all four operating quadrants. It consists of following main components:

- a new Machine Test Bench (773 1990) and
- a new Machine Test CASSY (773 1900)

With this system, we are offering a safe and highly efficient training system for electric drives.

### MACHINE TEST BENCH

The three-phase pendulum machine is a pendulum-mounted asynchronous servo with integrated incremental encoder for speed detection. The top-mounted stainless steel bending system with strain gauges for torque measurement can be easily calibrated by moving a mass piece.

This machine can drive all 300 W-class machines or break them to a standstill. Like all electrical machines in the 300 W class, it is also mounted on an aluminium base with slide rails.

### MACHINE TEST CASSY: *New in the CASSY family*

The control and measuring device with integrated frequency inverter for supplying and controlling the machine test bench is an innovative new development by LD DIDACTIC.

The Machine Test CASSY not only includes all functions of the Power Analyser CASSY, but also displays the speed, torque, and electrical parameters of the pendulum machine.

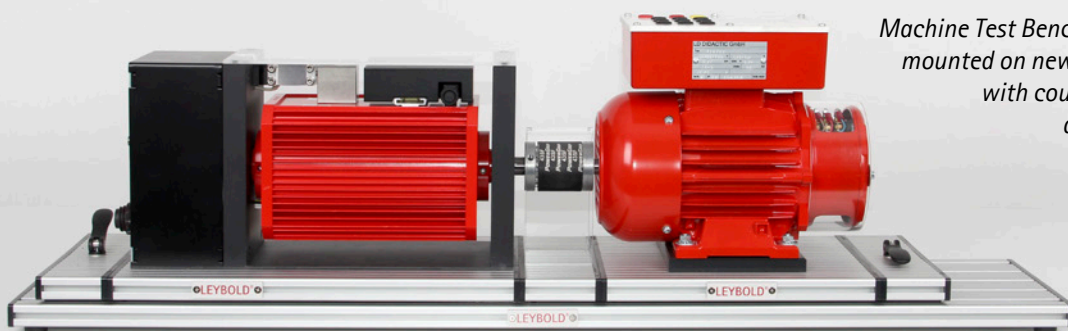
Its main application is the automatic or pointwise recording of characteristic lines in all four quadrants of the speed/torque level.

### MACHINE BASE UNIT & COUPLING AND SHAFT END GUARD

The new Machine Base Unit (773 110) ensures safe position of the motors and permits tool-free locking. The new coupling and shaft end guard (773 108) prevents removal during operation.

## PRODUCT HIGHLIGHTS

- ★ Machine Test System developed in line with the latest safety requirements
- ★ Compatible with existing drive technology equipment
- ★ Integrated Power Analyser CASSY functions to analyse the specimen in the control unit
- ★ Part of the CASSY family, compatible with all CASSY Lab 2, CASSY App, digital experiment manual "Lab Docs", MATLAB® und LabView™



*Machine Test Bench (left) 300 W class, mounted on new Machine Base Unit with coupling guard (centre) and specimen (right)*



## COM3LAB THE COMPACT LAB FOR DIGITAL VOCATIONAL TRAINING



### 3 COMPONENTS BECOME ONE LAB

COM3LAB offers one-stop theoretical as well as practical knowledge transfer. Learning materials are first taught methodically, then deepened on the basis of practical experiments.

COM3LAB is being successfully used in the following apprenticeship trades:

- Automotive mechatronics engineer
- Electronics technicians for automation engineering
- Electronic technician for power and building technology
- Electronics technician for devices and systems
- Electronics technician for information / telecommunication technology
- Communication technician
- Electronics technician for machines and drive technology
- Electronics system technician

COM3LAB consists of a master unit and several courses. Each course includes an experiment board and learning software. Full access to the board components also allows for free experimenting beyond the course syllabus.

The master unit is the basic unit through which the learning software and the experiment board communicate with each other. It contains all necessary measuring devices, signal generators, and power supplies. The master unit impresses with its modern design as well as safe and easy handling.

700 XX01	Course of your choice: <i>All COM3LAB courses and the corresponding equipment can be found under: <a href="https://www.leybold-shop.de">https://www.leybold-shop.de</a></i>
700 020	COM3LAB: Master Unit
700 00CBT	DVD: COM3LAB Software

### PRODUCT HIGHLIGHTS

- ★ Simultaneous 4-channel oscilloscope with differential inputs and 2 multimeters with 8 measuring ranges each
- ★ Extendable functionality, ensured by additional interfaces such as USB port for external experiments and "Extension Slot"
- ★ Support for USB, WLAN, and wired Ethernet
- ★ 2 mm safety sockets and cables
- ★ Theft protection with Kensington lock

### EXAMPLES FOR OPERATION:

- Fundamentals of electrical engineering
- Fundamentals of electronics
- Power electronics and electrical machines
- Renewable energies
- Communication technology
- Control technology
- Automation





## COM3LAB SENSOR TECHNOLOGY DIGITAL EDUCATIONAL CONCEPT FOR AUTOMOTIVE & ELECTRICAL ENGINEERING



The COM3LAB Sensor Technology Course (700 8401) teaches fundamental knowledge about measuring non-electrical quantities. Using many examples, explanations, exercises, and practical tasks, it presents the principles and functions of the sensors and the associated measuring circuits in an intuitively accessible manner.

With its the optimal combination of compact design and the abundance of experiments with real sensors, learners cover the following topics during the course:

- Measuring circuits for measuring temperature
- Functionality and characteristics of different temperature sensors: Pt 100, NTC, KTY, and thermal element
- Functionality and characteristic lines of pressure sensors
- Force measurement with strain gauge
- Force measurement with beam and torsion rod
- Distance, angle, and speed measurement
- Measurements with optical encoder
- Hall sensors
- Ultrasound measurements

700 8401	COM3LAB Course: Sensor Technology
700 8402	COM3LAB Course: Sensor Technology Accessories
700 020	COM3LAB: Master Unit
700 00CBT	DVD: COM3LAB Software

### FIELDS OF STUDY / EDUCATIONAL OBJECTIVES

- Gain knowledge of the operation of sensors and analysis electronics
- Learn the principles of measuring non-electrical quantities

### COM3LAB course automotive sensors

Many things are now automatic in cars. The lights turn on at dark, and the windshield wiper adjusts its wiper speed to the amount of rain. To accomplish this, up to 100 sensors are installed in the car. They detect physical quantities, such as temperatures, speeds, angles, pressures, etc., and convert them in electrical quantities.

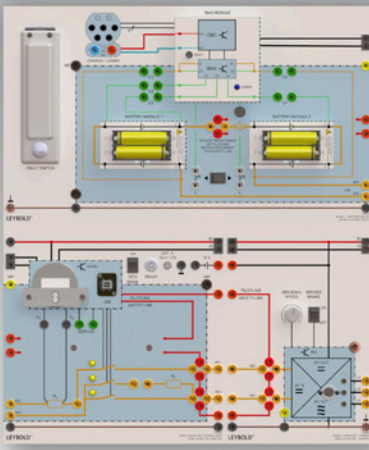
The COM3LAB course, Automotive Sensor Technology (700 6201) thus covers the electrical components and sensors by explaining their function and role in a car in detail.

700 6201	COM3LAB Course: Automotive Sensor Technology
700 020	COM3LAB: Master Unit
700 00CBT	DVD: COM3LAB Software

### FIELDS OF STUDY / EDUCATIONAL OBJECTIVES

- Master fundamental physical principles
- Learn about the most important components and sensors





## AUTOMOTIVE TECHNOLOGY HV BATTERY TRAINER

### SAFELY STUDY HIGH-VOLTAGE BATTERIES

The topic of batteries in the field of electromobility is still a contentious one, because the high-voltage battery is – at least from a European point of view in general, and the German view in particular – the weak point of an electric vehicle. Inadequate ranges due to insufficient capacity and long loading times due to suboptimal cells are the main causes of this problem. To understand this issue, the curriculum studied by automotive high-voltage technicians fittingly covers the high-voltage component, the "high-voltage battery". Inherent in the system, however, is a particularly great danger potential due to the high voltages of up to 800 V.

LD DIDACTIC therefore offers the high-voltage battery trainer as a supplement to the high-voltage trainer. Students can acquire all the necessary knowledge in this area, modelled and transformed to noncritical 24 V. The best part: Since the cell blocks are separate, they can be exchanged to study different cell chemistries, such as lithium-ion cells or lithium-iron phosphate cells.

### PRODUCT HIGHLIGHTS

- ★ Intrinsic safety on a 24 V basis
- ★ Supplement to the system, educational electric power machines, and high-voltage trainers
- ★ Operation with different cell chemistry structures
- ★ Use Li-ion or LiFe cells in the same system
- ★ Integrated fault switch box

A 2.7.2.6

High voltage battery technology

The system contains:

- Individually exchangeable cell blocks
- Replaceable battery management units
- Main contactor with switching logic
- Monitoring through a safety line
- Service disconnect either between the cell blocks or in the main contactor
- Battery data acquisition
- Cell temperature simulation
- Fault switch for the simulation of defective cells
- On-board charging infrastructure

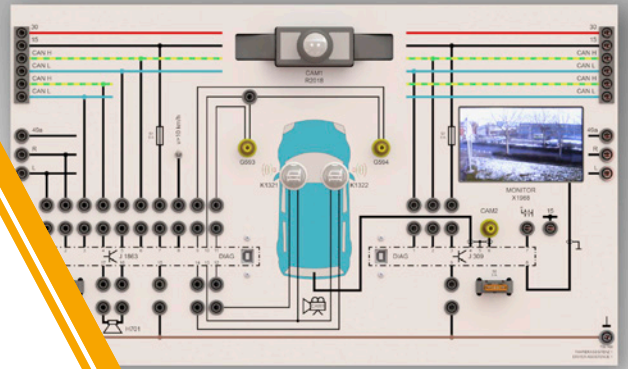
In addition, an inverter unit is available that, in combination with the "educational electric machine" system, allows for the construction of a complete traction drive. The detection of motor operating data, including the signals of the rotor position sensor, is easily possible, for example with the Sensor-CASSY 2.

In addition, an electric vehicle can be activated in the complete system. All required components are already integrated and can thus be used for practical work.

### TRAINING OBJECTIVES

- Diagnosis and repair of a networked drive, comfort, and safety systems
- Prepare cars for safety inspection and certification
- Check and repair components on hybrid or electric cars

## AUTOMOTIVE TECHNOLOGY SIDE ASSIST

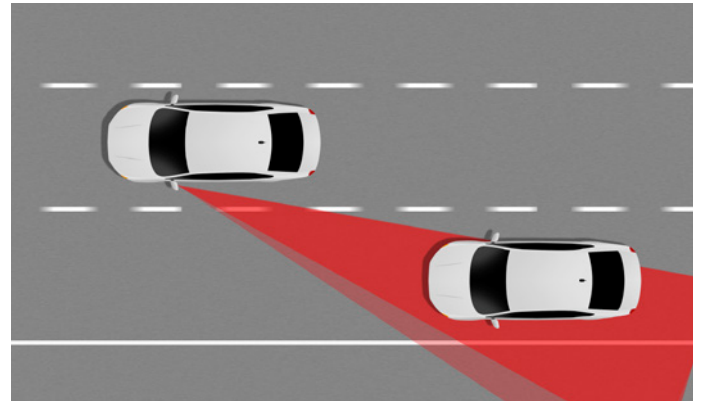


### DRIVER ASSISTANCE SYSTEM FOR DETECTING THE BLIND SPOT

Everyone has learned this: look over your shoulder to see areas that are not visible in the mirrors. Driving instructors stress this over and over again. "It's about the look to cover the blind spot when changing lanes or turning. Failure to do so can result in serious accidents." \* (\*aus [www.bussgeldkatalog.org/schulterblick](http://www.bussgeldkatalog.org/schulterblick))

Once again, driver assistance systems can help prevent such accidents. Accident prevention, as opposed to accident mitigation, starts before an accident occurs. The "Side Assist" is such a system. It can assess the directional stability of the vehicle, detects vehicles located to the side, and intervenes in hazardous situations by issuing a warning or performing active corrections.

The Side Assist system represents a straightforward signal processing flow. IPO – input, process, output – is implemented didactically in the curriculum.



### PRODUCT HIGHLIGHTS

- ★ Blind spot detector, including reversing camera and monitor
- ★ Ultrasonic sensors as a tabletop device
- ★ Supplement for standard lighting
- ★ Supplement for lighting with CAN bus

### TRAINING OBJECTIVES

- Identifying and eliminating malfunctions
- Performing service tasks on comfort and safety systems
- Diagnosis and repair of a networked drive, comfort, and safety systems
- Removing, converting, and retrofitting systems and components

A 3.7	Side Assist
739 760	Driver assistance I



PHYSICS

CHEMISTRY  
BIOLOGY

ENGINEERING



## CONTACT

### GERMANY:

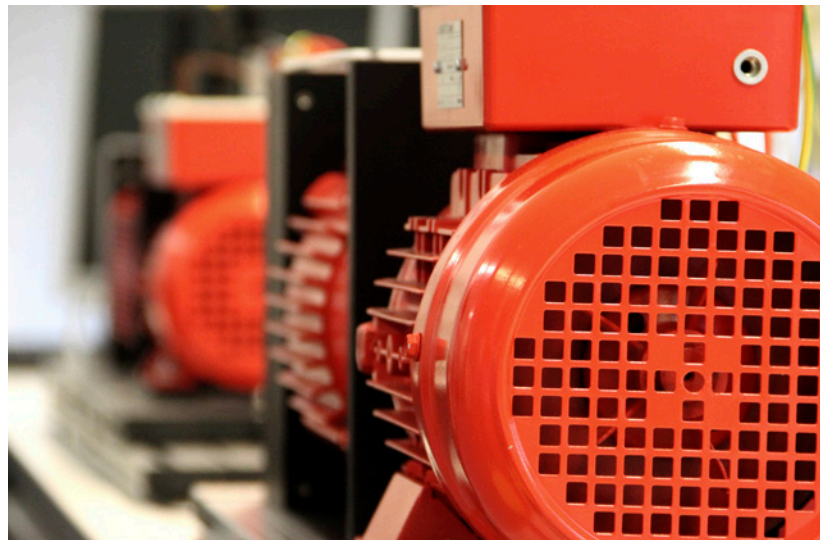
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