



# Autotronica, ingegneria elettrica nel settore automobilistico

AUTOMOTIVE - Elementi fondamentali di elettronica per la tecnologia nel settore automobilistico

ETS DIDACTIC



## ELECTRICAL ENGINEERING FOR AUTOMOTIVE TECHNOLOGY

Fundamentals of Electronics for Automotive Technology

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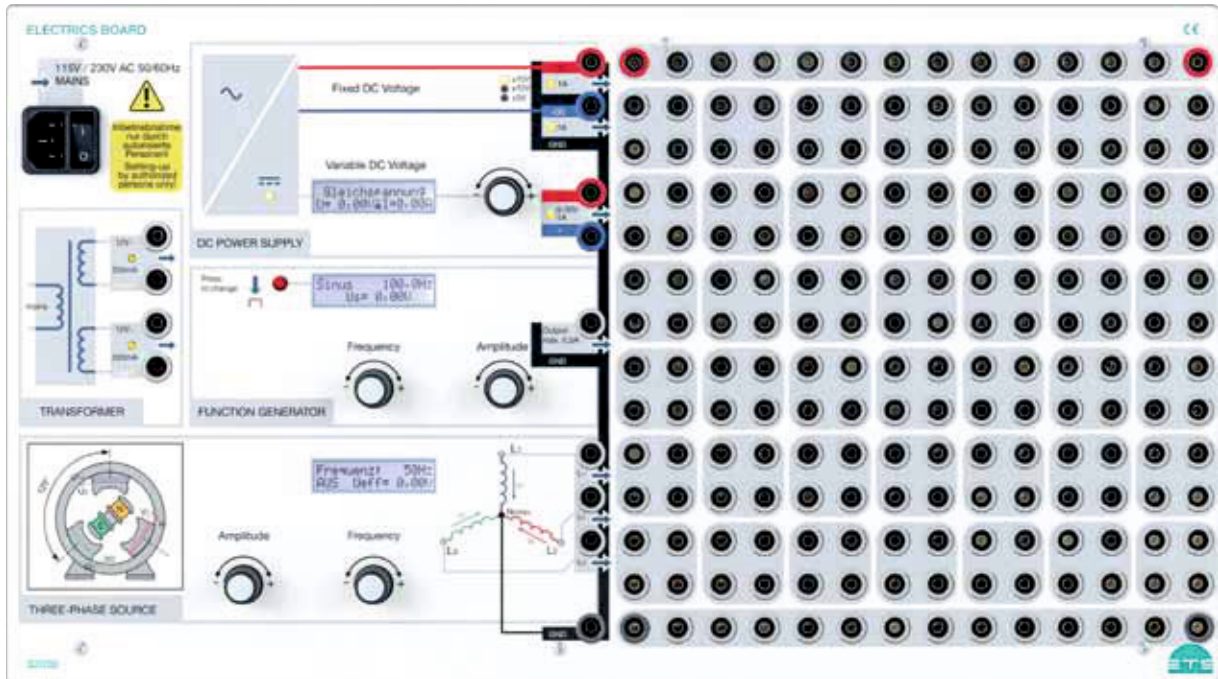
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# automotive electronics

## Basics Board electronics



### Learning objectives

- Basics of electrical engineering
- how to use oscilloscope and multimeter
- Passive components in the Dc circuit
- capacitors and coils in the ac circuit
- transformers
- three-phase current systems
- voltage, temperature and light-dependant resistances
- Operational amplifiers

### Technical data

- voltage sources: Dc +/-15 v or +/-12 v or +/- 5 v/1 a; Dc 0...30 v / max. 1 a with voltage and current display; ac 2 x 12 v/0,2 a (protected by polyswitch)
- function generator: f requency 0.1 hz...200 khz, amplitude 0...10vp variable wave form, display of all parameters
- three phase current generator: Phase voltage: 0...10 vrms; line voltage: 0...17.3 vrms; frequency: 1...120 hz, adjustable, display of all parameters, phase current load: max. 400 marms
- 42 plug-in areas in a 19mm grid, each with 4 electrically

connected 4mm safety jacks

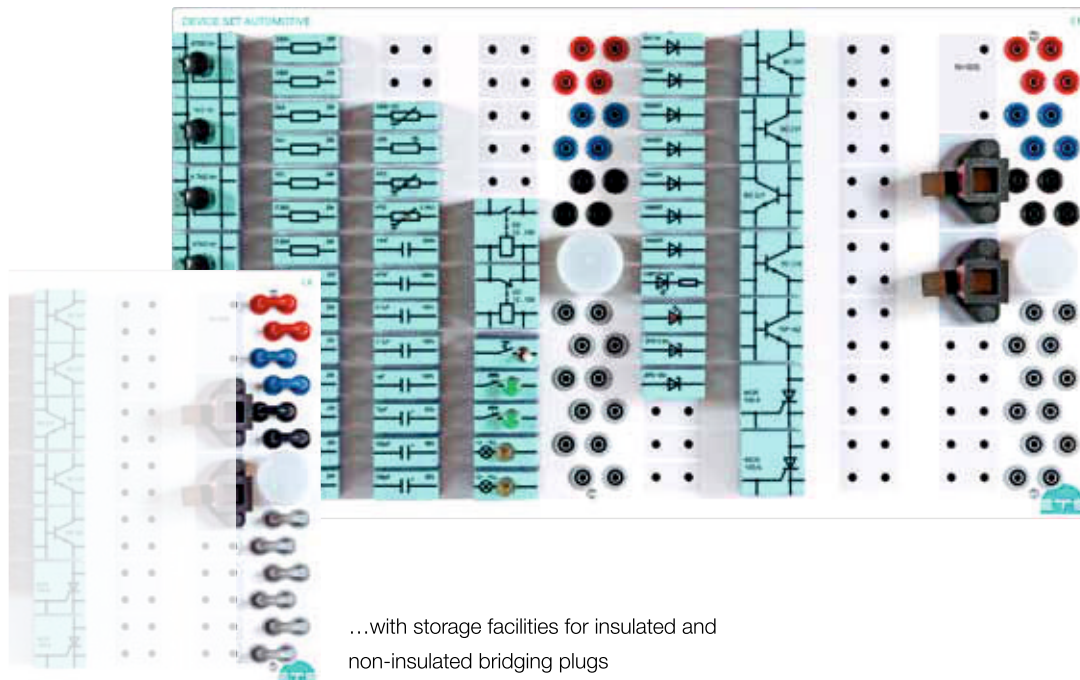
- mains connections 230 v ac; 50 hz; 75 W; protection class i

- supply outputs short-circuit-proof, reverse protection up to 40 v Dc / 24 v ac, 40 W



No.	Designation	Order No.
1	electrical Board	32030

## Device set – automotive



...with storage facilities for insulated and non-insulated bridging plugs

### Technical data

set of plug-in components for experiments on the fundamentals of electrical engineering/electronics in automotive engineering, including storage plate for plug-in models and 24 safety jumper plugs, printed with the circuit symbols of the components.

- › Film resistors 22Ω / 2W
- › Film resistors 33Ω / 2W
- › Film resistors 100Ω / 2W
- › Film resistors 330Ω / 2W
- › Film resistors 1kΩ / 2W
- › Film resistors 2,2kΩ / 2W
- › Film resistors 4,7kΩ / 2W
- › Film resistors 10kΩ / 2W
- › Film resistors 47kΩ / 2W
- › Film resistors 100kΩ / 2W
- › Film resistors 1MΩ / 2W
- › Potentiometer linear 470Ω / 0,5W
- › Potentiometer linear 1kΩ / 0,5W
- › Potentiometer linear 4,7kΩ / 0,5W
- › Potentiometer linear 47kΩ / 0,5W
- › vDr resistance, 11v / 1ma
- › IDr resistance
- › NTC resistance (6kΩ)
- › PTC resistance (3,9kΩ)
- › capacitor 10nf / 500v
- › capacitor 47nf / 500v
- › capacitors 0,1µf / 160v
- › capacitor 1µf / 100v
- › electrolytic capacitor 10µf / 63v
- › electrolytic capacitor 10 µf / 35v
- › coils n = 900
- › tape-wound core (pair)
- › ga-as light emitting diode, red, without series resistor
- › ge diode, 30ma
- › light source
- › si-diodes, 1a
- › Zener diode, 3,3v / 130ma
- › Zener diode, 10v / 40ma
- › thyristors mcr100-6, 0,8a
- › transistor Bc547 nPn, 45v / 500mW, base left
- › transistor BD237 nPn, 80v / 25W, base left
- › transistor BD237 nPn, 80v / 25W, base right
- › transistor BD238 PnP, 80v / 25W, base left
- › Darlington transistor tiP162 nPn 380v/ 125W, base left

No.	Designation	Order No.
1	Device set automotive	32004

# Plug-in components

## Passive and active components



### Resistors

- > Series E12, 1  $\Omega$  ... 10 M $\Omega$ /2 W  
(1,0 1,2 1,5 1,8 2,2 2,7 3,3 3,9 4,7 5,6 6,8 8,2)

### Potentiometers

- > linear, 470  $\Omega$ , 1 k $\Omega$ , 4,7 k $\Omega$ , 10 k $\Omega$ , 47 k $\Omega$ , 0,5 W

### Non-linear resistors

- > vDr-, lDr-, ntc-, Ptc resistors

### Capacitors

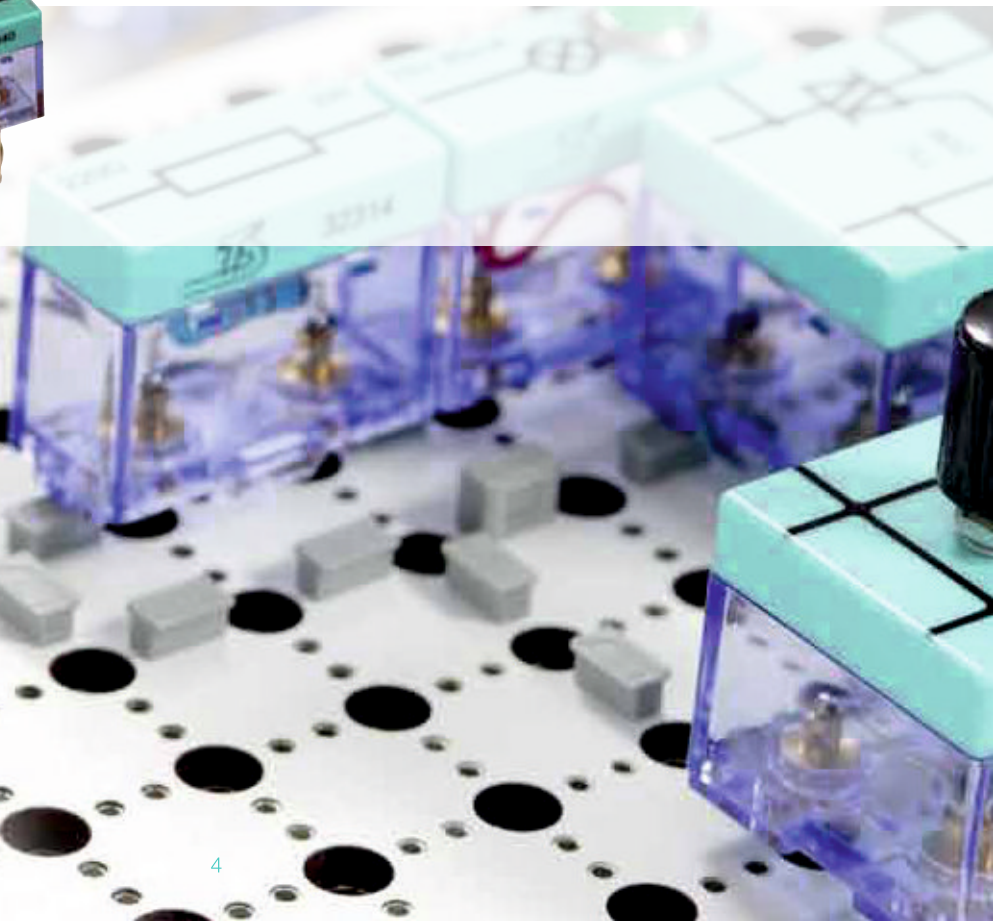
- > Series E6, 10 pF ... 1  $\mu$ F  
(1,0 1,5 2,2 3,3 4,7 6,8)

### Electrolytic capacitors

- > Values 10  $\mu$ F, 100  $\mu$ F, 470  $\mu$ F

### Coils

- > 100 mh
- > t ransformer coils with 300 / 900 turns



### Semiconductor components

- › germanium and silicon diodes
- › nPn and PnP transistors
- › Pn unijunction transistor
- › D-MOS field effect transistor
- › junction field effect transistor, N- and P-channel
- › diac, thyristor, triac, igB t
- › operational amplifier
- › Zener diodes ZPD  
values: 3,3 v, 10 v
- › photo diode, photo transistor
- › leDs in red, green, yellow, blue, white

### Switch, and display components

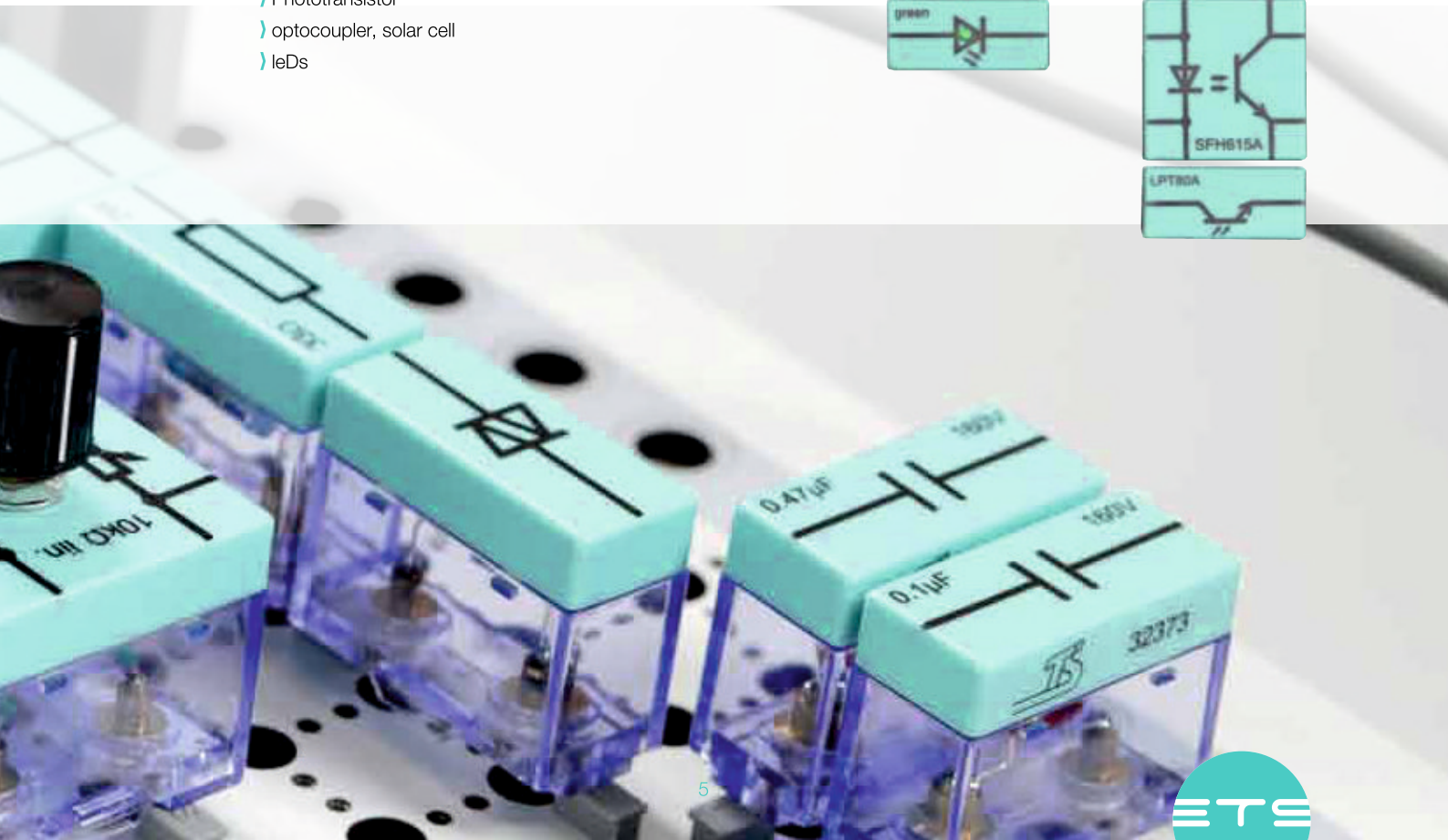
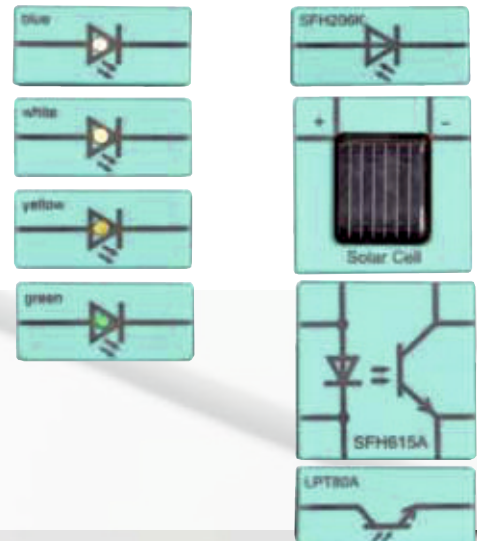
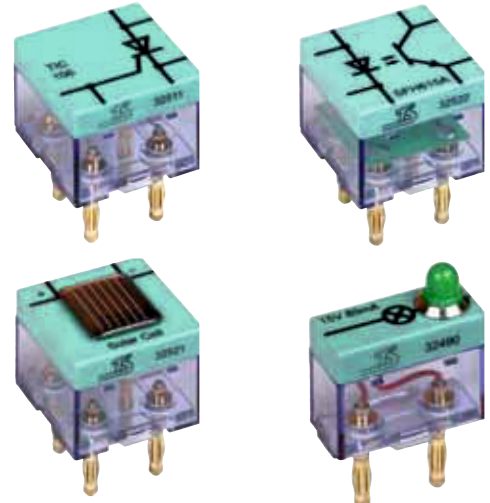
- › switch, pushbutton, relays
- › lamp

### Other

- › empty housings, 2- and 4-pole

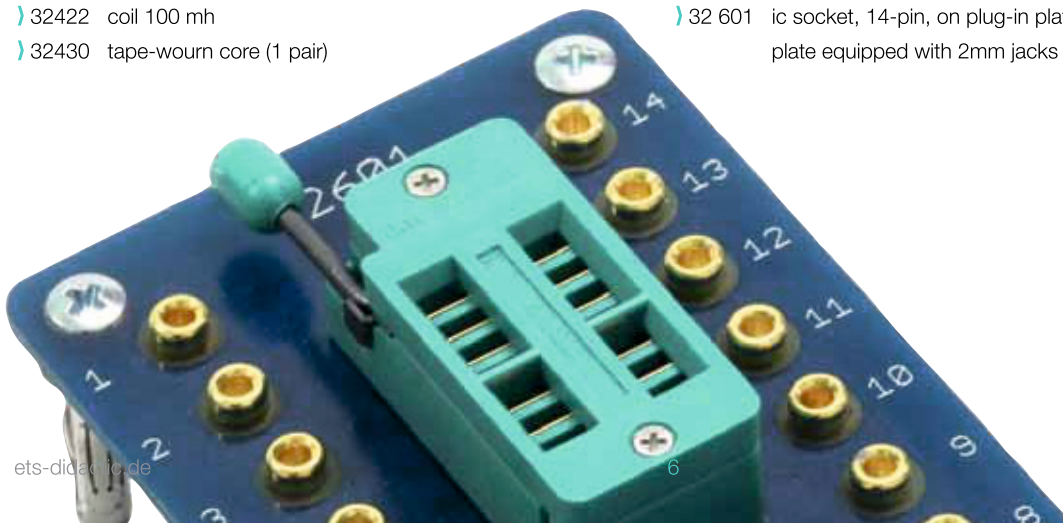
### Optoelektronics

- › Device set optoelectronics 32104  
(as a supplement to Device set 32204)
- › Phototransistor
- › optocoupler, solar cell
- › leDs



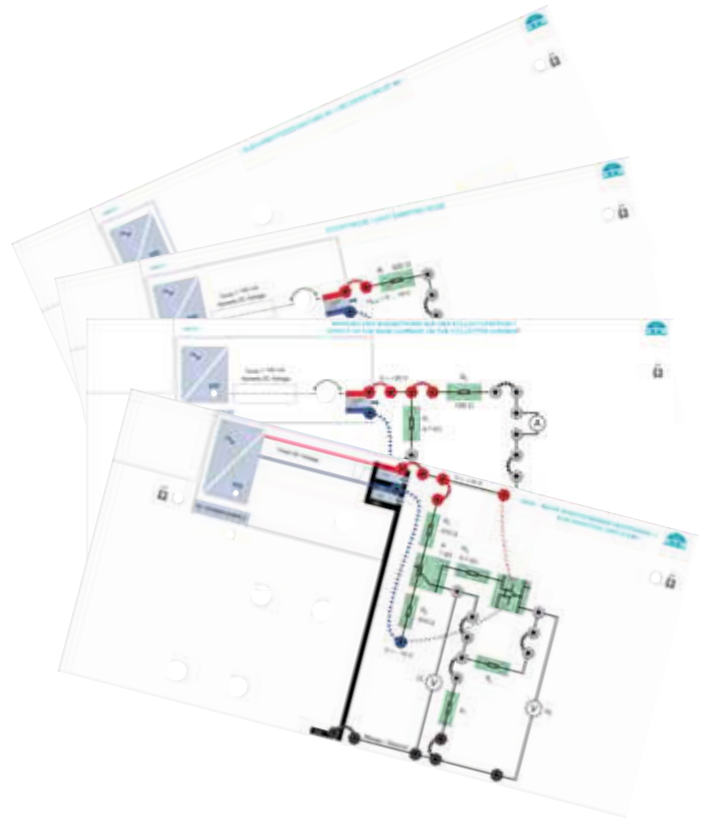
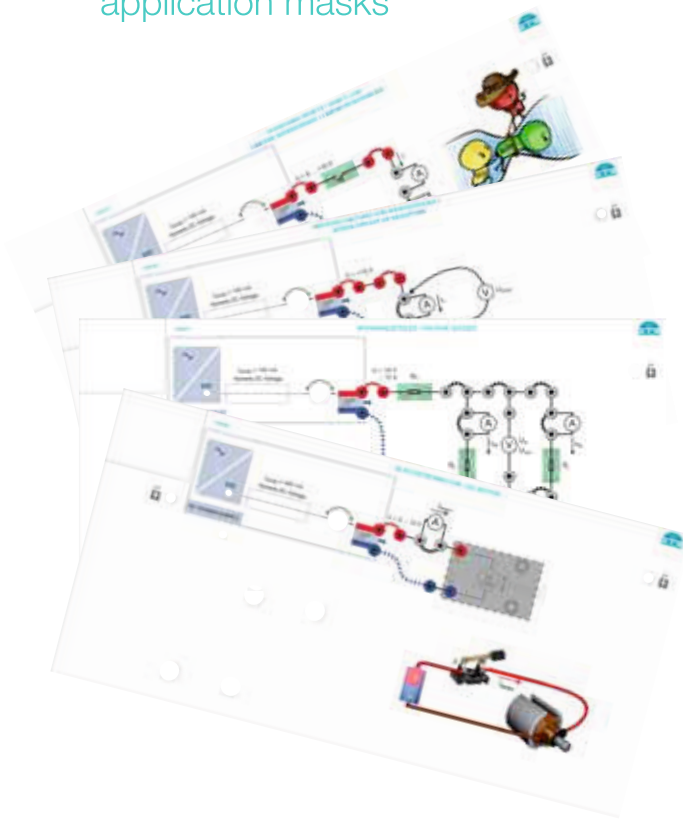
## component overview

- } 32302 set of empty housings with 2 lamella plugs (10 pcs.)
- } 32305 set of empty housings with 2 lamella plugs (10 pcs.)
- } 32310 film resistor 10  $\Omega$ /2 W
- } 32311 film resistor 22  $\Omega$ /2 W
- } 32312 film resistor 33  $\Omega$ /2 W
- } 32313 film resistor 100  $\Omega$ /2 W
- } 32314 film resistor 220  $\Omega$ /2 W
- } 32315 film resistor 330  $\Omega$ /2 W
- } 32316 film resistor 470  $\Omega$ /2 W
- } 32317 film resistor 680  $\Omega$ /2 W
- } 32318 film resistor 1 k $\Omega$ /2 W
- } 32319 film resistor 2,2 k $\Omega$ /2 W
- } 32320 film resistor 4,7 k $\Omega$ /2 W
- } 32321 film resistor 10 k $\Omega$ /2 W
- } 32322 film resistor 22 k $\Omega$ /2 W
- } 32323 film resistor 47 k $\Omega$ /2 W
- } 32324 film resistor 100 k $\Omega$ /2 W
- } 32325 film resistor 1 M $\Omega$ /2 W
- } 32340 VDR resistor 12 V/10 k $\Omega$
- } 32342 NTC resistor (6 k $\Omega$ )
- } 32345 IDr resistor
- } 32370 capacitor 100 pf/500 v
- } 32371 capacitor 10 nf/500 v
- } 32372 capacitor 47 nf/500 v
- } 32373 capacitor 0,1  $\mu$ f/160v
- } 32374 capacitor 0,22  $\mu$ f/160 v
- } 32375 capacitor 0,47  $\mu$ f/160 v
- } 32376 capacitor 1  $\mu$ f/100 v
- } 32390 electrolytic capacitor 10  $\mu$ f/63 v
- } 32391 electrolytic capacitor 100  $\mu$ f/35 v
- } 32392 electrolytic capacitor 470  $\mu$ f/35 v
- } 32402 linear potentiometer 1 k $\Omega$  0,5 W
- } 32403 linear potentiometer 10 k $\Omega$  0,5 W
- } 32420 transformer coil n = 300
- } 32421 transformer coil n = 900
- } 32422 coil 100 mh
- } 32430 tape-wound core (1 pair)
- } 32440 Zener diode 10 v/40 ma
- } 32441 Zener diode 3,3 v/130 ma
- } 32442 ga-as light emitting diode, red, without dropping resistor
- } 32443 light source
- } 32444 leD, 5 mm, blue
- } 32445 ge diode, aa118
- } 32446 leD, 5 mm, warm white
- } 32447 leD, 5 mm, yellow
- } 32448 leD, 5 mm, green
- } 32450 si diode 1 a
- } 32480 toggle switch
- } 32490 lamp, green, 15 v
- } 32501 transistor nPn, Bc237, base left
- } 32502 transistor nPn, Bc140, base left
- } 32503 transistor nPn, Bc140, base right
- } 32504 transistor PnP, Bc160, base left
- } 32505 unijunction transistor Pn 2n4870
- } 32506 D-MOS field effect transistor, BS250, p-channel, gate left
- } 32507 Jfet transistor 2n5485, 25 v/10 ma, n-channel, gate left
- } 32508 Jfet transistor 2n5461, 20 v/10 ma, p-channel, gate left
- } 32510 diac, er 900
- } 32511 thyristor tic 106
- } 32512 triac tic 206
- } 32520 photodiode
- } 32521 solar cell
- } 32522 optical coupler sfh615a
- } 32523 phototransistor IPT80a
- } 32598 operational amplifier OP741 with 4mm connection sockets on the top
- } 32485 relay Dc 12...15 v noc, 2a
- } 32486 relay Dc 12...15 v ncc, 2a
- } 32 601 ic socket, 14-pin, on plug-in plate for 19mm grid, plate equipped with 2mm jacks for easy connection





# elektrical engineering application masks

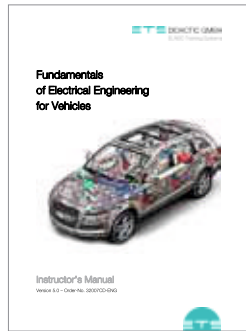


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2	set 2 f ull page	32070

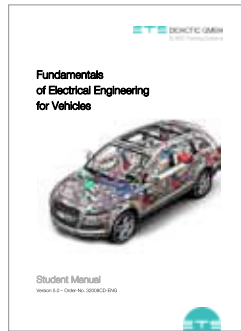




courseware



2



3

Basics of Electrical engineering / electrics for automotive engineering

- > the electrical circuit
- > ohm's law
- > electrical resistors
- > interconnection of voltage sources
- > electric power and work
- > Efficiency
- > types of current and their characteristics
- > active power of alternating voltages
- > three-phase alternating current (three-phase current)
- > the capacitor
- > electromagnetism and coils
- > transformers
- > Diodes and rectifier circuits
- > Bipolar transistors
- > elektrical and electronic switches
- > the thyristor triode

Printed and digital

TECHNOCard®

**Variable DC Voltage**  
The adjustable DC voltage source for providing potential-free DC between 0 V and 30 V. The setting of the output voltage is done by means of the incremental switch. The current voltage of the output of the adjustable DC source is displayed in the LC display. The output is internally short-circuited at maximum 1 A. From 1 A load current onwards, you enter the output domain. The voltage reference is applied at the output. No component errors indicated by green/red lighting of the LED. The output voltage is adjustable from 1.2 A onwards in 0.2 A steps. The LED changes to red and the display shows overload. The output voltage is changed from 0 V reference. The load current is dependent on the impedance of the load.

**Three-phase source**  
The electronic 3-phase current source generates, at the three outputs 0, 12 and 12 V, a three-phase AC with an adjustable frequency of between the magnitude 1 Hz and 100 Hz. The phase angle is adjustable in a maximum of 120°, with respect to the zero.

**CAUTION!**  
Please observe all the technical data and safety instructions. Do not touch the board when it is powered on. Do not touch the board when it is powered on. Do not touch the board when it is powered on.

4

No.	Designation	Order No.
1	set of ets ring binders	91903
2	fundamentals of electrical engineering - instructor's manual	32007cD-eng
3	fundamentals of electrical engineering - student manual	32008cD-eng
4	technocard - electric networks Board ii	32201-eng



# MEasuring devices

## digital multimeter, analog multimeter



1

2



3

### Professional digital multimeter

The multimeter for education  
The professional multimeter is designed to measure dc & ac voltage up to 1000 v in the measurement category CAT III 600 V or CAT IV 300 V safety according to the specifications of IEC/En 61010-1.

The device equipped with a mechanical protection against operating errors. The multimeter has a large, high-resolution display with bargraph and a autoPowerOff function to conserve battery power.

Ideally suited for laboratory use in school and training.

### Functions

- > mechanical malfunction
- > ac and dc voltage up to 1000 v
- > ac and dc current up to 10 a
- > resistance measurement with 30 MΩ and continuity test
- > Frequency and capacitance
- > Temperature with PT-1000 probe
- > Diode test and duty cycle
- > automatic range selection
- > Max/Min and data HOLD
- > autoPowerOFF

### Analog multimeter

The multimeter meets the requirements for teaching and professional training and is also suitable for adjustment and revision work in service.

### Functions

- > voltage measurement  
0...100/300 mv/1 v=0 ... 3/10/30/100/300 v=/~
- > current measurement 0 ... 100 ma/1/10/100 ma/1/3 a = ~
- > Optional setting:  
**Zero left / center**
- > Excellent overload capability, automatic battery shutdown
- > accessories

No.	Designation	Order No.
1	digital Multimeter	90600
2	storagecase "universal" for 8 Measuring devices	90275
3	analog Multimeter	90200

## Oscilloscopes



1



2

### Color Digital Oscilloscope 30MHz

- › 125 Ms amples/s per channel
- › Signal memory 10.000 x 8 Bit per channel
- › 2 channels
- › Deflection coefficients 2 mV/div ... 10 v/div, time base 5 ns/div ... 100 s/div
- › USB interface incl. software and driver
- › Color display

No.	Designation	Order No.
1	Pc Measurement interface	90272
2	c olor digital Oscilloscope 30MHz	90266



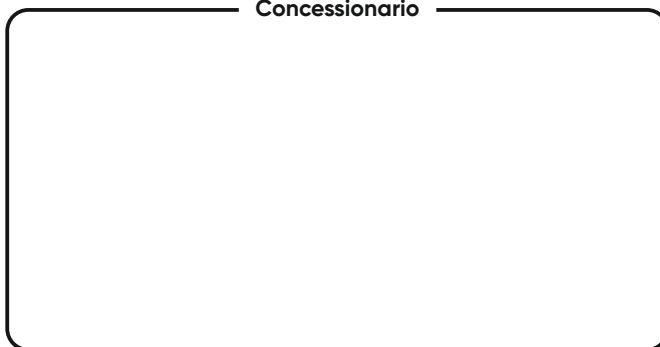


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