

# EASY ENTRY INTO ELECTRONICS

## MASK-GUIDED BASICS

This system is suitable for a first contact to some basic electronic circuits and is recommended e.g. for higher grades in secondary schools or similar.

The Easy Electronics Case is a battery-operated training kit which holds everything that is needed for an interesting training. It can be used in regular classrooms with no extra laboratory instruments and it requires no special preparation.

### Learning Content:

- Measurements with Analogue Instruments
- Ohms Law
- Resistors in Series and Parallel
- Bridge Circuits
- Extended Series / Parallel Connection
- Unloaded / Loaded Voltage Divider
- Diode
- Transistor as Switch
- Capacitor in DC Circuits
- Temperature Dependant Resistors
- NTC / PTC / LDR
- Circuit with Relay (Addition Kit)
- Continuity Test (Addition Kit)



## EASY ELECTRONICS CASE

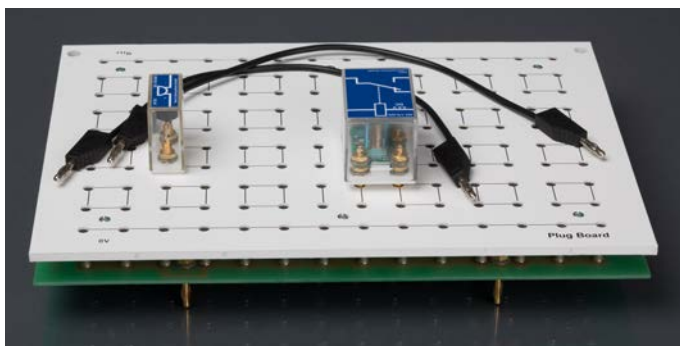
### Content of Supply:

- Aluminium case with key and detachable cover 460 x 340 x 210mm (WxDxH).
- Integrated storage panel equipped with:
  - 8x 19mm Connecting Plugs
  - 1x Analogue Ammeter
  - 1x Analogue Voltmeter
  - 1x Potentiometer
  - 7x Resistor
  - 1x Switch
  - 1x Pushbutton
  - 1x Lamp
  - 2x Light Emitting Diode
  - 1x Diode
  - 1x PTC Resistor
  - 1x NTC Resistor
  - 1x Capacitor
  - 1x LDR
  - 1x Transistor

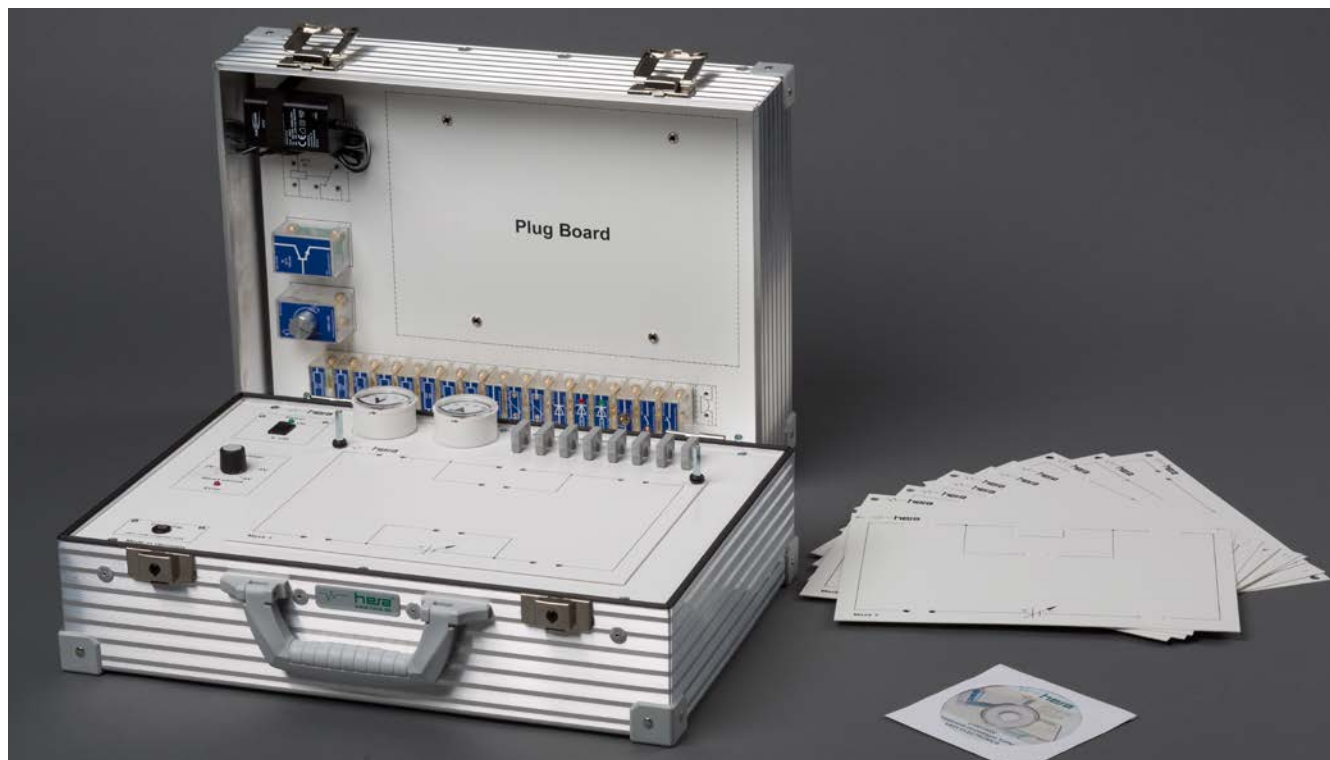
- Experimental plug-field with 11 circuit masks.
- Adjustable DC supply with accumulator for mains independant use.
- Incl. charge controller and mains connector.
- CD manual (DE + EN) as pdf file with tests and solutions.

### Addition Kit consisting of:

- Plug-field for variable experiments with 4mm jacks in 19mm raster
- Buzzer
- Relay
- 4mm Laboratory Cables



510.010.100 Addition Kit for variable use



510.010.000 Easy Electronics Case

### Easy Electronics Case

510.010.000 | Easy Electronics Case

510.010.100 | Addition Kit

# ELECTRIC / ELECTRONIC ENGINEERING

The following plug-board solutions for basic - and advanced electronics offer a wide range of fundamental knowledge in AC/DC - and semiconductor technology which is essential for all electric / electronic professions. With respect to the curriculum the plug-boards are available with a different assortment of components and suitable student - and instructor manuals. The plug-boards and components are made in 19mm standard raster and allow the configuration of flexible circuits.

For deepening the courses the basic plug-boards can be followed by topic-specific trainers, e.g. for digital electronics, power electronics, control engineering, etc.

The boards are in standard size with scratch-proofed hardlaminated front and due to the ergonomically tilted cover and front-side cable connection they can be used directly on the table or hanging in training system frames.



## BASIC ELECTRIC CIRCUITS

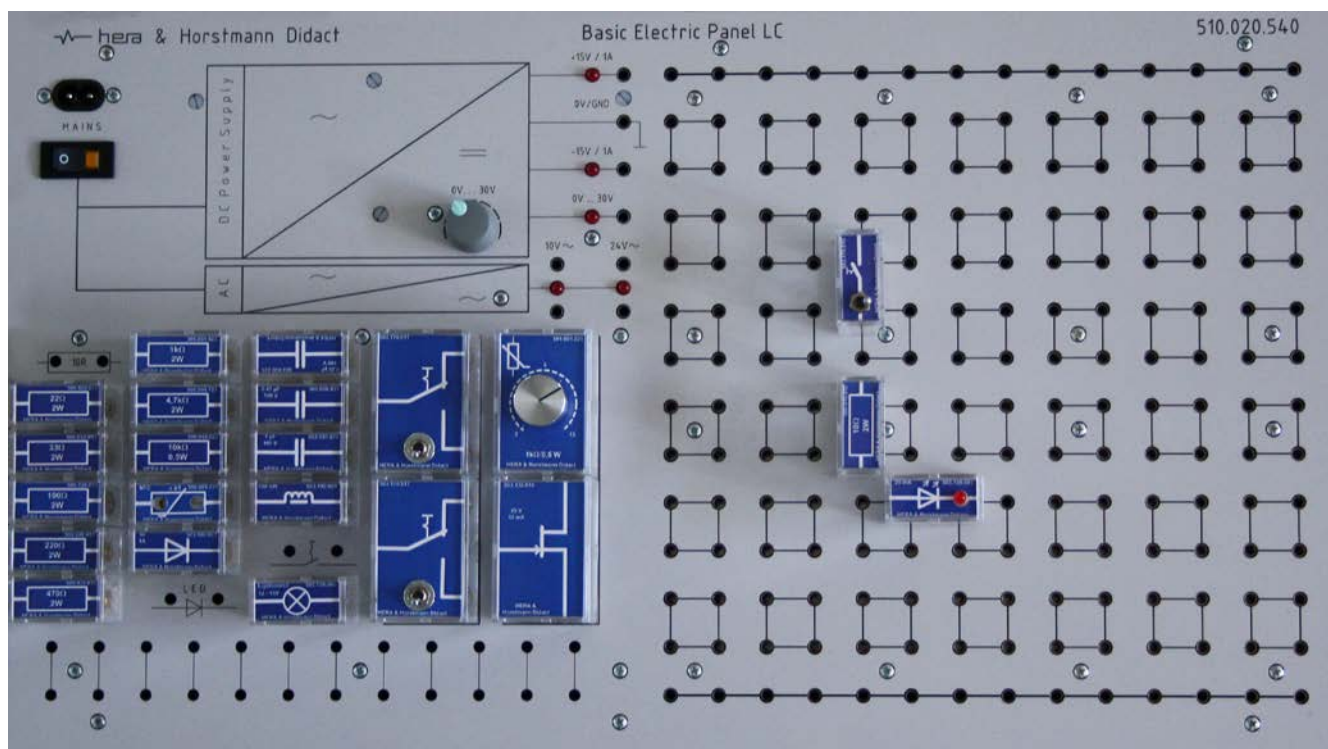
The Basic Electric Panel LC is a compact training system with a small set of components for a choice of 1phase AC and DC circuits.

The training system is equipped with all necessary short-circuit proofed power supplies and a plug-board for variable circuits. All required components are directly positioned on a storage field. The plug-board is equipped with 4mm jacks in 19mm raster.

The training system can be directly plugged into a standard outlet and holds everything required for a sufficient training.

For your tests you will need an oscilloscope and a multimeter.

Operating voltage: 110...230V, 50/60Hz



Basic Electric Panel LC 510.020.540

### Learning Content:

- Ohm's Law
- Voltage and Current Error Circuits
- Electric Resistors
- Voltage Sources
- Efficiency
- Parameter in AC Circuits
- Capacitors in AC Circuits
- Diodes
- Transistors

### Technical Data:

- DC Voltage: +/- 15V, 1A (+/- 5%) and 0...30V, 1A
- AC Voltage 1phase: 10V, 100mA; 24V, 100mA

### Included Components:

- |                         |                    |
|-------------------------|--------------------|
| 9x Resistors            | 1x Potentiometer   |
| 1x NTC                  | 1x Transistor      |
| 3x Capacitors           | 1x Toggle Switch   |
| 1x Coil                 | 1x Selector Switch |
| 1x Diode                | 1x Lamp            |
| 1x Light Emitting Diode |                    |

### Basic Electric Circuits and Accessory

510.020.540	Basic Electric Panel LC incl. Set of Components	510.029.001	Manual with CD, Basic Tests in Electric / Electronic Engineering
510.022.040	Set of Cables and Connectors to Basic Electric LC		

## BASIC ELECTRIC /ELECTRONIC CIRCUITS

The Basic Electric Panel and Addition Electric Panel is a compact training system with a comprehensive set of components for the major circuits in AC / DC technology. In addition to the tests of the Basic Electric Panel LC it covers a wide range of 3phase AC experiments.

The component set of the Addition Electric Panel is adapted to the manual 510.028.001 Basic Tests in Electric / Electronic Engineering.

For your tests you will need an oscilloscope and two multimeters (e.g. 1x digital, 1x analogue).

Operating voltage: 110...230V, 50/60Hz

Dimensions: 532 x 297mm (WxH)

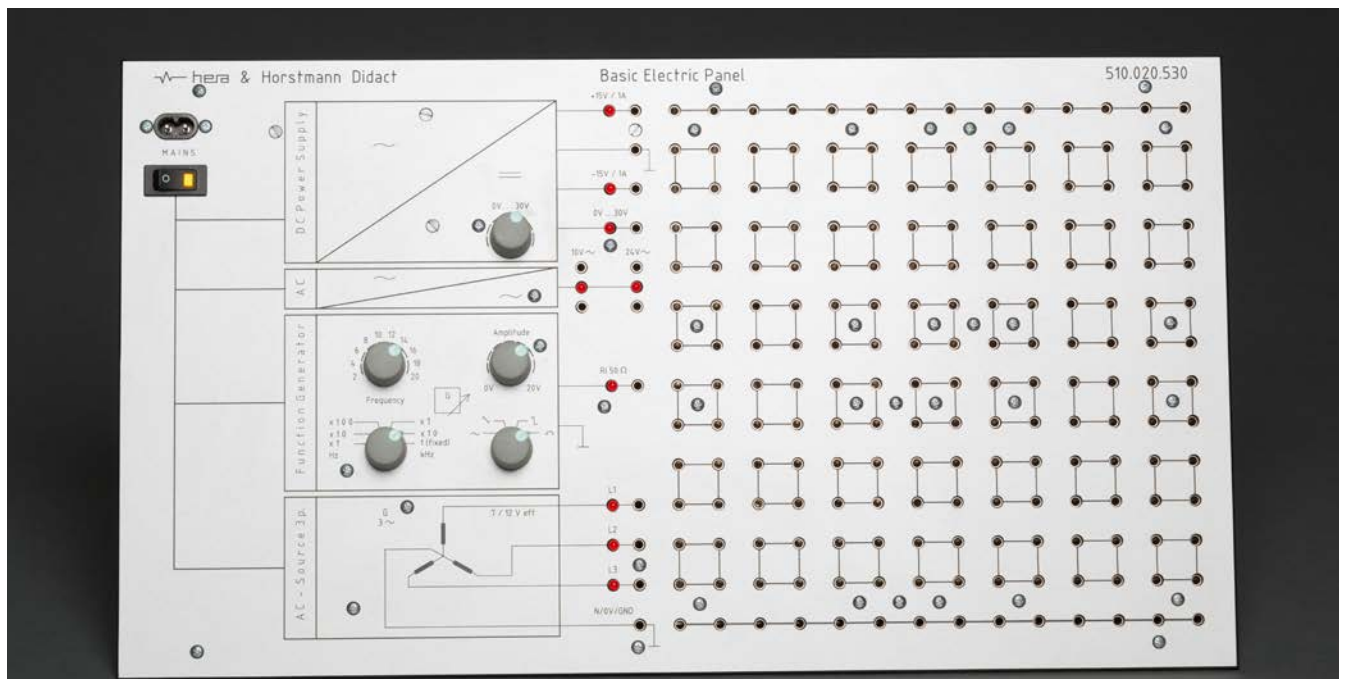
### Learning Content:

- Electric Circuits
- Ohm's Law
- Voltage and Current Error Circuits
- Electric Resistors NTC, PTC, LDR
- Resistors in Series, in Parallel and Combined
- Voltage Sources
- Parameters in AC Technology
- Current -, Voltage - and Power Matching
- Parameters and Presentation of AC Signals
- Threephase Systems (Star & Delta)
- Resistors, Capacitors and Coils in AC Circuits
- Transformer / Transmitter
- Wheatstone's Bridge
- Diodes
- Sine Generator
- Transistors
- Thyristors
- Operational Amplifiers

### Technical Data:

- DC Voltage: + 15V, 1A (+/- 5%)  
- 15V, 1A (+/- 5%)  
0...30V, 1A
- AC Voltage: 10V, 100mA  
24V, 100mA
- 3phase Generator: 7 / 12V (eff.) max. 50mA
- Function Generator:
  - Wave Forms: sinus, triangle, square and positive pulse
  - Frequency: 2Hz...200kHz
  - Voltage: 0...20V

Basic Electric Panel 510.020.530



## ADDITION ELECTRIC PANEL

equipped with:

- 16 Resistors
- 1 NTC
- 1 LDR
- 1 Potentiometer
- 1 Laminated Iron Core
- 3 Coils (2x 300N, 1x 900N)
- 1 Coil 100mH
- 1 Transistor
- 1 Thyristor
- 1 Switch
- 2 Lamps
- 1 OP-AMP

Dimensions: 266 x 297mm (WxH)



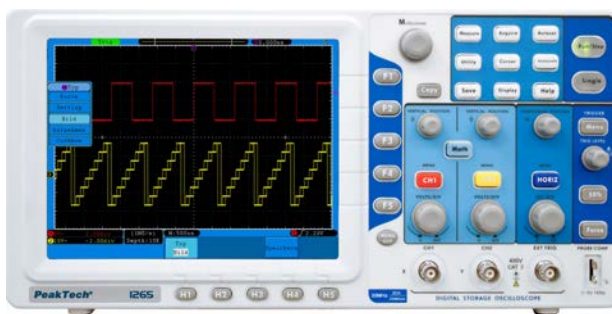
Addition Electric Panel 510.021.020 (19mm connectors included in cable set 510.022.000)



Analogue Multimeter  
590.100.005



Digital Multimeter  
590.100.003



Oscilloscope 30MHz  
590.126.500

### Basic Electric / Electronic Circuits and Accessory

510.020.530	Basic Electric Panel	590.100.003	Digital Multimeter
510.021.020	Addition Electric Panel	590.100.005	Analogue Multimeter
510.022.000	Set of Cables and Connectors to Basic Electric	590.126.500	Oscilloscope 30MHz
510.028.001	Manual with CD, Basic Tests in Electric / Electronic Engineering	590.130.500	Oscilloscope 70MHz

## ADVANCED ELECTRONIC CIRCUITS

The Basic Electronic Panel and Addition Electronic Panel is a compact training system with a comprehensive set of components for advanced electronic circuits for AC and DC Technology and Semiconductor Technology.

For your tests you will need an oscilloscope and two multimeters (e.g. 1x digital, 1x analogue).

Operating voltage: 110...230V, 50/60Hz

Dimensions: 532 x 297mm (WxH)

### Technical Data:

- DC Voltage:                    + 15V, 1A (+/- 5%)  
                                     - 15V, 1A (+/- 5%)  
                                     0...30V, 1A
- AC Voltage:                    10V, 100mA  
                                     24V, 100mA
- 3phase Generator:         7 / 12V (eff.) max. 50mA

- Function Generator:

Wave Forms:                 sinus, triangle, square and positive pulse

Frequency:                    2Hz...200kHz

Voltage:                        0...20V

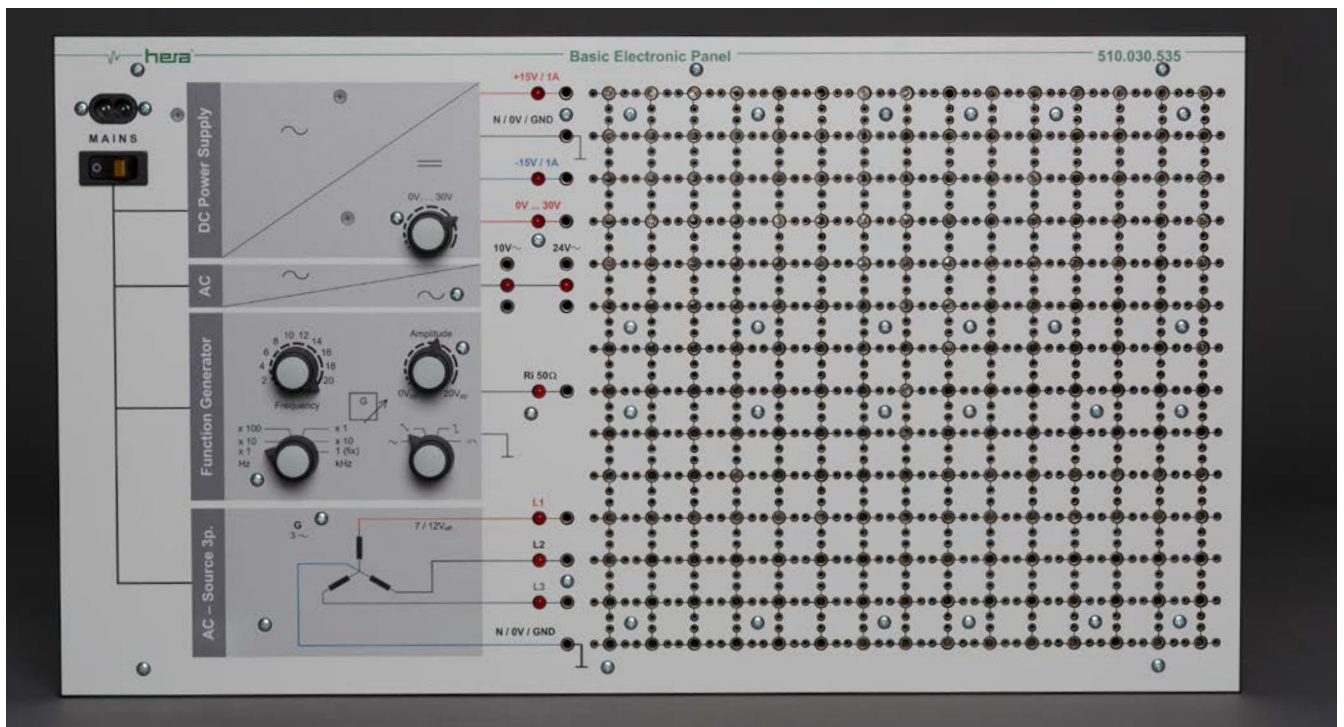
### Learning Content to AC/ DC Technology:

- Electric Circuits
- Ohm's Law
- Voltage and Current Error Circuits
- Electric Resistors NTC, PTC, LDR, VDR
- Resistors in Series, in Parallel and Combined
- Voltage Sources
- Parameters in AC Technology
- Current -, Voltage - and Power Matching
- Parameters and Presentation of AC Signals
- Threephase Systems (Star & Delta)
- Resistors, Capacitors and Coils in AC Circuits
- Transformer / Transmitter
- Wheatstone's Bridge

### Learning Content to Semiconductor Technology:

- Diodes (Rectifier, Z-Diodes, LEDs)
- Bipolar Transistors
- Unipolar Transistors
- MOSFET
- Unijunction Transistor (UJT)
- Thyristors (DIAC, TRIAC, Thyristor)
- Trigger Circuits (squarewave generator, multivibrator, monoflop, flip-flop, saw-tooth generator, sine generator)
- Modulator - Demodulator (Amplitude, Frequency)
- Power Supplies (Rectifier Circuits)
- Binary Operations (AND, OR, NOT, NAND, NOR for DTL, TTL, CMOS)
- Operational Amplifiers

Basic Electronic Panel 510.030.535



## ADDITION ELECTRONIC PANEL

The Addition Electronics Set is adapted to our manuals Basics of AC / DC Technology and Semiconductor Technology.

Tests for the optional components are included in the manuals.

Dimensions: 532 x 297mm (WxH)

equipped with:

- 28 Resistors
- 1 NTC
- 1 LDR
- 1 VDR
- 15 Capacitors
- 2 Potentiometers
- 4 Coils
- 1 Laminated Iron Core
- 10 Diodes
- 9 Transistors
- 1 DIAC
- 1 Thyristor
- 1 TRIAC
- 1 Switch
- 2 Lamps
- 1 OP-AMP



Addition Electronic Panel 510.031.030

Advanced Electronic Circuits and Accessory		Options incl. Tests	
510.030.530	Basic Electronic Panel	510.031.100	Opto-Electronics (Fototransistor / Optical Coupler)
510.031.030	Addition Electronic Panel	950.050.700	PV Modules (Pair)
510.032.000	Set of Cables and Connectors to Basic Electronic Panel	950.044.100	IC-Socket with Timer 555
510.038.011	Manual with CD, Basic Tests to AC/DC Technology		
510.038.021	Manual with CD, Basic Tests to Semiconductors		

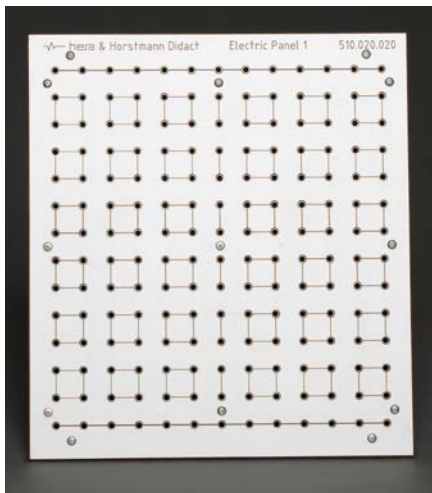


## EXPERIMENTAL PLUG BOARDS FOR BASIC ELECTRIC

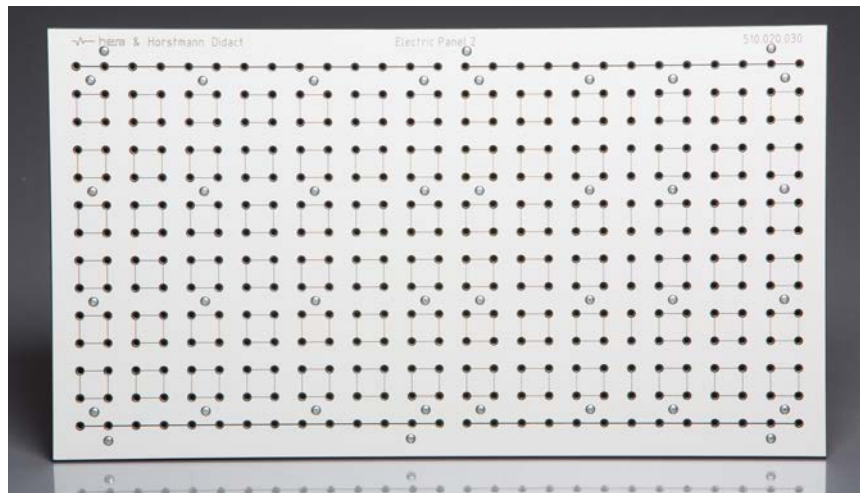
The experimental plug boards are for all standard plug components in 19mm raster with 4mm lamella plugs.

The plug boards are also available for safety lab cords.

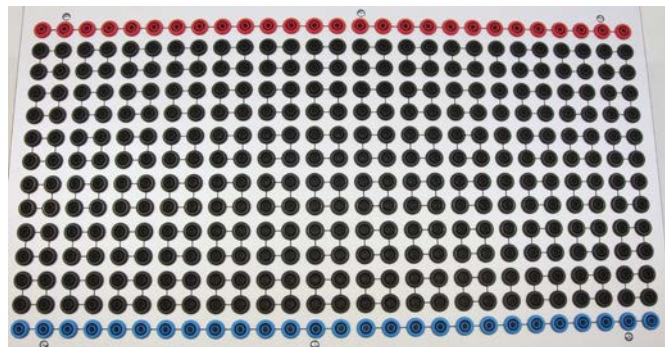
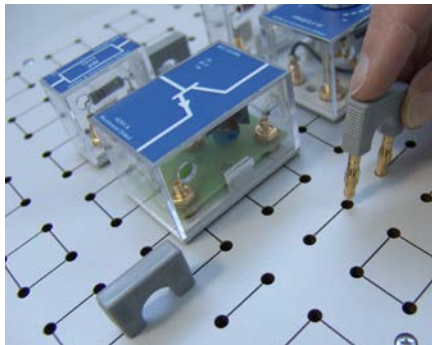
External power supply is required!  
See suitable power supplies on the next pages.



Electric Panel 1 510.020.020



Electric Panel 2 510.020.030



Electric Panel Safety Jacks 2, 510.025.030

### Experimental Plug Board Electric

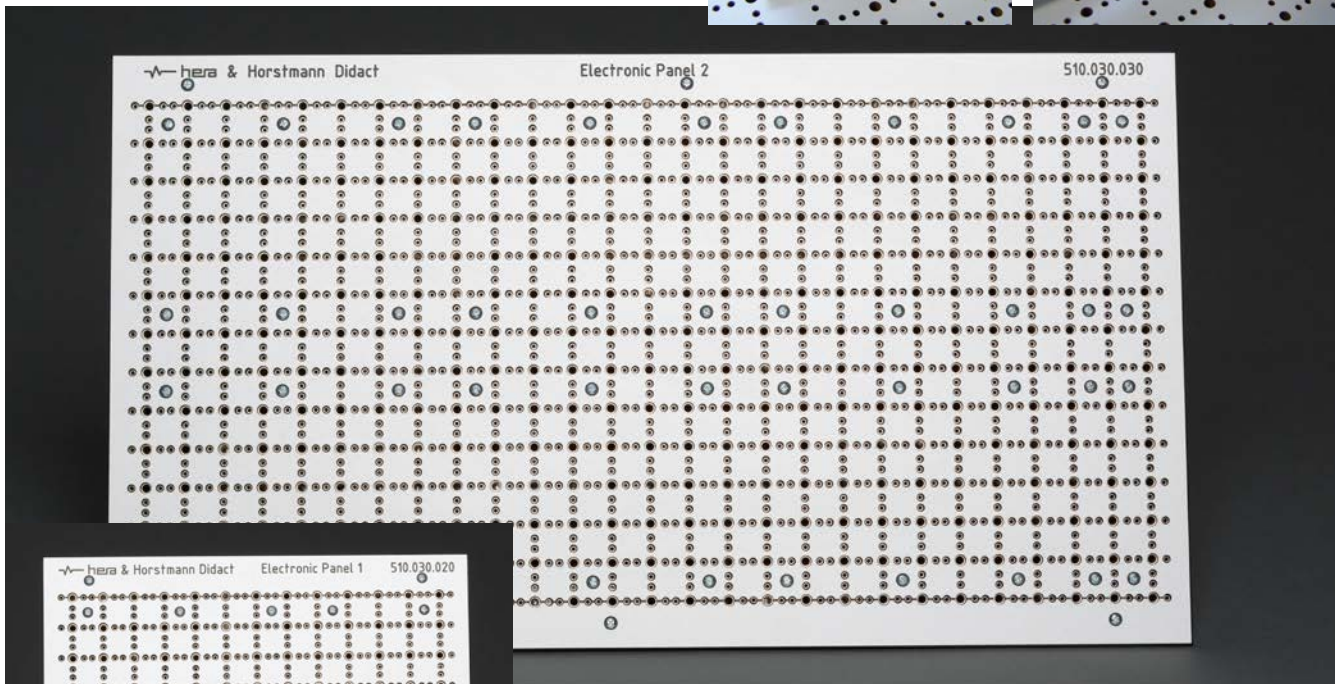
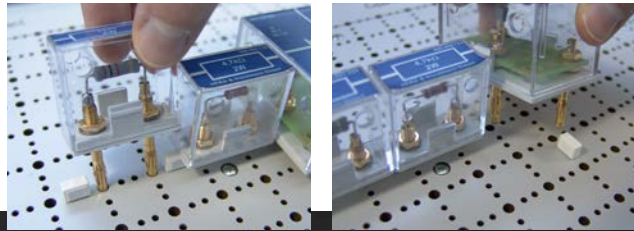
510.020.020	Electric Panel 1 small (266 x 297mm)
510.020.030	Electric Panel 2 large (532 x 297mm)

510.025.020	Electric Panel Safety Jacks 1 small (266 x 297mm)
510.025.030	Electric Panel Safety Jacks 2 large (532 x 297mm)

## EXPERIMENTAL PLUG BOARDS FOR BASIC ELECTRONIC

The experimental plug boards are for all standard plug components in 19mm raster with 4mm lamella plugs, connections between the components need to be done with 2mm standard plugs.

External power supply is required!  
See suitable power supplies on the next pages.



Electronic Panel 2 510.030.030

Electronic Panel 1 510.030.020

### Experimental Plug Board Electronic

510.030.020	Electronic Panel 1 small (266 x 297mm)
510.030.030	Electronic Panel 2 large (532 x 297mm)

## UNIVERSAL SUPPLY FOR ELECTRIC / ELECTRONIC

The Universal Supply Panel is suitable for the external supply of the Experimental Plug Boards without integrated power supply or for the supply of different low voltage signals in educational laboratories.

All outputs are short-circuit protected and equipped with 4mm safety jacks.

Dimensions: 266 x 297mm (WxH)  
 Operating voltage: 110...240V, 50/60Hz



Electric Supply Panel 510.030.520

### Voltages:

- DC Voltages: + 15V, 1A (+/- 5%)  
- 15V, 1A (+/- 5%)  
0...30V, 1A
- AC Voltages: 10V, 100mA  
24V, 100mA

### 3 Phase Generator:

- Voltage L-N: 7V (eff.)
- Voltage L-L: 12V (eff.)
- Current: max. 50mA
- Frequency: approx. 50Hz (60Hz)

### Function Generator:

- Wave Forms: sinus, triangle, square, positive pulse
- Internal Resistance:  $R_i = 50\Omega$
- Duty Cycle:  $V = 2$
- Frequency: 2Hz...200kHz
- Voltage: 0...20V  
0...8V at positive pulse

### Universal Supply for Electric / Electronic

510.030.520

Electric Supply Panel (DC Supply, AC Supply 1phase, AC Supply 3phase, Function Generator)

510.060.520

DC Supply Panel (Lab Power Supply 0-30V 0-2A, analogue reading with selector for current or voltage)

## ICOM DIDACTIC SUPPLY WITH USB INTERFACE

The ICOM Didactic Supply is suitable for the external supply of the Experimental Plug Boards without integrated power supply or for the supply of different low voltage signals in educational laboratories.

With background illuminated graphical LC-Display.

Operating voltage:  $110V_{AC} \dots 125V_{AC}$  resp.  $220 \dots 240V$ ,  
50/60Hz

The ICOM Didactic Supply is available in a carrying case for bench top use or integrated in a bench rack as KP, EP or MP module.

Front side with USB - and rear side with LAN interface.



### Output Voltages:

- DC Voltages:  $+5V, +12V, +15V / 1A$   
 $0 \dots 30V, 0 \dots 2A$
- AC Voltages:  $10V, \text{max. } 0,2A$   
 $24V, \text{max. } 0,2A$

### 3Phase Generator:

- Voltage L-N:  $0 \dots 10V_{L-L} \text{ RMS}$
- Voltage L-L:  $0 \dots 17,4V_{L-N} \text{ RMS}$
- Current:  $\text{max. } 400mA$
- Frequency:  $1 \dots 120Hz, \text{res. } 1Hz$

### Function Generator:

- Wave Forms: sinus, triangle, square, saw tooth (rising / falling), trapezium signal, positive pulse
- Internal Resistance:  $R_i = 50\Omega$
- Frequency:  $0,5Hz \dots 200kHz$
- Voltage:  $0 \dots 15V_{ss}$

#### ICOM Didactic Supply

630.800.301	ICOM Didactic Supply (Operating Voltage 220...240VAC)
630.800.308	ICOM Didactic Supply (Operating Voltage 110...125VAC)
394.205.301	Desktop Housing 2EP 535 x 195 x 142mm (LxDxH)

## RESISTORS

Plug component in a transparent plastic housing with detachable cover and 2 nickel plated 4mm lamella plugs in 19mm raster.

The power resistors are in a metal housing.

Load capacity of resistors < 10kΩ: 2 Watt, higher resistance values: 0,5 Watt and the power resistors: 10 Watt.

Tolerance +/- 5%.

Dimensions of housing: 38 x 19 x 35mm (WxDxH).



Plug Components: Resistor 2W				
Value	x 1Ω	x 10Ω	x 100Ω	x 1kΩ
1,0	500.001.012	500.010.012	500.100.012	500.001.022
1,2	500.001.212	500.012.012	500.120.012	500.001.222
1,5	500.001.512	500.015.012	500.150.012	500.001.522
1,8	500.001.812	500.018.012	500.180.012	500.001.822
2,2	500.002.212	500.022.012	500.220.012	500.002.222
2,7	500.002.712	500.027.012	500.270.012	500.002.722
3,3	500.003.312	500.033.012	500.330.012	500.003.322
3,9	500.003.912	500.039.012	500.390.012	500.003.922
4,7	500.004.712	500.047.012	500.470.012	500.004.722
5,6	500.005.612	500.056.012	500.560.012	500.005.622
6,8	500.006.812	500.068.012	500.680.012	500.006.822
8,2	500.008.212	500.082.012	500.820.012	500.008.222

Plug Components: Resistors 0,5W			
Value	x 10kΩ	x 100kΩ	x 1MΩ
1,0	500.010.022	500.100.022	500.001.030
1,2	500.012.022	500.120.022	500.001.230
1,5	500.015.022	500.150.022	500.001.530
1,8	500.018.022	500.180.022	500.001.830
2,2	500.022.022	500.220.022	500.002.230
2,7	500.027.022	500.270.022	500.002.730
3,3	500.033.022	500.330.022	500.003.330
3,9	500.039.022	500.390.022	500.003.930
4,7	500.047.022	500.470.022	500.004.730
5,6	500.056.022	500.560.022	500.005.630
6,8	500.068.022	500.680.022	500.006.830
8,2	500.082.022	500.820.022	500.008.230

Plug Components: Resistor 10W			
Value	x 1Ω	Wert	x 1Ω
1,0	500.001.014	15,0	500.015.014
2,2	500.002.214	22,0	500.022.014
5,1	500.005.114	33,0	500.033.014
10,0	500.010.014	43,0	500.043.014

## POTENTIOMETERS & DEKADES

Plug component in transparent plastic housing with detachable cover and three nickel plated 4mm lamella plugs in 19mm raster.

Load capacity 0,5 Watt and 4 Watt.

Dimensions of housing: 38 x 57 x 35mm (WxDxH).



Plug Components: Potentiometer			
501.022.020	22kΩ / 0,5W	501.100.014	100Ω / 4W
501.047.020	47kΩ / 0,5W	501.250.014	250Ω / 4W
501.100.020	100kΩ / 0,5W	501.470.014	470Ω / 4W
501.500.020	500kΩ / 0,5W	501.001.024	1,0kΩ / 4W
501.001.030	1,0MΩ / 0,5W	501.004.724	4,7kΩ / 4W
950.058.500	Decade 0...9kΩ		

## SPECIAL RESISTORS

Plug component in transparent plastic housing with detachable cover and 2 nickel plated 4mm lamella plugs in 19mm raster.

Dimensions of housing 38 x 19 x 35mm (WxDxH).



### Plug Components: Special Resistors

500.011.099	VDR	500.080.019	PTC Resistor P330
500.470.029	NTC Resistor 470Ω with series resistor	500.085.029	LDR FW200
500.004.729	NTC Resistor 4,7kΩ		

## Z DIODES

Plug component in transparent plastic housing with detachable cover and 2 nickel plated 4mm lamella plugs.

### Plug Components: Z Diodes

503.110.001	Zener Diode 3,3V, 130mA
503.110.002	Zener Diode 4,7V, 90mA
503.110.003	Zener Diode 6,2V, 64mA
503.110.004	Zener Diode 6,2V, 160mA
503.110.005	Zener Diode 10V, 40mA
503.110.006	Zener Diode 10V, 105mA
503.110.007	Zener Diode 12V, 86mA



## DIODES AND LIGHT-EMITTING DIODES

Plug component in transparent plastic housing with detachable cover and 2 nickel plated 4mm lamella plugs.



### Plug Components: Diodes and Light-Emitting Diodes

503.100.004	Si-Diode 6A / 600V	503.120.030	Ga-As-LED, red, 5V, with series resistor
503.100.003	Si-Diode 1A	503.120.020	Ga-As-LED, yellow, 5V, with series resistor
503.100.002	Ge-Diode 30mA	503.120.010	Ga-As-LED, green, 5V, with series resistor
503.100.001	Si-Diode 200mA	503.120.006	Ga-As-LED, red, 15V, with series resistor
503.120.003	Ga-As-LED, red	503.120.005	Ga-As-LED, yellow, 15V, with series resistor
503.120.002	Ga-As-LED, yellow	503.120.004	Ga-As-LED, green, 15V, with series resistor
503.120.001	Ga-As-LED, green	950.007.700	Ga-As-LED, white
503.120.000	Ga-As-LED, blue		

## CAPACITORS

Plug component in transparent plastic housing with detachable cover and 2 nickel plated 4mm lamella plugs in 19mm raster.

Dimensions of housing 38 x 19 x 35mm (WxDxH).

Max. rated current: 100V.



### Plug Components: Tantalum Capacitors

Value	x 1pF	x 10pF	x 0,1nF	x 1nF	x 0,01µF	x 0,1µF
10	502.010.015	502.100.015	502.001.025	502.010.025	502.000.135	502.001.035
15	502.015.015	502.150.015	502.001.525	502.015.025	---	502.001.535
22	502.022.015	502.220.015	502.002.225	502.022.025	502.000.235	502.002.235
33	502.033.015	502.330.015	502.003.325	502.033.025	502.000.325	502.003.335
47	502.047.015	502.470.015	502.004.725	502.047.025	502.000.425	502.004.735
56	502.056.015	502.560.015	502.005.625	502.056.025	502.000.525	502.005.635
68	502.068.015	502.680.015	502.006.825	502.068.025	502.000.625	502.006.835

### Plug Components: Electrolytic Capacitors (poled)

2,2µF / 63V	502.002.234	100µF / 35V	502.100.033
4,7µF / 63V	502.004.734	470µF / 35V	502.470.033
10µF / 63V	502.010.034	1000µF / 63V	502.001.044
22µF / 63V	502.022.034	2200µF / 63V	502.002.244
47µF / 63V	502.047.034	4700µF / 63V	502.004.744

## TRANSISTORS

Plug component in transparent plastic housing with detachable cover and nickel plated 4mm lamella plugs.



### Plug Components: Transistors

503.130.001	Transistor PNP 24V, 200mA, base left	503.130.009	Transistor NPN 40V, 1A, base right
503.130.002	Transistor PNP 20V, 100mA, base left	503.130.010	Transistor NPN 60V, 15A, base left
503.130.003	Transistor PNP 20V, 100mA, base right	503.130.011	Transistor PNP 60V, 15A, base right
503.130.004	Transistor PNP 40V, 1A, base left	503.130.012	Transistor PNP 40V, 1A, base left
503.130.005	Transistor PNP 40V, 1A, base right	503.130.013	Unijunction Transistor 35V, 50mA
503.130.006	Transistor NPN 20V, 100mA, base left	503.130.014	MOS-FET Transistor, 40V, 50mA, P-Channel, base left
503.130.007	Transistor NPN 20V, 100mA, base right	503.130.015	Barrier Layer Field Effect Transistor 25V, 10mA
503.130.008	Transistor NPN 40V, 1A, base left	503.130.016	Barrier Layer Field Effect Transistor 20V, 10mA
503.130.900	Photo Transistor BP103, 50V	503.130.017	MOS-FET Transistor, 40V, 50mA, N-Channel, base left

## DIACS, TRIACS AND THYRISTORS

Plug component in transparent plastic housing with detachable cover and 3 nickel plated 4mm lamella plugs.



Plug Components: DIACs, TRIACs and Transistors	
503.140.001	DIAC 33V, 1mA
503.160.002	TRIAC 4A
503.150.001	Thyristor 3A
503.130.000	Transistor Socket

## OPERATIONAL AMPLIFIERS

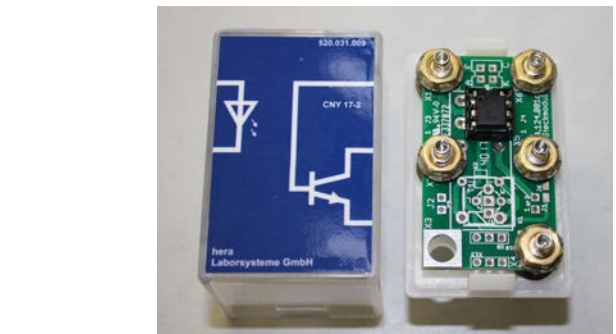
Plug component in transparent plastic housing with detachable cover and 3 nickel plated 4mm lamella plugs.



Plug Components: OP AMPs	
503.180.001	OP AMP
503.180.002	OP AMP, voltage supply from above

## OPTICAL COUPLERS

- Plug component in transparent plastic housing with detachable cover and 5 nickel plated 4mm lamella plugs.
- Optical coupler OPTO-EL.CNY17-2.



Plug Component: Optical Coupler	
520.031.009	

## COILS

Plug component in transparent plastic housing with detachable cover.



Plug Components: Coils	
503.190.005	10mH
503.190.006	20mH
503.190.010	30mH
503.190.007	40mH
503.190.008	80mH
503.190.009	100mH
503.190.011	200mH, big housing

## TRANSFORMER SET

Different coils with 4mm lamella plugs and iron core for step up / step down transformer.



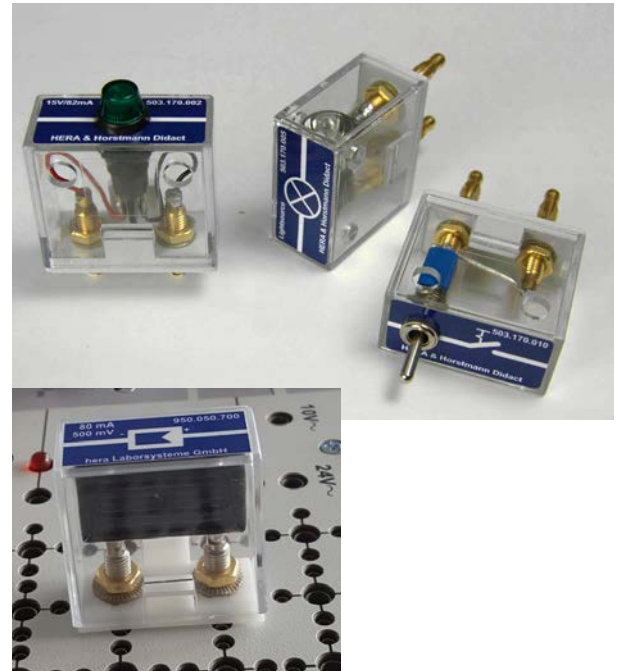
Plug Components: Transformers	
503.190.001	Coil N = 100
503.190.002	Coil N = 300
503.190.003	Coil N = 900
503.190.004	Laminated Iron Core, 1 Pair



## OTHER PLUG COMPONENTS

Plug component in transparent plastic housing with detachable cover and 3 nickel plated 4mm lamella plugs.

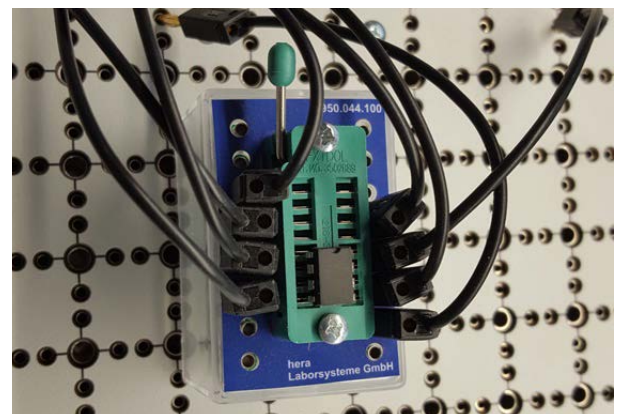
Plug Components: Switches, Relays and Lamps	
503.170.021	Relay 12V, 1 change over
503.170.020	Relay 24V, DC, 1 NOC
503.170.012	Button, NOC
503.170.014	Button, change over
503.170.013	Button, NCC
503.170.011	Change Over, 1pole
503.170.010	Toggle Switch, 1pole
503.170.005	Light Source
503.170.004	Lamp yellow, 15V, 82mA
503.170.003	Lamp red, 15V, 82mA
503.170.002	Lamp green, 15V, 82mA
503.170.001	Lamp Socket E10
950.050.700	Solar Cell 0,5V DC / 0,08A



## IC SOCKET WITH **TIMER 555**

- Transparent plastic housing with detachable cover and nickel plated 4mm lamella plugs.
- IC socket 16poles with quick fastener for ICs.
- IC contacts with 2mm sockets.
- Timer NE555.
- 8x lab cables 2mm (75mm).

IC Socket with Timer NE555	950.044.100
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## CONNECTORS AND **EMPTY HOUSINGS**

Transparent plastic housing for plug systems are available in following dimensions:

- small: 38 x 19 x 35mm (WxDxH).
- large: 38 x 57 x 35mm (WxDxH).

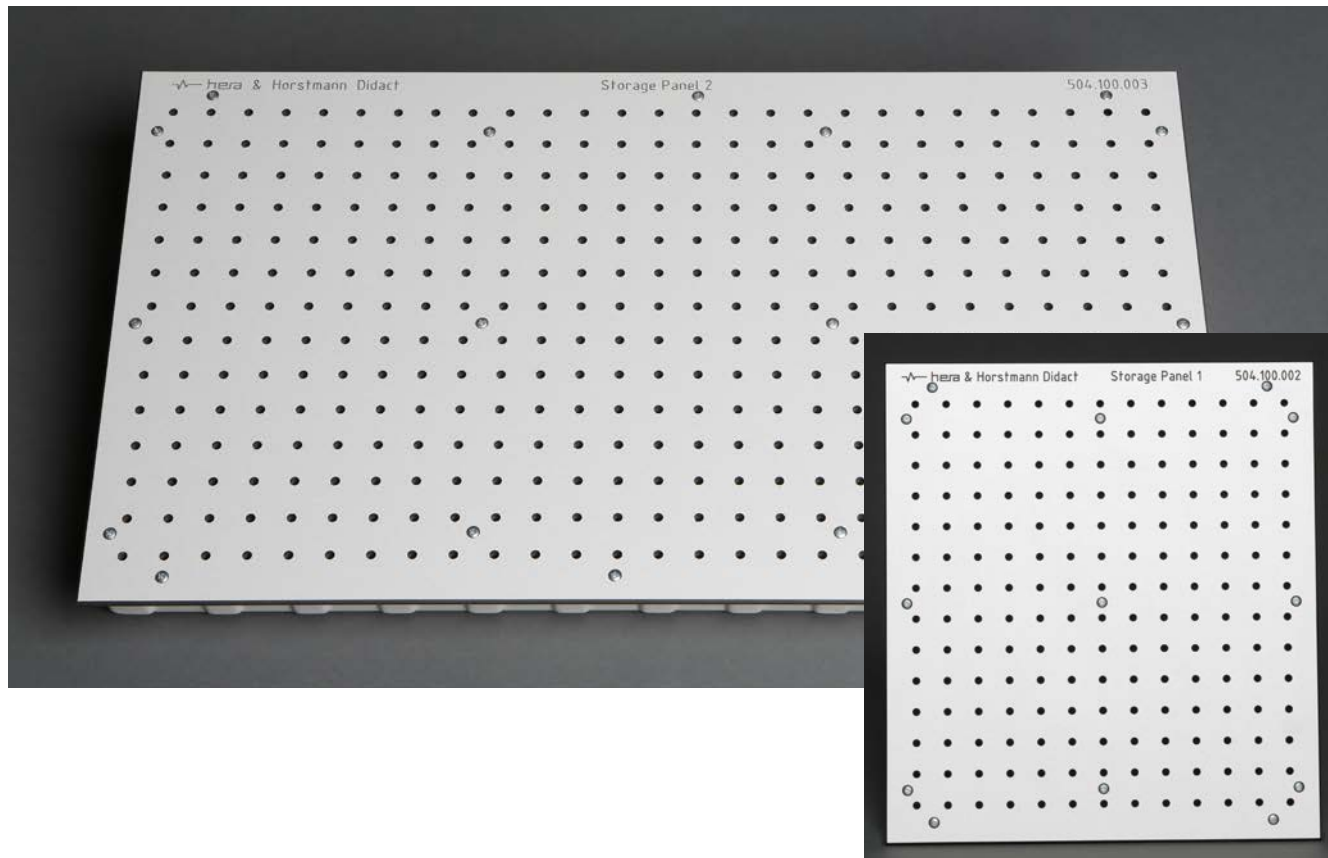
Connectors and Empty Housings	
505.000.010	Connector 2mm (plug spacing 5mm)
505.000.020	Connector 4mm (plug spacing 19mm)
505.000.022	Adapter 4mm plug to 2mm socket, black
505.000.023	Adapter 4mm plug to 2mm socket, red
505.000.030	Safety Connector 4mm (plug spacing 19mm)
504.001.001	Empty Housing, small with 2 lamella plugs
504.001.002	Empty Housing, small
504.001.003	Empty Housing, large with 3 lamella plugs
504.001.004	Empty Housing, large



## STORAGE BOARDS FOR PLUG COMPONENTS

If you decide for an individual selection of plug components or you prefer to hand out only a selection instead of the whole set, then the storage boards in different sizes will be perfect to store or hand out.

Storage boards are not electrically connected.



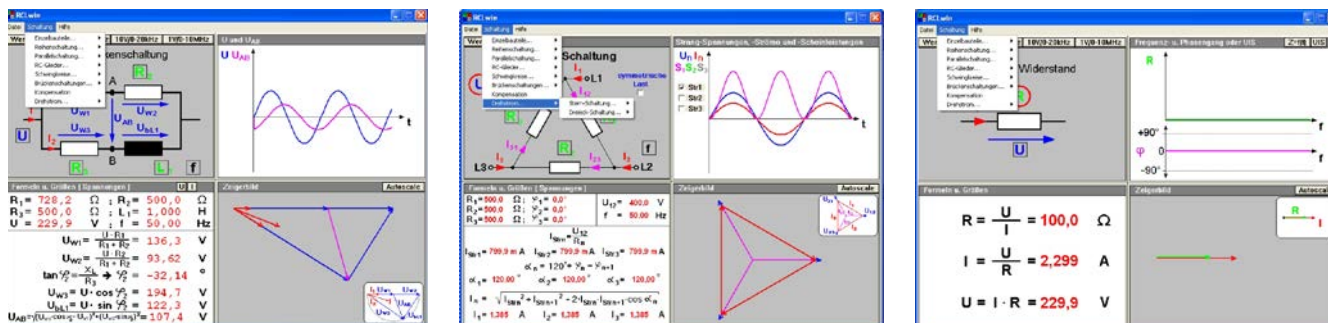
## SOFTWARE COURSE ALTERNATING CURRENT

RCLwin is a selfsufficient teachware for the comprehension of alternating current circuits.

The trainee can choose AC circuits from a big library and examine its behavior when changing different parameters. The program continuously runs the values when increasing or decreasing the parameters.

RCLwin presents the calculated values in frequency - and phase response or UIS - and pointer diagram. The parameter can also be entered directly.

RCLwin is an ideal learning aid for students of technical colleges, universities or technical vocational schools.



Storage Panel for Plug Components		Software Course Alternating Current	
504.100.001	Storage Panel 133 x 297mm	510.900.003	RCLwin, Classroom License, EN
504.100.002	Storage Panel 266 x 297mm		
504.100.003	Storage Panel 532 x 297mm		

## BASICS TO OPERATIONAL AMPLIFIER

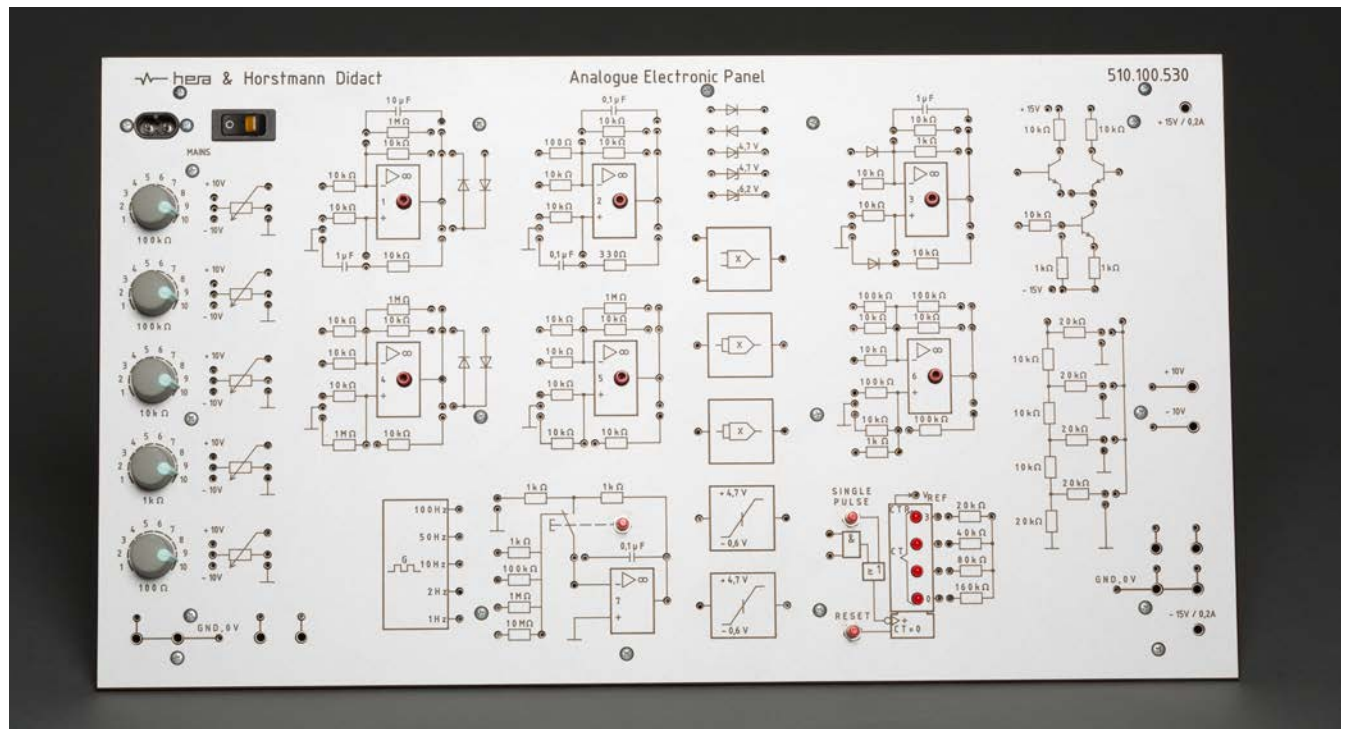
The Operational Amplifier Panel is a compact training system that imparts comprehensive knowledge to all kind of operational amplifier circuits such as used for designing or repairing laboratory devices. The panel holds 11x operational amplifiers  $\mu A$  741 and 5x potentiometers for voltage adjustment.

All connections are done with 2mm lab cords. There are two 2mm resp. 4mm jacks for the connection of external instruments ( $\pm 15V$ , 0,2A). For your tests you will need a multimeter.

Operating voltage: 110...230V, 50/60Hz  
 Dimensions: 532 x 297mm (WxH)

### Learning Content:

- Differential Amplifier
- Inverter Circuits (inverted - / non-inverted amplifiers)
- Impedance Converter
- Calculation Circuits (summing, subtraction, multiply)
- Comparator (threshold switch, Schmitt trigger)
- Constant Current / Constant Voltage Source
- Precision Voltage Source, Precision Rectifier Circuits
- Astable / Monostable Multivibrator
- Integrator
- Function Generator (triangle, saw tooth)
- Differentiator
- RC-Oscillator with OP Amp
- AC Voltage Amplifier
- Squaring / Root-Extraction with Diodes Network
- A/D\_D/A Converter and R2R Networks
- Divider / Root-Extraction



Operational Amplifier Panel 510.100.530

Basics to Operational Amplifiers			
510.100.530	Operational Amplifier Panel	590.100.003	Digital Multimeter
510.102.000	Set of Cables and Connectors		
510.108.001	Manual with CD, Basics to Operational Amplifiers		

## BASICS OF POWER ELECTRONICS

The Power Electronic Panel is a compact training system that enables to do tests in the field of power electronics in DC, AC and 3phase AC circuits on safety low voltage base.

The panel holds resistive -, inductive - and capacitive loads. Optionally the PID-C Motor Panel can be used for load and generator.

Operating Voltage: 220...240V 50Hz (resp. 60Hz)  
Dimensions: 532 x 297mm (WxH)

### AC Tests 1phase:

- Uncontrolled Halfwave Rectifier
- Uncontrolled Bridge Rectifier
- Half-Controlled Rectifier Bridge
- Controlled Rectifier Bridge
- Line-Commutated Rectifier
- Pulse Group Control

### AC Tests 3phases:

- Uncontrolled Rectifier M3
- Uncontrolled Rectifier B6
- Controlled Rectifier M3
- Controlled Rectifier B6

### DC Tests:

- Basic Circuits for Pulse Width Modulation (PWM)
- PWM with H-Bridge (MOSFET)

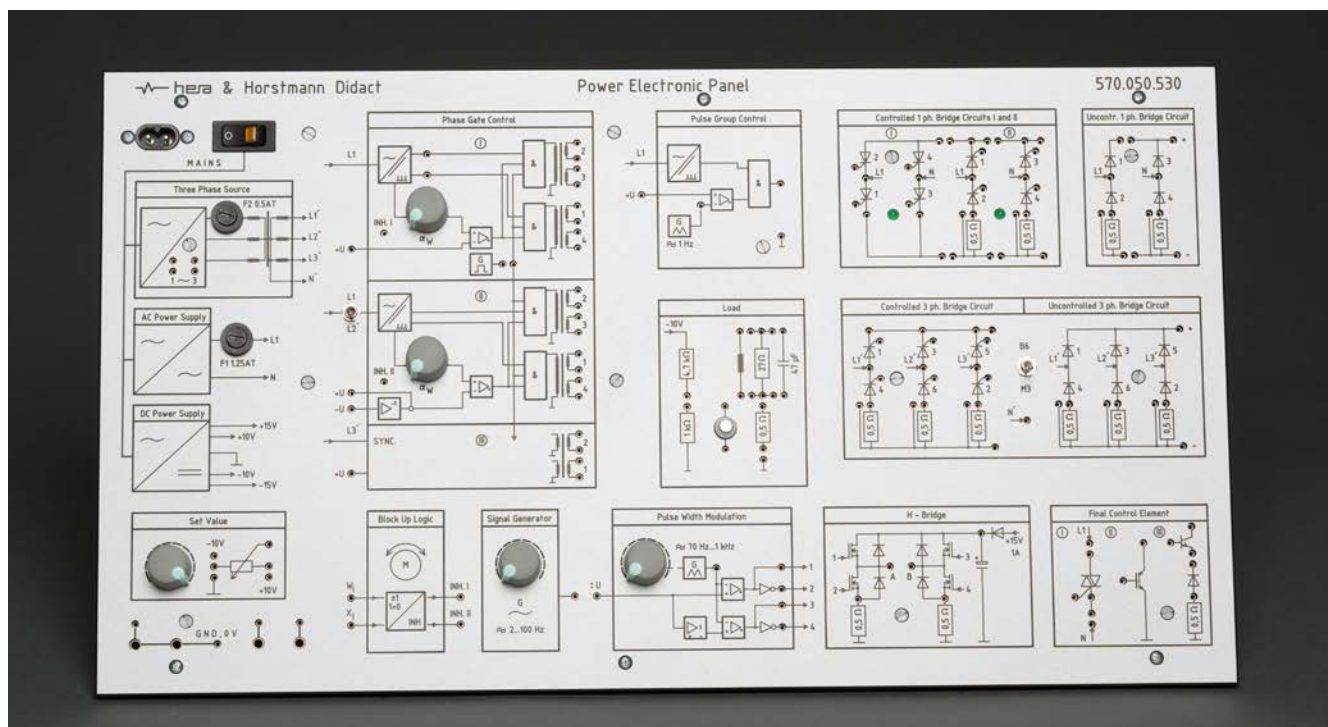
### Tests to GTO:

- Triggering Pulse Manipulation
- GTO as Chopper

### Technical Data:

- 3phase AC source: 12V / 20,5V
- 1phase AC source: 13V
- DC Souce : +15, +10V, -10V and -15V
- Adjustable Voltage, Signal Generator, Block Up Logic

>> SEE COMBINATION WITH PID-C MOTOR PANEL



Power Electronic Panel 570.050.530

Basics of Power Electronics			
570.050.530	Power Electronics Panel	570.052.000	Set of Cables and Connectors
570.050.536	Power Electronic Panel (60Hz)	590.126.500	Oscilloscope, 30MHz
570.058.001	Manual with CD, Principles of Power Electronics		

## BASICS TO PID CONTROL

The PID Control Panel is a compact training system for studying the characteristics of controllers with P -, PI -, PD - and PID characteristics.

The panel consists of a set point generator -10V ... +10V and set point integrator, a sequence control 10ms ... 20s for measurements with standard oscilloscopes. It holds different types of P -, I -, D - elements that can be added to various control behaviors. An output limiter allows the adaption of the output voltage to external systems.

The PID Control Panel can be used in combination with following controlled systems: Light - and Temperature Control, PID-C Motor Panel, Fill Level Plant.

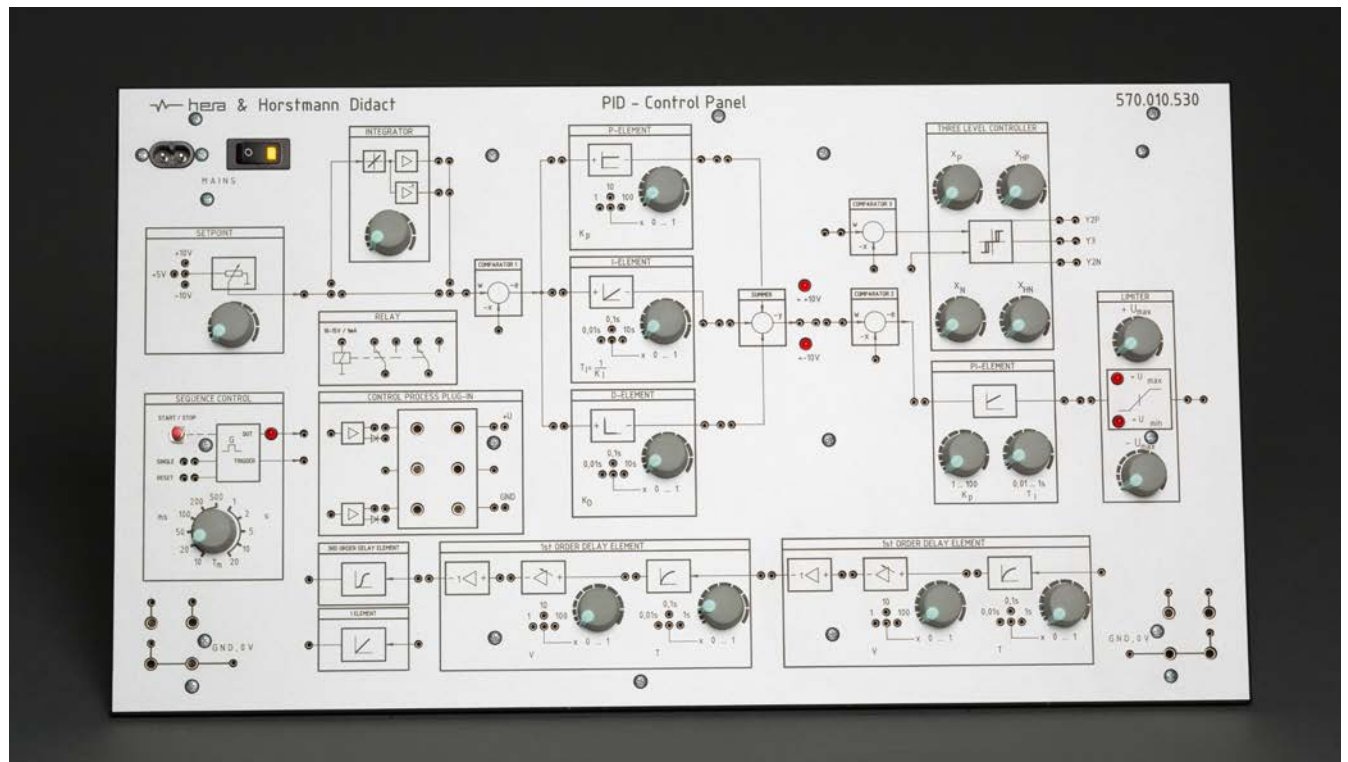
For doing you tests you will need an oscilloscope.

Operating voltage: 110...230V, 50/60Hz  
 Dimensions: 532 x 297mm (WxH)

### Learning Content (with Power Electronic Panel):

- Functionality and Measurements of P -, I - and D- Controllers
- 2-Level Control and 3-Level Control
- P-Controlled Systems with 1st / 3rd Order Delay
- I-Controlled Systems, with and without delay
- I-Controlled Systems with dif. proportional coefficients
- PID-Controller
- Position Control
- Controller Optimization

>> SEE COMBINATION WITH PID-C MOTOR PANEL AND FILL LEVEL PLANT



PID-Control Panel 570.010.535

Basics to PID Control			
570.010.530	PID-Control Panel	570.031.200	Light - and Temperature Control
570.012.000	Set of Cables and Connectors	570.038.001	Manual with CD, Controlled Systems
570.018.001	Manual with CD, Closed Loop Technology	590.126.500	Oscilloscope 30MHz

## CONTROLLED SYSTEM - MOTOR AND GENERATOR UNIT

The PID-C Motor Panel can be used in combination with the PID Control Panel or with the Power Electronic Panel.

The integrated machine unit holds a DC motor (12V / 0,58mA) with actual current indication and plugable load, the shaft-connected DC generator is with tachogenerator, plugable gyrating mass and an encoder for rotation speed and - direction.

The DC power amplifier is for the direct control of the motor with controller or PLL circuit. A plug-field allows circuit enhancement with light- and temperature control.

For your tests you will need an oscilloscope.

Operating voltage: 110...230V, 50/60Hz  
Dimensions: 266 x 297mm (WxH)

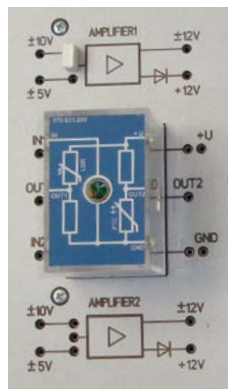
### Learning Content (with PID Panel):

- Static/dynamic measurements for loaded/unloaded DC motor with (-out) gyrating mass (min-1, mA, mNm), current or torque controlled with a flexible combination of P-I-D controllers
- Voltage control by generator
- Speed control with underlaid current control (e.g. Servo)
- Behavior of the different controllers in the light - and temperature system
- One - and four quadrant operation

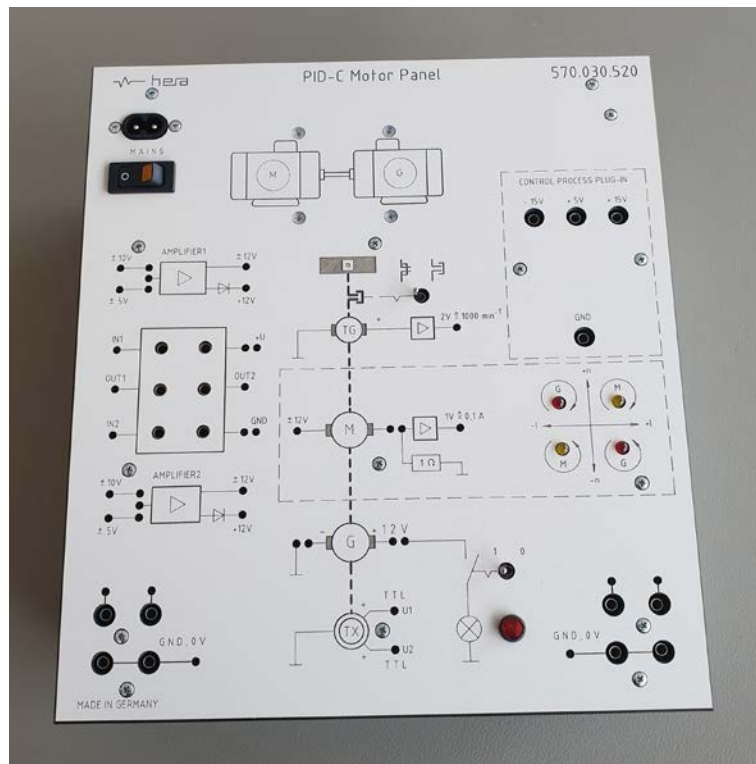
### Learning Content (with Power Electronic Panel):

- DC Motor with controlled / uncontrolled half-wave converter (with big or small load)
- With / without smoothing choke
- Rotation speed with dependence to control angle
- Multipulse triggering
- DC motor with 3 quadrant H-bridge
- Counter-torque
- Unloaded motor output voltage/short-circuit current
- Electric load / load characteristics

### >> APPLICABLE ALSO FOR THE PLC PANEL



Light - and Temperature Control 570.031.200



PID-C Motor Panel 570.030.520

#### Controlled Systems

570.030.520	PID-C Motor Panel
570.038.001	Manual with CD, Controlled Systems
570.031.200	Light - and Temperature Control

## CONTROLLED SYSTEM - FILL LEVEL PLANT

The Fill Level Plant Panel is a controlled system for the PID Control Panel and the PLC Panel. The manual offers an easy understanding of the expressions from control engineering. It simulates the effects of the different industrial controllers by value and LED bars.

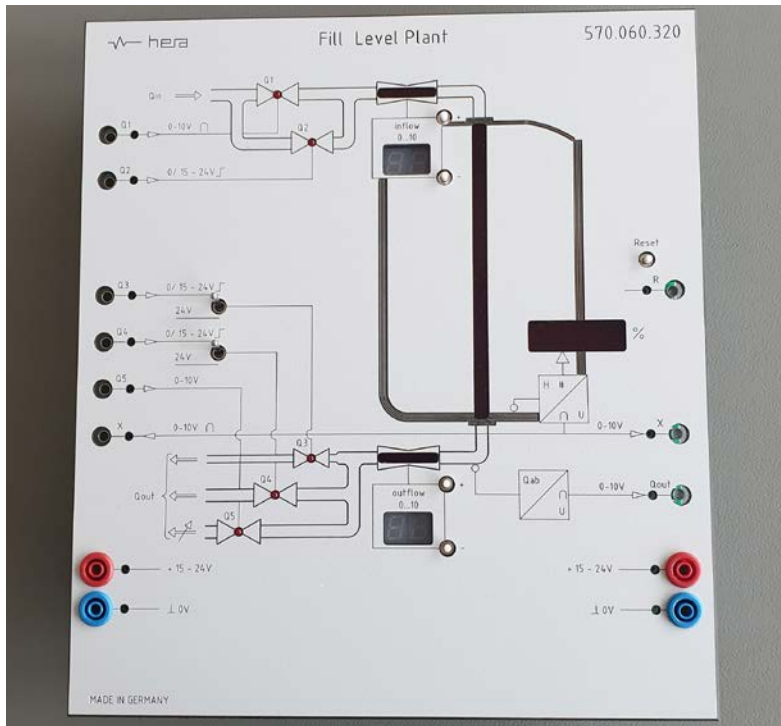
### Characteristics:

- Visualization of fill level, quantity of in- and outflow
- Outflow per time in dependance to fill level
- Cascadable for controlled system of higher order
- Applicable for industrial controllers, PLC and micro-processors

- Binary input controllable with 5V (microprocessor) and 24V (PLC)
- Analogue inputs 0 - 10V
- Analogue outputs 0 - 10V proportional to fill level and outflow per time
- Simulation fill level with LED bar and 7-segment display
- Indication of in- and outflow with 7-segment display
- In- and outflow simulation with running lights
- Valve simulation with LEDs

Operating voltage: 5...24V  
 Dimensions: 532 x 297mm (WxH)

>> **APPLICABLE ALSO FOR THE PLC PANEL (MANUAL WITH EXAMPLE AVAILABLE)**



Fill Level Plant 570.060.320

Control Engineering Lab with PID Panel, PID-C Motor Panel, Plug Component Light and Temperature System, Fill Level Plant (full training set up)



Controlled System	
570.060.320	Fill Level Plant

## SOFTWARE CONTROL ENGINEERING

### Control Engineering I:

Software for examination of different controllers (P, I, PI, PID and 2-position control) and different controlled systems for various industrial processes.

All results are stored and can be presented in graphical and statistical diagrams.

Simulated Processes:

- Examination of Controller Behavior
- Liquid Level Control
- Temperature Control
- Temperature Control with Delay Time
- Control of a Mixing Container Cascade
- Analysis of Ptn-controlled systems with P, I, PI, PID
- Analyses of Controller Behavior

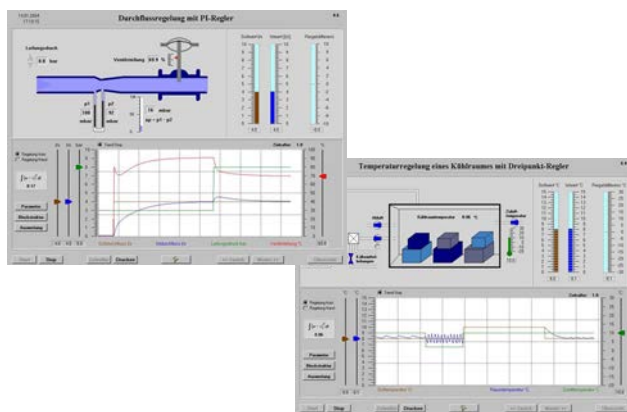
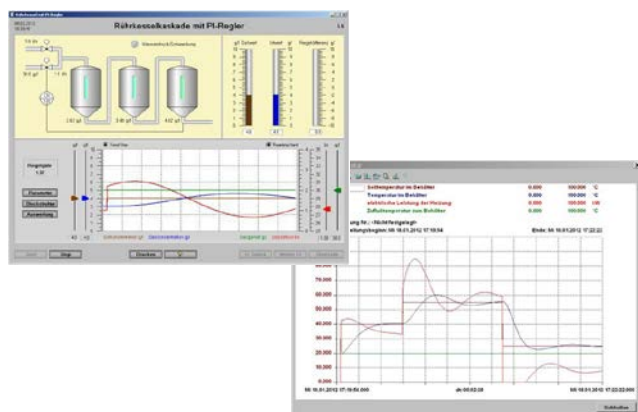
### Control Engineering II:

Software for examination of different controllers (P, I, PI, PID and 3-position control) and different controlled systems for various industrial processes.

All results are stored and can be presented in graphical and statistical diagrams.

Simulated Processes:

- Flow Rate Control
- Engine Speed Control
- Room Temperature Control
- Cooling Chamber Control with 3-Position Controller
- Liquid Level Control with Standard Controller plus 3-Position Controller



**Note: Both courses only differ in applications - no advanced course!**

Software Control Engineering			
570.900.201	Control Engineering I (EN, DE), Single License	570.900.301	Control Engineering II (EN, DE, FR), Single License
570.900.210	Control Engineering I (EN, DE), 10x License	570.900.310	Control Engineering II (EN, DE, FR), 10x License



## BASICS TO 1PHASE AND 3PHASE TRANSFORMERS

The Transformer Panel is the ideal training system for doing all relevant tests and calculations for 1phase and 3phase transformers of different vector groups in unloaded or loaded circuits (different combinations of resistive -, inductive - and capacitive loads) and suitable safety installations.

For your tests we recommend 2 multimeters.

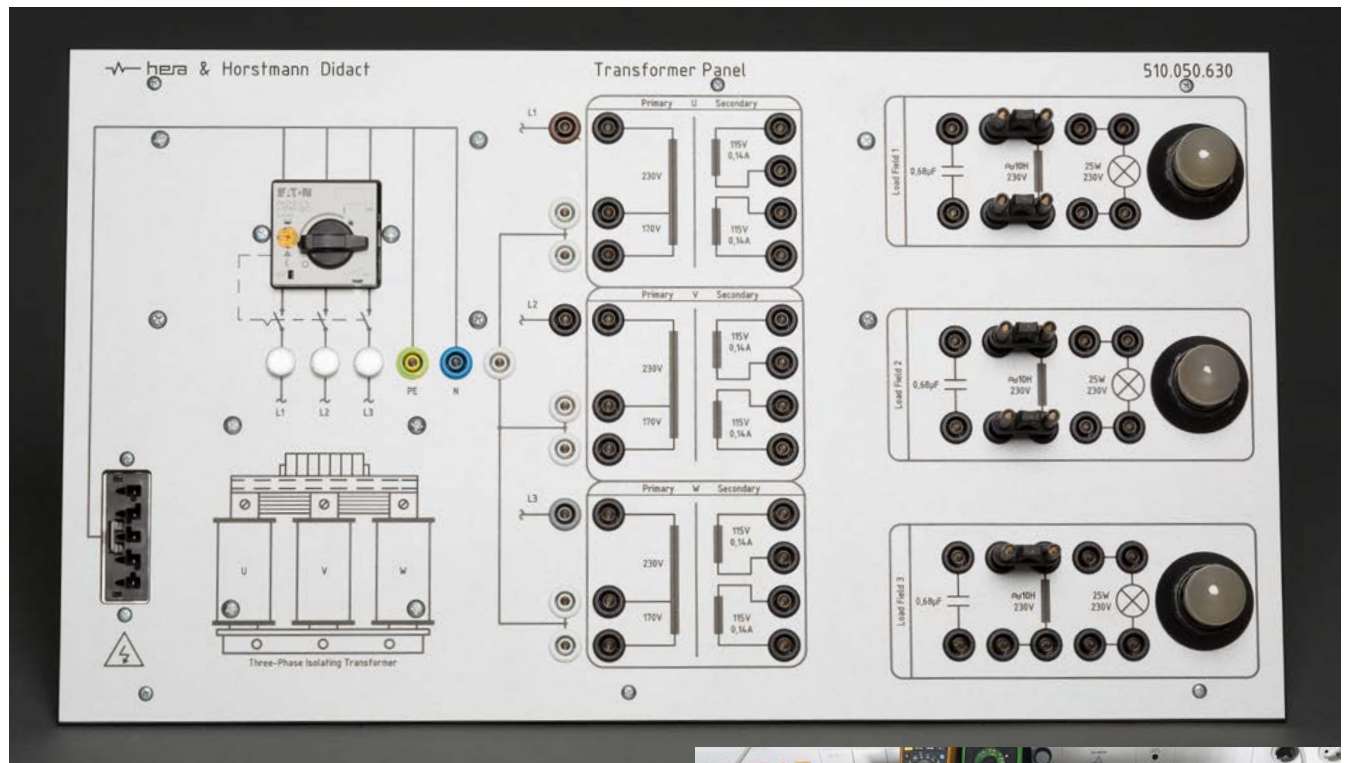
### Technical Details:

- Power Connection: CEE plug 400VAC 50/60Hz
- 3phase transformer, rated power: 100VA
- Primary: 3x 400V / secondary 6x 115V
- Pluggable resistive, inductive and capacitive load
- Applicable as autotransformer and isolating transformer
- Circuit breaker with adjustable tripping current

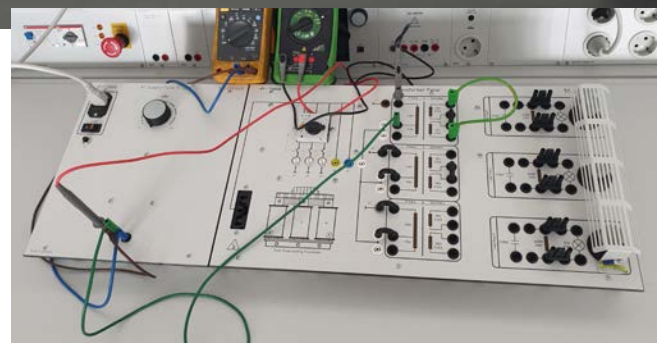
### Learning Content:

- Types, functions and windings
- Operation without load and with different loads
- Up - and down transformation
- Autotransformer
- Short circuit operation
- 1phase transformers, ideal transformers, transformer loss
- 3phase transformers with different vector groups: Yd-, Yy-, Yz- Dy-, Dd and Dz
- Phase multiplier circuit
- Symmetric and asymmetric loads
- Dimensioning of circuit breaker for transformer

>>Operating voltage: 400V, 3phase, 50/60Hz >>  
 Dimensions: 532 x 297mm (WxH)



Transformer Panel 510.050.630



Short Circuit Test with Transformer Panel and AC Supply Panel

### Basics to Transformers

510.050.630	Transformer Panel	510.052.000	Set of Cables and Connectors
510.050.640	AC Supply Panel 0...30V, 1A (for short circuit test)	510.058.001	Manual with CD, Basics to Transformers

## BASICS TO INDUSTRIAL SENSORS

The Sensorics Test Panel is equipped with a motor-driven linear unit for tests to sensing distance as well as a coded disk for frequency counting and rotation speed as well as two digital counters.

The linear unit can be either directly controlled at the panel or externally with TTL signals or 24V for PLC control with feedback.

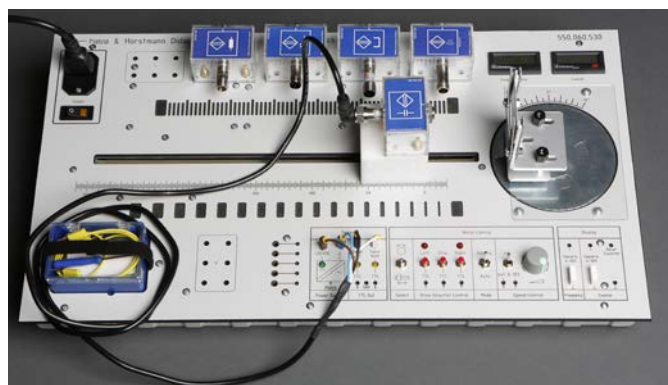
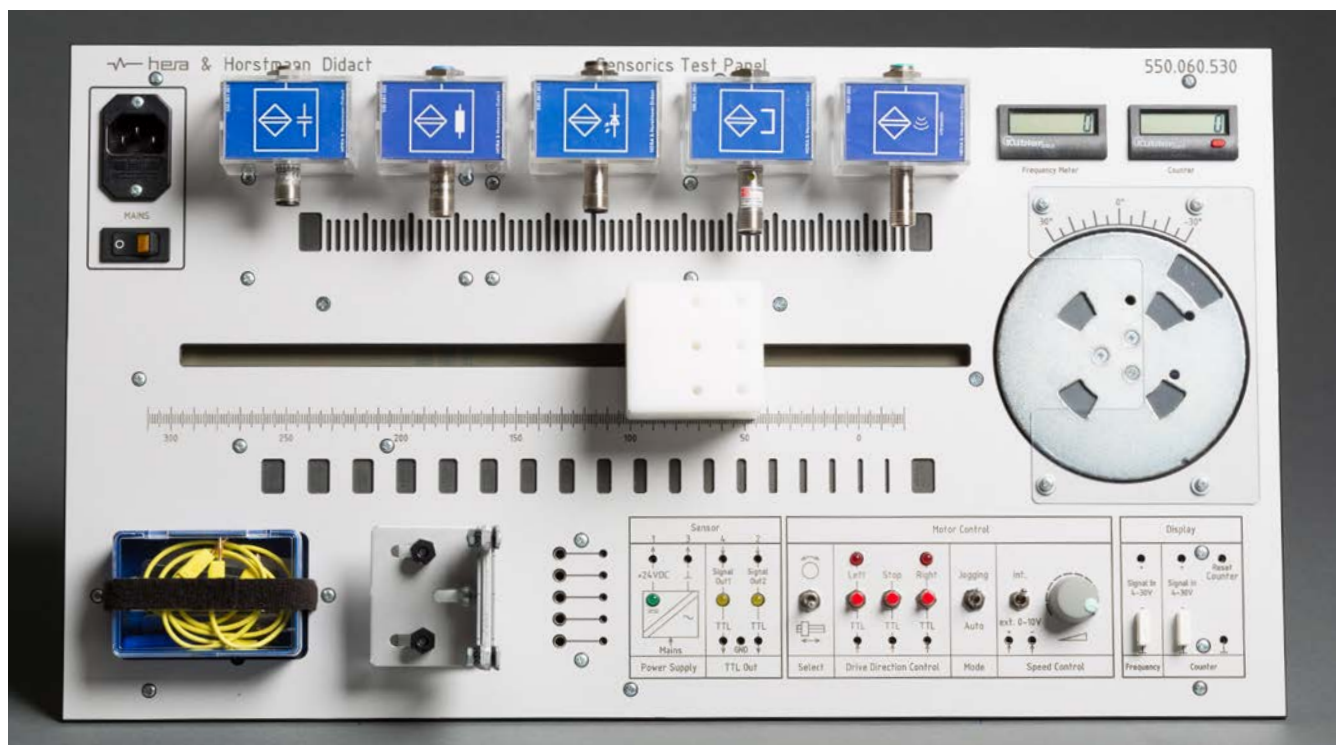
The basic system holds capacitive -, inductive -, resistive and optical sensors as well as material samples and cables. No additional equipment is required!

Operating power: 110 - 240V, 50/60Hz

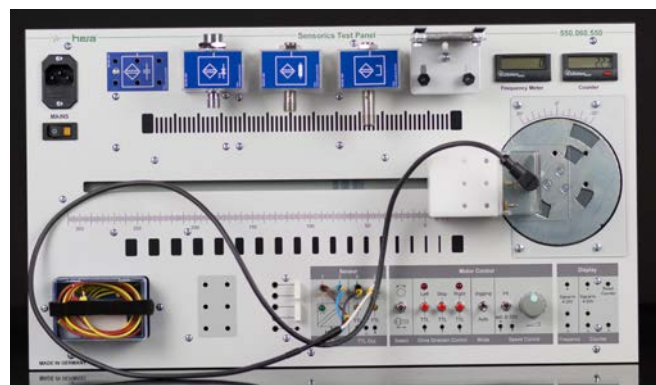
Dimensions: 532 x 297mm (WxH)

### Learning Content:

- Active / passive sensors, switching hysteresis, reduction factor, response curve, sensing distance, responsive material
- Rotation counts and frequency measurement
- End position detection with sensitivity adjustment
- Hall sensors, magneto-resistive sensor, saturation core sensors
- Light barriers, adjustments and deflection on inclined surfaces
- Basics and tests to the optional sensors: inductive analogue sensors, ultrasonic sensors, optical fibers and explosion-safe NAMUR sensors.



Test to sensing distance for different sensors and materials



Rotation speed with inductive sensor

### Basics to Industrial Sensors

550.060.530	Sensorics Test Panel (magnetic, capacitive, inductive, optical sensor)	550.061.005	Ultrasonic Sensor
550.068.001	Manual with CD, Basics of Sensor Technology	550.061.006	Fibre Optics with Holder
038.111.100	2mm/4mm Adapter (10 Stck.) (for application with PLC Panel)	550.061.007	Analogue Sensor
		550.061.008	NAMUR Set (inductive, capacitive, magnetic)

## BASICS TO DIGITAL TECHNOLOGY

The Digital Panel is for a comprehensive understanding of common integrated circuits and their combination of NAND, NOR, XNOR and XOR gates.

The panel holds **input elements** (8x high/ 8x low membrane buttons, 1x debounced pushbutton, 1x hexadecimal dual coding switch, signal source 0...5V<sub>DC</sub>, a square signal generator for TTL signals and pluggable frequency divider), **processing elements** (7x AND/NAND, 7x AND/NAND with pull-up resistors, 5x OR/NOR, 5x OR/NOR with pull-up resistors, AND/OR combination, antivalence, equivalence and integrated ICs) and **output elements** (7segment reading with two 7segment decoders for hexadecimal codes, Sub-D 25poles for variable options).

For your tests you will need a multimeter!

Operating voltage: 110...230V, 50/60Hz

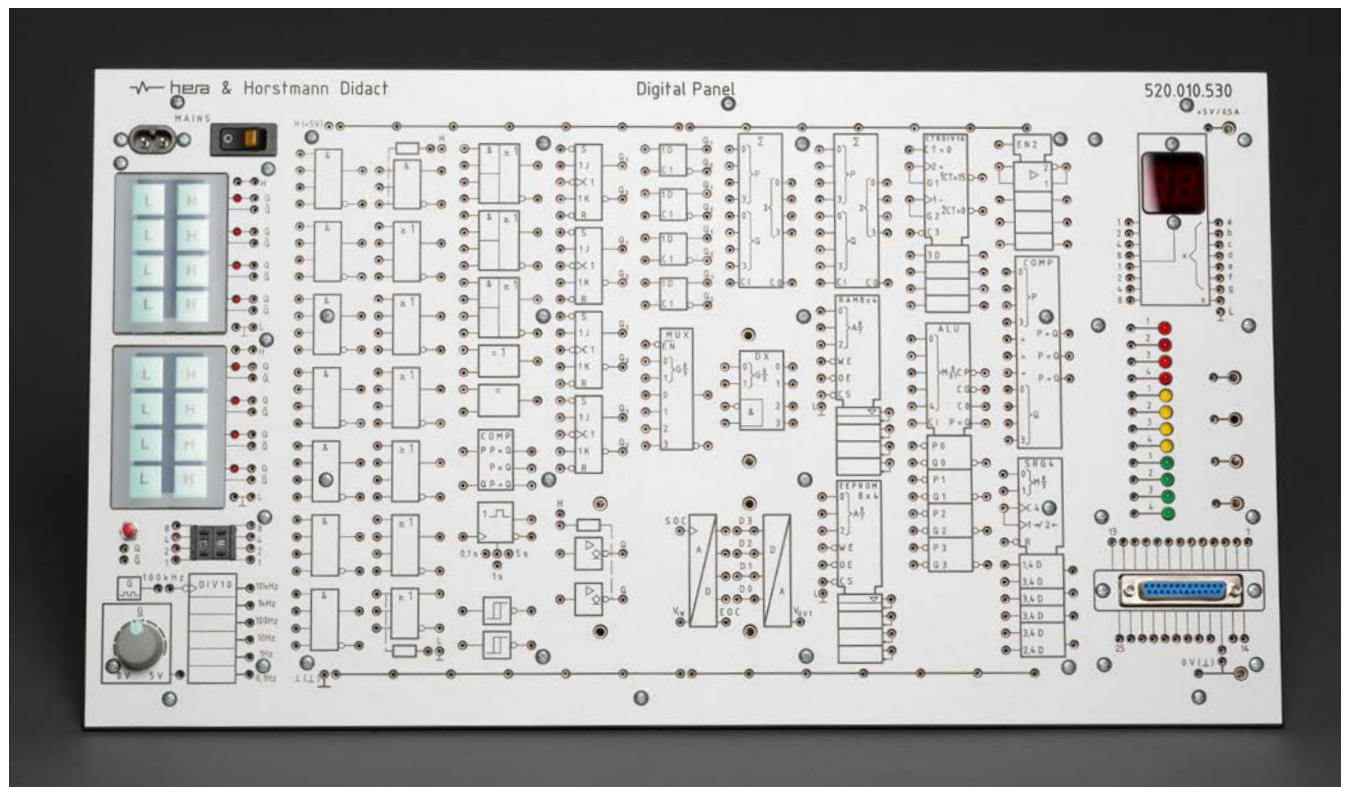
Dimensions: 532 x 297mm (WxH)

### Learning Content:

- Boolean Algebra and Karnaugh Diagrams
- NAND / NOR technology and pseudo tetrades
- Equivalence - and antivalence gates (XNOR/XOR)
- TTL 74 series (pull-up / pull-down resistors)
- Schmitt trigger (inverted / not-inverted)
- SR flip-flops presented with NAND/NOR gates
- different types of SR -, D -, JK flip-flops
- Mono-flop
- Code converters (8421-BCD to Excess-3-, Decimal, 7-Segment)
- Calculating circuit (correcting tetrads and carry overs)
- Arithmetic Logic Unit 74HC/HCT181(with/ without accu)
- Different types of counters (up, down, modulo-n, PLC,..)
- Register circuit, shift register
- Multiplexer / demultiplexer
- AD / DA converter

Plugging the elements is clearly indicated with MP4.

### >> APPLICABLE FOR CONTROL OF THE STEP MOTOR PANEL



Digital Panel 520.010.530

Basics of Digital Technology			
520.010.530	Digital Panel	590.100.003	Digital Multimeter
520.012.000	Set of Cables and Connectors		
520.018.001	Manual with CD, Digital Technology		

## DIGITAL TECHNOLOGY WITH COMMON ICs

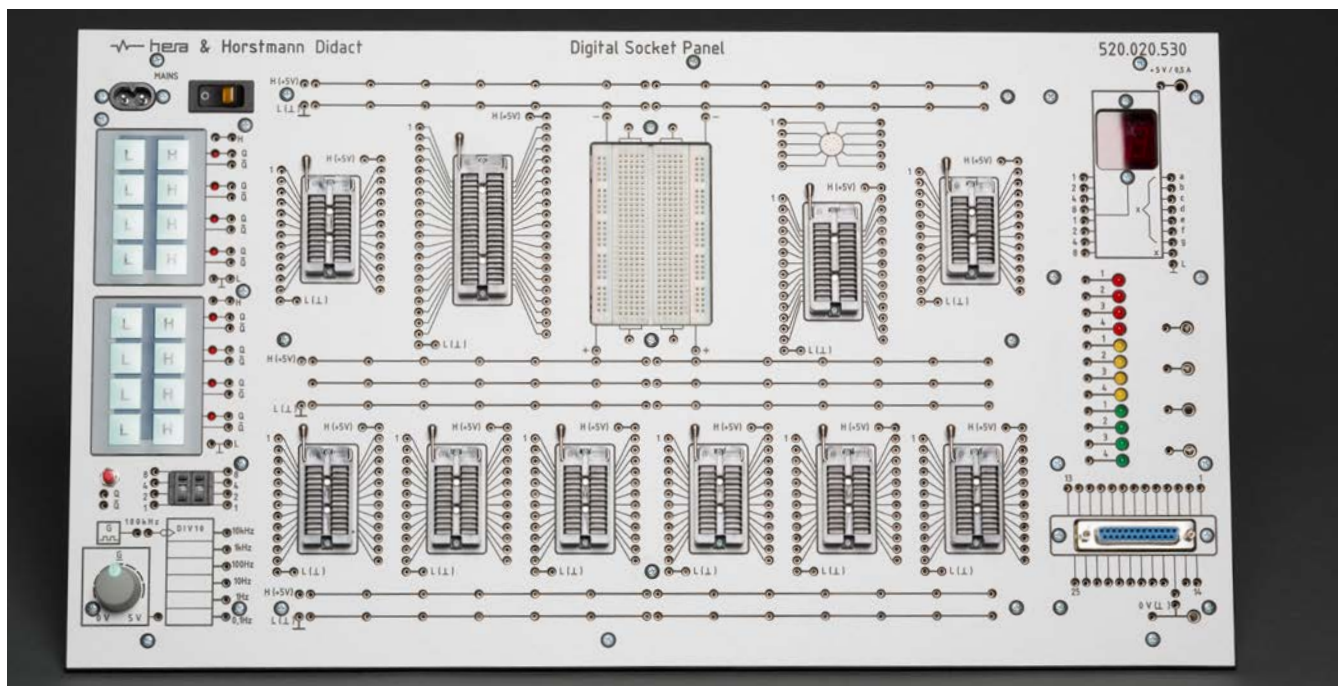
Instead of the integrated ICs the Digital Socket Panel is for direct use of ICs with fast connectors.

Like the Digital Panel, it holds **input elements** (8x high/ 8x low membrane buttons, 1x debounced pushbutton, 1x hexadecimal dual coding switch, signal source 0...5V<sub>DC</sub>, a square signal generator for TTL signals and pluggable frequency divider) and **output elements** (7segment reading with two 7segment decoder for hexadecimal codes, Sub-D 25poles for variable options). For integration of the **processing elements** there are IC fast connectors and a bread board.

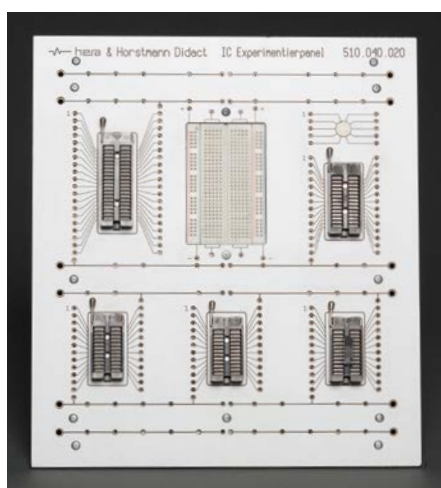
In combination with the Set of Components 520.011.000, the system teaches the same topics than the Digital Panel 520.010.530 or it can be used with other ICs for flexible tests.

For your tests you will need a multimeter!  
Operating voltage: 110...230V, 50/60Hz

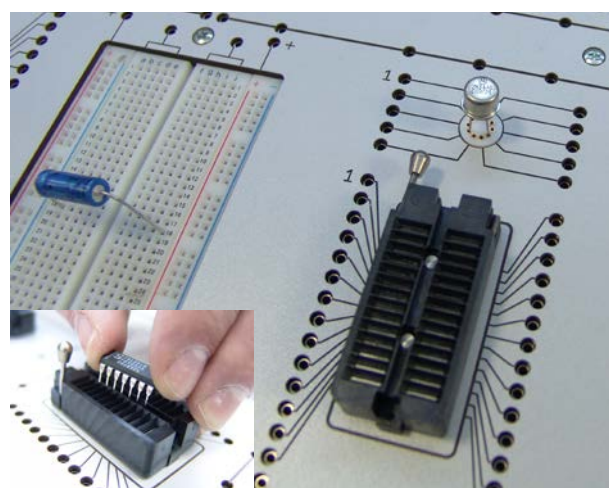
The IC Socket Panel does not hold any in- and output options, but it allows the integration of ICs or resistors into other training systems e.g. Basic Electronic Panel.



Digital Socket Panel 520.020.530 (532 x 297mm)



IC Socket Panel 510.040.020 (266 x 297mm)



Digital Technology with Common ICs			
520.020.530	Digital Socket Panel	520.028.001	Manual with CD, Digital Technology
520.022.000	Set of Cables and Connectors	510.040.020	IC Socket Panel
520.011.000	Set of Common ICs	510.042.000	Set of Cables to IC Socket Panel

## BASICS TO STEP MOTOR

The Step Motor Panel is a self-sufficient training system with 12V<sub>DC</sub>, 0,18A unipolar motor, which can be used as step motor or synchron motor. It can be operated with control logic, 4 manual switches or externally by phase shifting. If the amplifier is connected, then the motor can be controlled with the squarewave generator of the Digital Panel, the Digital Socket Panel or with Software Digiwin plus the Multi Interface Panel.

For capturing rotation speed, rotation angle and rotation direction the reflective sensor can be plugged.

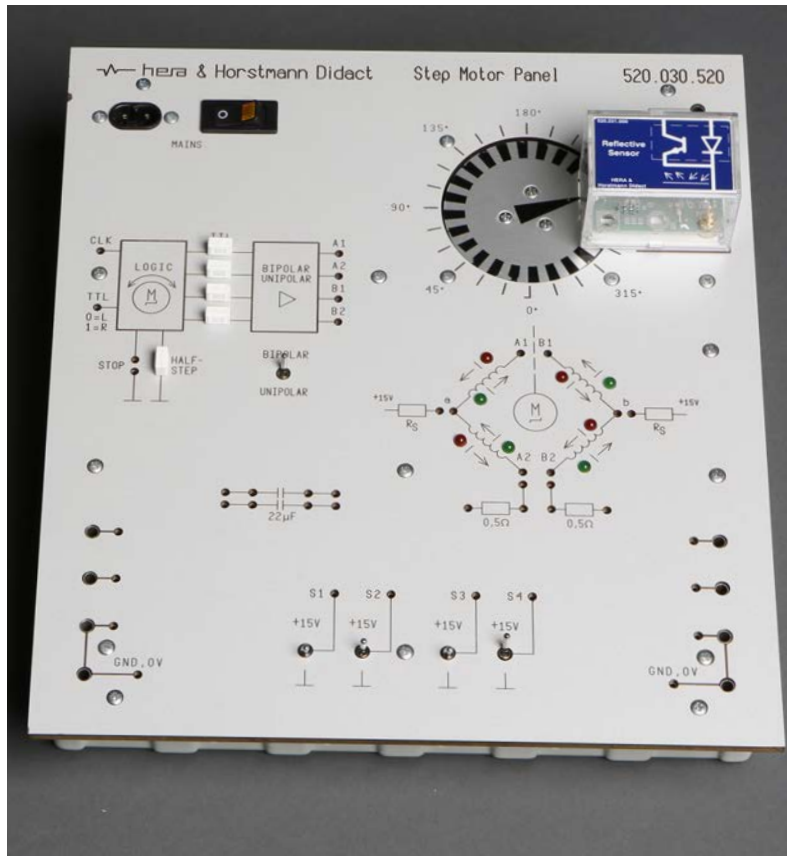
Operating voltage: 110...230V, 50/60Hz  
 Dimensions: 266 x 297mm (WxH)

### Learning Content:

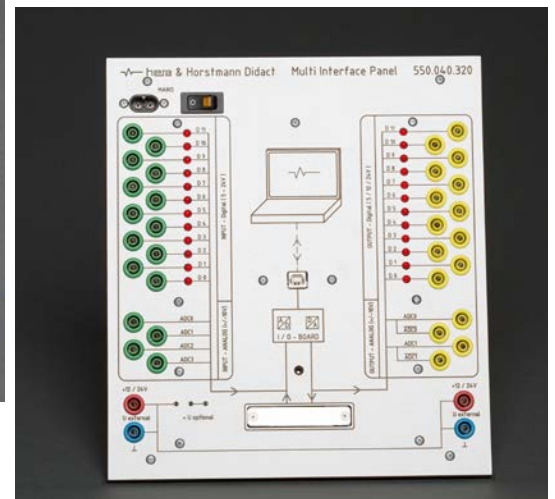
- Control Logic and Power Electronics of a Step Motor
- Microstep and sinus operation
- Bipolar and unipolar operation of a step motor
- Rest position, holding torque and induced voltage
- Determination of winding parameters

### Following test are available for Digital Panel or Digiwin Software with Multi Interface Panel:

- Step mode with specified number of steps (single phase and double phase)
- Double phase full step operation with shift register
- Clockwise rotation for full step operation with synchron counter
- Clockwise and counter-clockwise rotation for full step operation with synchron counter



Step Motor Panel 520.030.520



Multi Interface Panel 550.040.320 (266 x 297mm)

Basics to Step Motor			
520.030.520	Step Motor Panel	550.040.320	Multi Interface Panel
520.031.000	Reflectic Sensor (Plug Component)	550.040.324	Set of Cables to Multi Interface Panel
520.038.001	Manual with CD, Step Motor Panel	550.042.000	I/O Interface 37poles for Multi Interface Panel
		550.040.322	Integrated Power Supply 12V or 24V

## SOFTWARE DIGITAL - AND PID SIMULATION

### Digiwin:

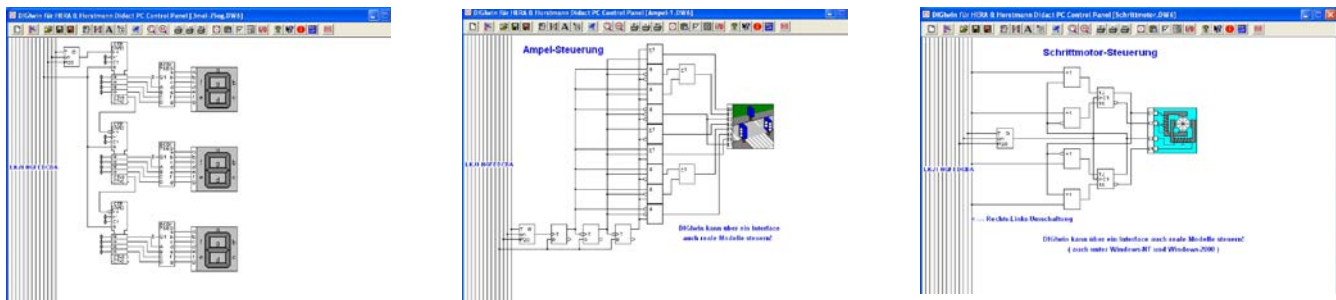
Digiwin is a simulation software for digital circuits, which can be either used as a self-sufficient learning software or in combination with the Multi Interface Panel for the control of external devices e.g. the step motor panel.

The circuits are generated in Windows with standard symbols, then the function can be tested. Digiwin holds a variety of combinatorial and sequential circuits, such as flip-flop JKMS, 4-bit counters and shift registers and also allows model simulations like traffic lights, step motors or press.

Modules for recording the KV diagram for 2, 3 and 4 variables as well as the simulation of PLF chips with 8 and 16 in- and outputs.

The program was developed with particular importance to easy handling, high operation speed and minimum hardware requirements.

The help function provides detailed information to all functions and components.



### Messwin:

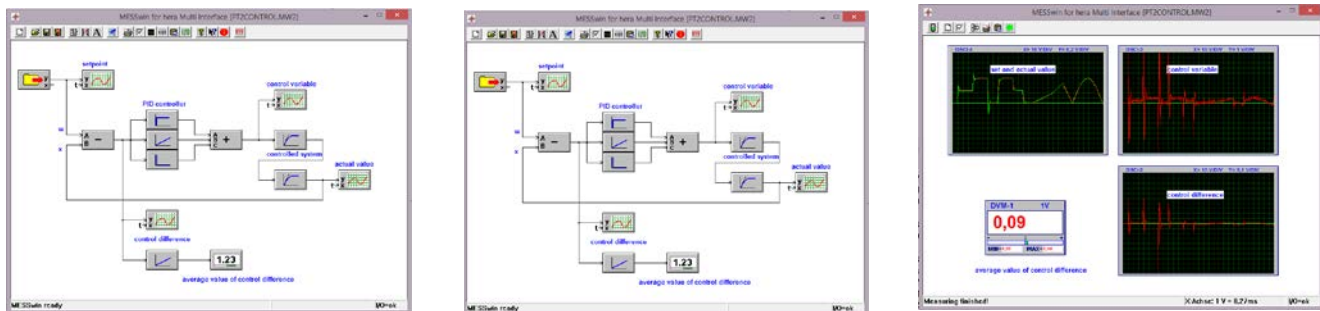
Messwin is a graphic program generator for all desired measure -, closed-loop - and control tasks in Windows.

Programming is done by generating the circuit diagrams with the parametrizable function blocks from the library, like generator digital voltmeter, oscilloscope, A/D- or D/A-converter. Messwin generates the necessary program code and displays, prints or saves the measured results.

Due to its easy use, Messwin is particularly suitable for educational purpose in universities, colleges and technical training centers.

Messwin contains all basic elements of the closed-loop technology like 2-level - and PID controllers.

This enables either closed-loop simulation or if combined with the Multi Interface Panel external closed-loop systems can be connected e.g. PID-C Motor Panel with Light and Temperature Control and Fill Level Plant.



Software for Digital - and PID Simulation			
520.900.302	Digiwin Multiple License, DE	570.900.199	Messwin, Multiple License, DE
520.900.305	Digiwin Multiple License, EN	570.900.105	Messwin, Multiple License, EN

## MICROCONTROLLER PROGRAMMING

The Microcontroller Panel is an ideal training system for the basic understanding of microcontrollers and to learn its programming. The training system bases on the ATmega168 as ATMEL is a leading manufacturer for microcontrollers.

Programming can be done in Assembler, C / C++ and Bascom although the manual supports Assambler and Bascom. The panel is clearly arranged in I-P-O principle. For **Input** there are 6 switches and 3 potentiometers, the ATmega168 for **Processing** and an RGB LED, 12 LEDs and a Piezo buzzer as **Output** elements.

### Learning Content:

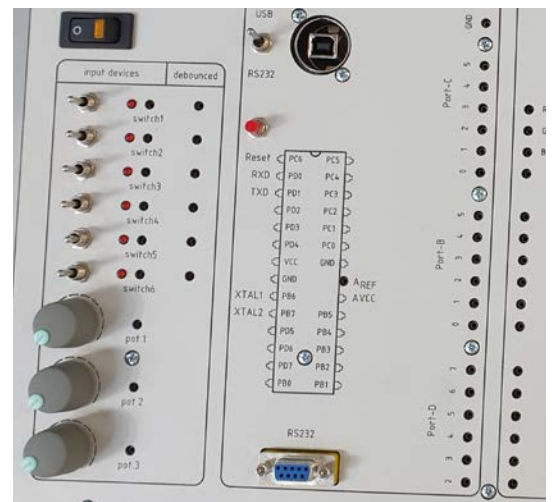
- Basics to Microcontrollers
- Programming in Assembler and C, Commands
- Bit Manipulation, Ports, Timer, Include Files
- Hardware PWM
- AD-Converter, Watchdog, Interrupt, I<sup>2</sup>C Bus
- Basic Structure of a Program
- Programming an In- and Output Test
- Programming a LED Flasher
- Programming a RGB-LED with PWM
- Programming an external interrupt

Depending on the learning content, the panel can be used as basic version for programming the standard output elements or it can be enhanced with LC-Display, Real Time Clock, external EEPROM and Temperature Sensor.

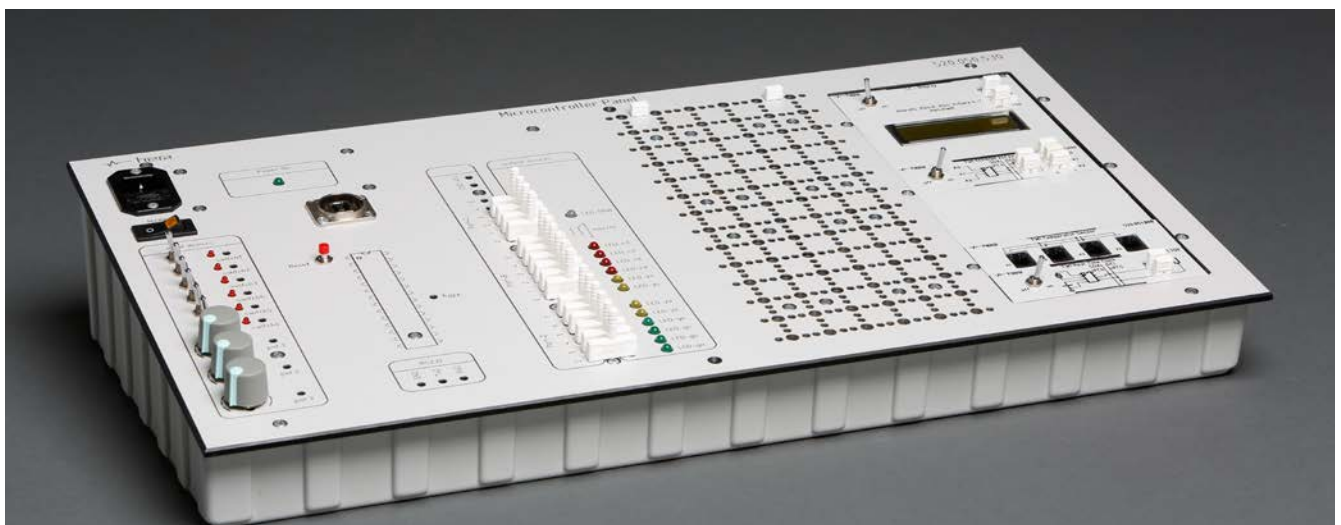
For even more flexibility an integrated plug-board allows to add flexible configurations with plug-components to the microcontroller circuit, e.g. transistor cirucits. Integrated TTL ports allow to connect the Digital Panel, the Digital Socket Panel, the Step Motor Panel or the Sensor Test Panel for more advanced applications.

The panel is with USB interface for communication with the PC, a bootloader is pre-installed.

Operating voltage: 110...230V, 50/60Hz  
 Dimensions: 532 x 297mm (WxH)



Input - Processing - Output Elements



Microcontroller Panel with ATmega168 with all options: LC-Display, Real Time Clock, EEPROM and Temperature Sensor

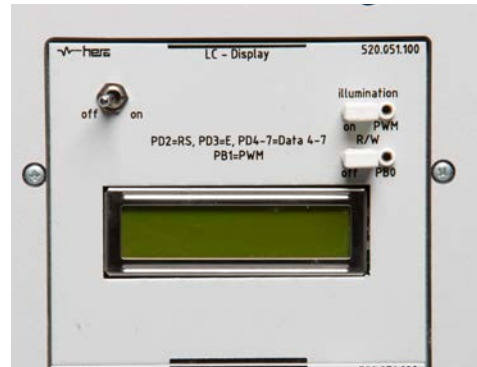
Microcontroller Programming			
520.050.530	Microcontroller Panel	520.051.000	Set of Cables and Connectors
520.058.001	Manual with CD, Basics to Microcontroller		

## OPTIONS FOR MICROCONTROLLER PANEL

The right side of the Microcontroller Panel in basic version is covered with blank panels or it can be equipped with a variable selection of following options:

### Option LC-Display

The LC-Display is an optional module, that can be integrated for the programming of a digital display, it is also the base for more experiments where a comfortable status display might be useful.



Option: LCD Display 520.051.100

### Option EEPROM

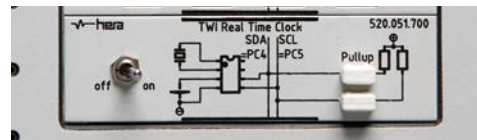
The EEPROM is an option, that allows the integration of extra memory by I<sup>2</sup>C bus into the microcontroller circuit. Data can be stored in an external memory and the full procedure is imparted in a comprehensive way.



Option: TWI EEPROM 520.051.600

### Option Real Time Clock

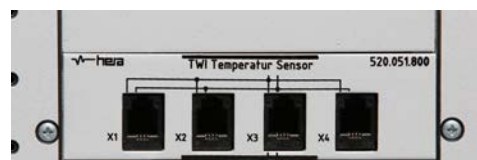
The Real Time Clock is an option, that allows the integration of real-time-clock ICs by I<sup>2</sup>C bus into the microcontroller circuit. The serial real time clock possess a decimal calendar with seconds, minutes, hours, days, month, year and leap year. 24h or 12h mode is available. Address and data transfer is done with a bi-directional serial bus.



Option: TWI Real Time Clock 520.051.700

### Option Temperature Sensor

The Temperature Sensor allows the measurement of the ambient temperature and its measurement can be indicated in the LC display. Instead of the common PTC - or NTC resistor, the sensor is a LM75 sensor. The LM75 measures temperatures with 0,5 degree resolution and the results are transmitted by I<sup>2</sup>C bus, also included is a thermostat with adjustable threshold value and hysteresis.



Option: TWI Temperature Sensor 520.051.800

#### Options to Microcontroller Panel

520.051.100	LC-Display	520.051.600	TWI EEPROM
520.051.700	TWI Real Time Clock	520.051.800	TWI Temperature Sensor



## BASICS TO IT TECHNOLOGY

The Local Area Network (LAN) Panel is a compact training system, which holds all necessary components for setting up a networks and doing the necessary networks configurations. Besides the tests, the manual holds extensive fundamental informations about networks technology.

### Technical Details:

- 8 Port Switch 1Gbit/s
- Power Line Adapter 500Mbit/s
- WLAN Access Point 300Mbit/s Repeater / Bridge, Client, Multi-SSID
- 5 Port Router
- Potentiometer for cable length simulation

Operating voltage: 110...230V, 50/60Hz  
 Dimensions: 532 x 297mm (WxH)

### Learning Content:

- ISO / OSI reference modell
- TCP / IP reference modell
- Transmission cables and categories, wireless
- Network devices and functions
- Topologies
- Networks communications and protocols
- Firewall / Virtual Private Networks (VPN)
- Network configurations e.g. IP addresses, DHCP server
- Power Line
- Configuring a network with one or more LAN Panels
- Influence of cable length to transmission speed



Local Area Network (LAN) Panel

Basics to IT Technology			
580.140.030	Local Area Network (LAN) Panel	580.141.000	Set of Cables and Connectors
580.148.001	Manual with CD, LAN Technology		

## PANEL CASE FOR TRANSPORT OR STORAGE

The panel case is a convenient possibility to transport the standard panels from room to room or for storage. One or two training panels (532 x 297mm) can be firmly installed in the case or the lid can be prepared for the acceptance of the manual and cables.

For a comfortable training the case and lid can be separated. The case comes with lock and 2 keys.

Dimensions:  
555 x 390 x 250mm (WxDxH).



### Panel Case

509.002.000

Panel Case

509.010.001

Flap for Lid