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Introduction

Selection of plug-in components

Plug-in components are inserted into universal mounting panels and sometimes – for completing a circuit – also into experimental panels.

Using the instruction modules listed in the following selection tables, experiments can be made in any arrangement desired. If experiments are to be carried out in line with our instructions, we recommend using our assembly kits.

Dimensions of the plug-in components:

For double pin connection (without plugs)

(WxHxD) 37x35x18 mm

for three- and four pin connection (without plugs)

(WxHxD) 35x35x35 mm
The universal mounting panel is equipped with gold-plated 4-mm-sockets arranged in a 19 mm grid (total of 320 sockets). Every four adjacent sockets are interconnected to form a ring. Provision is also made for gold-plated 2-mm-sockets which are used for the power supply of operational amplifiers (8 plug-in stations). When a module is inserted, it is always connected to the supply voltage with the correct polarity.

The two top and the two bottom rows of sockets are through-connected for power supply purposes. From bottom to top:
- 15 V, ground/0 V, + 5 V, + 15 V.

The universal mounting panel has a cover for protecting the connections on the rear. For installation on a bench, mounting accessories permitting the panel to be mounted at an angle of 30° is provided on the rear.

Dimensions (WxH) 493 x 297 mm
Weight approx. 4 kg

Order-No. W5430-1A
Assembly kit "Fundamentals of Electrical Engineering"

The following experiments can be carried out:

- The electric circuit
- Ohm’s law
- Series connection of ohmic resistors
- Parallel connection of ohmic resistors
- Group connection of ohmic resistors
- Voltage dividers
- Delta-star transformation
- Voltage sources
- Electrical energy, electric power, efficiency
- Power matching
- Capacitors
- Series and parallel connection of capacitors
- Electromagnetism
- Conductor circuit and magnetic circuit
- Theory of alternating current
- AC resistors
- AC circuits
- Three-phase current

Contents of the assembly kit:

<table>
<thead>
<tr>
<th>Resistors</th>
<th>Resistors</th>
<th>Potentiometer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 1 Ω</td>
<td>1 6.8 kΩ</td>
<td>1 100 Ω linear</td>
</tr>
<tr>
<td>1 10 Ω</td>
<td>2 10 kΩ</td>
<td>1 1 kΩ linear</td>
</tr>
<tr>
<td>1 22 Ω</td>
<td>1 22 kΩ</td>
<td>1 10 kΩ linear</td>
</tr>
<tr>
<td>1 47 Ω</td>
<td>1 33 kΩ</td>
<td></td>
</tr>
<tr>
<td>2 82 Ω</td>
<td>1 47 kΩ</td>
<td></td>
</tr>
<tr>
<td>1 100 Ω</td>
<td>1 68 kΩ</td>
<td></td>
</tr>
<tr>
<td>1 120 Ω</td>
<td>1 82 kΩ</td>
<td></td>
</tr>
<tr>
<td>1 150 Ω</td>
<td>1 100 kΩ</td>
<td></td>
</tr>
<tr>
<td>2 220 Ω</td>
<td>1 1 MΩ</td>
<td></td>
</tr>
<tr>
<td>1 330 Ω</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 470 Ω</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 680 Ω</td>
<td>1 10nF</td>
<td></td>
</tr>
<tr>
<td>3 1 kΩ</td>
<td>1 0.1 μF</td>
<td></td>
</tr>
<tr>
<td>2 1.5 kΩ</td>
<td>1 0.47 μF</td>
<td></td>
</tr>
<tr>
<td>1 2.2 kΩ</td>
<td>1 1 μF</td>
<td></td>
</tr>
<tr>
<td>1 3.3 kΩ</td>
<td>1 2.2 μF</td>
<td></td>
</tr>
<tr>
<td>1 4.7 kΩ</td>
<td>2 2200 μF</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Capacitors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 1 mF</td>
</tr>
<tr>
<td>2 0.1 μF</td>
</tr>
<tr>
<td>1 0.47 μF</td>
</tr>
<tr>
<td>1 1 μF</td>
</tr>
<tr>
<td>1 2.2 μF</td>
</tr>
<tr>
<td>2 2200 μF</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reactors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 10 mH</td>
</tr>
<tr>
<td>1 200 mH</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Plug-in modules</th>
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</thead>
<tbody>
<tr>
<td>1 On/Off switch single pin</td>
</tr>
<tr>
<td>1 Selector switch single pin</td>
</tr>
<tr>
<td>1 W5101-2D 3-phase current source</td>
</tr>
</tbody>
</table>

Order-No. W5101-8H

Order-No. W3025-7B

Experimental manual "Fundamentals of Electrical Engineering"

Set of connecting leads and plugs, consisting of:

- 20 connector plugs, 19 mm
- 4 adapter plugs
- 10 4-mm connecting leads 25 cm
- 10 4-mm connecting leads 50 cm
- 2 2-mm connecting leads 30 cm
- 4 2-mm connecting leads 15 cm

Order-No. W3901-8H

Required equipment to carry out the experiments:

- 1 Universal mounting panel
- 1 Function Generator
- 1 Power supply
- 1 Oscilloscope
- 1 Multimeter
- Alternatively: Universal-Experimenter IV
- Alternatively: Universal-Experimenter IV
- Alternatively: Universal-Experimenter IV
- i.e. 20 MHz/2-channels
Assembly Kit "Electronic Components and Fundamentals of Analog Technology"

The following experiments can be carried out:

**Electronic components**

**Resistors**
- Linear resistors
- Potentiometers
- Non-linear resistors
- PTC resistors
- NTC resistors
- Varistors

**Capacitors**
- Types of design
- Electrolytic capacitors
- Metallized-paper capacitors
- Plastic-film capacitors
- Ceramic capacitors
- Connections of capacitors to resistors

**Semiconductor diodes**
- Doping of semiconductors
- Diodes
- Application of diodes

**Bipolar transistors**
- Input characteristic
- Output characteristic
- Short-circuit forward current transfer
- Reverse voltage transfer ratio characteristic
- Four-quadrant family of characteristics of a transistor

**Unipolar transistors**
- Transistor in constant-current source

**Components with triggering characteristic**
- Unijunction transistors
- Thyristors

**Optoelectronic components**
- Extrinsic photoelectric effect
- Intrinsnic photoelectric effect
- Photo-Voltaic effect
- Photo-Resistors
- Photodiodes
- Phototransistors
- Optocouplers

**Fundamentals of analog technology**

**Basic diode connections**
- One-way rectifier connection
- Center-tap rectifier connection
- Bridge connection
- Voltage stabilization via Zener diodes for varying input voltage
- Voltage stabilization via Zener diodes for varying load impedance
- Diode as switch
- Voltage doubler connection
- Voltage multiplier connection

**Basic transistor connections**
- Common-collector connection
- Common-emitter connection
- Darlington connection
- Switching transistor
- Alternating voltage amplifier
- Direct voltage amplifier

**Oscillator circuits with transistors**
- Wien-bridge generator
- RC phase-shifting generator
- Colpitts oscillator

**Operational amplifiers**
- Adjusting the balance of an operational amplifier
- Operational amplifiers in power supply
- Operational amplifiers as impedance transformers
- Operational amplifiers as adders
- Operational amplifiers as difference amplifier
- Operational amplifiers as inverting alternating voltage amplifiers
- Operational amplifiers in astable flipflop circuits
- Operational amplifiers in an oscillator circuit

**High pass, low pass and band pass**
- Integrator
- Differentiator
- High pass
- Band pass

**Application of components with triggering characteristic**
- Unijunction transistor as pulse generator
- Generalized phase control

**Application of optoelectronic components**
- Light barrier
- Photo-electric lighting controller
Assembly Kit "Basic Digital Circuits"

The following experiments can be carried out:

<table>
<thead>
<tr>
<th>Basic logic operations</th>
<th>Digital flipflops</th>
<th>Logic algebra</th>
</tr>
</thead>
<tbody>
<tr>
<td>AND operation</td>
<td>RS flipflop</td>
<td>Boolean algebra</td>
</tr>
<tr>
<td>OR operation</td>
<td>D flipflop</td>
<td>Karnough map</td>
</tr>
<tr>
<td>NOT operation</td>
<td>Master-slave flipflop</td>
<td>Examination of a digital circuit with the logic analyzer</td>
</tr>
<tr>
<td>NAND operation</td>
<td>JK flipflop</td>
<td></td>
</tr>
<tr>
<td>NOR operation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ExOR operation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ExNOR operation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Flipflop circuits</th>
<th>Counters and registers</th>
<th>Logic level comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Astable flipflop</td>
<td>Asynchronous dual up counters</td>
<td>Integrated circuits</td>
</tr>
<tr>
<td>Monostable flipflop</td>
<td>Asynchronous dual down counters</td>
<td>Logic family</td>
</tr>
<tr>
<td>Bistable flipflop</td>
<td>Asynchronous reversible counters</td>
<td>Logic level</td>
</tr>
<tr>
<td>Schmitt trigger circuit</td>
<td>Parallel dual up counters</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ring counters</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Registers</td>
<td></td>
</tr>
</tbody>
</table>

Contents of the kit

### Plug-in Modules

<table>
<thead>
<tr>
<th>2 W5101-4M</th>
<th>1 W5101-5V</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 toggle switch (L-H input)</td>
<td>2 digital chopper</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2 W5101-4N</th>
<th>1 W5101-4P</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 LED displays</td>
<td>1 clock-pulse generator</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1 W5101-4W</th>
<th>1 W5101-5A</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 AND/NAND arrays, 2 inputs</td>
<td>4 OR/NOR gates, 2 inputs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1 W5101-4V</th>
<th>1 W5101-4U</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 OR/NOR arrays, 2 inputs</td>
<td>1 AND/NAND gates, 4 inputs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1 W5101-5C</th>
<th>1 W5101-4T</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 inverter</td>
<td>1 OR/NOR gates, 4 inputs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1 W5101-5D</th>
<th>1 W5101-6D</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 EX-OR gates, 2 inputs</td>
<td>IC socket 14 pin</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1 W5101-5B</th>
<th>1 W5101-6E</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 AND/NAND gates, 2 inputs</td>
<td>IC socket 16 pin</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1 W5101-5H</th>
<th>1 W5101-4B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 D flipflop</td>
<td>9 resistors</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2 W5101-5K</th>
<th>1 W5101-4C</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 JK flipflop</td>
<td>9 resistors</td>
</tr>
</tbody>
</table>

### Plug-in Components

<table>
<thead>
<tr>
<th>1 Zener diode ZD 4.7V</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Diode 1N4004</td>
</tr>
<tr>
<td>1 Potentiometer, 1kΩ linear</td>
</tr>
</tbody>
</table>

### Experimental manual "Basic Digital Circuits"

set of connecting leads and plugs, consisting of:

<table>
<thead>
<tr>
<th>20 connector plugs, 19 mm</th>
<th>2 4-mm connecting leads 50 cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 connector plugs, 38 mm</td>
<td>2 4-mm connecting leads 100 cm</td>
</tr>
<tr>
<td>10 adapter plugs</td>
<td>10 2-mm connecting leads 7.5 cm</td>
</tr>
<tr>
<td>4 adapter plugs</td>
<td>10 2-mm connecting leads 15 cm</td>
</tr>
<tr>
<td></td>
<td>10 2-mm connecting leads 30 cm</td>
</tr>
</tbody>
</table>

### Required equipment to carry out the experiments:

<table>
<thead>
<tr>
<th>1 Universal mounting panel</th>
<th>Alternatively: Universal Experimenter IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Function generator</td>
<td>Alternatively: Universal Experimenter IV</td>
</tr>
<tr>
<td>1 Power supply</td>
<td>Alternatively: Universal Experimenter IV</td>
</tr>
<tr>
<td>3 Multimeter</td>
<td></td>
</tr>
<tr>
<td>1 Oscilloscope</td>
<td>20 MHz/2-channel oscilloscope</td>
</tr>
</tbody>
</table>

Order-No. W5101-8D

Order-No. W3025-4B

Order-No. W3901-8D
Assembly Kit "Digital Data Processing"

The following experiments can be carried out:

**Encoders, decoders, code converters**
- Octal-to-binary conversion
- Binary-to-hexadecimal conversion
- BCD-to-decimal conversion
- Decimal-to-binary conversion
- Binary-to-BCD conversion

**Counters and counter applications**
- Decimal counters
- Decimal counters with set inputs
- Hexadecimal counters
- Hexadecimal counters with set inputs

**Registers and its applications**
- Shift registers as memory
- 8-bit shift registers
- Parallel input - serial output
- Serial input - parallel output

**Digital arithmetic-logic units**
- Addition of two single-digit dual numbers
- Half-adders
- Addition of multi-digit dual numbers
- Full adders
- Subtraction of dual numbers
- Half subtractor
- Subtraction of multi-digit dual numbers
- Full subtractors
- Multiplication of dual numbers

**Analog-to-digital conversion**
- Analog-to-digital conversion
- Digital-to-analog conversion
- Digital-to-analog conversion with R/2R network

**Multiplexers, demultiplexers**
- Multiplexers
- Demultiplexers
- Serial data transmission with multiplexers and demultiplexers

**Basic circuits phase-locked loop**
- PLL in captured range
- PLL as pulse generators

**Contents of the kit**

**Plug-in modules**
- 1 W5101-4U
  1-AND/NAND gates, 4 inputs
- 1 W5101-5B
  4-AND/NAND gates, 2 inputs
- 1 W5101-4W
  4-AND/NAND gates, 2 inputs
- 3 W5101-4T
  1-OR/NOR gates, 4 inputs
- 1 W5101-4V
  2-OR/NOR gates, 2 inputs
- 1 W5101-5A
  4-OR/NOR gates, 2 inputs
- 1 W5101-5D
  4-EX/OR gates, 2 inputs
- 3 W5101-4M
  4-toggle switches (L-H input)
- 3 W5101-4N
  4-LED displays
- 1 W5101-4P
  1 clock-pulse generator
    0 to 10 kHz

**Plug-in modules**
- 1 W5101-4D
  2 R/2R network
- 1 W5101-5C
  4 inverters
- 2 W5101-5K
  2-JK flipflop
- 1 W5101-5E
  2 hexadecimal displays
- 1 W5101-5P
  1 BCD/decimal decoder
- 1 W5101-5M
  1 binary/decimal up/down counter
- 1 W5101-5Q
  1 binary/BCD decoder
- 2 W5101-5L
  2 shift register
- 1 W5101-5T
  1 analog/digital converter

**Plug-in modules**
- 1 W5101-5U
  1 digital/analog converter
- 1 W5101-5R
  1 multiplexer
- 1 W5101-5S
  1 demultiplexer
- 1 W5101-6A
  1 PLL circuit
- 1 W5101-4E
  3 potentiometers

**Plug-in components**
- 1 resistor 10kΩ
- 1 resistor 22kΩ
- 1 resistor 220kΩ

**Capacitors**
- 1 capacitor 4,7 nF
- 1 capacitor 10 nF
- 1 capacitor 0,1 nF

**Experimental manual "Digital Data Processing"**

**Set of connecting leads and plugs, consisting of:**
- 20 connector plugs, 19 mm
- 4 connector plugs, 38 mm
- 10 adapter plugs
- 4 adapter plugs

**2 4-mm connecting leads 50 cm**
**2 4-mm connecting leads 100 cm**
**10 2-mm connecting leads 7,5 cm**
**10 2-mm connecting leads 15 cm**

**Required equipment to carry out the experiments:**
- 1 Universal mounting panel
- 1 Function generator
- 1 Power supply
- 3 Multimeter
- 1 Oscilloscope

Alternatively: Universal Experimenter IV

**Order-No. W5101-8E**

**Order-No. W3025-5B**

**Order-No. W3901-8E**
Assembly Kit "Components of Power Electronics"

The following experiments can be carried out:
- Investigation of semiconductor components such as diodes, Z diodes, bipolar transistors, field-effect transistors, diacs, unijunction transistors, thyristors, triacs
- Amplifier circuits such as low-signal amplifiers and push-pull power amplifiers
- DC power supply circuits such as voltage stabilization circuits and constant-current source
- Circuits for pulse generation such as pulse generation with diac and unijunction transistor
- Investigation of passive components

Contents of the kit:

**Resistors**
- 2 1 Ω/2W
- 1 10 Ω/2W
- 2 22 Ω/2W
- 1 47 Ω/2W
- 4 100 Ω/2W
- 1 150 Ω/2W
- 1 220 Ω/2W
- 2 330 Ω/2W
- 2 470 Ω/2W
- 1 1 kΩ/2W
- 1 3,3 kΩ/2W
- 1 4,7 kΩ/2W
- 1 10 kΩ/2W
- 1 22 kΩ/2W
- 1 47 kΩ/2W
- 2 100 kΩ/2W
- 1 1 MΩ/2W

**Capacitors**
- 2 10 nF
- 1 0,1 µF
- 1 0,15 µF
- 1 0,47 µF
- 1 1 µF
- 1 470 µF

**Transistors**
- 1 BC 141
- 1 BC 161
- 1 BC 237
- 1 BUZ 10, MOS-FET N-channel
- 1 2N4870, Unijunction

**Diac**
- 1 Diac ER 900

**Triac**
- 1 Triac TIC 206

**Thyristors**
- 2 Thyristors TIC 106

**Signal elements**
- 1 Incandescent lamp
  - 30 V/85 mA
- 1 LED green
- 1 LED red

**Order-No. W5101-8L**

**Order-No. W3007-5B**

**Order-No. W3901-8L**

Experimental manual "Components of Power Electronics"

**Set of connecting leads and plugs, consisting of:**
- 25 connector plugs, 19 mm
- 4 connector plugs, 38 mm
- 6 4-mm connecting leads 25 cm
- 4 4-mm connecting leads 50 cm
- 2 4-mm connecting leads 100 cm

**Required equipment to carry out the experiments:**
- 1 Universal mounting panel
- 1 Function generator
- 1 Power supply
- 3 Multimeter
- 1 Oscilloscope
  - 20 MHz/2-channel oscilloscope

Alternatively:
- Universal Experimenter IV
- Universal Experimenter IV
- Universal Experimenter IV

Catalog WA2E/02 Page 11
The Digital-trainer is a compact teaching and experimenting unit for training in digital technology. Simple logical combinations and even complex digital circuits can be realized using connecting leads with 2-mm plugs.

Blank IC sockets with any required number of poles and capable of free wiring according to requirements, can be plugged into three positions thus ensuring that the digital trainer is suitable for universal use (the IC sockets can be supplied as additional accessories).

The mains voltage is fed in at the front panel through a 3-pole plug. The detachable cover can be used as a storage tray for the connecting leads.

The Trainer includes:

1 stabilized short-circuit proof power supply unit + 5V DC/2A
1 variably adjustable clock pulse generator, 0 to 10kHz, with subsequent divider by 2/4/8/16
8 bounce-suppressed L/H toggle switches
8 LED displays
4 AND/NAND gates each 2 inputs
4 AND/NAND gates each 4 inputs
4 OR/NOR gates each 2 inputs
4 OR/NOR gates each 4 inputs
8 Ex/OR gates each 2 inputs
4 inverters
10 JK-master-slave flipflops
4 4 bit full adder
1 decimal counter with visual indicator
1 forward/reverse 4 bit binary counter
2 2 bit buffers with release function
1 variably adjustable monoflop, 10 s, with positive or negative input, Q and Q-not output
2 hexadecimal indicators with built-in decoder indications 0 to 9 and A, B, C, D, E, F
3 plug-in positions for blank IC sockets
1 multi-terminal busbar, + 5 V and 0 V

The IC-sockets (Textool) are used for experiments with IC-circuits. They are mounted on a plastic housing, which is plugged to the front panel of the digital training unit via 2-mm plugs. The IC-socket connectors are connected to 2-mm jacks and numbered.

Additional recommended equipment (not included in Trainer)
1 IC-socket 14-pin
1 IC-socket 16-pin
1 IC-socket 20-pin
1 IC-socket 24-pin
1 IC-socket 28-pin
1 IC-socket 40-pin
Set of Connecting Leads (five colours), consisting of:
10 4-mm connecting leads 50 cm
10 4-mm connecting leads 30 cm
20 4-mm connecting leads 15 cm
20 4-mm connecting leads 10 cm

Order-No. W5101-3E
Order-No. W5101-3F
Order-No. W5101-3G
Order-No. W5101-3H
Order-No. W5101-3J
Order-No. W5101-3K
Order-No. W5101-3L
Order-No. W5101-3V
IC - Trainer

The IC-trainer is a universally applicable unit for carrying out exercises in digital technology. It can be used in schools and institutes for training and further education and in the training centers of the industry. Each IC socket terminal is numbered and equipped with two 2-mm measurement sockets. All blank IC sockets are fitted with a tensioning facility to enable effortless insertion of ICs.

The mains voltage is fed on top through a 3-pole plug.

The detachable cover can be used as a storage tray for the connecting leads.

**The Trainer includes:**

1. Stabilized short-circuit proof power supply unit + 5V DC/1A
2. Varibly clock pulse generator, 0.5Hz to 10kHz, with subsequent frequency divider by 2/4/8/16 reset key, single pulse
3. Monoflop with Q and Q-not outputs
4. Rotary switch for 0.1s, 1s and 3s pulse width and switch setting for external wiring of the monoflop
5. 8 bounce-suppressed L/H toggle switches
6. 8 LED displays
7. 1 toggle switch can be wired freely
8. Combined pushbutton/toggle switch with Q-output
9. Hexadecimal indicators with built-in decoder indicators from 0 to 9, A, B, C, D, E, F
10. Blank IC sockets, 14-pole
11. Blank IC sockets, 16-pole
12. Blank IC sockets, 20-pole
13. Blank IC sockets, 24-pole
14. Multi-terminal busbar, +5V and 0V
15. Different multi-terminal busbars
16. 1 combined pushbutton/toggle switch with Q-output
17. Hexadecimal indicators with built-in decoder indicators from 0 to 9, A, B, C, D, E, F
18. Blank IC sockets, 14-pole
19. Blank IC sockets, 16-pole
20. Blank IC sockets, 20-pole
21. Blank IC sockets, 24-pole
22. Multi-terminal busbar, +5V and 0V
23. Different multi-terminal busbars

**Storage tray for connecting leads in the cover.**

**Technical Data:**

- Mains supply: 1 AC 230 V, 50/60 Hz
- Dimensions (W x D): 400x290mm
- Height (without cover): 50mm
- Cover depth: 50mm
- Total weight approx.: 3.8kg

All IC sockets are Textool sockets

**Order-No. W5101-3D**

- 20 4-mm connecting leads 15 cm
- 20 4-mm connecting leads 10 cm

**Order-No. W5101-3V**

- 20 4-mm connecting leads 15 cm
- 20 4-mm connecting leads 10 cm
Universal-Experimenter IV – Basic Unit

General
The Universal Experimenter IV is a compact, portable training and experimental unit for electrical engineering applications. The basic unit is incorporated in a case including the main functional units for the experiments. These are various power supplies, clock-pulse generator, measuring instrument, output interfaces and four locations for experimental panels. The experiments are set up using plug-in modules or experimental panels. The required assembly kits for the plug-in modules or the experimental panels, respectively, must be additionally ordered.

The experimenter is suitable for the following training topics
- Analog technology
- Digital technology
- Microprocessor technology
- Closed-loop control technology
- Power electronics with extra-low voltage
Universal-Experimenter IV  Output Interfaces

Output interface  Analog/Closed-Loop  Control Technology
(mounting location in section 3 of Universal Experimenter IV)
Equipped with
1 moving-coil voltmeter Zero mark in the middle measuring range 15-0-15 V DC, class 2, with 2-mm connector socket
1 location for controlled systems and plug-in components with 36 4-mm sockets that are assigned to a 19 mm grid; when arranging the controlled systems, these are automatically connected to the ±15 V DC operating voltage
2 user-connectable optocouplers providing electrical isolation
1 power amplifier, max. output current 1 A. The amplifier can be used as actuator in control engineering.
All inputs/outputs are brought out to several 2-mm hard-gold plated sockets and one parallel 4 mm hard-gold plated socket.
Dimensions (W x H) 125x370 mm
Weight approx. 1 kg
Order-No. W5101-0X

Output interface  Digital Technology
(mounting location in section 3 of Universal Experimenter IV)
Equipped with
8 LED displays including driver stages
4 hexadecimal displays with decoder; 0...9, A, B, C, D, E, F
All inputs/outputs are brought out to 2-mm hard-gold plated sockets.
Dimensions (BxH) 125x370 mm
Weight approx. 1 kg
Order-No. W5101-0Y

Universal assembly panel
(mounting location in section 2 and 3 of Universal Experimenter IV)
The pinboard is equipped with 324 4-mm sockets that are arranged in a 19-mm grid. Every 4 adjacent sockets are connected in a square. Additionally, 2-mm sockets are provided supplying operational amplifiers (8 locations) with power.
When plugging a module in, this module is connected to the supply voltage with correct polarity. The upper and lower socket row are through-connected for power supply.
Dimensions (BxH) 375x370 mm
Weight approx. 2 kg
Order-No. W5101-1J
Universal-Experimenter IV Analog Technology

Diodes and Transistors

for basic experiments with discrete components.
The experimental panel is equipped with two user-connectable transistors, a series transistor, an amplifier output stage and a Darlington stage. Additionally, user-connectable resistors, capacitors and diodes are available which can be arranged to large-scale circuits.

The panel must be supplied with operating voltage. +5V, and +15V are possible.

Dimensions (WxH) 125x183 mm
Weight approx. 0.4 kg

Order-No. W5101-0M

Operational amplifier I

Equipped with two operational amplifiers.
The amplifiers can work in inverting or non-inverting mode. Due to user-selectable input and feedback values different transient response can be chosen. The amplifiers are short-circuit proof with current sink and can drive an output current of 5 mA.

Two user-assignable potentiometers can be applied to generate different amplifying ratios.

Dimensions (WxH) 125x183 mm
Weight approx. 0.4 kg

Order-No. W5101-0B

Operational amplifier II

Equipped with two operational amplifiers and two multipliers (laser-calibrated).
The amplifiers can work in inverting or non-inverting mode. Due to user-selectable input and feedback values different transient response can be chosen.

The amplifiers are short-circuit proof with current sink and can drive an output current of 5 mA.
Both multipliers operate according to the equation: $U_a = 0.1 \times y$

Dimensions (WxH) 125x183 mm
Weight approx. 0.4 kg

Order-No. W5101-0C
Universal-Experimenter IV  Closed-Loop Control

Setpoint Generator
The reference variable is set by means of a potentiometer with reversible polarity: infinitely adjustable between 0 and ±10V. Via pushbuttons a setpoint step-change of ±1V is applied. 10% of a variable externally supplied are applied via pushbuttons, too.

Dimensions (WxH) 125x183 mm
Weight approx. 0,3 kg

Order-No.W5111-1A

Disturbance Generator
Setup and working identical to setpoint generator but used for applying disturbance values. Due to the different use and for clear assignment the disturbance generator was separately designed and identified.

Dimensions (WxH) 125x183 mm
Weight approx. 0,3 kg

Order-No. W5111-1B

Summing Unit
Negative system deviation is determined at a summing junction. The smoothing functions at the input can be separately activated/deactivated via switches for the inverting and non-inverting inputs.

Time constant of smoothing: $T_g = 5\text{ms}$

Inputs:
3 non-inverting inputs
3 inverting inputs

Output:
Sum of inputs, limited to ±10 V.
There are 2 separate adders on the panel.

Dimensions (WxH) 125x183 mm
Weight approx. 0,3 kg

Order-No. W5111-1C
Universal-Experimenter IV  Digital Technology

Experimental panel for Digital technology

All connections to the components are brought out to 2-mm sockets.

The panel contains the following components

- 4 AND/NAND arrays with 2 inputs
- 2 AND/NAND arrays with 4 inputs
- 4 OR/NOR arrays with 2 inputs
- 2 OR/NOR arrays with 4 inputs
- 8 EX/OR arrays with 2 inputs
- 4 J/K flipflops
- 4 inverters
- 1 D flipflop
- 1 RS flipflop
- 1 shift register
- 1 up/down counter

Dimensions
(WxH) 250x180 mm
Weight approx. 0.6 kg

Order-No. W5101-0N
Universal-Experimenter IV Microprocessor Technology

Experimental panel for Microprocessor Technology

**Hardware**
- Experimental panel with Central processing unit SAB 8085
- 8 Kbytes of ROM with monitor program expandable by 8 kBytes
- 8 Kbytes of RAM for user programs
- 6-digit 7-segment display for addresses and data
- Bus interface: all bus signals brought out via 2-mm lab sockets
- Parallel interface: programmable interface module SAB 8155 with two 8-bit input/output ports and one 6-bit input/output port brought out to 2-mm lab sockets
- Serial interface: RS 232 (V.24) brought out to 5-pin DIN plug connector
- Keyboard with 24 keys (0...9, A...F and 8 keys for monitor functions)
- Operating voltage +5 V current consumption approx. 500 mA

**Software**

Monitor program with the following functions:
- Control via function keys
- RESET: Running programs are aborted and the system can be operated via the other function keys with the help of the monitor.
- SUBST-MEM: Read-out and change of memory contents, e.g. input and change of programs
- SINGLE-STEP: Single step operation for testing programs
- GO: Program start
- EXAM-REG: Examination of register contents
- VECT-INTR: This key initiates a hardware interrupt (INTR 7.5).
- EXEC: Program execution
- NEXT: Next address, next instruction

**Training documents**
- Introductory course on the basics of microprocessor technology with practical experiments (also suitable for self-study)
- Detailed hardware and software description

The following subjects are dealt with
- Structure and working of a microprocessor
- Design of a microcomputer system
- Task of the various memory chips
- Instructions and instruction groups
- Logic operations
- Subroutine techniques
- Handling of input and output channels

The examples contain detailed instructions for processing and complete solutions.

**Selection and ordering data**

The microcomputer training system consists of:
- Experimental panel including keyboard
- 1 Experimental Manual Microprocessor-Trainingsystem W3026-5B
- Training documents for a basics course

Dimensions (W x H) 250x180 mm
Weight approx. 0.8 kg

Order-No. W5101-1G
### Universal-Experimenter IV

#### Power electronics

**DC chopper controller with thyristor**

With potential-free terminals for measuring the firing pulses of the main and the turn-of-thyristor; with additional 0 to 10V DC analog input for the connection of external controllers or programmable logic controls. Measuring shunts (1Ω) are integrated in the current paths for recording the currents on an oscillograph. All connections are brought out to 2-mm sockets.

**Technical data:**

- **Input voltage:** 15V DC
- **Output voltage:** up to 13V DC
- **Load current:** 1A
- **Clock frequency:** 200Hz

**Dimensions**

- (WxHxD): 125x183x35 mm
- **Weight approx.:** 0.4kg

**Order-No. W3654-4C**

#### DC chopper controller with bipolar transistor

With potential-free terminal for measuring the base voltage for the power transistor; with separate 0 to 10V DC analog input for the connection of external controllers or programmable controls. Measuring shunts (1Ω) are integrated in the current paths for recording the currents on an oscillograph. All connections are brought out to 2-mm sockets.

**Technical data:**

- **Input voltage:** 15V DC
- **Output voltage:** 0 to 15V DC
- **Load current:** 1A
- **Clock frequency:** 2kHz

**Dimensions**

- (WxHxD): 125x183x35 mm
- **Weight approx.:** 0.4 kg

**Order-No. W3654-4D**

#### DC chopper controller with IGBT

With potential-free terminal for measuring the base voltage for the power transistor; with separate 0 to 10V DC analog input for the connection of external controllers or programmable logic controls. Measuring shunts (1Ω) are integrated in the current paths for recording the currents on an oscillograph. All connections are brought out to 2-mm sockets.

**Technical data:**

- **Input voltage:** 15V DC
- **Output voltage:** 0 to 15V DC
- **Load current:** 1A
- **Clock frequency:** 2kHz

**Dimensions**

- (WxHxD): 125x183x35 mm
- **Weight approx.:** 0.4 kg

**Order-No. W3654-4Q**
Assembly Kits

Assembly kit
"Power electronics with the Universal Experimenter IV"

Order-No. W3654-0A

The following experiments can be carried out:

- Tracing of characteristics of Zener diodes, diodes, bipolar transistors, unipolar transistors, UJTs, thyristors, diac and triac. Basic transistor circuits, voltage stabilization circuits with Zener diode and with Zener diode and transistor etc., as exercises to learn fundamental principles of power electronics.
- DC chopper controller with bipolar transistor
- DC chopper controller with IGBT transistor
- DC chopper controller with thyristor, understanding the principle of capacitor turn-off, operating principle of ring-around circuit and free-wheeling diode, evaluation of switching performance
- AC power controller
- AC power controller as phase control, AC power controller as full-wave control, triggering of thyristors and triac
- Investigation of rectifier circuits
  - Uncontrolled rectifier circuits, connection types M1, M3, B2, B6
  - Half-controlled rectifier circuits, connection types B2, B6
  - Plotting of control characteristics and evaluation of switching performance
- Investigation of fully controlled rectifier circuits, connection types M1, M3, B2, B6
- Plotting of control characteristics and evaluation of switching performance
- Investigation of rectifier circuits in inverter operation

Required components:
(included in the kit)

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<tr>
<td>Analog output-interface W5101-0X</td>
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<tr>
<td>Universal mounting panel W5101-1J</td>
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<td>Set Components of Power electronics W5101-8L</td>
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<td>Experimental manual W3008-1A</td>
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Required accessories:
(not included in the kit)

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<td>Powermeter alternative</td>
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<td>Powermeter as Demonstration instrument W5431-1C</td>
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<tr>
<td>Phase-angle meter alternative</td>
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<tr>
<td>Phase-angle meter / as Demonstration instrument W5431-1D</td>
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</tr>
<tr>
<td>Set Connecting leads</td>
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</table>
Universal-Experimenter IV  Accessories

Universal assembly Panel
The panel is equipped with 90 4-mm sockets that are arranged in a 19-mm grid. Every 4 adjacent sockets are connected in a square. The upper and lower socket row are through-connected for power supply.
Dimensions (BxH) 250x183 mm
Weight approx. 0,6 kg
Order-No. W5101-0J

Component panel
For the solderless arrangement of analog and digital circuits using commercial components with wire diameters from 0.25 to 0.8mm. Total number of sockets: 1940
Dimensions (BxH) 250 x 183 mm
Weight approx. 0,6 kg
Order-No. W5101-0K

IC socket (14- and 16-pin)
1 14 pin Textool IC socket,
1 16 pin Textool IC socket, each pin is connected with two 2-mm sockets.
Dimensions (BxH) 125x183 mm
Weight approx. 0,35 kg
Order-No. W5101-0H

IC socket (20-pin)
One 20-pin Textool IC socket, each pin is connected to two 2-mm sockets.
Dimensions (BxH) 125x183 mm
Weight approx. 0,35 kg
Order-No. W5101-1C
Fault Simulators

General
The program consists of experimental panels for fault simulation in electronics. It permits typical faults to be input in order to simulate them in different basic circuits. The following can be simulated:
- Interruptions
- Short-circuits in lines and components
- Rating errors
- Various defects in semiconductors

locating faults occurring in actual practice enables trainees to familiarize themselves with the circuits. Each circuit contains up to 20 typical faults. The faults can be operated by means of switches. The switches are covered by a strip which can be closed off.

The panels are designed for insertion in the upright sections.

Dimensions of the panels:
- Height: 297 mm
- Width: 226 mm
- Size c: 452 mm

The plugs, connecting leads, plug-in modules and descriptions required for operating the fault simulators are included in the supplies.

Contactor circuit
for connection to + 15V DC.
A contactor operates a low-power-motor whose drive axis provided with a marking disc is visible from the front side.
10 faults are incorporated and can be operated by covered switches.

Dimensions
- (H x W): 297x226 mm
- Weight approx.: 1.5kg

Order-No. W5433-1Q

Reversing contactor circuit
for connection to ± 15V DC.
Two buttons "Left" and "Right" operate a reversing contactor which controls a low-power motor. Motor operation is demonstrated by a marking disc entered through the front panel.
10 faults are incorporated and can be operated by covered switches.

Dimensions
- (H x W): 297x226 mm
- Weight approx.: 1.5kg

Order-No. W5433-1R

Star-Delta Circuit
for connection to ± 15V DC.
Two buttons "Left" and "Right" operate a reversing contactor which controls a low-power motor.
Motor operation is demonstrated by a marking disc entered through the front panel.
12 faults are incorporated and can be operated by covered switches.

Dimensions
- (H x W): 297x226 mm
- Weight approx.: 1.5kg

Order-No. W5433-1S

Experimental Manual
"Fault simulators"

Order-No. W3024-8A