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ELABO TrainingsSysteme
Aus- und Weiterbildung GmbH

Safety of Electric Installations and Devices

www.elabo-ts.com

Mains Systems and Protective Measures
Testing Protective Measures

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ELABO TrainingsSysteme

Mains Systems and Protective Measures

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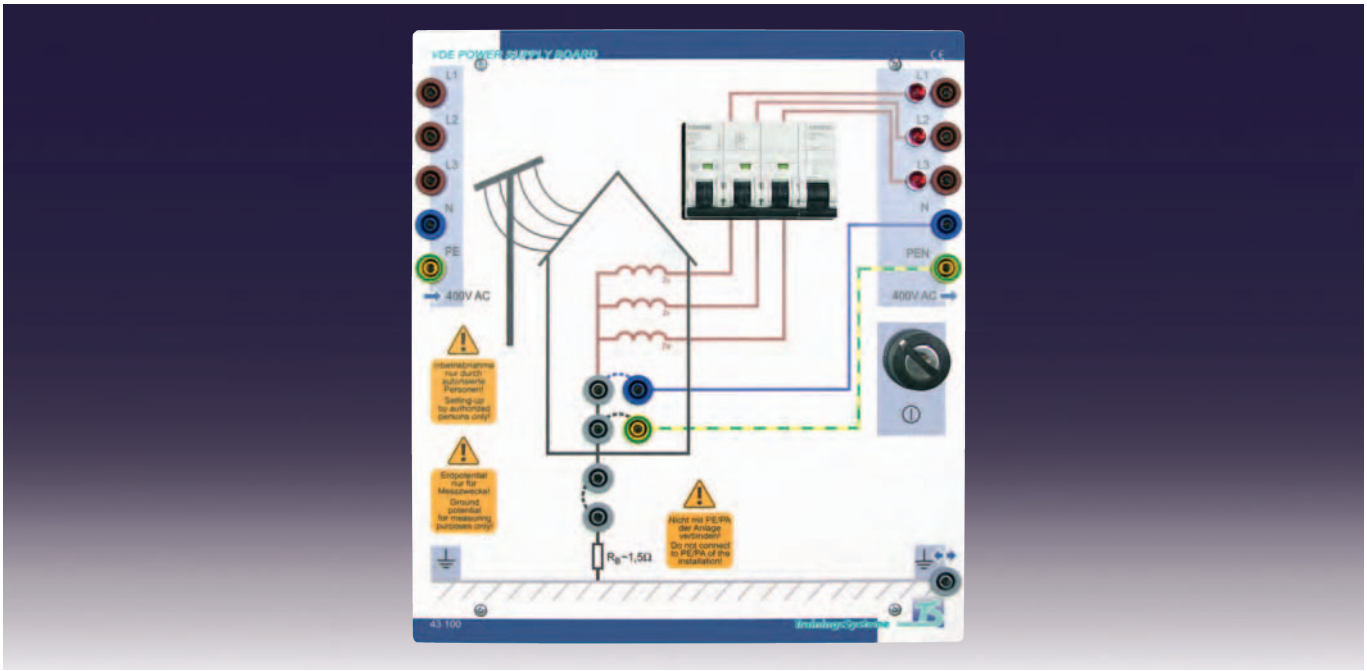
Mains Systems and Protective Measures

Mains supply



43 100 VDE Power Supply Board

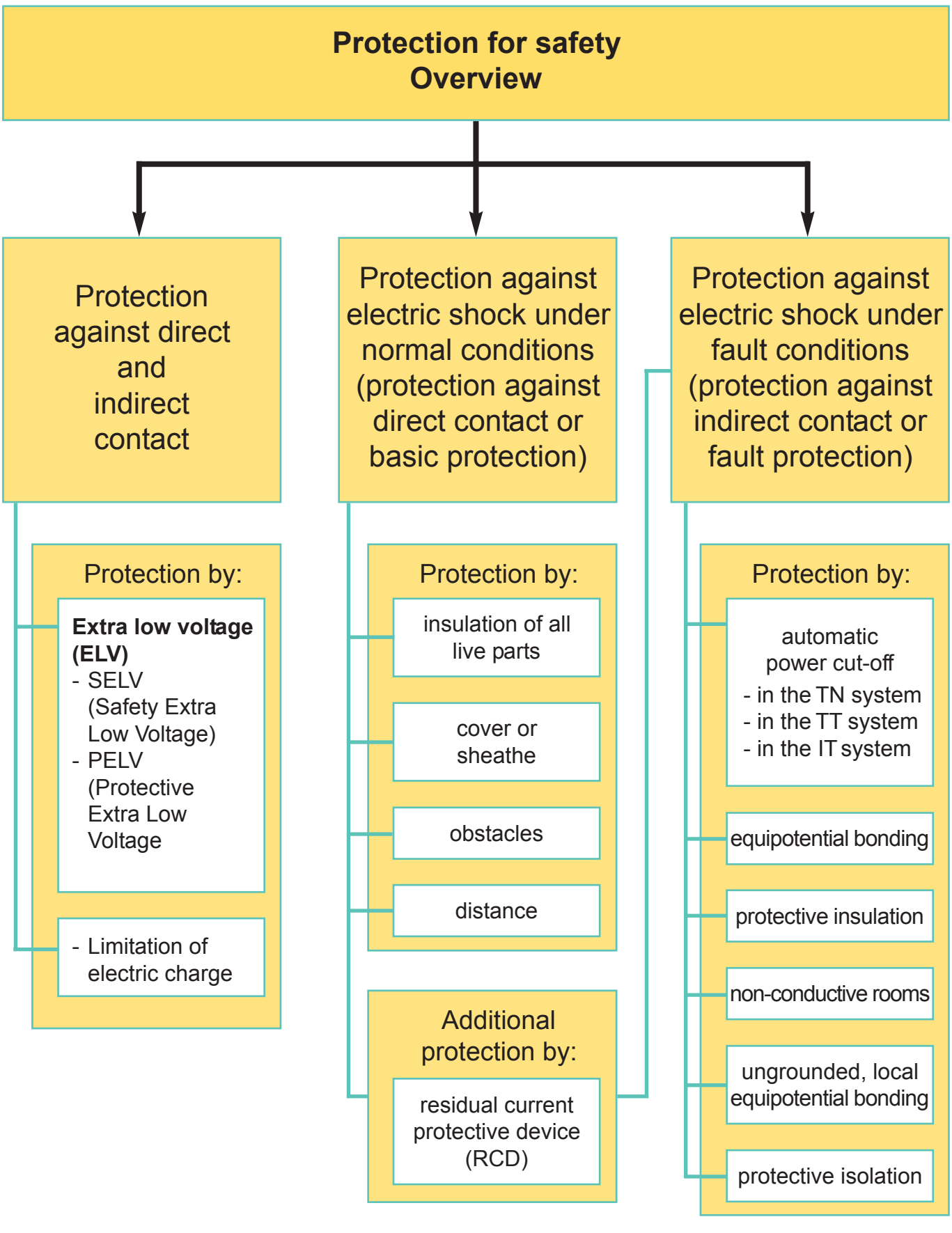
Learning Objectives:

- ✓ Using the voltage source of the mains system
- ✓ Getting familiar with the generation of mains systems with direct earthing (TN system; TT system)

Technical data

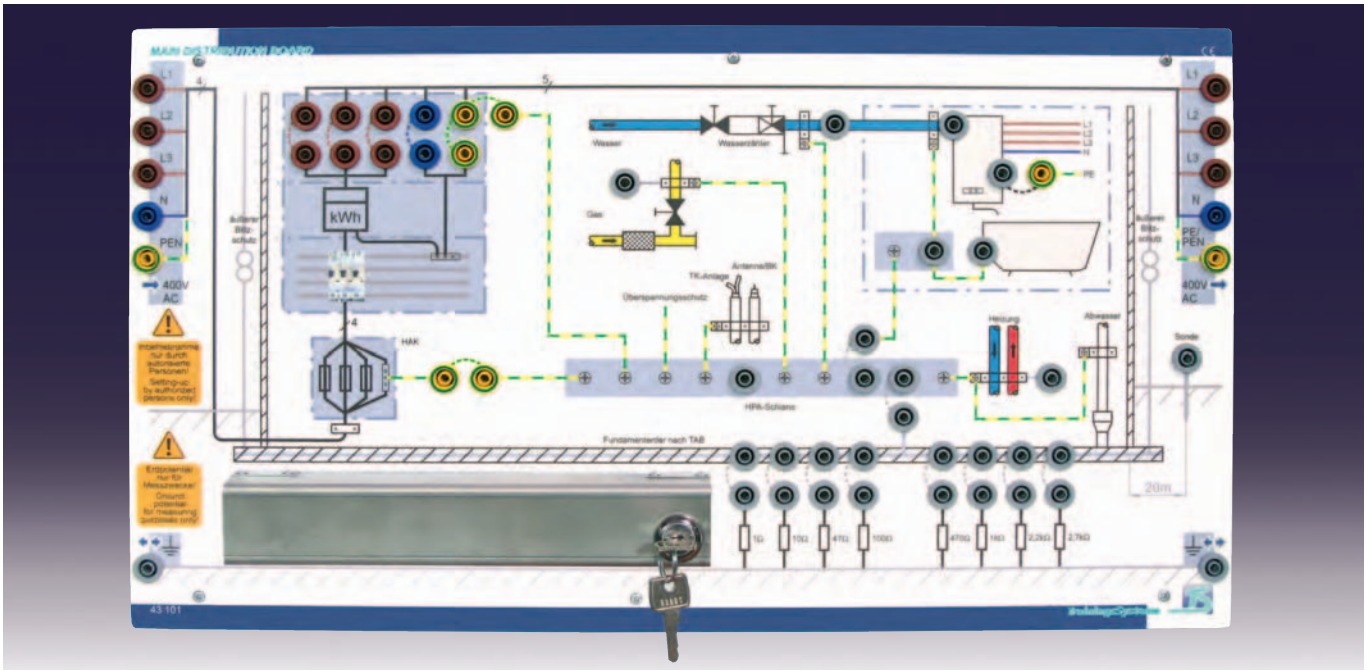
43 100 VDE Power Supply Board, consisting of:
- Line circuit breakers (I_N : 6 A) with undervoltage release
- Key-operated switch for voltage release
- Phase control lamps: L1, L2, L3
- Simple change of mains form with bridging plugs

Protection for safety
Overview



Mains Systems and Protective Measures

Electrical system in a customer's home



43 101 Main Distribution Board

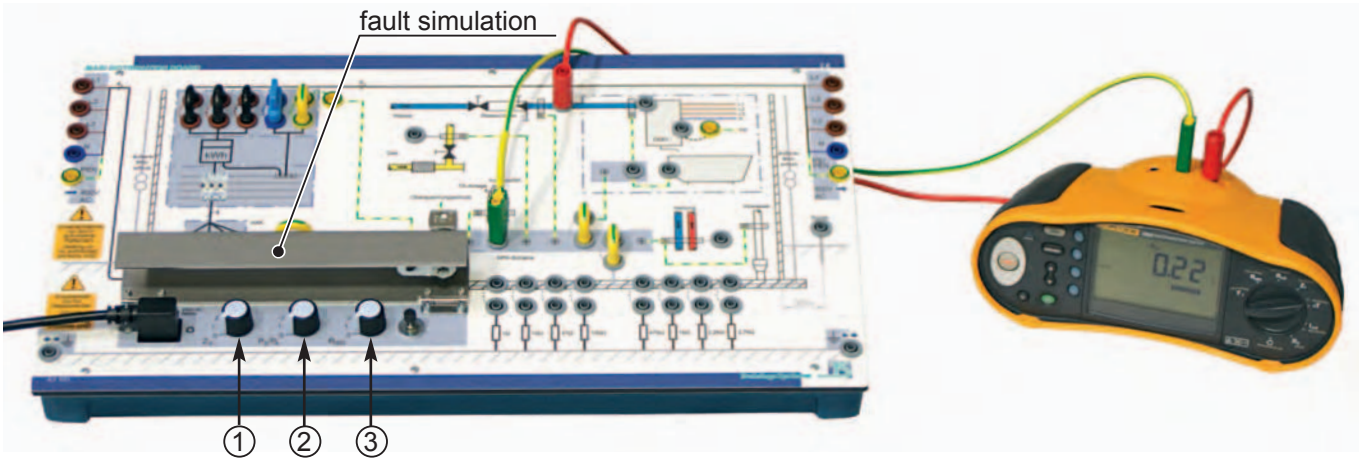
Learning Objectives:

- ✓ Consumers of the mains system
- ✓ What type (T**N** system; T**T** system) is the customer`s mains system
- ✓ Additional designations in the TN system (TN-**C** system; TN-**S** system; TN-**C-S** system)
- ✓ Functionality of the protective measures in the different mains
- ✓ Selection of the protective measures and devices according to the customer's system
- ✓ Consultation of the customer with regard to safety and availability of the electrical installation
- ✓ Getting acquainted to the measuring instruments used in the field of protective engineering
- ✓ Drawing up flow charts for the required tests
- ✓ Execution of initial tests
- ✓ Execution of repeated tests
- ✓ Writing test protocols

Technical data

43 101 Main Distribution Board, consisting of:

- Simulation of a foundation grounding with different grounding resistances
- Simulation of an outer lightning protector (two derivations with disconnection)
- Connector for an earth-resistance probe
- Simulation of a main equipotential bonding
- Simulation of additional equipotential bondings in the bathroom
- Simulation of the mains connection to the house with generation of the different mains systems with bridging plugs
- Simulation of the electric meter with generation of the diferent mains systems by bridging plugs
- Connection field for subdistributor
- Simple fault simulation with rotating switches for:
  - Loop impedance and mains interior resistance
  - Low-resistance connection of protective and equipotential bonding conductors
  - Insulation leakage



Troubleshooting and test preparation

① Loop impedance fault:

Fault 1: Additional resistance in L3

Fault 2: Additional resistance in PEN

Fault 3: Additional resistance in N and PE

Fault 4: Additional resistance in N

② Protection and equipotential bonding fault:

Fault 1: Interruption in the equipotential bonding of the heating

Fault 2: Resistance in the connection to the water pipe

Fault 3: Resistance between main and additional equipotential bonding

Fault 4: Interruption of the equipotential bonding to the hot-water boiler

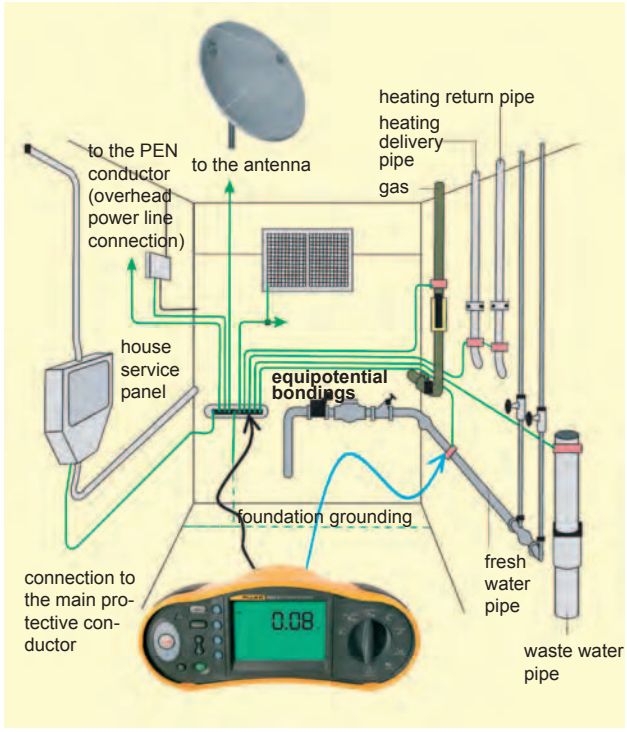
③ Insulation fault:

Fault 1: Voltage-dependant insulation fault between L1, L2 and PE

Fault 2: Insulation fault between L1 and PE

Fault 3: Insulation fault between L2 and PE

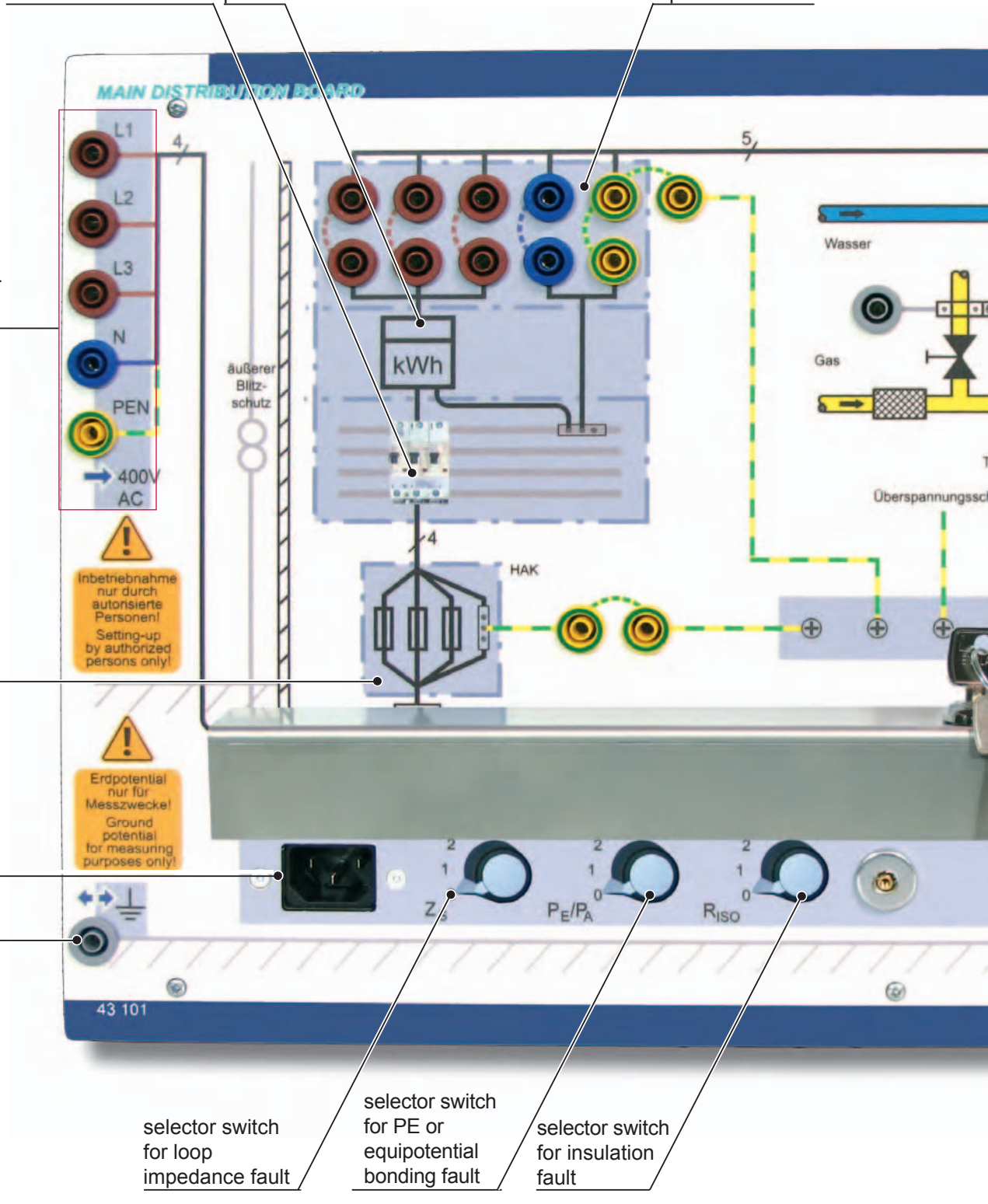
Fault 4: Insulation fault between L1, L3 and PE

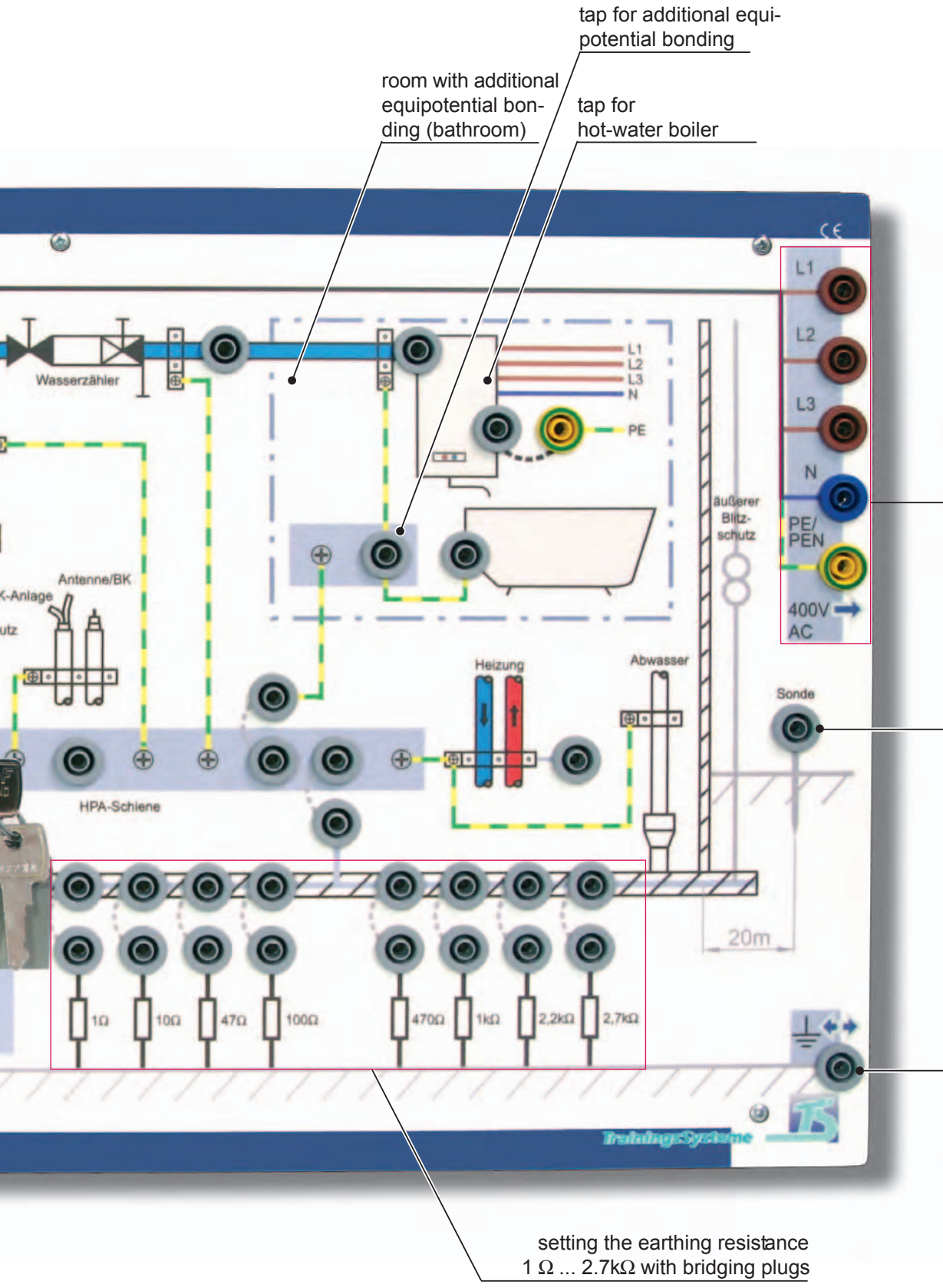


Source: Fluke Deutschland GmbH

Mains Systems and Protective Measures

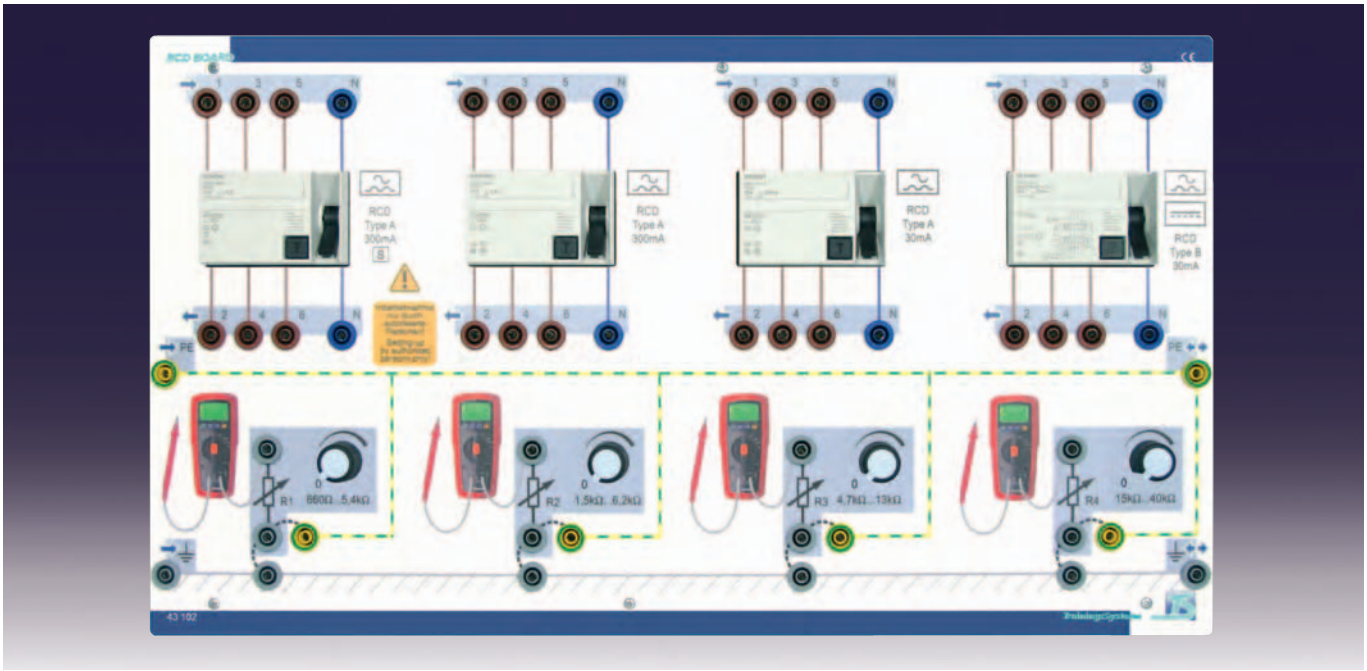
Electrical system in a customer's home




tap for additional equi-potential bonding
room with additional equipotential bon-ding (bathroom)
tap for hot-water boiler
voltage output to RCD Board (43 102) or Sub-Distribution Board (43 103) or Insulation Monitor Board (43 105)
tap for earthing resistance measurement probe
tap for ground potential
setting the earthing resistance 1 Ω ... 2.7kΩ with bridging plugs
L1
L2
L3
N
PE
PE/ PEN
400V AC
Wasserzähler
Antenne/BK
äußerer Blitz-schutz
Heizung
Abwasser
Sonde
HPA-Schiene
20m
1Ω
10Ω
47Ω
100Ω
470Ω
1kΩ
2,2kΩ
2,7kΩ

Mains Systems and Protective Measures

RCDs



43 102 RCD Board

Learning Objectives:

- ✓ Influence of the rated residual current on circuit-breaking
- ✓ Influence of the earthing resistance on the RCD selection in a TT system
- ✓ Series circuiting and grouping of several RCDs
- ✓ Examining the application of RCDs in the IT system
- ✓ Function and application of the residual current protective devices type A and type B
- ✓ Application of type B in classrooms
- ✓ Application of type B in three-phase rectifier circuits
- ✓ Measuring of AC residual currents

43 111 Universal RCD Board

Technical data

43 102 RCD Board, consisting of:
- Selective residual current protective device $I_{\Delta N}$ 300 mA
- Residual current protective device $I_{\Delta N}$ 300 mA, type A
- Residual current protective device $I_{\Delta N}$ 30 mA, type A
- Residual current protective device $I_{\Delta N}$ 30 mA, type B
- Four different potentiometers for simulation of residual currents

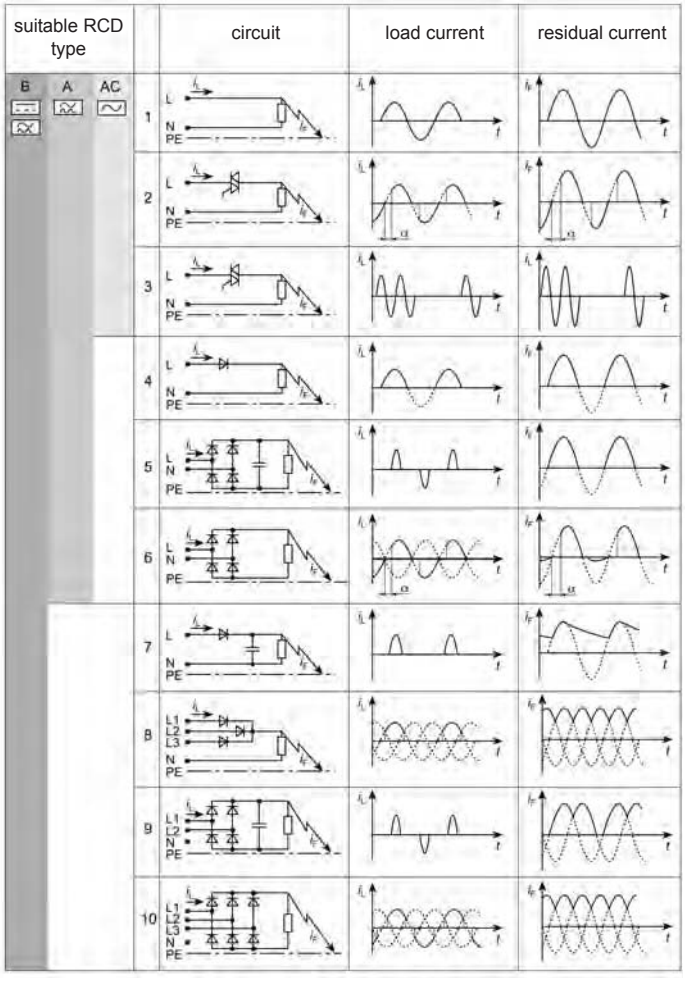
43 111 Universal RCD Board, equipped with RCD type A:
- Residual current protective device $I_{\Delta N}$ 30 mA, type A

Type A

RCDs of ***type A*** detect sine-wave AC residual currents, but also pulsating DC residual currents.

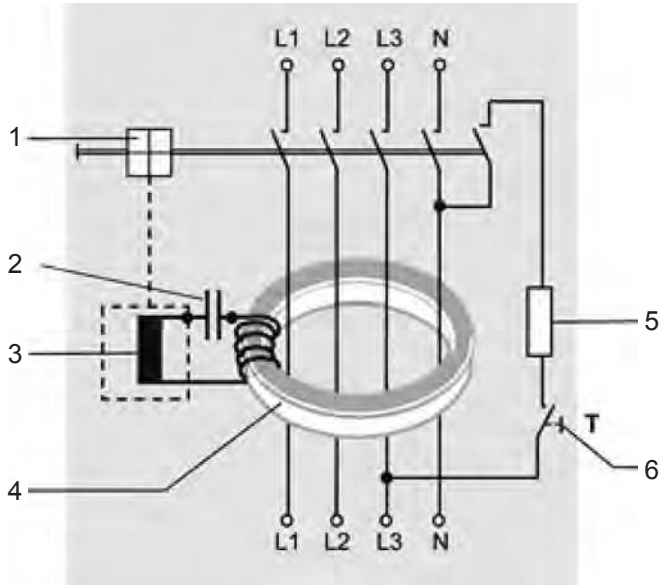
Type B

Apart from detecting the residual current waveforms of type A, the residual current protective devices of ***type B*** also serve to detect smooth DC residual currents which may occur in the following circuits:



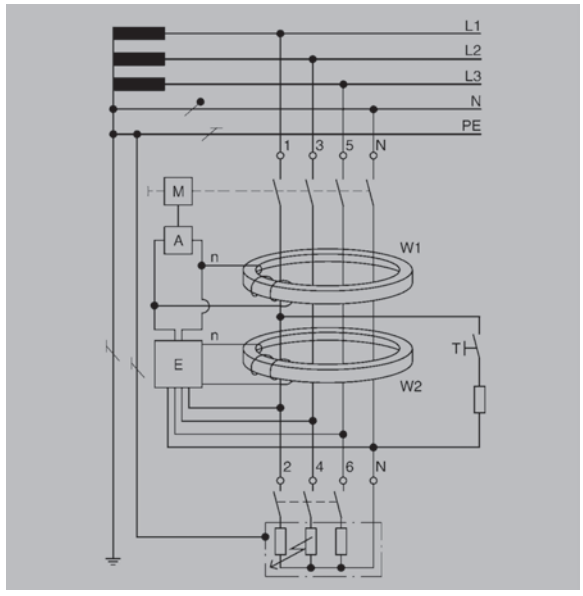
Some fabricants of frequency converters, e. g. Siemens or SEW, stipulate the use of RCDs ***type B*** (see model plate).

Design of an RCD type A



1 Mechanics of the protective device
2 Release circuit
3 Holding magnet release
4 Summatic current transformer
5 Test resistance
6 Test equipment

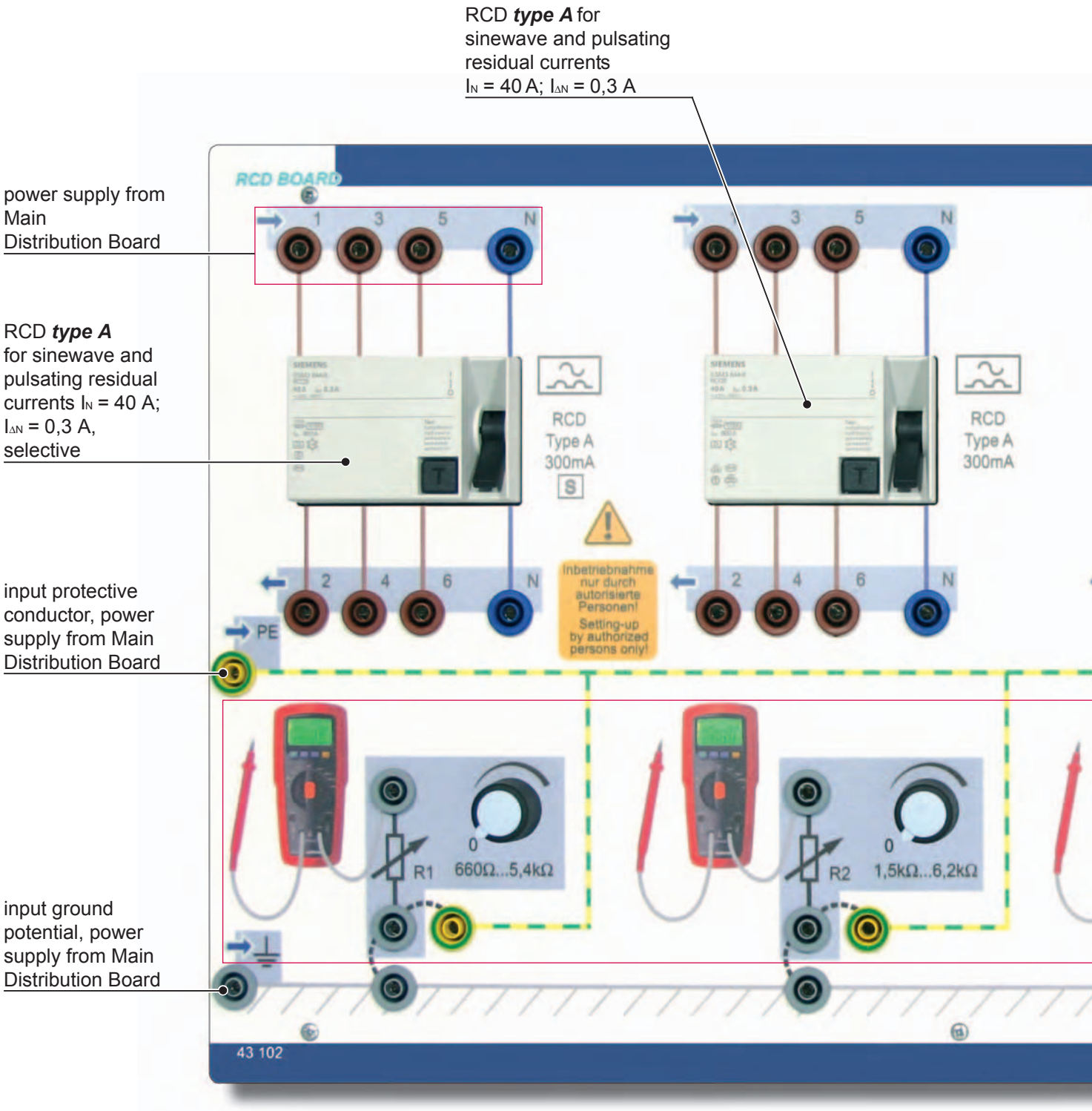
Design of an RCD type B



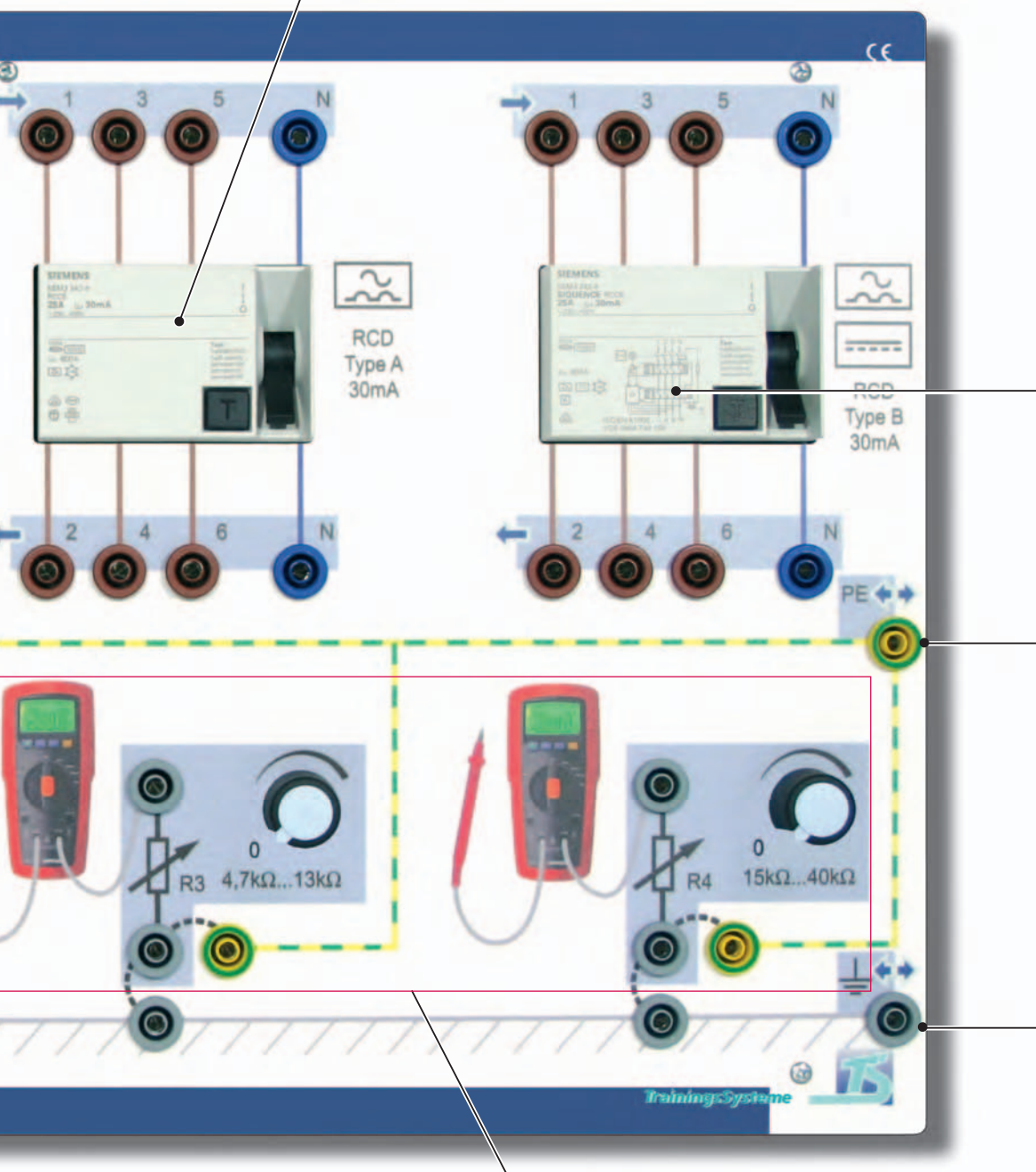
A Holding magnet release
E Electr. for tripping in the event of smooth DC res. currents
T Test equipment
W1 Summation current transformer
W2 Summation current transformer for detection of smooth DC residual currents

Mains Systems and Protective Measures

RCDs



RCD ***type A*** for sinewave and pulsating residual currents I_N = 25 A; $I_{\Delta N}$ = 0,03 A



RCD ***type B*** universal current-sensitive and short-time delayed I_N = 25 A; $I_{\Delta N}$ = 0,03 A

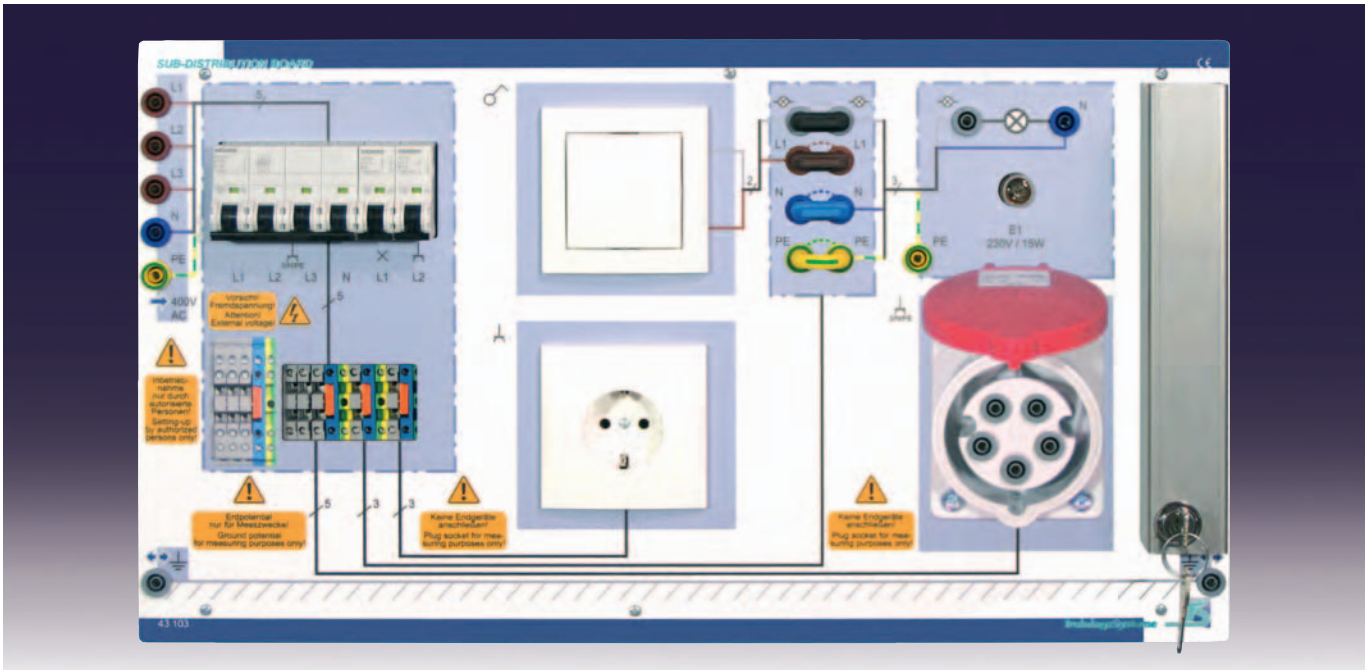
tap for protective conductor

tap for ground potential

potentiometer for generating fault currents

Mains Systems and Protective Measures

Sub-distribution in the customer's home



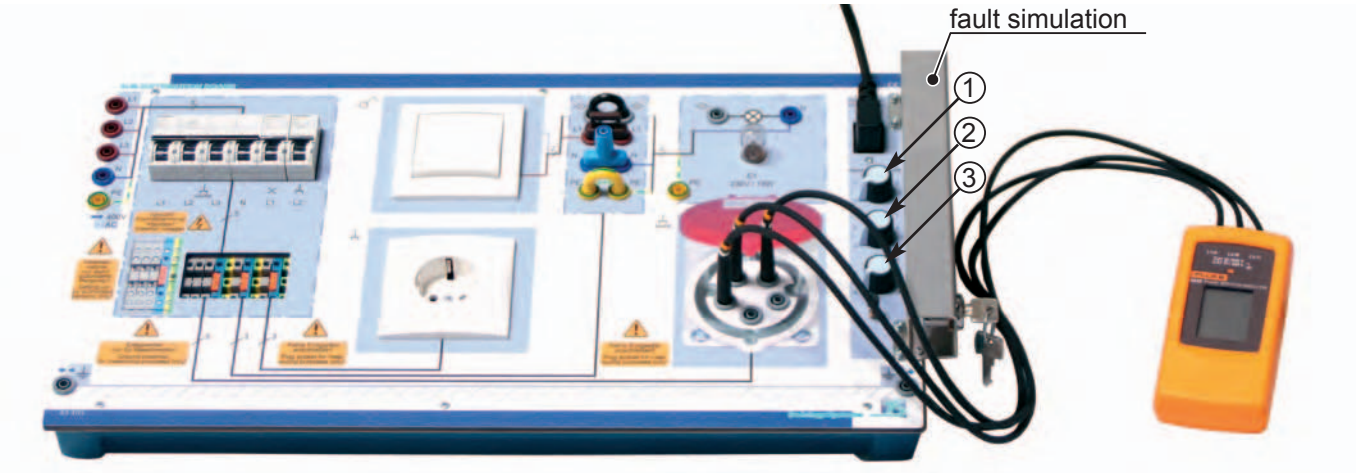
43 103 Sub-Distribution Board

Learning Objectives:

- ✓ Getting acquainted with the functionalities of the protective measures in the different mains systems
- ✓ Selection of the protective measures and devices acc. to the requirements of the customer`s system
- ✓ Consultation of the customer with regard to safety and availability of the electric installation
- ✓ Getting acquainted with the measuring instruments used in the field of protective engineering
- ✓ Drawing up flow charts for the required tests
- ✓ Selecting the required measuring instruments and defining suitable measuring points
- ✓ Properly assessing the measuring values with regard to their precision and security
- ✓ Describing, planning and executing initial and repeated tests of the electric installation and writing a test protocol
- ✓ Recognizing, describing and measuring fault-caused dangers in the electric installation and measuring them
- ✓ Systematic fault detection in electric installations
- ✓ Properly assessing and documenting the dangers caused by faulty electric installation and advising the customer thereof
- ✓ Communicating with the customer:
  - upon delivery of the system
  - during the repeated test
  - in the case of a failure/breakdown of the electric installation
  - after successful repair

Technical data

43 103 Sub-Distribution Board, consisting of:
- Sub-distributor with:
  - Line circuit breaker: C 16A; 4-pole
  - Line circuit breaker: B 13A; 1-pole
  - Line circuit breaker: B 6A; 1-pole
  - Measuring points available at standard line-up terminals
- Consumers:
  - Three-phase consumer:
    - Imitation of a 5-pole CEE socket with safety sockets
  - AC consumer:
    - Lamp operated by a switch with junction box
    - Protective AC power socket
  - Fault simulator:
    - For simple fault simulation with regard to function and protective measure



verification of the CEE socket`s direction of rotation with a phase-sequence indicator

Troubleshooting and test preparation

① Possible faults in the CEE socket:

Fault 1: Voltage-dependant insulation fault between L1 and PE
Fault 2: Insulation fault between L3 and PE
Fault 3: Insulation fault between N and PE
Fault 4: Loop impedance too high in PE
Fault 5: Mistake N for PE
Fault 6: Left-hand rotary field in the CEE socket
Fault 7: Mistake L1 for PE
Fault 8: Interruption of PE

② Possible faults in the lighting circuit:

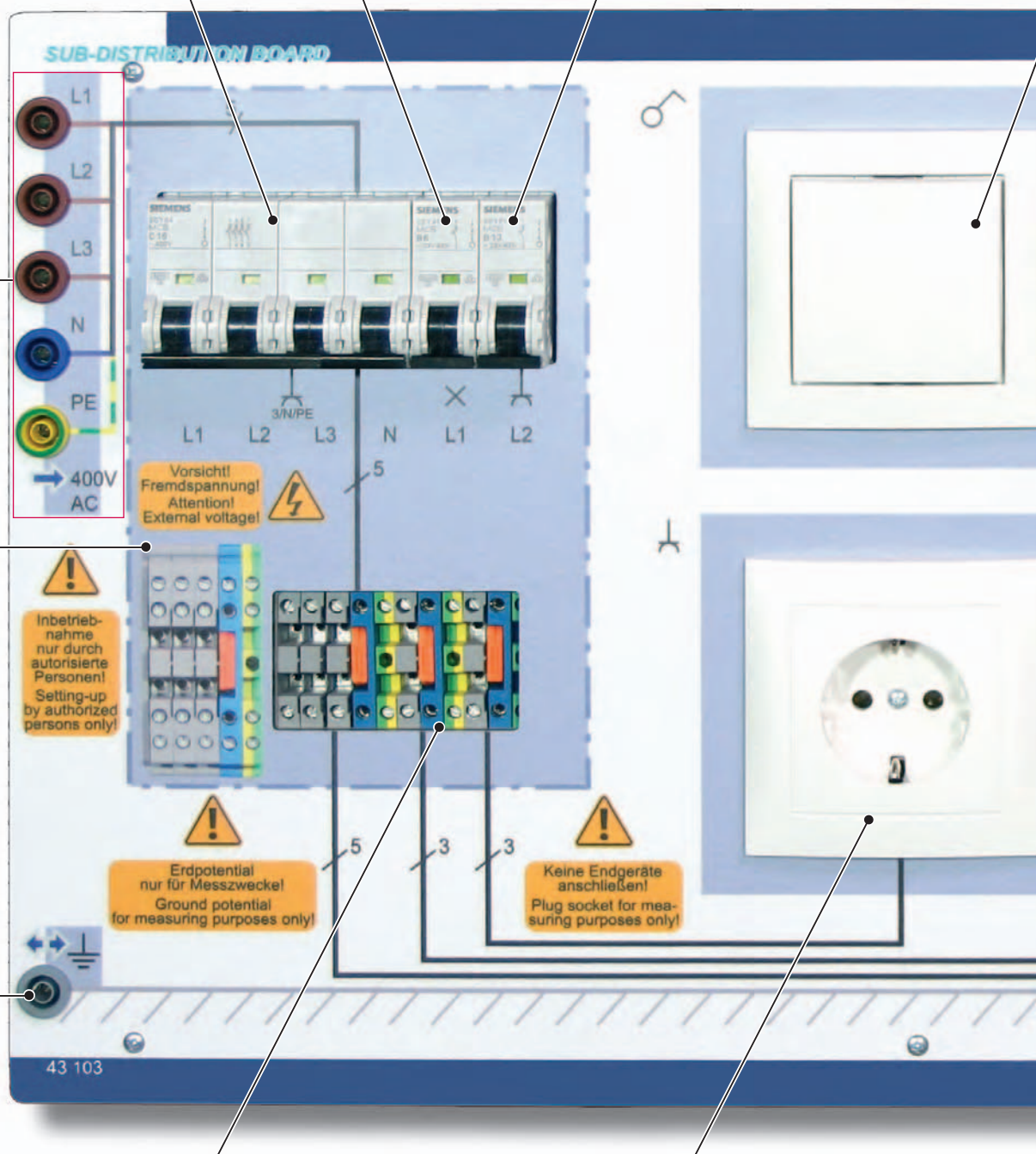
Fault 1: Insulation fault between L and PE
Fault 2: Loop impedance too high in N and PE
Fault 3: Wire between junction box and lamp disconnected
Fault 4: Mistake N for PE in the lamp
Fault 5: Not PE, but N at the lamp housing
Fault 6: Loop impedance N and PE too high
Fault 7: Loop impedance N and PE too high
Fault 8: Mistake L for N in the lamp

③ Possible faults in the power socket:

Fault 1: Voltage-dependant insulation fault between L1 and PE
Fault 2: Insulation fault L and PE, N and PE
Fault 3: Missing neutral conductor, PE and N are bridged
Fault 4: Loop impedance too high in N and PE
Fault 5: Loop impedance too high in N
Fault 6: Interruption of N and PE
Fault 7: No power supply of the socket
Fault 8: N and PE mistaken

Mains Systems and Protective Measures

Sub-distribution in the customer's home



line circuit breaker 4-pole C 16 A for CEE socket

line circuit breaker 1-pole B 6 A for lighting circuit

line circuit breaker 1-pole B 13 A for protective AC power socket

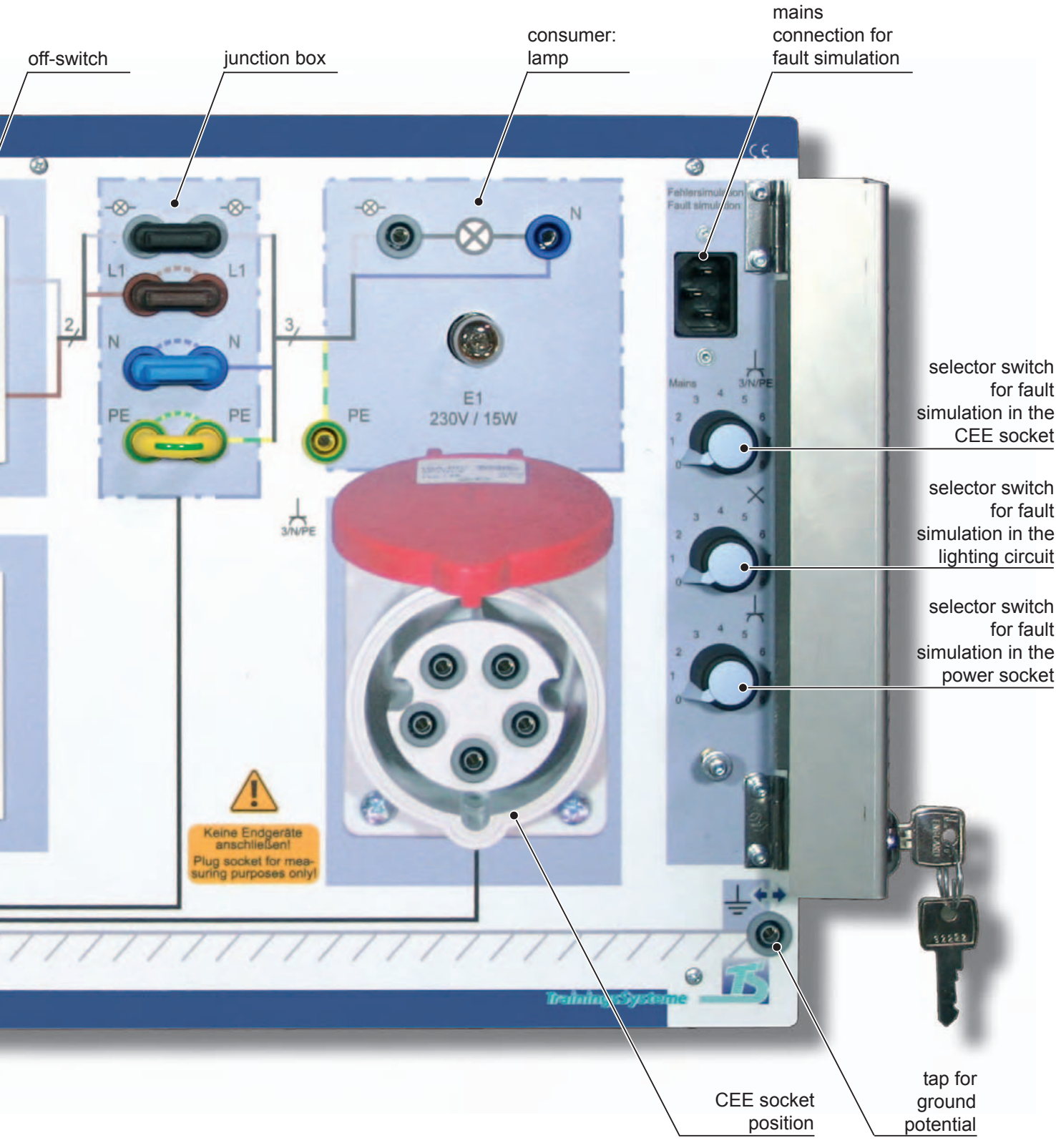
input for power supply of L1/L2/L3/N/PE

sub-distributor

input for ground potential

output terminal for consumer current circuits allowing to isolate N for troubleshooting

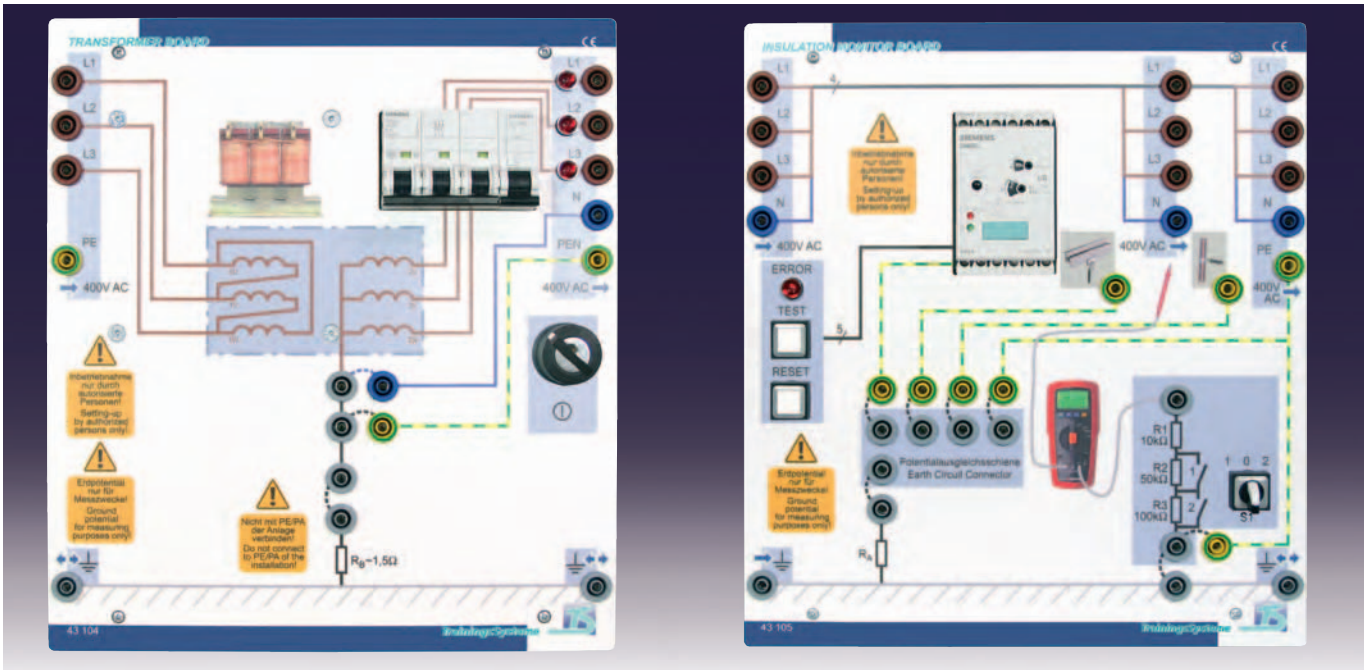
protective AC power socket



German version depicted!
Country-specific designs on request:

Mains Systems and Protective Measures

IT system: Insulation monitoring



43 104 Transformer Board

43 105 Insulation Monitor Board

Learning Objectives:

- ✓ Introduction of an IT system with insulation monitoring
- ✓ Selecting and using measuring and testing instruments and interpreting the measuring results
- ✓ Proceeding according to regulations of initial and repeated tests and drawing up a flow chart of the required measurements
- ✓ Checking protective measures in the IT system
- ✓ Writing test protocols
- ✓ In connection with the RCD Board (43 102):
  Examining RCD applications in unearthed AC power supply systems (IT system)

Technical data

43 104 Transformer Board, consisting of:
- Three-phase transformer (400/400 V / 200 VA)
- Line circuit breakers (I_N : 1 A)
- Key-operated switch
- Phase control lamps: L1, L2, L3
- Simple change of mains form via bridging plugs

Technical data

43 105 Insulation Monitor Board, consisting of:
- Insulation monitoring unit for insulation monitoring of unearthed AC power supply system (IT system) with one or three phases
- Supply voltage: 115/230 V AC
- Measuring voltage: up to 500 V AC
- Measuring range: 1 - 110 kΩ
- Pushbutton for resetting of the stored alarm
- Pushbutton for error simulation (external test button)
- Pilot lamp for alarm signal
- Simulation of the building equipotential bonding
- Switchable measuring resistors for generation of insulation faults / earth leakage

TRAINING PACKAGE TP 26.1

IT SYSTEM

ELABO TrainingsSysteme

Mobile Learning Trainer (MLT):
Order informations page 37!

Mains Systems and Protective Measures

Courseware

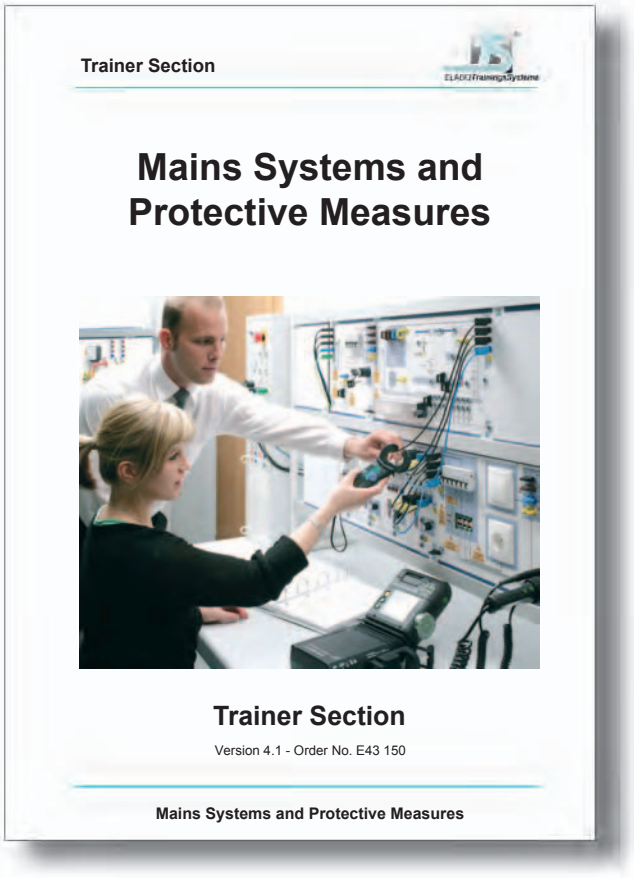
On paper and on CD!

Contents of manual:

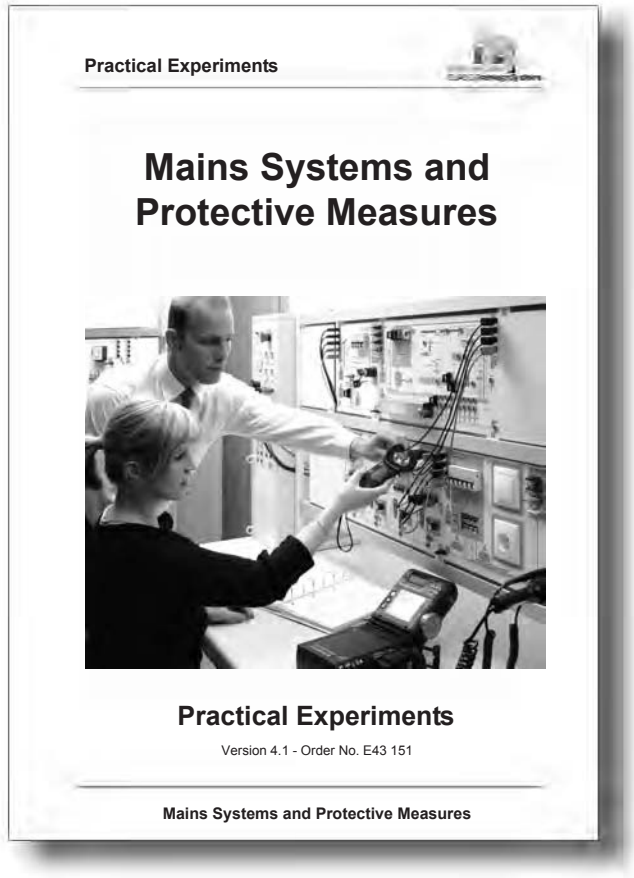
1. Principles
   - Mains systems and protective measures
   - Securing electric power supply and safety of devices
2. Practical measurements
   - TN system
   - TT system
   - IT system
3. Inspection of electric installations
   - Initial test
   - Repeated test
   - Test protocol

Without illustration:

E43 152CD Transparencies
Mains systems and protective measures

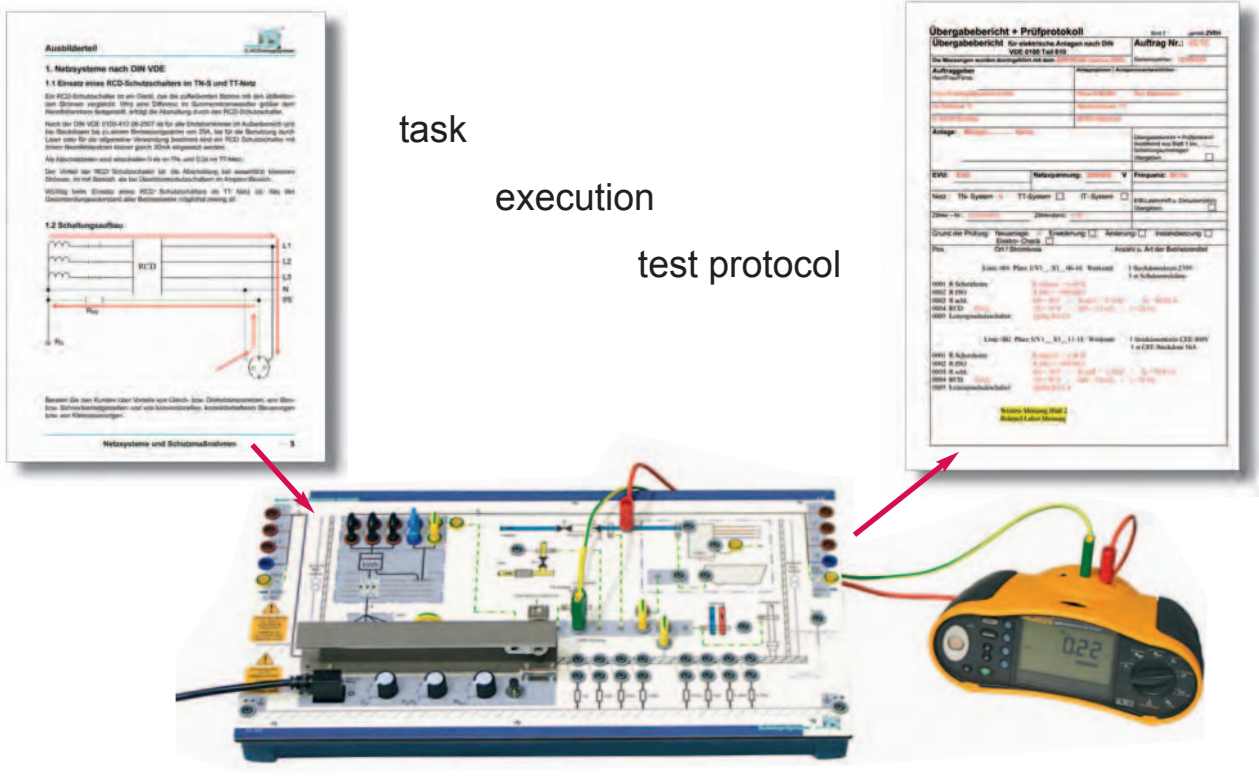


E43 150CD Manual Trainer Section
Mains Systems and Protective Measures



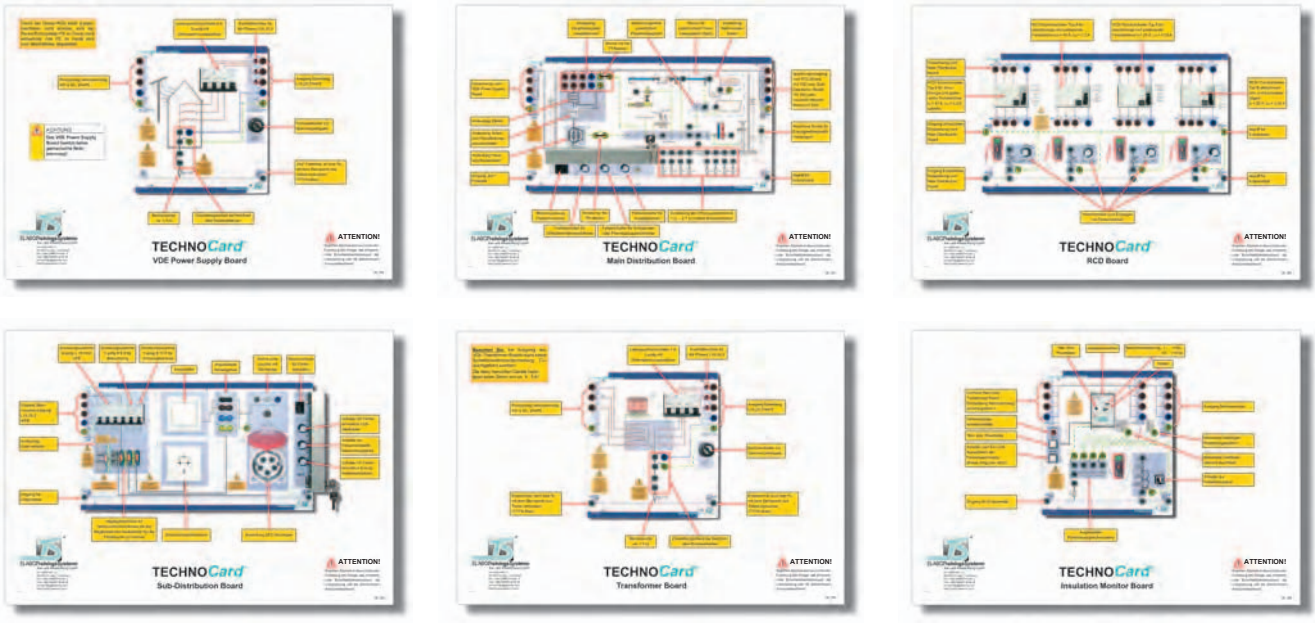
E43 151CD Manual Practical Experiments
Mains Systems and Protective Measures

From the principles to the test protocol ...



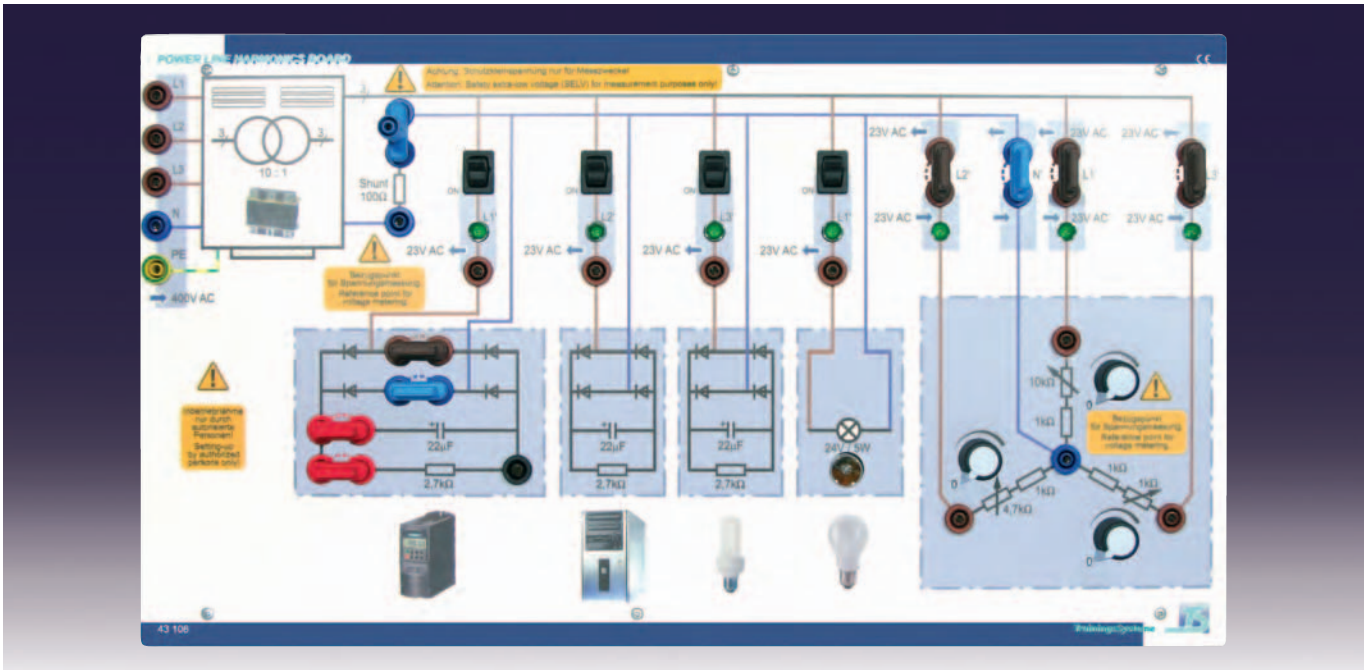
43 153 Satz TechnoCards „Netzsysteme und Schutzmaßnahmen“

- TechnoCard VDE Power Supply Board (43 160)
- TechnoCard Main Distribution Board (43 161)
- TechnoCard RCD Board (43 162)
- TechnoCard Sub-Distribution Board (43 163)
- TechnoCard Transformer Board (43 164)
- TechnoCard Insulation Monitor Board (43 165)



Loads on the Neutral Conductor

Symmetrical and unsymmetrical load



43 106 Power Line Harmonics Board

Learning Objectives:

- ✓ Comprehending by measurement, calculation and drawing of line diagrams the linkage of voltages and currents
- ✓ Determining currents, voltages and powers in star circuit for symmetrical and unsymmetrical loads
- ✓ Examining disturbances, e. g. failing of the neutral conductor, outer conductor or load resistor
- ✓ Recognizing the function of the neutral conductor in star circuit and determine its cross section
- ✓ Proving by measurement the formation of harmonics by non-linear consumers such as PCs, motor control devices and energy saving lamps
- ✓ Recognizing and measuring overloading of the neutral conductor by the 3rd harmonics
- ✓ Selection of the protective measures for a consumer system
- ✓ Structure and function of the rectifier circuits M1 and B2
- ✓ Measurement of voltages and currents in the rectifier circuits

Technical data

43 106 Power Line Harmonics Board, consisting of:
- Isolating transformer 10:1
- Test circuit of a three-phase consumer in star circuit
- Test circuits of AC consumers with and without rectifier

TRAINING PACKAGE TP 26.2

LOADS ON THE NEUTRAL CONDUCTOR

Mobile Learning Trainer (MLT):
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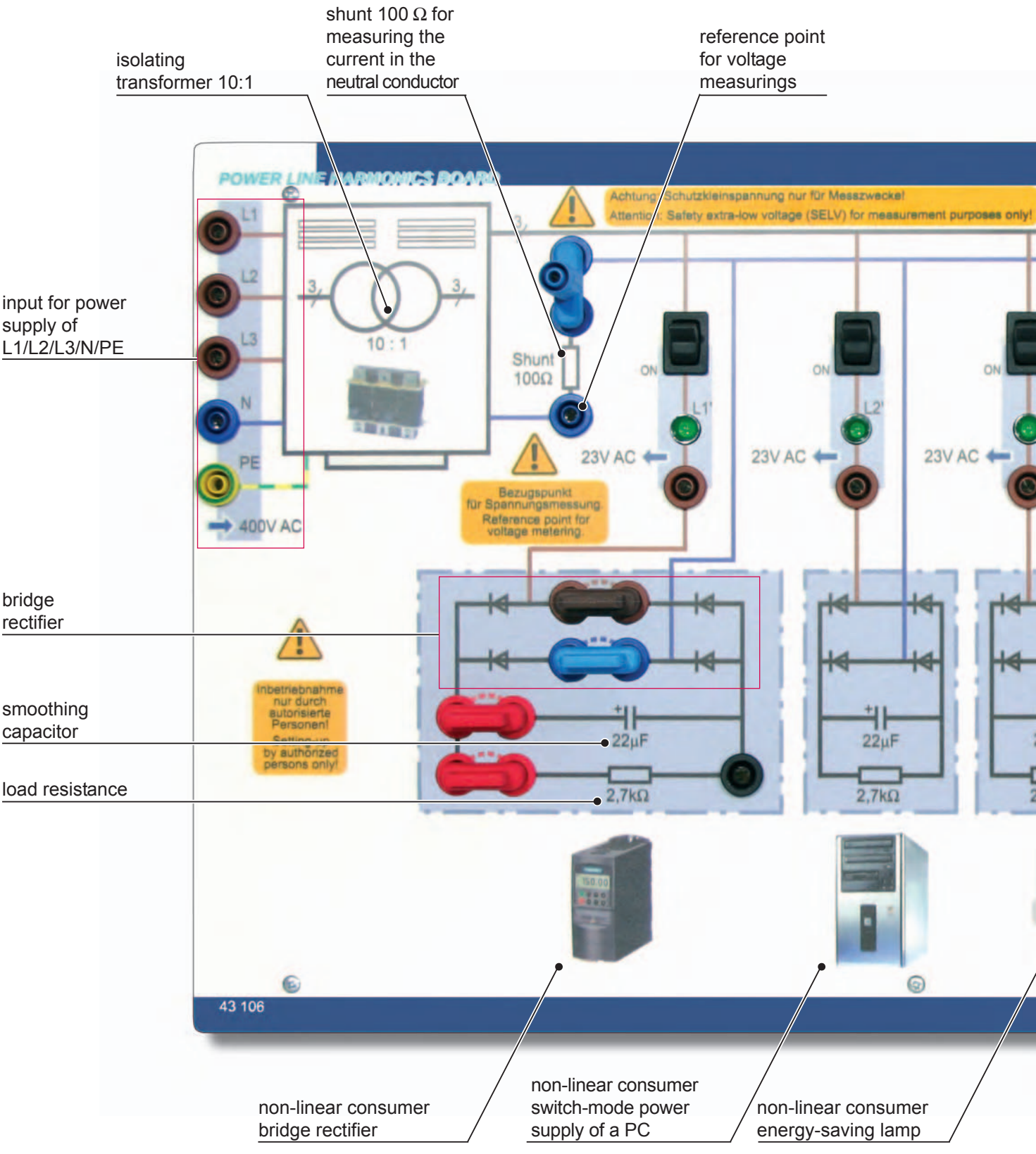
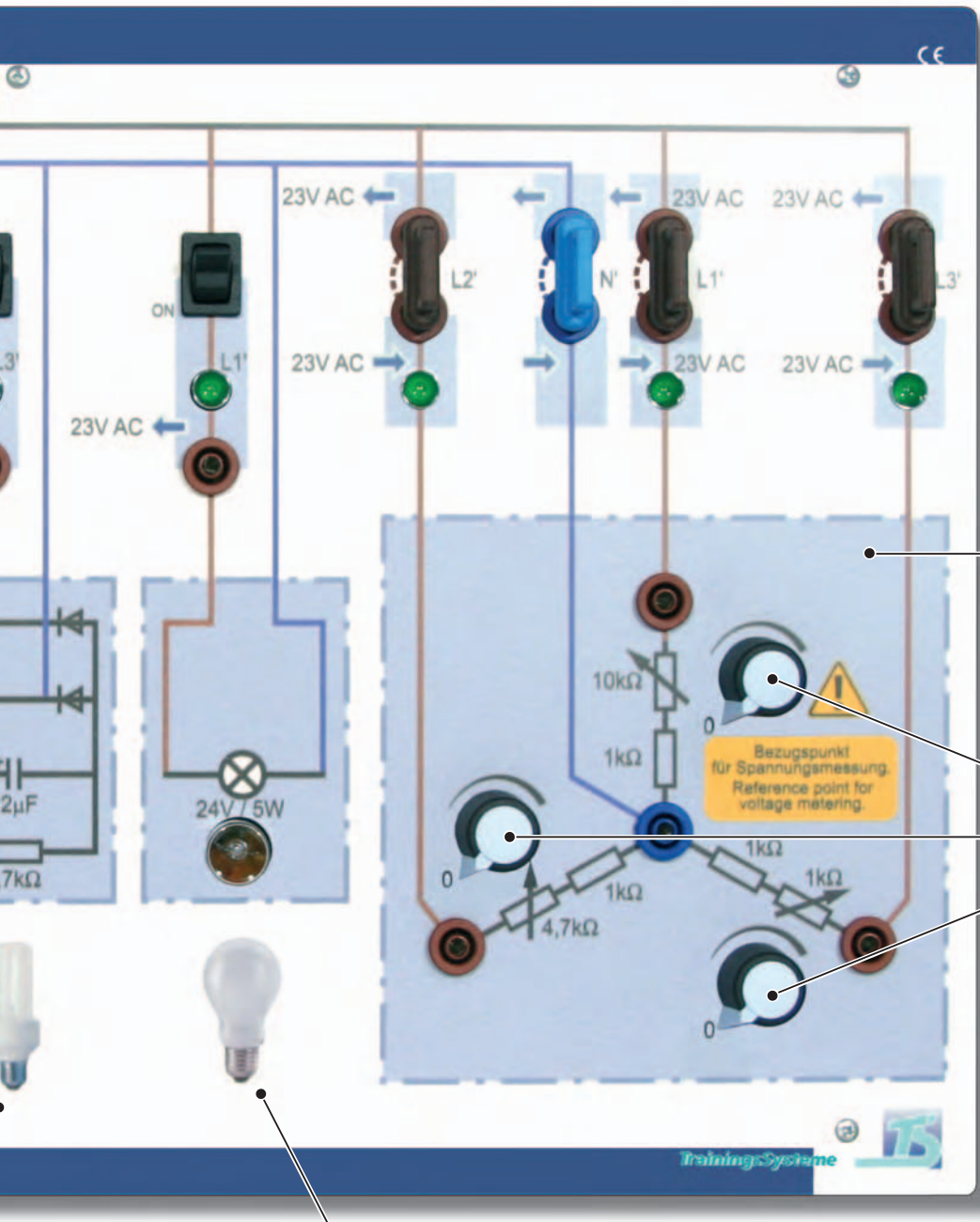
Loads on the Neutral Conductor

Symmetrical and unsymmetrical load





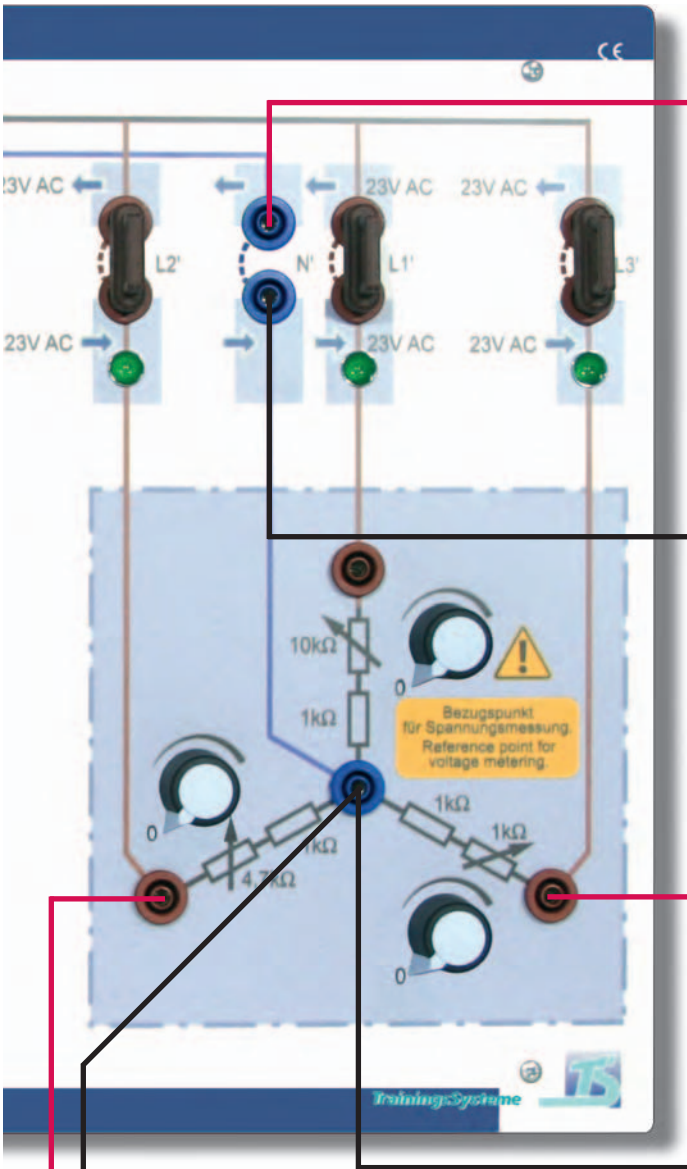
star-shaped mains

adjustable load resistances

linear consumer light bulb

Loads on the Neutral Conductor

Symmetrical and unsymmetrical load



current in neutral conductor

voltage
outer conductor L3

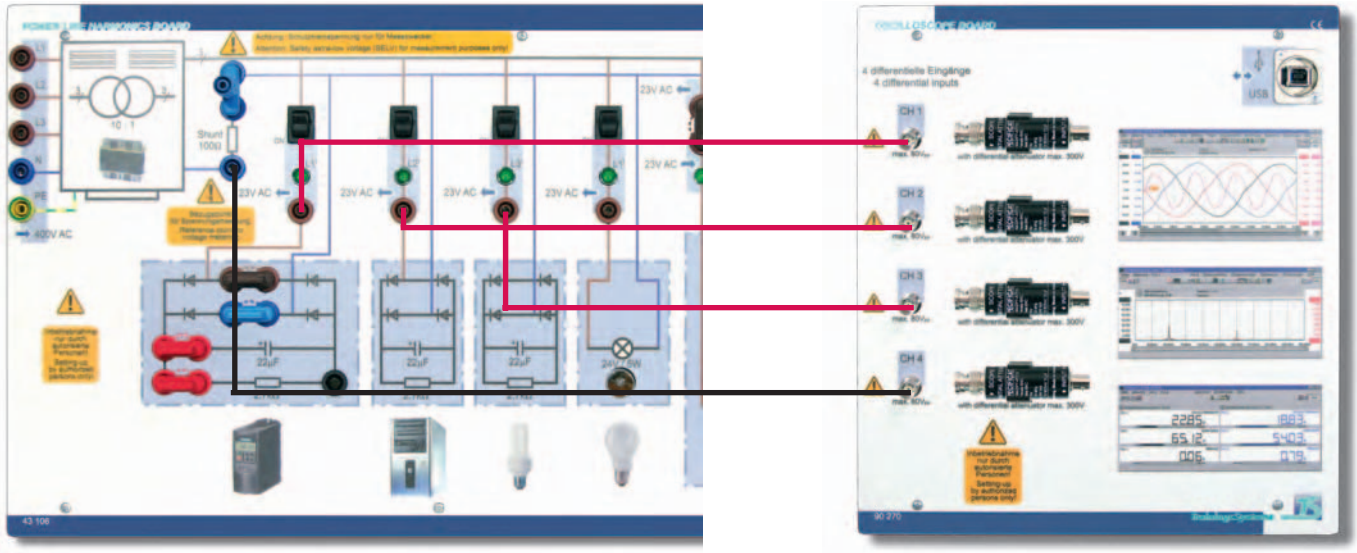
voltage
outer conductor L2

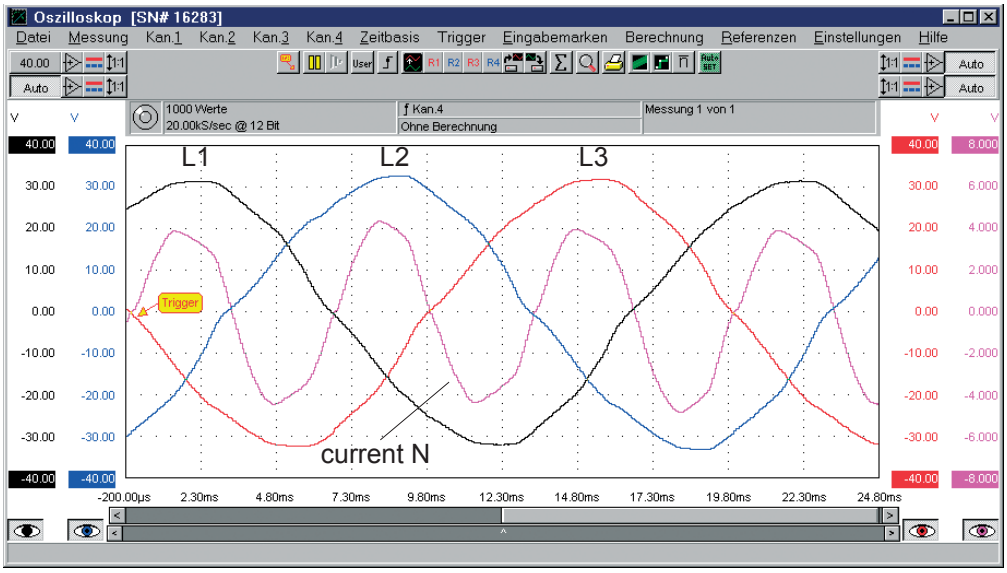
Current in neutral conductor:
with symmetrical load approx. 0 mA
with unsymmetrical load higher than 0 mA

With connected neutral conductor the voltages in the outer conductors are approximately equal.

Voltage offsets occur when the neutral conductor is not connected, with the lowest volt age drop on the wire with the lowest resistance and the highest voltage drop on the wire with the highest resistance.

Non-linear load





Current in neutral conductor:

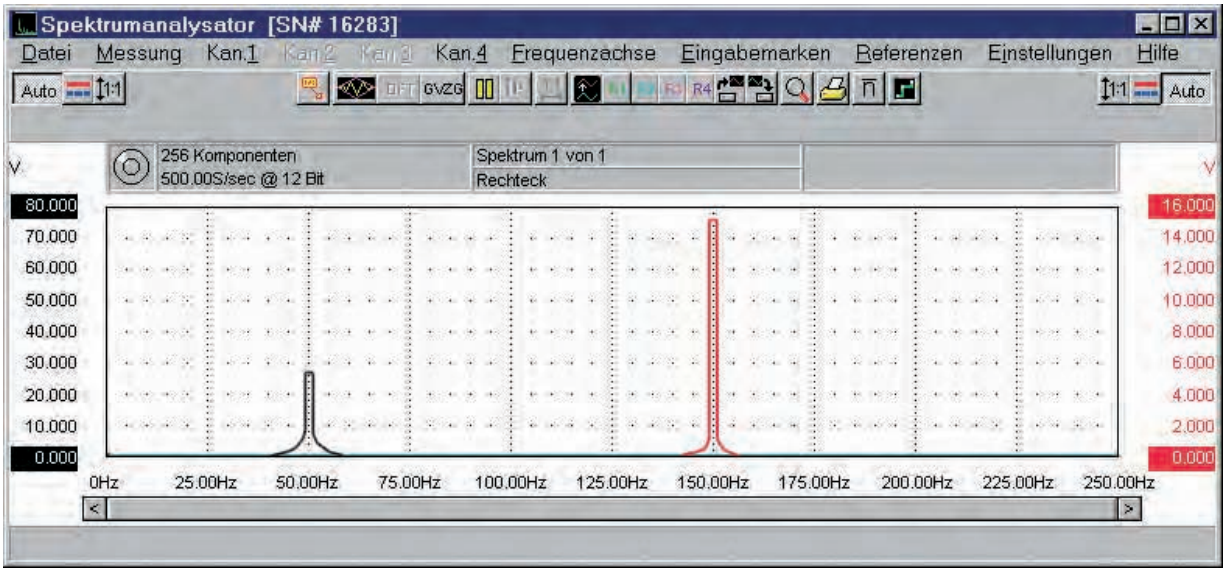
Display of the three outer conductors and the neutral conductor current with a load from three non-linear consumers

It shows a current with triple frequency flowing through the neutral conductor!

3rd harmonics 150 Hz:

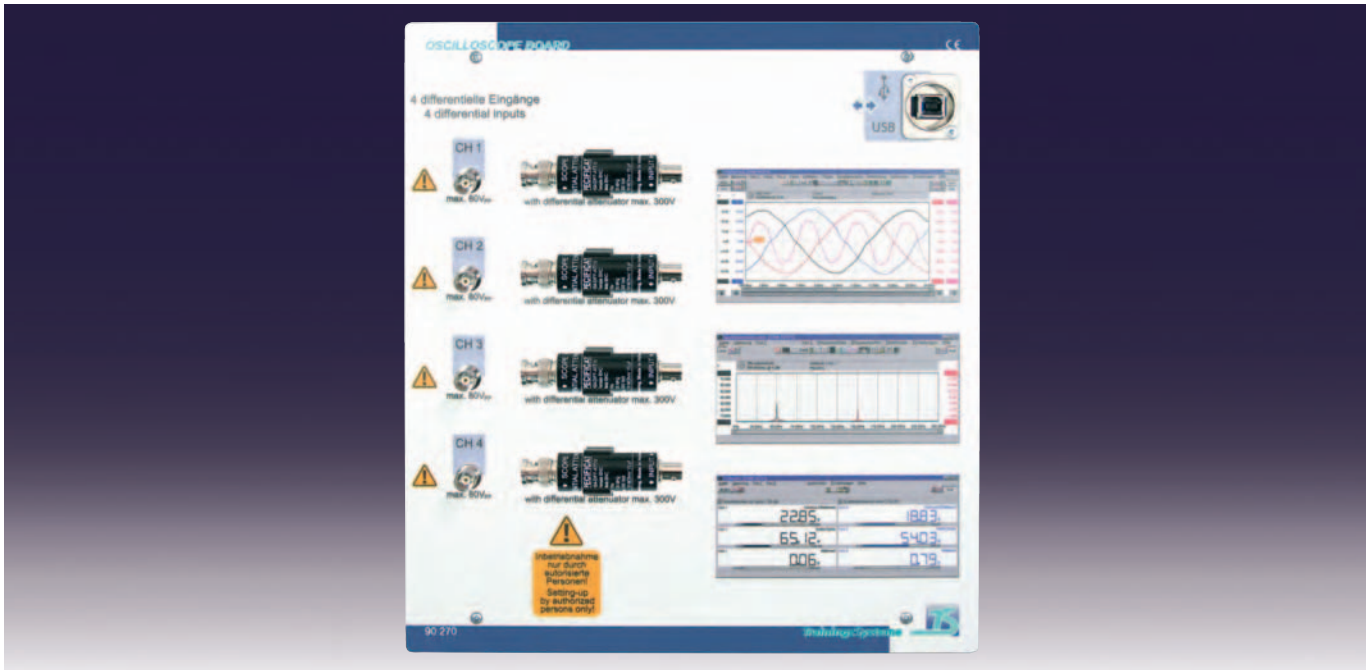
Each of the outer conductors L1, L2 and L3 ist loaded with one non-linear consumer.

This results in a three times higher current!



Loads on the Neutral Conductor

Measuring with the Oscilloscope Board



90 270 Oscilloscope Board

Learning Objectives:

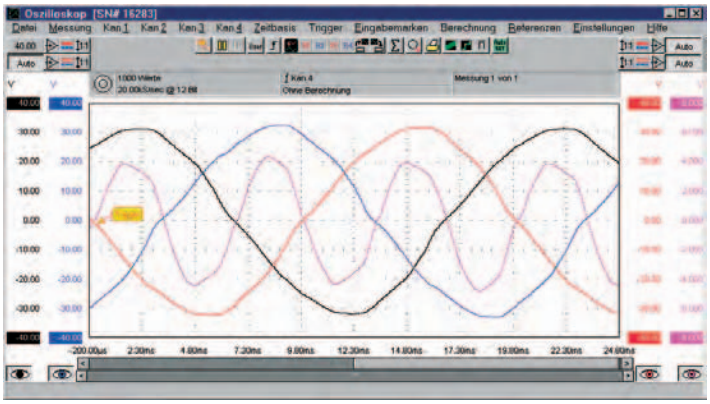
- ✓ Plotting and interpreting measuring charts
- ✓ Utilization of an oscilloscope in the region of power lines
- ✓ Spectrum analyses

Technical data

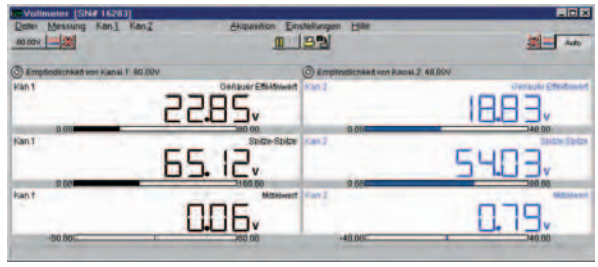
90 270 Oscilloscope Board, consisting of:
- 4 measuring instruments in one unit
  - 12-16 bit 4-channel oscilloscope
  - spectrum analyzer
  - transient recorder
  - voltmeter
- Sampling rate of up to 5 MHz per channel
  - 16 bits up to 200 kHz
  - 14 bits up to 3 MHz
  - 12 bits up to 5 MHz
- 5 MHz bandwidth
- input sensitivity from 50 mV to 80 V, with integrated differential attenuators 1:10 300 V
- Spectrum analyzer with distortion factor calculation
- Comprehensive trigger function
- Rapid transient recorder with 0.01 s - 500 s sampling time
- Automatic memory function up to 1000 files
- USB 2.0 connection (USB 1.1 compatible)

PC minimum requirements:

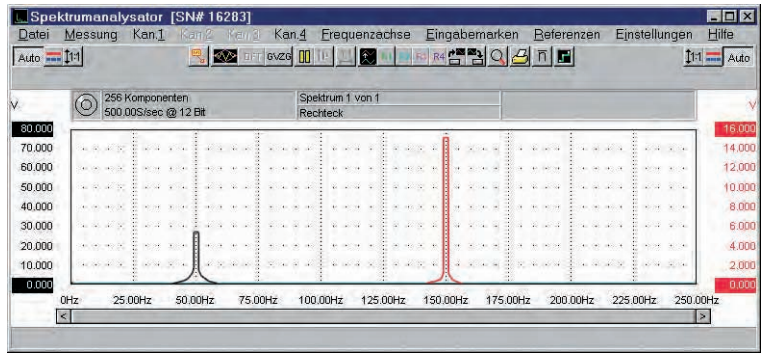
Processor:	Pentium processor
Memory:	RAM: 16 MB, hard disk: 6 MB
Operating system:	Windows 98/2000/ME/XP
Drive:	CD-ROM



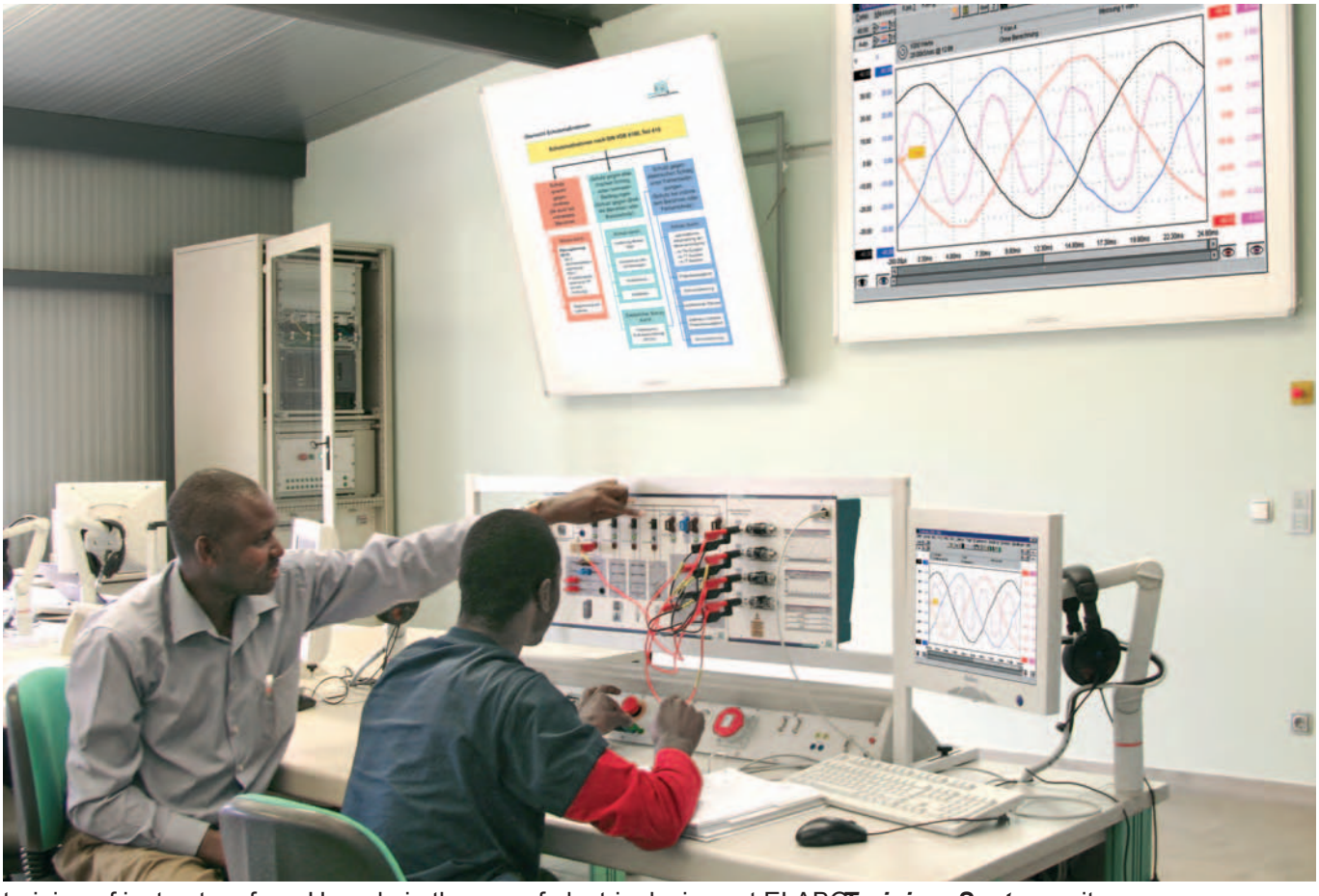
4-channel oscilloscope



digital display



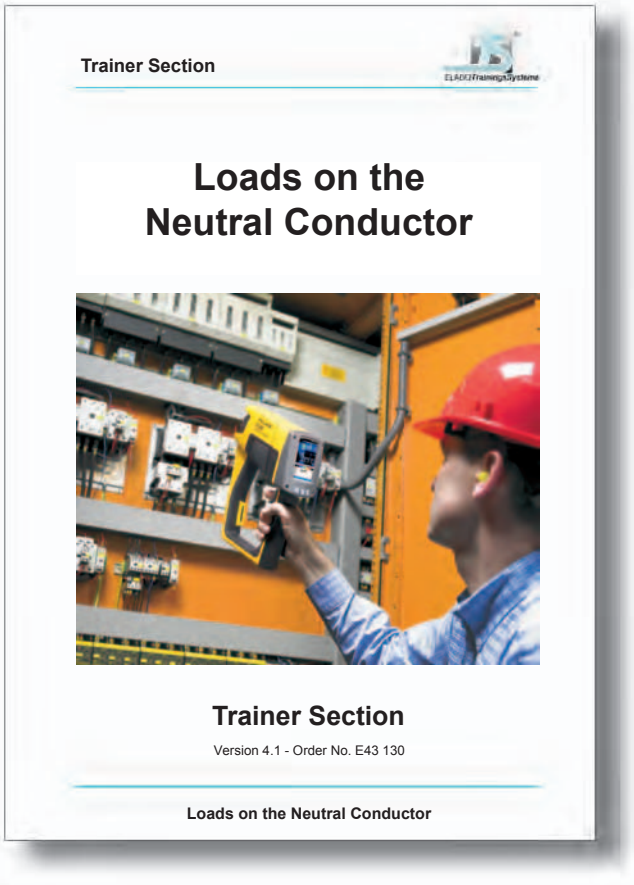
spectrum analysis



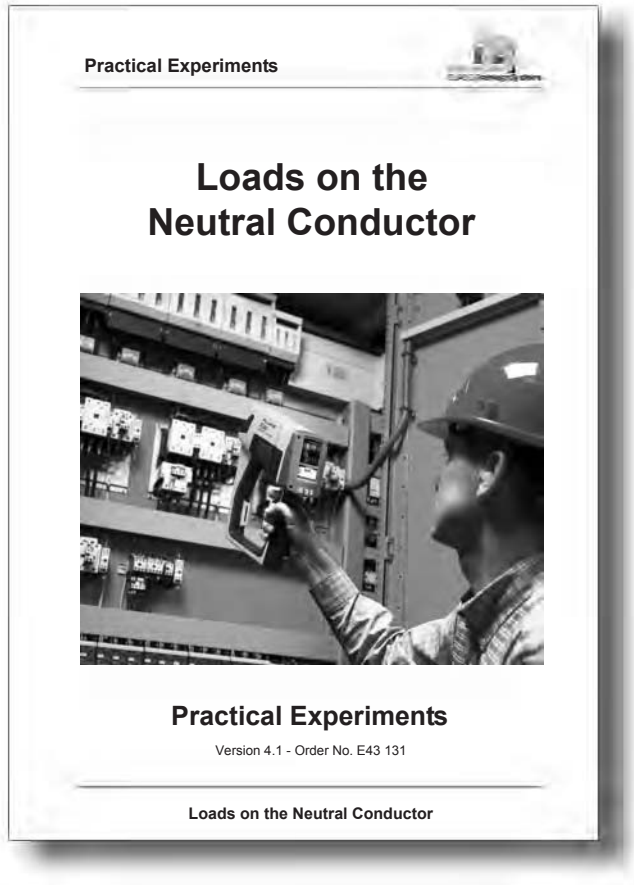
training of instructors from Uganda in the use of electric devices at ELABO*TrainingsSysteme* site

Loads on the Neutral Conductor

Courseware



E43 130CD Manual Trainer Section
Loads on the Neutral Conductor



E43 131CD Manual Practical Experiments
Loads on the Neutral Conductor

Contents of the manual:

1. Significant technical terms

2. Interlinking in three-phase current

2.1 Star circuit with symmetrical load

2.2 Star circuit with unsymmetrical load

2.3 Disturbances in the star circuit

2.4 Precautions

3. Neutral conductor currents in electronic devices

3.1 Neutral conductor current with symmetrical load by non-linear-loaded devices

3.2 Currents and voltage on one, two or three non-linear-loaded wires

3.3 Spectrum analysis of the neutral conductor current

4. Occurrence of harmonics

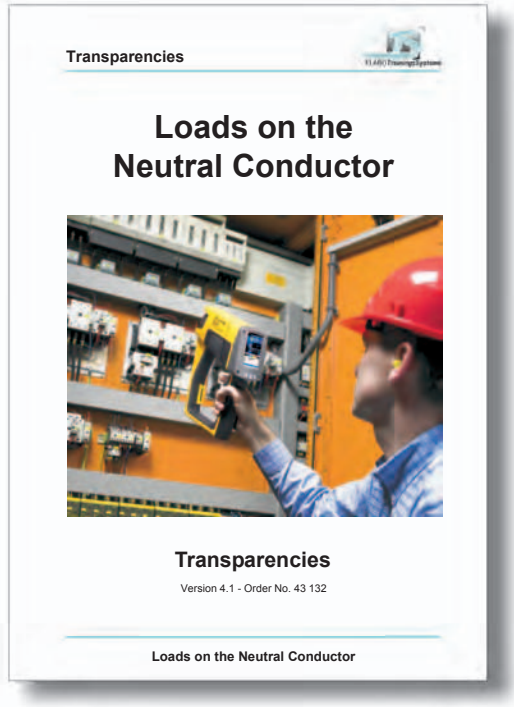
4.1 Examination of the B2 two-pulse bridge rectifier circuit

4.2 Examination of the M1 single-pulse mid-point rectifier circuit

4.3 Comparison between B2 and M1 rectifier circuits

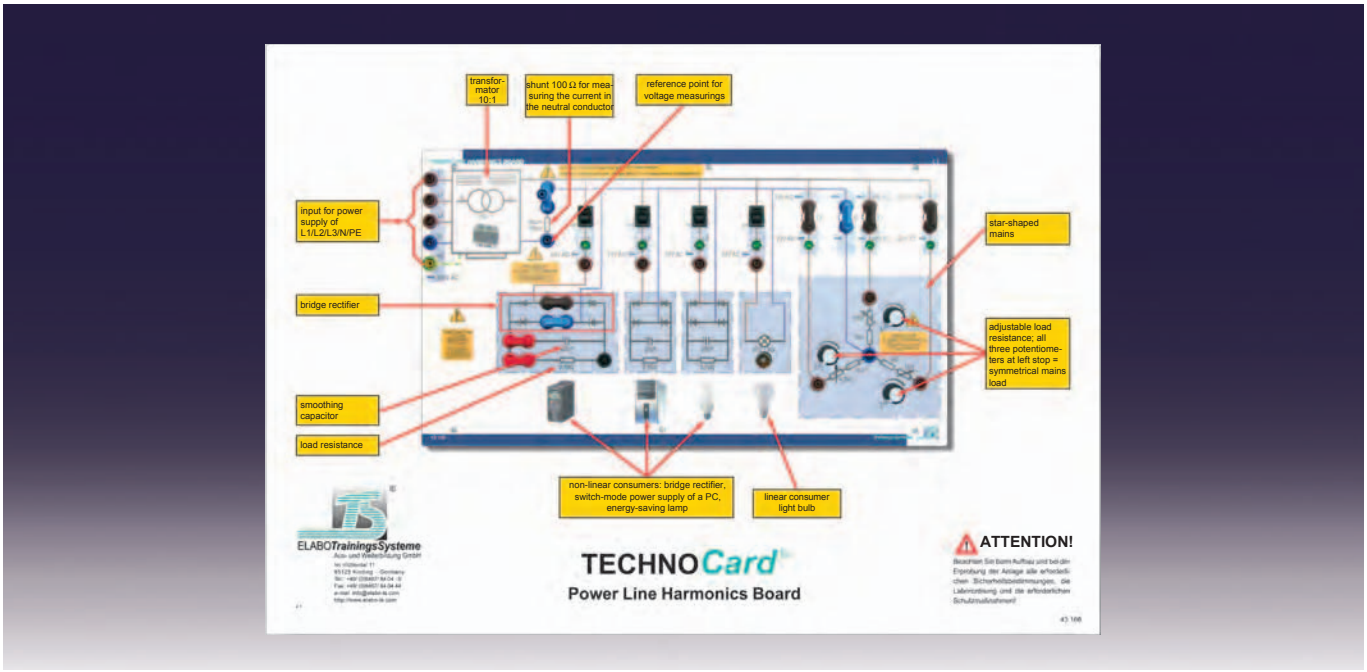
5. Combination of linear and non-linear devices

6. Summarizing questions and practical problems



E43 132CD Transparencies
Loads on the Neutral Conductor

TechnoCards



E43 133 Set ofTechnoCards "Loads on the neutral conductor"

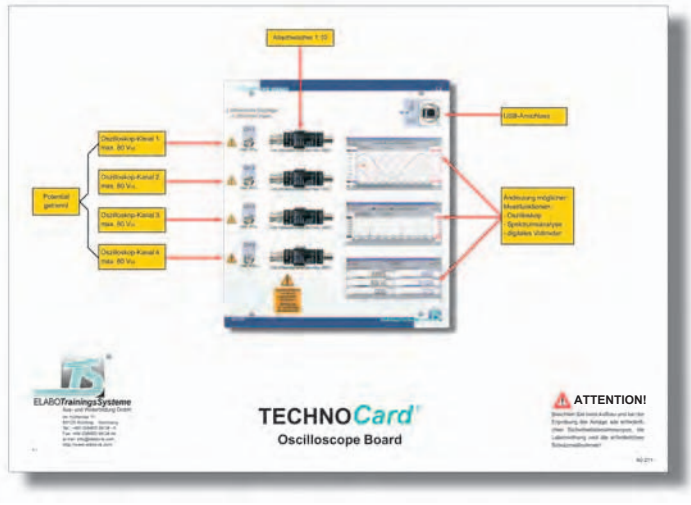
Learning Objectives:

- ✓ Utilization of technical documentation
- ✓ Getting familiar with the components
- ✓ Troubleshooting

Set of TechnoCards "Loads on the neutral conductor"

E43 133 Set consisting of:

- TechnoCard Power Line Harmonics Board (E43 166)
- TechnoCard Oscilloscope Board (E90 271)



Intelligent System Solutions

laboratory table

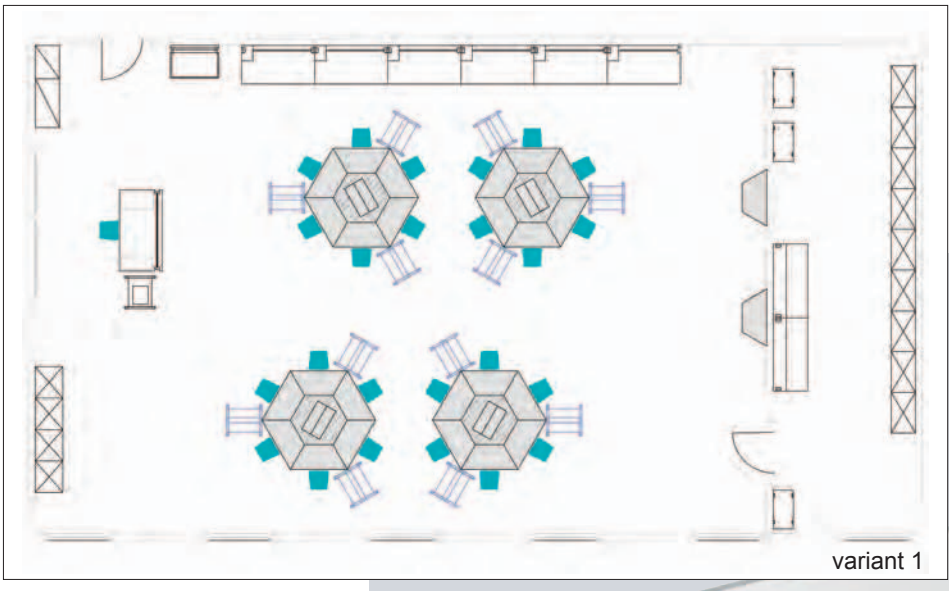
“island” arrangement

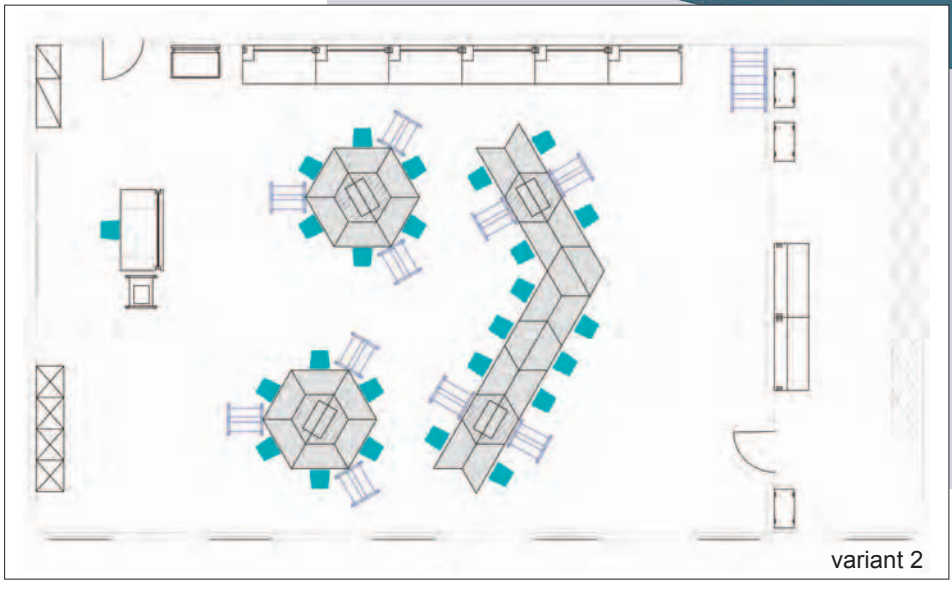
“Safety of Electrical Systems and Devices” laboratory

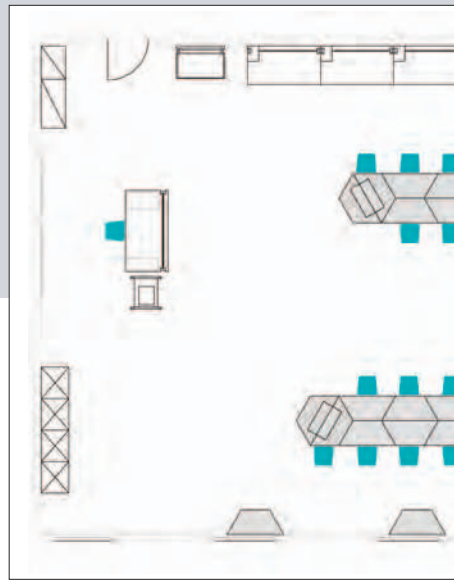
Mobile **L**earning **T**rainer (**MLT**)

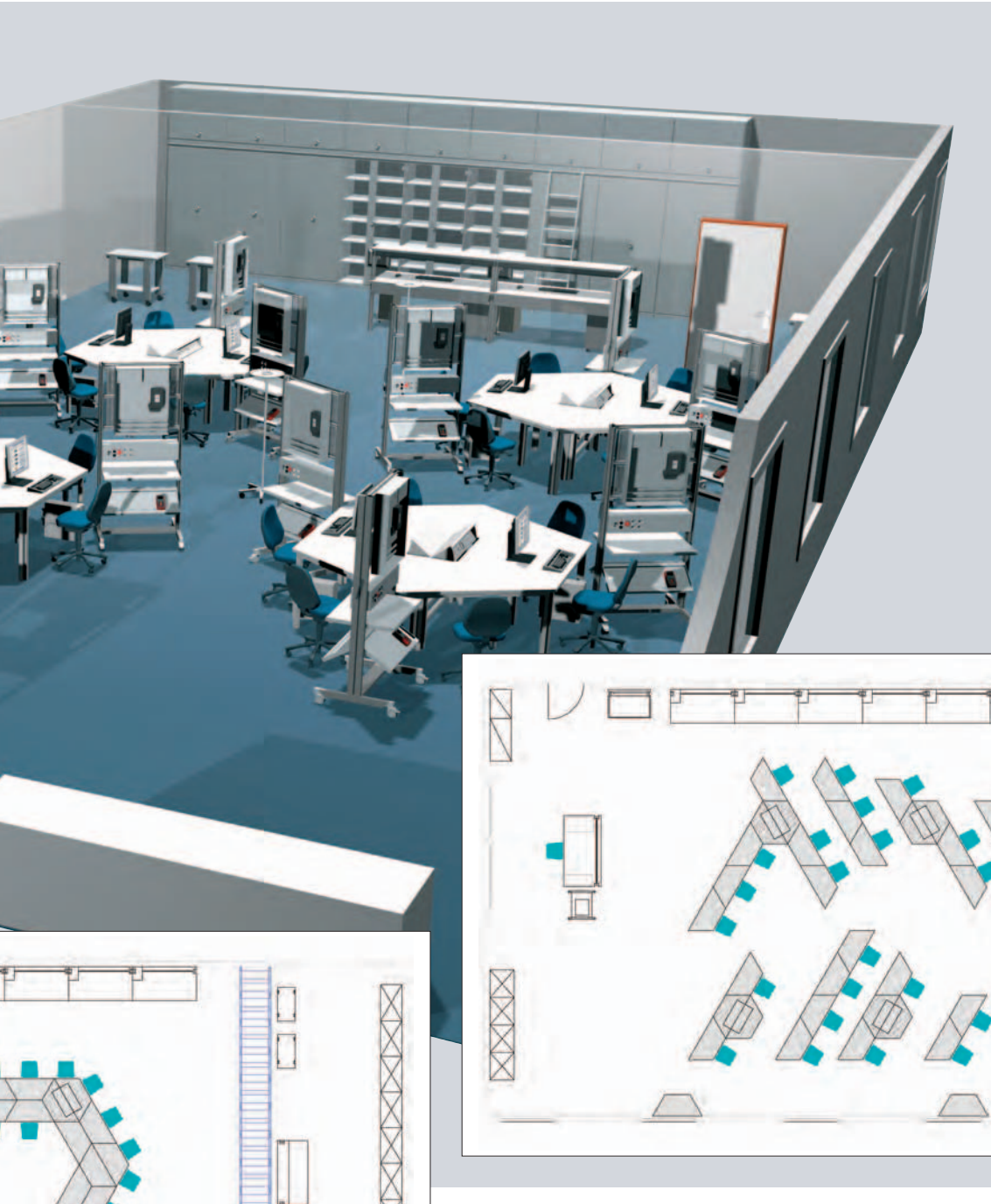
From **planning** to **reality** ...

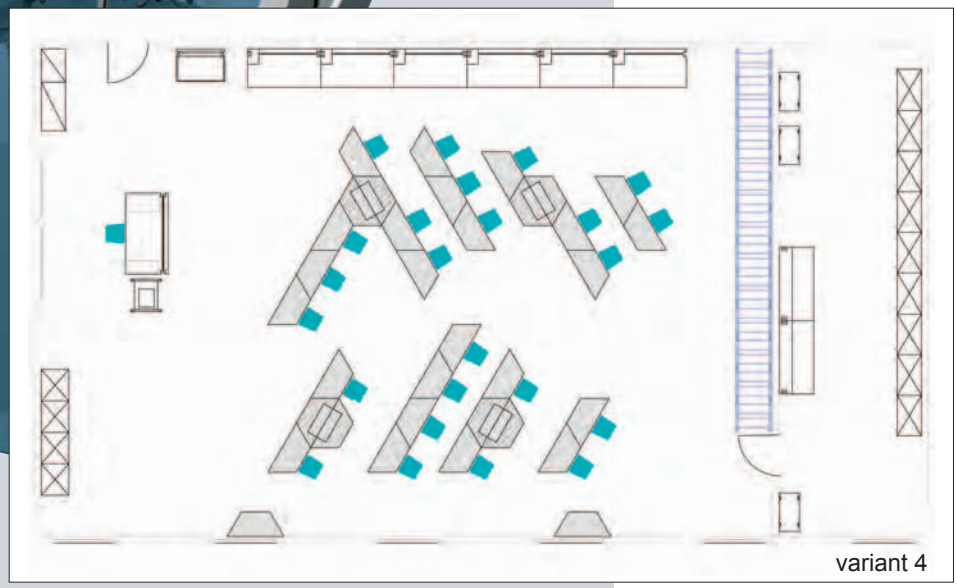
Flexibility due to modular System Elements



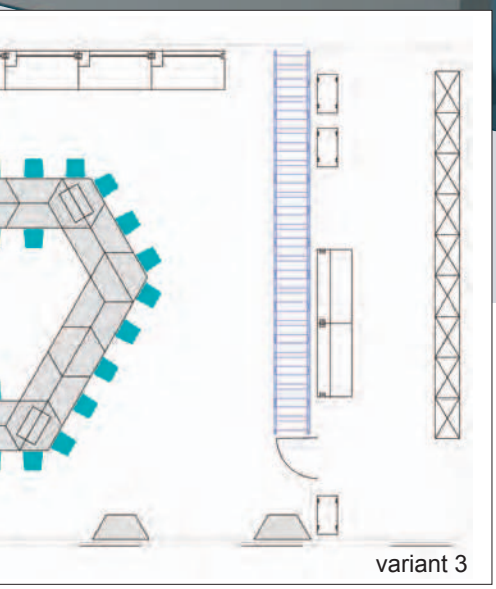








variant 4



variant 3

Mobile structures for enduring versatility

Testing Electrical Devices

Safety of electric devices

42 117 Set ofAppliance Simulator

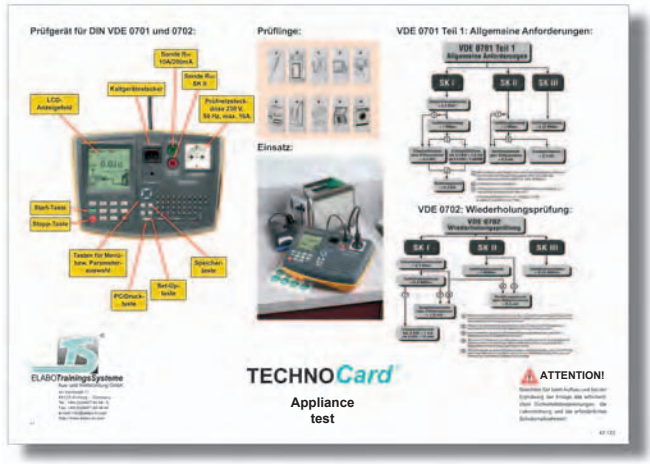
Learning Objectives:

- ✓ Legal provisions
- ✓ Understanding the data on the type plate
- ✓ Describing the protection classes of the devices and assigning symbols
- ✓ Describing the protection types of the devices and assigning symbols
- ✓ Describing the insulation classes of the devices and assigning symbols
- ✓ Testing the suitability of the selected devices for the location
- ✓ Proceeding according to the regulations of repeated tests and drawing up a flow chart of the required measurements
- ✓ Selecting and using measuring and test instruments according and interpreting the measuring results
- ✓ Planning, executing and describing repeated tests of electric devices and writing test protocols
- ✓ Systematic troubleshooting of devices
- ✓ Describing the tests (test steps, limit values)
- ✓ Documenting the repair work

Technical data

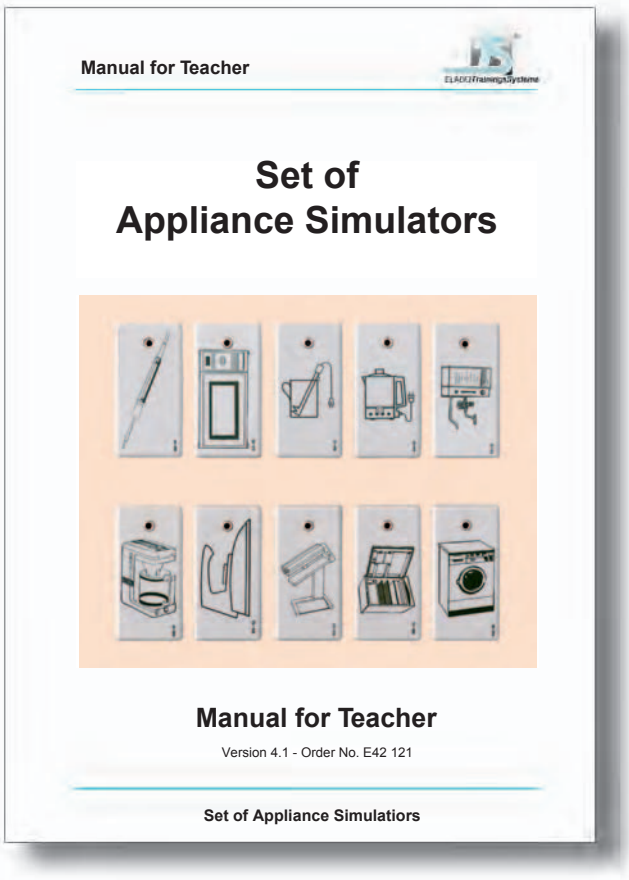
42 117 Set of appliance simulators:
for conducting tests
- protective conductor resistance
- insulation resistance
- equivalent leakage current
- PE potential
- consumer current
- leakage current

consisting of:
- Module: soldering iron
- Module: microwave oven
- Module: immersion coil
- Module: kettle
- Module: water heater
- Module: coffee machine
- Module: electric iron
- Module: rotary ironer
- Module: refrigerator
- Module: washing machine
- A4 plate to hold all the 10 modules

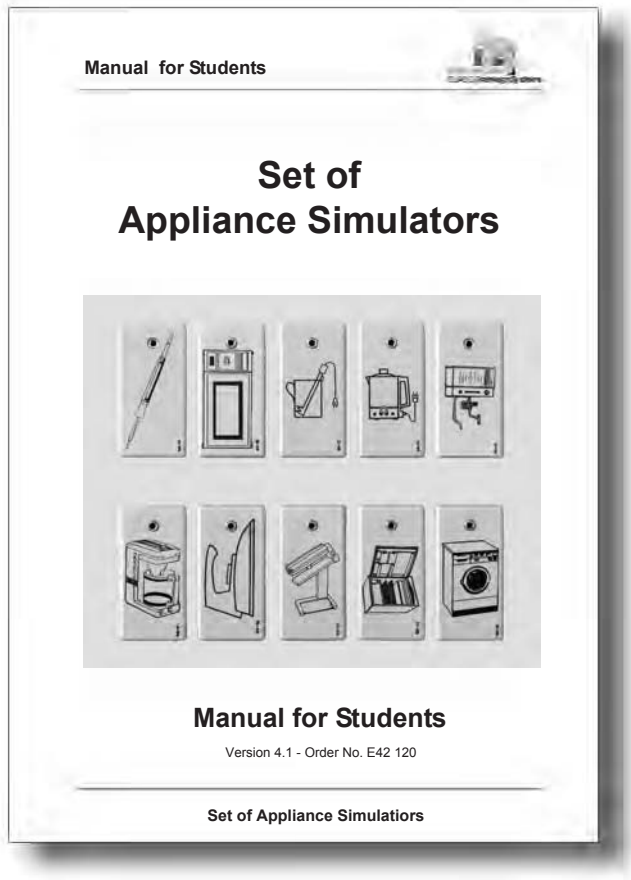


E42 123 TechnoCard
Appliance test

Manual



E42 121 Manual for Teacher
Set of Appliance Simulators



E42 120 Manual for Students
Set of Appliance Simulators

Testing Electrical Devices

Projects: Installation Technology

Learning Objectives:

- ✓ Setup and commissioning of cross and two-way circuits
- ✓ Mounting of meter cabinet and subdistribution
- ✓ Inspection

Project 1:

A company wants to use an empty basement room for storage. For this purpose, a lighting shall be installed consisting of two fluorescent lamps which are to be actuated from three access doors. The room can be ventilated, but not heated. As the room is only intended for storage use, the electrical installations are mounted on the surface. The installation material to be selected should be suitable for damp locations.

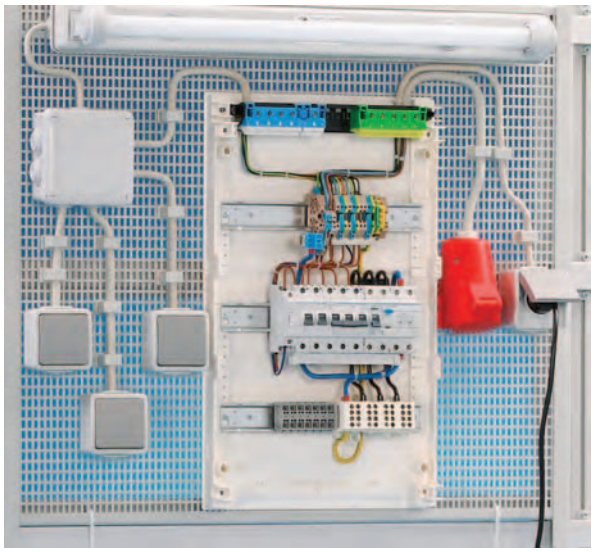
Project 2:

The company does not want to use the basement room from project 1 for storage any longer, but to rent it to another company. For this purpose, the electrical installations have to be modified. The room installations are planned for control via a meter cabinet with T-N-C-S system and subdistribution. The cross circuit established in project 1 is laid idle and replaced by a pushbutton circuit. Furthermore a 16 A CEE socket has to be installed and connected. The electrical installation has to be made in IPX4 and the subdistribution in IP30. Calculation and drawing of the distributionplan is made by means of a planning software. Mounting of the installations has to be efected in compliance with the provisions for protective areas.

Project 3:

The system mounted in project 2 has to be inspected with submission of a measuring and inspection protocol.

Set of devices



Technical data

42 210 Set of components and devices, consisting of:
- 2 x off and two-way switch
- 1 x cross switch
- 1 x light bar
- 1 x fluorescent tube
- 1 x distribution box
- 3 x pushbutton
- 1 x standard socket
- 1 x CEE socket
- 1 x three-phase meter 40A
- 1 x meter cabinet and meter field
- 1 x selective line circuit breaker 3-pole
- 1 x subdistributor AP 3 rows
- 1 x earth leakage circuit breaker
- 1 x line circuit breaker B16A3-pole
- 1 x line circuit breaker B16A1-pole
- 1 x line circuit breaker B10A1-pole
- 1 x remote switch
- 1 x phase bar
- 1 x main line distributor terminals
- 1 x bus bar with terminals
- 1 x set of accessories
- 1 x planning software with the following functions:
  - fully automatic one- and all-pole circuit diagram
  - calculation program/product data base
  - autom. requirements-finding function for meter cabinet

42 211 Basic set of cables and wiring material
- accessories

89 200 Mobile Learning Trainer (MLT) as a double workstation for project work
- accessories

89 210 Exchangeable grid plate for hanging in the frames of the Mobile Learning Trainer (MLT); approx. 766x687x45 mm (wxhxd)

Screws and dowels

Technical data

D90 203 Set dowels 5/10 (100 per unit)
D90 204 Set dowels 5/5 (100 per)
90 055 Set assembly accessories, consisting of:
- dowels 5 x 5 mm, 100 pieces
- dowels 5 x 10 mm, 100 pieces
- screws 3,5 x 12 mm, 100 pieces
- screws 3,5 x 20 mm, 100 pieces
- screws 3,5 x 30 mm, 100 pieces

90 055 Assembly accessory set

Testing Electrical Devices

Manual Installation Technology

On paper and on CD!

Contents of manual:

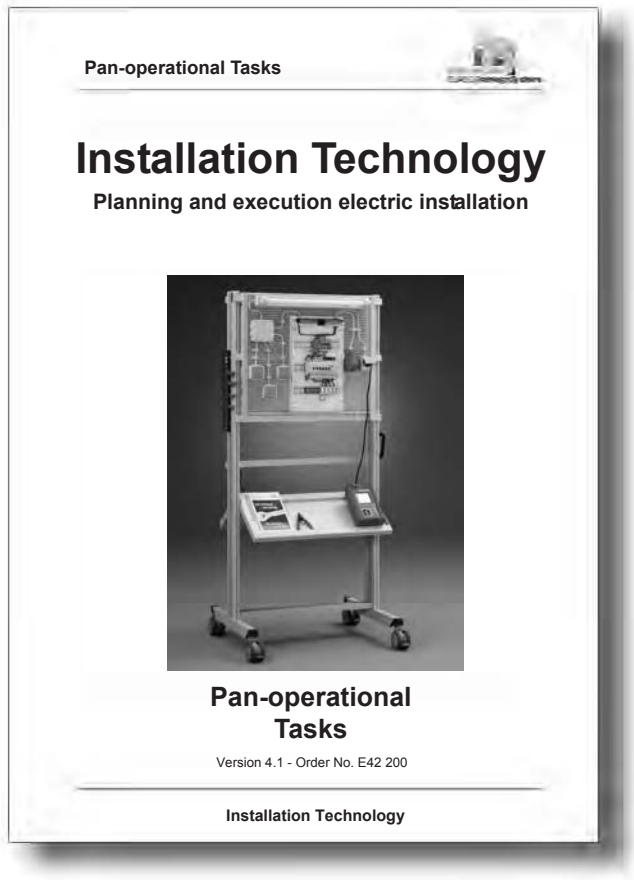
1. **Project 1: Circuit types / circuit setup**
2. **Project 2: Mounting of meter cabinet and subdistributor**
3. **Project 3: Inspection**

Without illustration:

42 202CD Commissioning and trouble shooting: Installation Technology

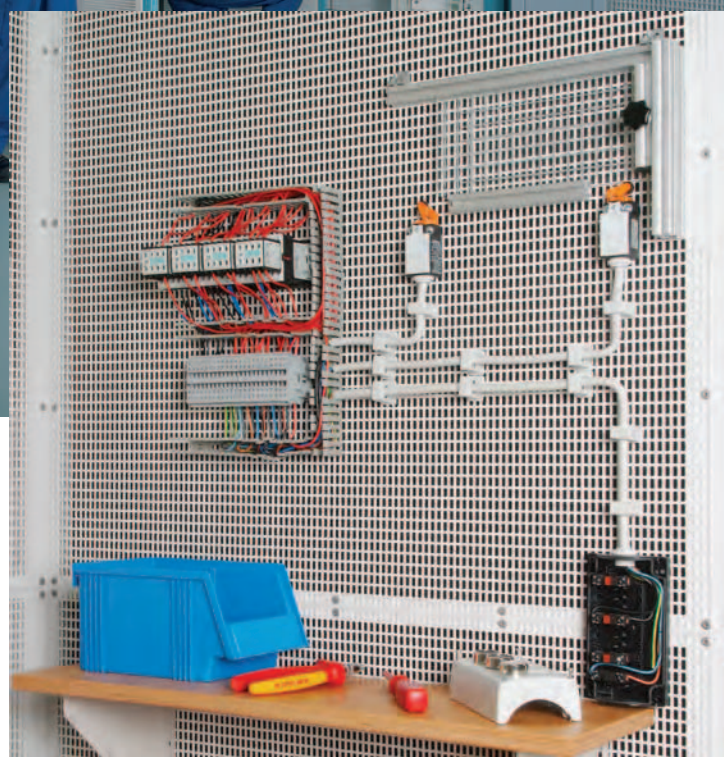
42 203 Presentation aids Installation Technology

E42 201CD Manual Pan-operational Solutions, incl. technical documentation Installation Technology



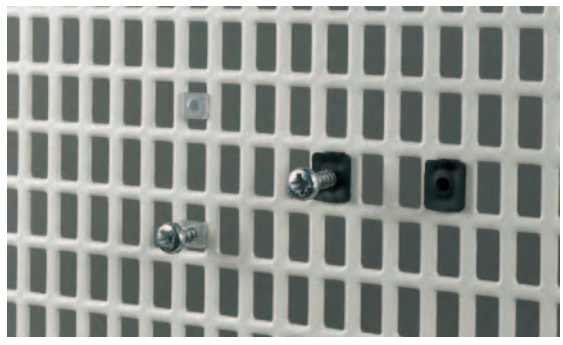
E42 200CD Manual Pan-operationalTasks, Installation Technology

Installation cabins for practical training



ELA605A Installation cabins (1200 x 1000 x 2000

Training close to practice
The installation cabins measuring 1200 x 1000 x 2000 mm, enable practical instruction in switchboard wiring. Surface installation with cable conduit around corners and overhead can be practiced. The collapsible cabins consist of a back wall, two side walls and a ceiling.



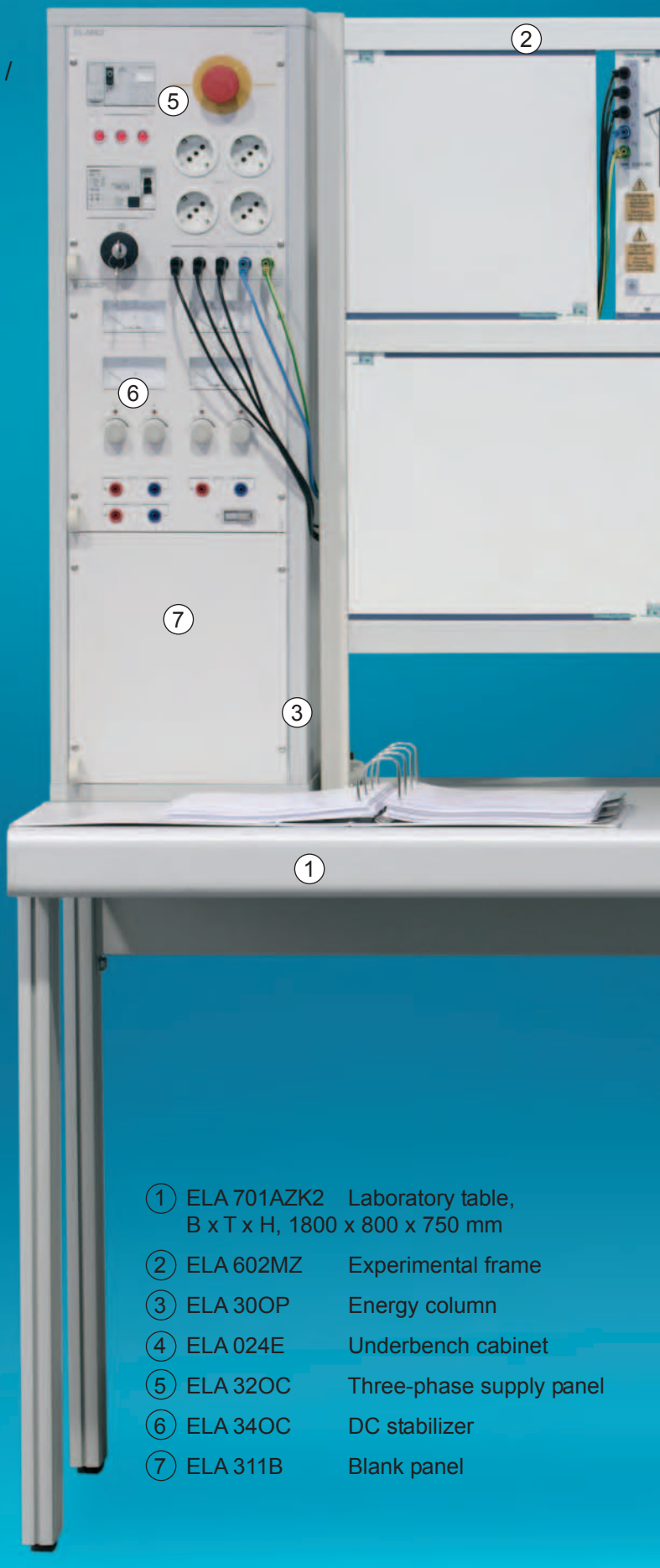
Training Package TP 26.1

Mains Systems and Protective Measures

Learning Objectives:

- ✓ Structure of the public power supply system / incoming mains supply
- ✓ Consumer installation system
- ✓ Selection of the protective measures for a consumer installation
- ✓ Selecting and using measuring and testing instruments for measurings according to: IEC 60364

  Interpreting the measuring results
- ✓ Applying the provisions for the initial and repeated tests and drawing up a flow chart of the required measurements
- ✓ Carrying out initial and repeated tests of electric installations and writing a test protocol



1	ELA 701AZK2	Laboratory table, B x T x H, 1800 x 800 x 750 mm
2	ELA 602MZ	Experimental frame
3	ELA 30OP	Energy column
4	ELA 024E	Underbench cabinet
5	ELA 32OC	Three-phase supply panel
6	ELA 34OC	DC stabilizer
7	ELA 311B	Blank panel

European equivalent to IEC 60364 (6.61):

Austria	ÖVE/ÖNORM E8001
Belgium	A.R.E.I/R.G.I.E
Denmark	Starkstrombekendtgorelsen 6
Finland	SFS 6000
France	NF C 15-100
Germany	DIN VDE 0100/0413
Italy	CEI 64-8
Netherlands	NEN 1010
Norway	NEK 400
Portugal	HD 384
Spain	UNE 20460
Sweden	SS 4364661 / ELSÄK-FS 1999:5
Switzerland	NIN / SN SEV 1000 und NIV
United Kingdom	BS 7671 16th Edition IEE Wiring Regulations

ELABO TrainingsSysteme

Digital multimeters

90 280 Digital multimeter

90 281 True-rms digital multimeter

Technical data

90 280 Digital multimeter:

DC voltage:	0.1 mV - 600 V
AC voltage:	0.1 mV - 600 V
DC current:	1 mA - 10 A
AC current:	1 mA - 10 A
Resistance:	0.1 Ω - 40 MΩ
Capacitance:	1 nF - 10,000 µF
Frequency:	0.01 Hz - 50 kHz
Display:	6,000 counts Analog bargraph with 33 segments
Diode test:	range/resolution: 2,000 mV/1 mV

Technical data

90 281 True-rms digital multimeter:

DC voltage:	0.1 mV - 1000 V
AC voltage:	0.1 mV - 1000 V
DC current:	0,01 mA - 10 A
AC current:	0,01 mA - 10 A
Resistance:	0.1 Ω - 50 MΩ
Capacitance:	1 nF - 10,000 µF
Frequency:	0.01 Hz - 100 kHz
Temperature:	-40°C to 400°C
Display:	6,000 counts Analog baragraph with 33 segments
Diode test:	range/resolution: 2,000 mV/1 mV
Audible continuity tester	

90 282 True RMS logging multimeter

Technical data

90 282	True RMS logging multimeter with PC interface and software:
DC voltage:	1 µV - 1000 V
AC voltage:	1 µV - 1000 V
DC current:	0.01 µA - 10 A
AC current:	0.01 µA - 10 A
Resistance:	0.01 Ω - 500 MΩ
Capacitance:	1 pF - 50,000 µF
Frequency:	0,01 Hz - 1 MHz
Temperature:	-200.0 °C to 1090.0 °C
Conductance:	0.01 nS - 500 nS
Display:	50,000 counts 320 x 240 dot LCD
Logging memory:	180 hours

Accessories included!

Electric testers and current clamp meter

90 284 Phase rotation indicator for 3-phase systems

90 285 Voltage and continuity tester

Technical data

90 284 Phase rotation indicator for 3-phase systems:

Voltage range:	40 - 700 V
Frequency range:	15 - 400 Hz
Operating time:	continuous
Power supply:	from unit under test

Technical data

90 285 Voltage and continuity tester:

DC voltage:	12 - 690 V
AC voltage:	12 - 690 V
Continuity:	0 - 400 kΩ
Phase rotation:	100 - 690 V

90 283 Leakage current clamp meter

Technical data

90 283 Leakage current clamp meter:

General data:	
Detection mothod:	mean value
Display:	digital disply: 3200 counts bar-graph display: LCD with 32 segments
Circuit voltage:	≤ 300 V rms
Diameter of measurable conductor:	max. 40 mm
Electrical data:	
3 mA:	resolution: 0.001 mA
30 mA:	resolution: 0.01 mA
3 A:	resolution: 0.01 mA
60 A:	resolution: 0.1 mA
Max. permissible current:	60 A rms

The use of current clamp meters in training courses is of growing importance, as tendency goes towards not cutting off circuits during troubleshooting!

ELABO TrainingsSysteme

Installation and appliance testers

90 286 Installation tester

Technical data

90 286 Installation tester:

AC voltage:	range: 500 V
Continuity testing:	ranges: 20 Ω, 200 Ω, 2000 Ω
Insulation resistance measurements:	test voltages: 50 - 100 - 250 - 500 - 1000 V insulation: 10 kΩ - 50 MΩ live circuit detection: inhibits test if terminal voltage > 30 V prior to initiation of test
Loop impedance measurement:	loop impedance: phase to earth line impedance: phase to neutral
RCD testing:	
Tripping time test (ΔT):	current setting: 10, 30, 100, 300, 500, 1000 mA multiplier: x 1 - x 5
Tripping current (ramp test):	50% to 110% from RCD's rated current
Earth Resistance Test (R_E):	measuring range 200 Ω
Phase sequence:	icon Phase Sequence Indicator is active

German version depicted!
Country-specific designs on request:

Supplementary accessories:
90 288 Data management software
90 289 I/O adapter infrared– USB

Accessories included!

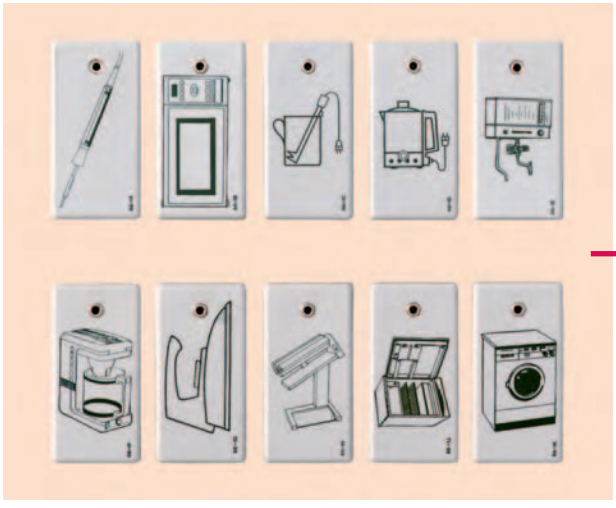
Installation and appliance testers

90 287 Appliance tester

Technical data

90 287 Appliance tester:
Earth bond test (Rpe): display range: 0 to 19.99 Ω
Insulation test (Riso): display range: 0 to 299 MΩ
Touch current test: display range: 0 to 1.99 mAAC
Substitute leakage current test: display range: 0 to 19.99 mAAC
Load/leakage tests:
load current: display range: 0 to 13 A
load power: display range: 0 to 999 VA
leakage current: display range: 0 to 19.99 mA
PELV test
Tester with keyboard for data entry, back-up data storage with compact flash memory card, auto-test sequences

German version depicted!
Country-specific designs on request:



Test with appliance simulators

Data Management Software

90 288 Data management software

Technical data

90 288 Data management software:
- Comfortable, extensible software for administration and reporting of installation tests
- Comfortable, extensible software for administration and reporting of mobile appliances
- Clear and logic hierarchy, easy to handle directory structure always visible
- Measurement data transfer from test instrument to PC
- Print of test reports

90 289 I/O adapter infrared– USB

Technical data

90 289 I/O adapter infrared – USB
- Interface for data transmission
- incl. CD-ROM with drivers

Power quality analyzers and clamp meters

90 290 Single-phase power quality analyzer

Technical data

90 290 Single-phase power quality analyzer:

Measuring ranges:	true-rms voltage (AC + DC): 5 V - 1250 V
	true-rms current (AC + DC): 60A - 1250 kA
	frequency: 10 Hz - 15 kHz
	CF crest factor: 1.0 - 10.0
	power W, VA, VAR: 250 W - 1.56 GW
	power factor λ: 0.0 - 1.0
	cos φ: 0.0 - 1.0
	harmonics (V, A, W): fundamental - 51st harmonic
	(40 ... 70 Hz at fundamental harmonic)
	resistance: 500 Ω - 30 MΩ
	capacitance: 50 nF - 500 µF
Recordings:	parameters: V, A, Hz, W, VA, VAR, λ, cos φ
	times: 4 min to 16 days
Transient recording:	minimum pulse width: 40 ns
Inrush current:	ranges: 1 A - 1,000 A
	times: 1 s - 5 min

Technical data

90 290 Single-phase power quality analyzer:
Oscilloscope functions: DC, AC, AC + DC, peak-peak, frequency, duty cycle,
phase, pulse width, crest factor
sampling rate: 25 MS/s:
band width channel 1: 20 MHz (voltage)
band width channel 2: 15 kHz (current)
Memory: 20 screens
Current clamp: 400 A: 5 A - 400 A
USB interface cable
Test leads
Line voltage adapter/battery charger
Software

Power and mains quality analyzers

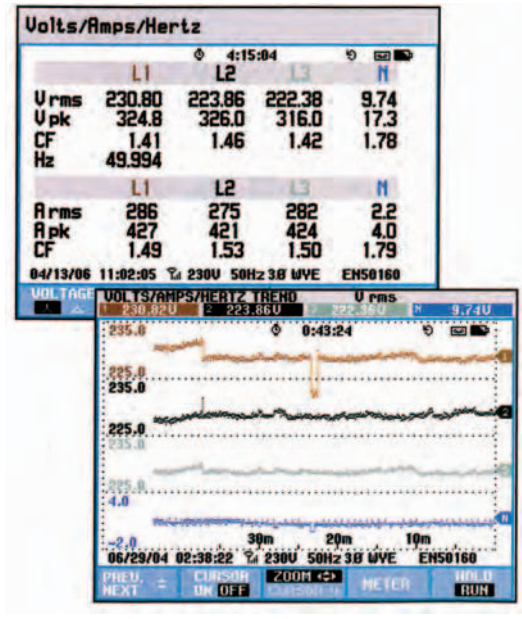
90 291 Three-phase power quality analyzer

Technical data

90 291 Three-phase power quality analyzer:

Measuring ranges:	true-rms voltage (AC + DC): 1 V - 1,000 V
	true-rms current (AC + DC): 0.5A - 400 A
	frequency: 0 Hz - 3,500 Hz
	CF crest factor: 1.0 - 10.0
	power W, VA, VAR: 1.0 VA ... 20 MVA (depending on current clamp)
	power factor λ: 0.0 - 1.0
	cos φ: 0 - 1.0
	harmonics (V, A, W): fundamental - 49th harmonic
	(42.5 ... 57.5 Hz at fundamental harmonic)
Recordings:	sags and swells of current and voltage:
	Vrms: 0 ... 100% of rated voltage
	Arms: 0 ... 20 kA
	autotrend recording
Transient recording:	minimum pulse width: 5 µs
Inrush current:	ranges: 0 A - 20 kA (depending on current clamp)
	times: 7.5 s - 30 min
Memory:	50 screens
Current clamp:	400 A: 5 A - 400 A
Accessories:	USB interface cable
	Test leads
	Line voltage adapter/battery charger
	Software

Accessories included!



AutoTrend automatically records all the displayed parameters in the background

Measuring experiments at ELABO*TrainingsSysteme*

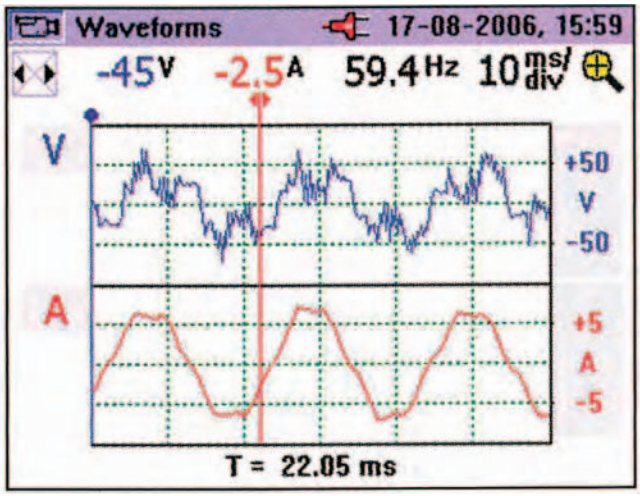
Power quality anlyzers and clamp meters

90 292 Power quality clamp meter

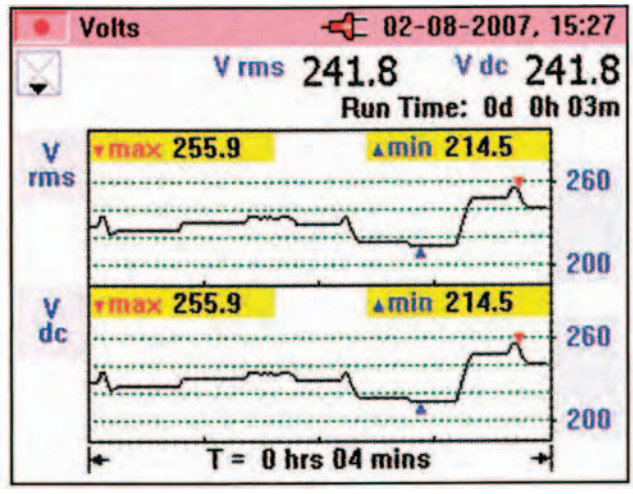
Technical data

90 292 Power quality clamp meter:

Measuring ranges:	true-rms voltage (AC + DC): 4 V - 1,000 V
	true-rms current (AC + DC): 40 A - 2,000 A
	frequency: 15 Hz - 1 kHz
	CF crest factor: 1.1 - 3.0
	power W, VA, VAR: 4 kW - 1,200 kW
	power factor λ: 0.3 - 1.0
	cos φ: 0.3 - 1.0
	harmonics (V, A, W): fundamental - 30th harmonic
	(45 ... 65 Hz at fundamental harmonic)
	energy: 4 kWh - 40,000 kWh
Inrush current:	ranges: 40 A - 2,000 A
	times: 1 s - 5 min
Oscilloscope functions:	current: 10 A - 2,000 A
	voltage: 4 V - 1,000 V
	time base: 2.5 ms - 50 ms/div.
Memory:	50 screens; 150,000 individual measurements
Accessories:	USB interface cable
	Test leads
	Line voltage adapter/battery charger
	Software



Display of signal forms for device testing and adjusting



Recording of parameters over a longer period for detecting intermitting faults

Thermal imager

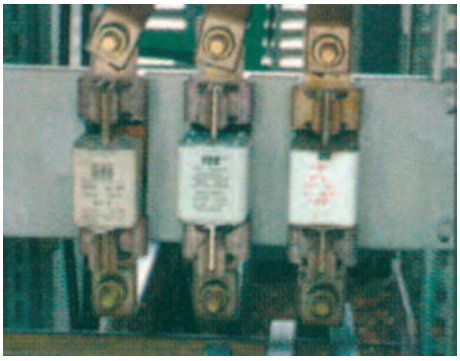
90 293 Thermal imager

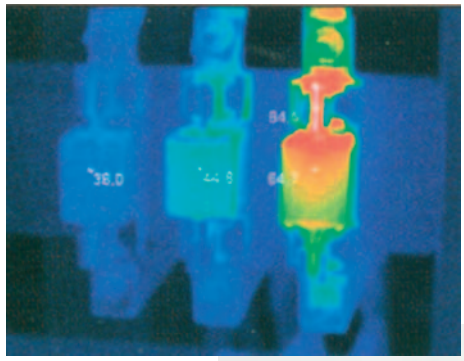
Fast and easy reporting with InsideIR software

Technical data

90 293 Thermal imager:

Thermal specs:	temperature range: -10 to +350 °C detector type: 128 x 96 thermal element focal plane array uncooled microbolometer temperature indication resolution: 0.1 °C
Optical/IR:	spectral range: 7.5 - 14 microns target sighting: single laser dot optical resolution: 75:1 min. diameter measurement spot: 8.1 mm at 61 cm field of view (FOV): 20° horizontal x 15° vertical
Controls:	focus: manual, min. focus distance: 15 cm temperature scale: °C or °F selectable palettes: greyscale, ironbow or rainbow, selectable
Operational:	LCD: TFT technology; optimized for both indoor and outdoor use, 70.5 mm x 53.5 mm thermal analysis software: InsideIR PC operating systems: Windows 2000/XP
Electrical:	power: rechargeable battery pack, min. 3 h data transfer: USB interface storage device: flash memory





Temperature differences between phases are an indicator for dissymmetry, harmonic distortions, failing components, poor connections or wiring mistakes. These may cause higher energy cost s or damages on cables or machines, or even electrical fires. Therefore even minor temperature dif ferences between phases should be examined to find out their root.

Accessories included!

Information and Consultation

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- ▶ Comprehensive system determination
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- ▶ Classroom layout concepts
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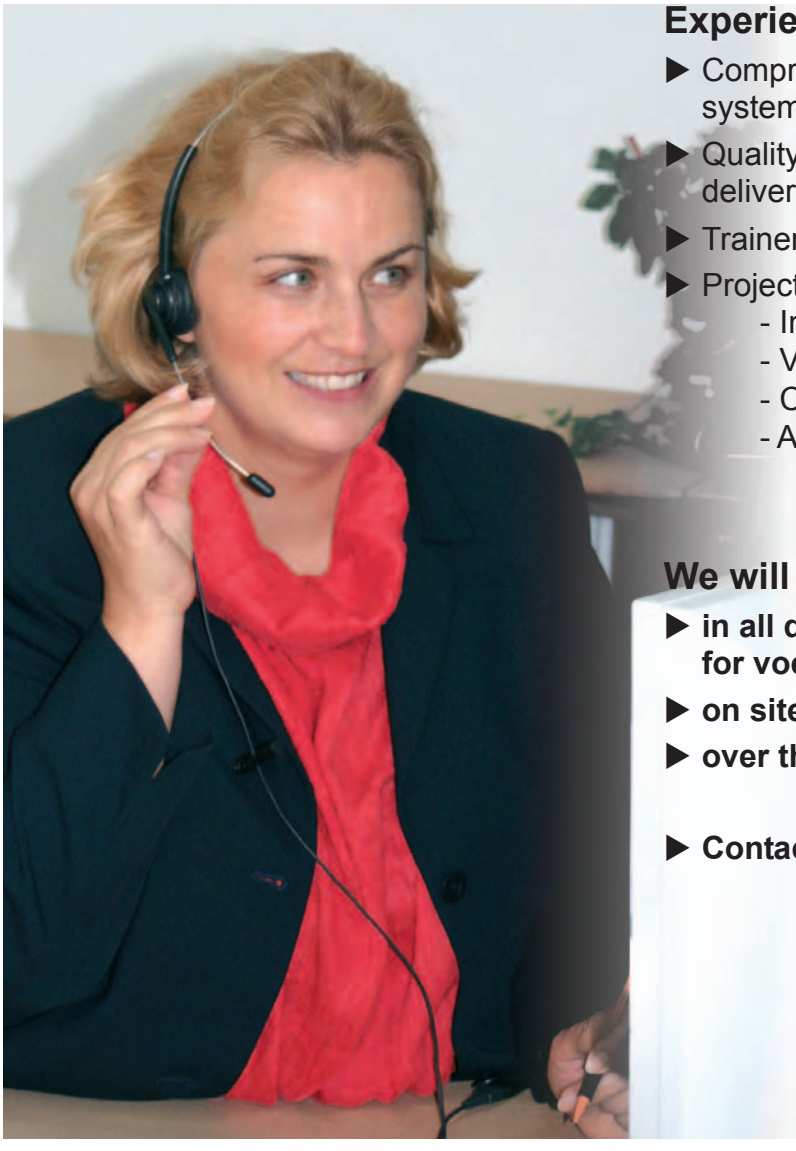
- ▶ Joint compilation of offers
- ▶ Information about our products / manuals
- ▶ Planning of seminars

Where this catalogue ends, we start consulting ...



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❑ 90 293	Thermal imager (page 58)

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