



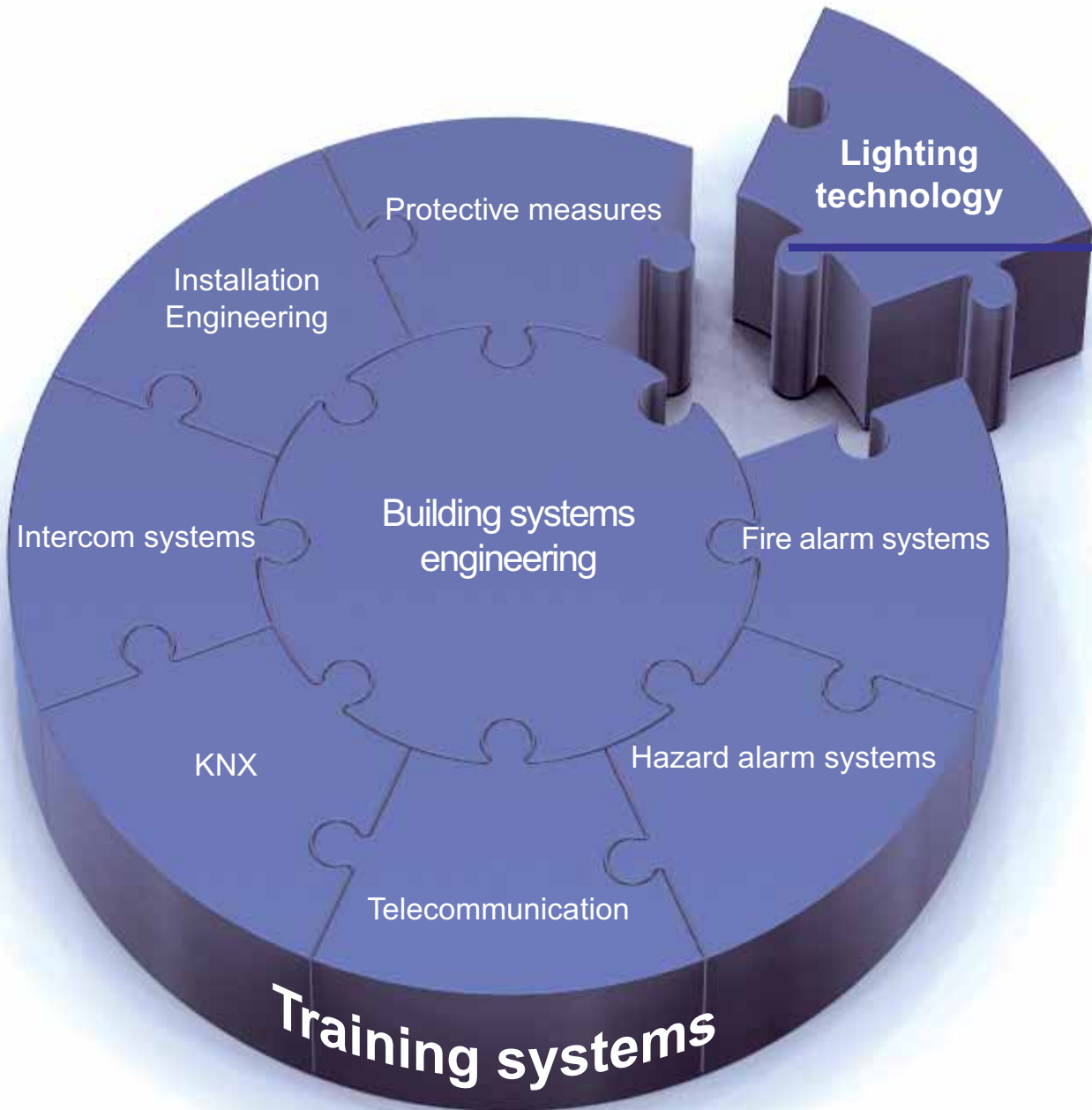
# Installation Engineering

## Lighting Technology



# PROJECTING LIGHTING SYSTEMS

and putting them into operation



INSTALLATION ENGINEERING



Page 4 - 9

ENERGY SAVING LAMPS



Page 10 - 15

FLUORESCENT LAMPS



Page 16 - 23

LED EFFECT LIGHTING



Page 24 - 29

LED LIGHT MANAGEMENT SYSTEMS



Page 30 - 35

SPECIAL LAMPS



Page 36 - 41

DALI CONTROLLERS



Page 42 - 47

INFORMATION AND CONSULTING

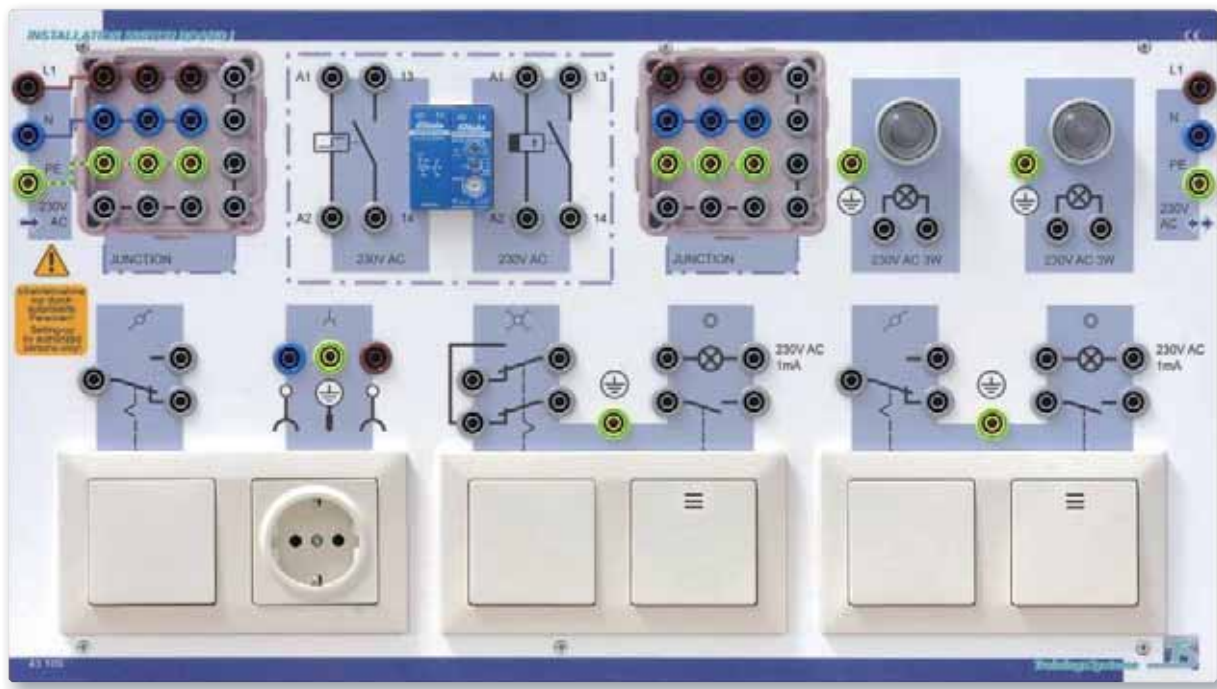


Page 48 - 49



# INSTALLATION ENGINEERING

## Installation Switch Board I



43 109 Installation Switch Board I

### LEARNING OBJECTIVES

- ✓ Planning and realizing electrical installations
- ✓ Analyzing circuits: components, function description, operation principle
- ✓ Commissioning and troubleshooting

### Technical Data

- 2 distribution fields
- 2 two-way switches
- 2 pushbuttons
- 2 pilot lamps for pushbuttons
- 1 intermediate switch
- 1 Schuko socket
- 1 remote switch
- 1 universal staircase relay with off-prewarning timer, settable time: 1...30 min
- 2 indicator lamps for free wiring
- Connection of all in- and outputs via safety sockets (4 mm)

### Mechanical design:

- Experimenting Board in A4 format with photorealistic, four-colour front panel design.
- Wiring designed according to standard colour code.
- A special coating makes the panel surface scratch-proof.
- Didactic standard labelling with operating instructions and connection possibilities facilitate commissioning by the user.



## Experimental Modules



20 108 Schuko socket  
250 V / 16 A



20 123 Staircase relay  
230 V, 1...30 min



20 124 Junction box



20 118 Pushbutton, blank

### 20 196 Set of Experimental Modules

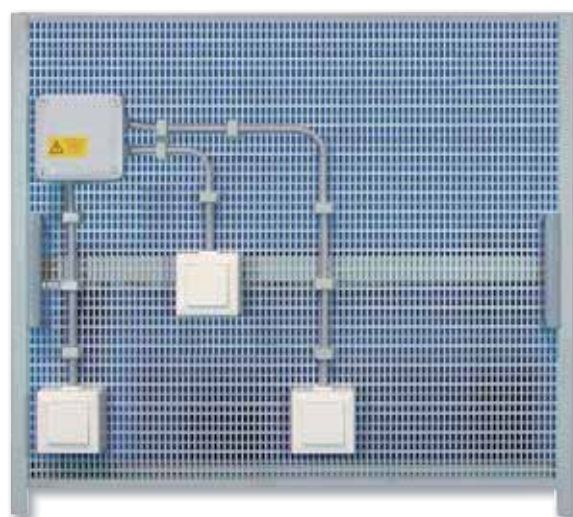
#### 13-part module set consisting of:

- 1 Schuko socket
- 1 lamp socket E27 with lamp 60 W / 230 V
- 1 on/off switch 1-pole
- 2 two-way switches
- 1 intermediate switch
- 2 pushbutton switches, blank
- 1 current surge relay 230 V, 1 NO
- 1 staircase relay 230 V, 1..30 min
- 1 lamp socket, 3-fold, E14 with lamps 230 V / 25 W
- 2 junction boxes

### 20 191 Moulded Tray

- for experimental modules  
(w x h x d) 310 x 700 x 35 mm

## Electrical Circuit Components



Example:

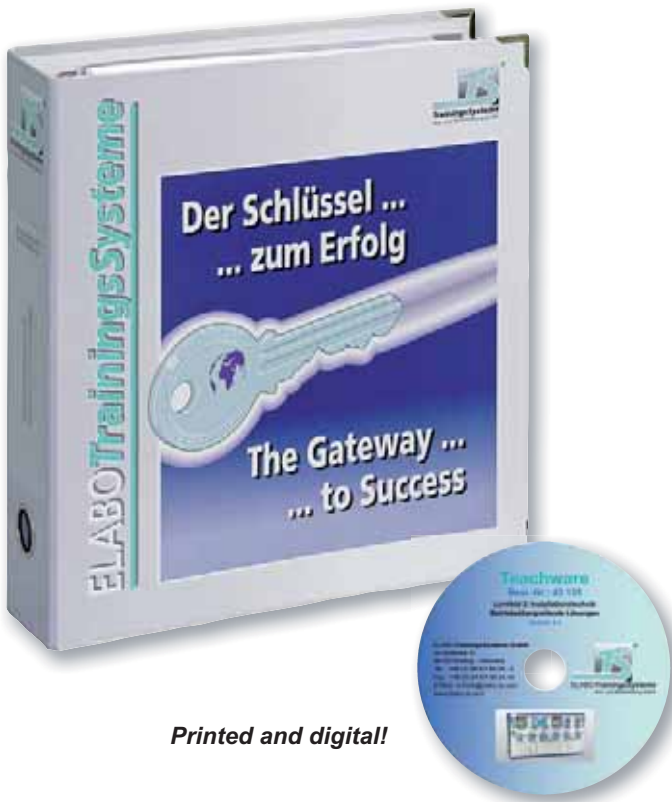
20 020 Set of electrical circuit components  
mounted on a grid board

### 20 020 Set of Electrical Circuit Components

- consisting of:
- 1 on/off switch
  - 1 two-circuit switch
  - 2 two-way switches
  - 1 intermediate switch
  - 3 pushbuttons with light symbol
  - 1 Schuko socket
  - 2 Schuko plugs
  - 3 junction boxes
  - 3 indicator lamps
  - 3 lamps
  - 1 automatic staircase switch
  - 1 current surge relay
  - 4 fluorescent lamp holders
  - 2 starter holders
  - 4 starters (for single and series operation)
  - 2 chokes 18 W
  - 1 choke 36 W
  - 2 fluorescent lamps 18 W, shatterfree
  - 1 capacitor 3.6  $\mu$ F
  - 1 capacitor 4.5  $\mu$ F
  - 2 mounting brackets for capacitors
  - 1 pushbutton I-0-II
  - 3 contactors 230 V, 3-pole, 2NO/2NC
  - 2 tophat rails
  - 1 time relay, on-delay
  - 30 pressure fastening clips
  - 1 set of fixing material
  - 1 set of push-in wire connectors
  - 2 moulded storage trays

# COURSEWARE

## Manual

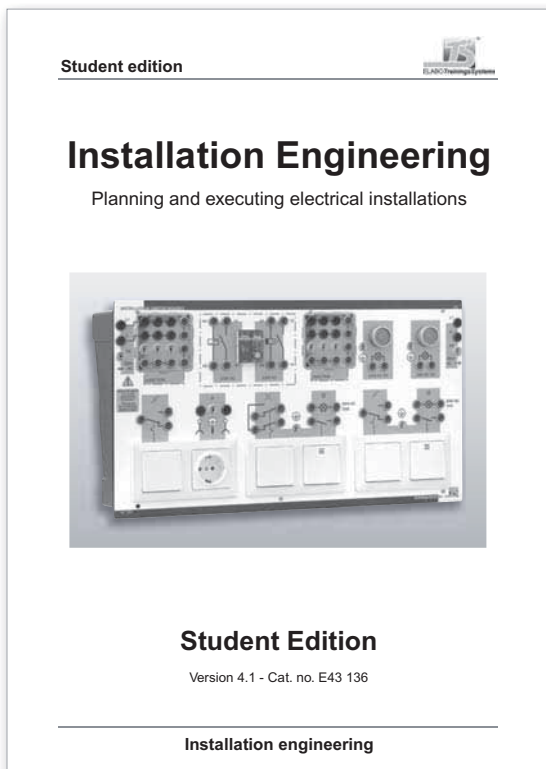


**Printed and digital!**

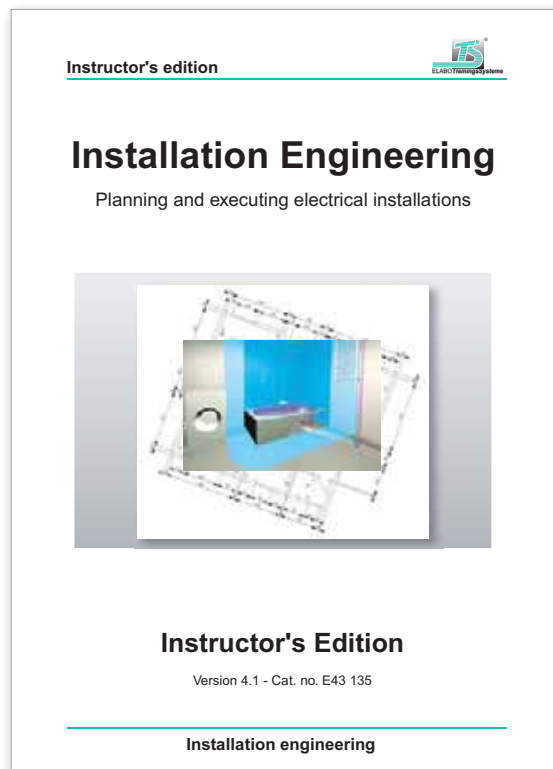
### Manual – Contents

Customer inquiry, customer consulting  
 Order analysis, order planning  
 Selection of the components  
 Work sequence and work preparation  
 Construction  
 Commissioning  
 Technical documentation

- **Project 1**  
 Fundamentals, electronic symbols, classification of objects, cable installation, insulating and wiring of cables and lines
- **Project 2**  
 Cut-off circuit
- **Project 3**  
 Two-way circuit
- **Project 4**  
 Two-way economy circuit with wall outlet
- **Project 5**  
 Two-way control circuit
- **Project 6**  
 Pushbutton circuit
- **Project 7**  
 Stairway lighting circuit




*E43 136CD Manual: Installation engineering  
 Planning and executing electrical installations  
 Student edition*




*E43 135CD Manual: Installation engineering  
 Planning and executing electrical installations  
 Instructor's edition*

Transparency set



## Installation Engineering

Planning and executing electrical installations



### Transparency Set

Version 4.1 - Cat. no. E43 137

Installation engineering

## Transparency set – Contents


- Installation Switch Board I
- Electronic symbols in installation plans
- Classification of objects
- Types of installations
- Junction boxes
- Junction boxes (windproof)
- Junction boxes (accessories)
- Wires and cables
- Wall-mounted installation
- On-off circuit
- Two-way circuit
- Intermediate circuit
- Staircase circuit
- Installation zones (general)
- Installation zones (bathroom)
- Installation zones (kitchen)
- Methods of electrical wiring
- IP protection types
- Protection type symbols
- Impulse switches
- Staircase time switches

Printed and digital!



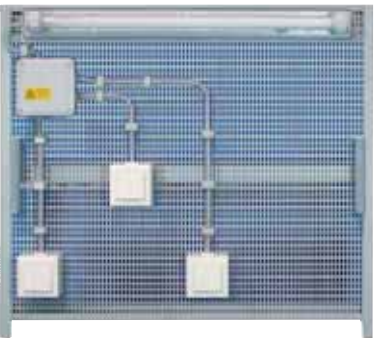
E43 137 Manual: Installation engineering  
Planning and executing electrical installations  
Transparency set

Commissioning and troubleshooting



## Installation Engineering

Planning and executing electrical installations

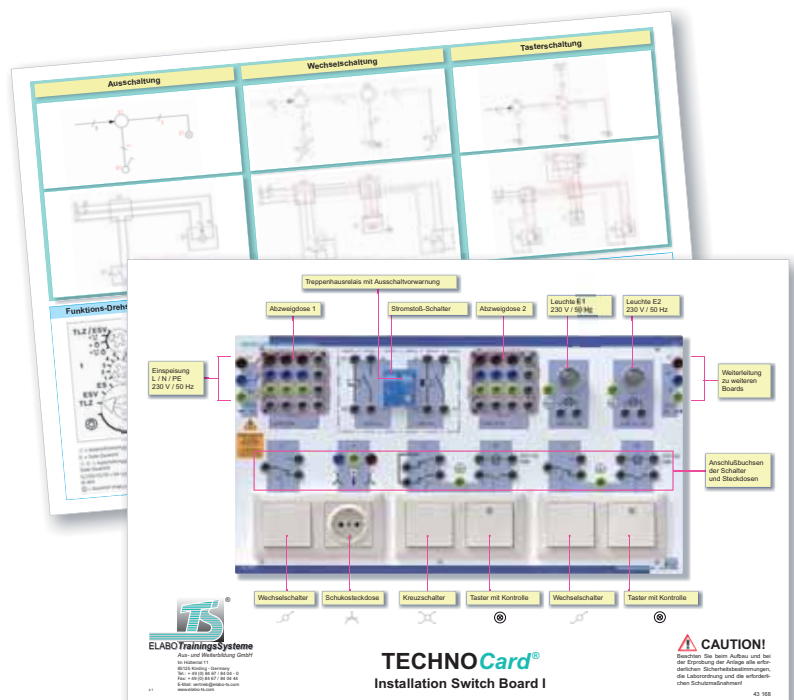


### Commissioning and Troubleshooting

Version 4.3 - Cat. no. E42 202

Installation engineering

## TECHNOCard®



TechnoCard®  
Installation Switch Board I

**CAUTION!**  
Beachten Sie beim Aufbau und bei der Fehlersuche die Angabe der elektrischen Sicherheitsabstände, die Leiterabstände und die verbleibende Schutzabstände!

E42 202CD Manual: Installation engineering  
Planning and executing electrical installations  
Commissioning and troubleshooting

E43 168 TECHNOCard® Installation Switch Board I



# BUILDING SYSTEM TRAINER

Flush mounted installation

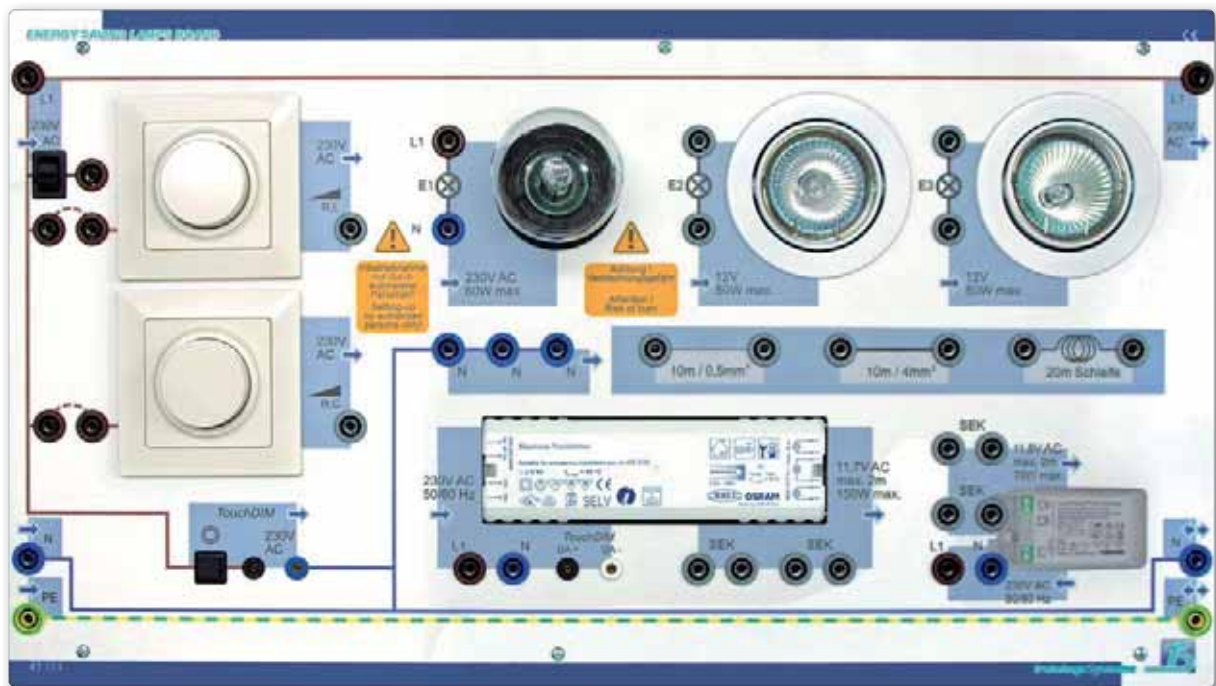






## ENERGY SAVING LAMPS

## Energy Saving Lamps Board



43 114 Energy Saving Lamps Board

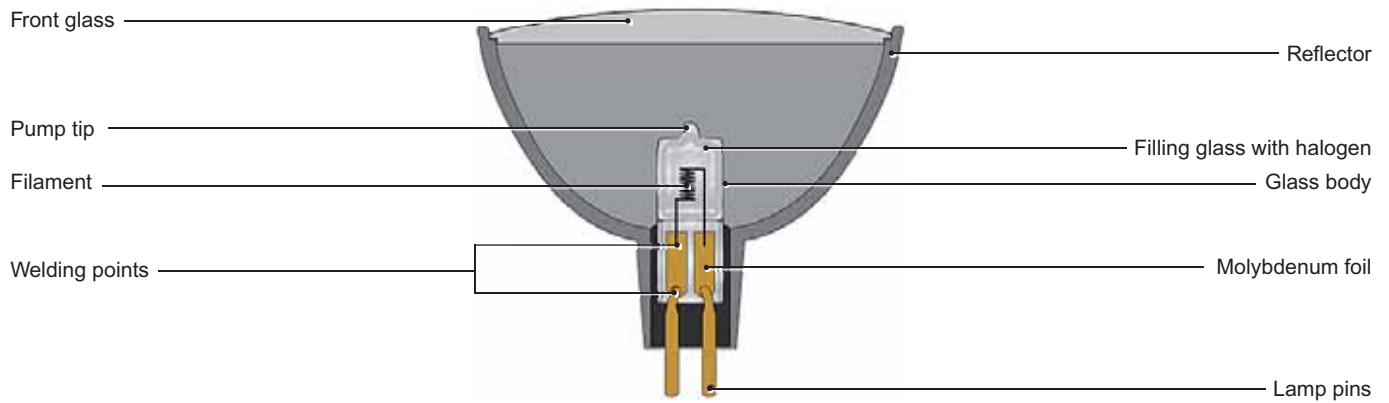
## LEARNING OBJECTIVES

- ✓ Principles of lighting technology, lighting current, light intensity, luminance intensity, efficiency, light density
- ✓ Types of lamps, thermal radiators, discharge lamps and solid radiators
- ✓ Lamp control gear, electronic control gear
- ✓ Dimming lamps
- ✓ Evaluation of applications
- ✓ Calculations of lighting systems
- ✓ Metrological investigation of lamps
- ✓ Networking of operating devices via DALI
- ✓ Control and diagnosis of operating devices via DALI

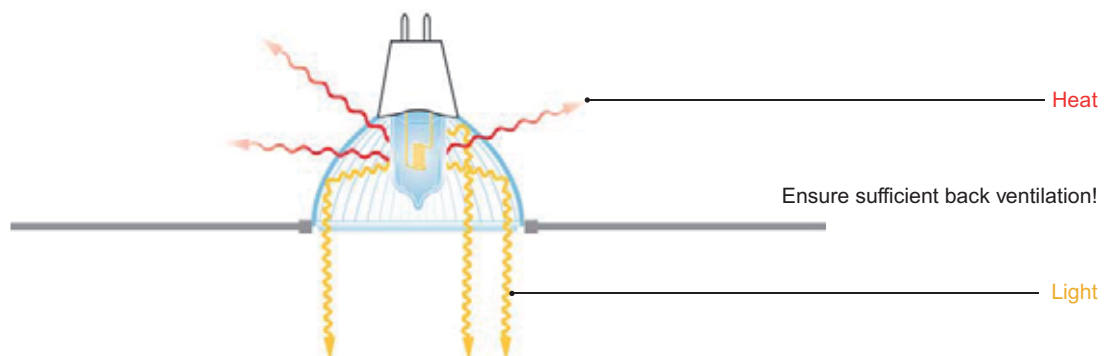
## Technical data

- 1 dimmer for incandescent lamps
- 1 lamp holder E27
- 1 dimmer for electronic transformers
- 1 electronic ballast for LV halogen lamps with DALI interface and TOUCH DIM function
- 1 electronic transformer for LV halogen lamps
- 2 LV halogen lamps max. 50 W
- 1 set of lamps for 43 114
- 1 standard LV halogen reflector lamp
- 1 ECO LV halogen reflector lamp
- 1 unit HV halogen incandescent lamp E27 / 28 W
- 1 energy-saving lamp 5 W
- 1 LED lamp E27 / 8 W
- 1 simulation of small conductor cross-section
- 1 simulation conductor loop
- 1 pushbutton for TOUCH DIM function
- 1 switch on / off
- All the required connections via 4mm and 2mm safety sockets

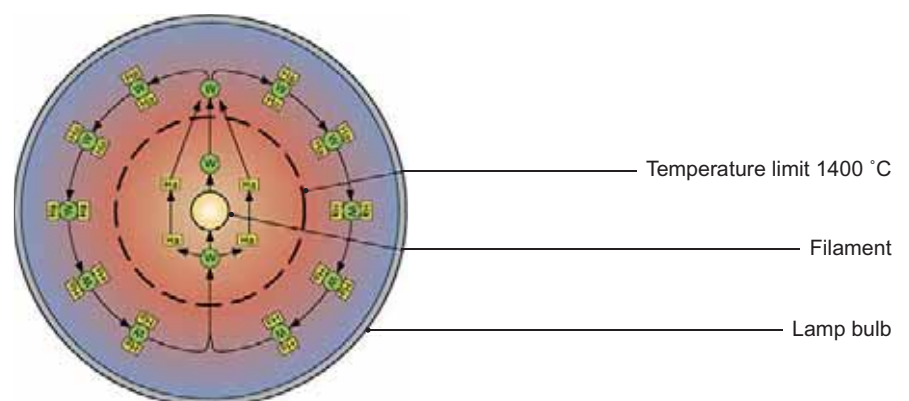
## Components of a halogen incandescent lamp





## Cold light reflector lamp



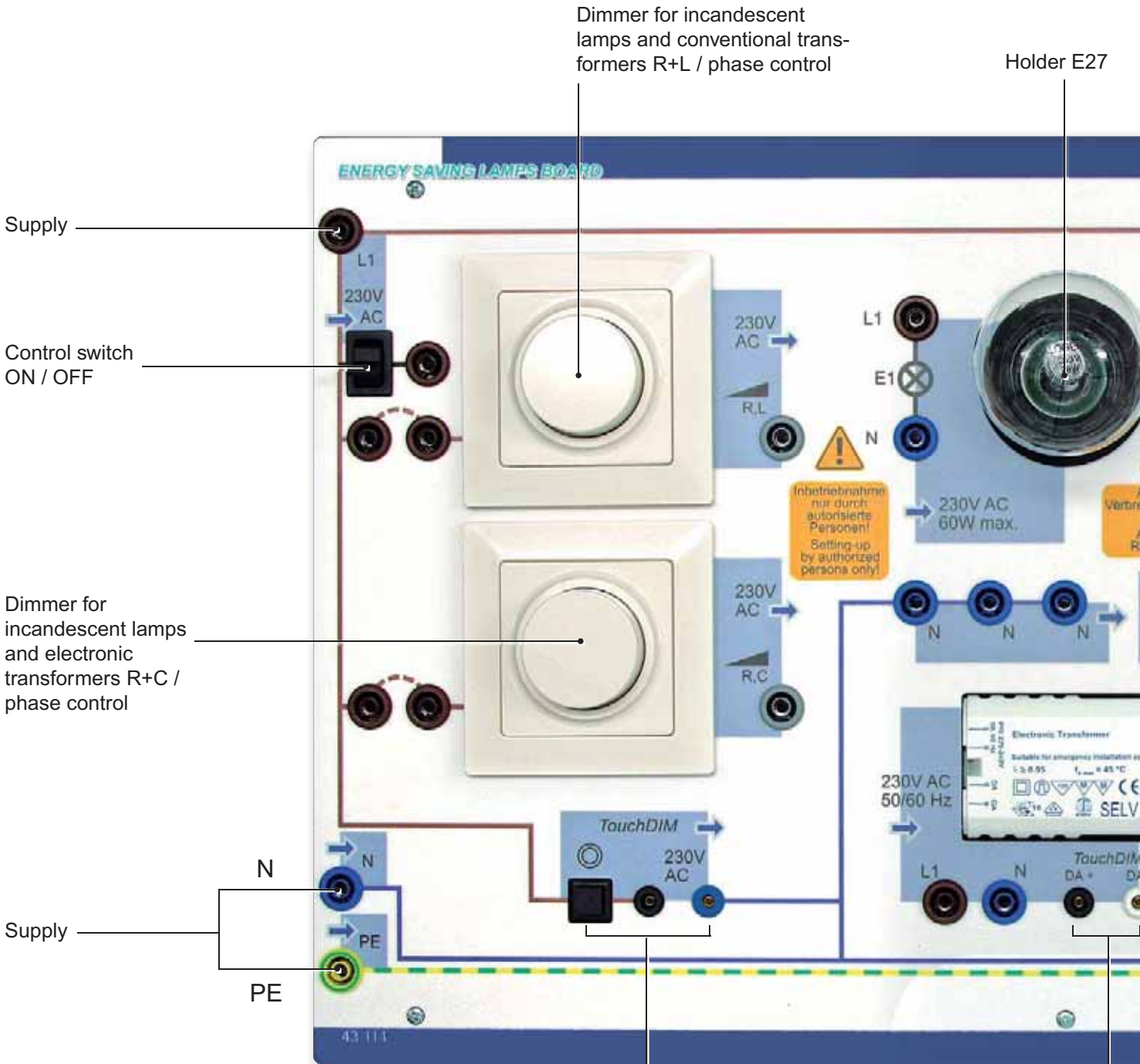
## Halogen circuit process



 Tungsten atom  
 Halogen

# ENERGY SAVING LAMPS

## Energy Saving Lamps Board

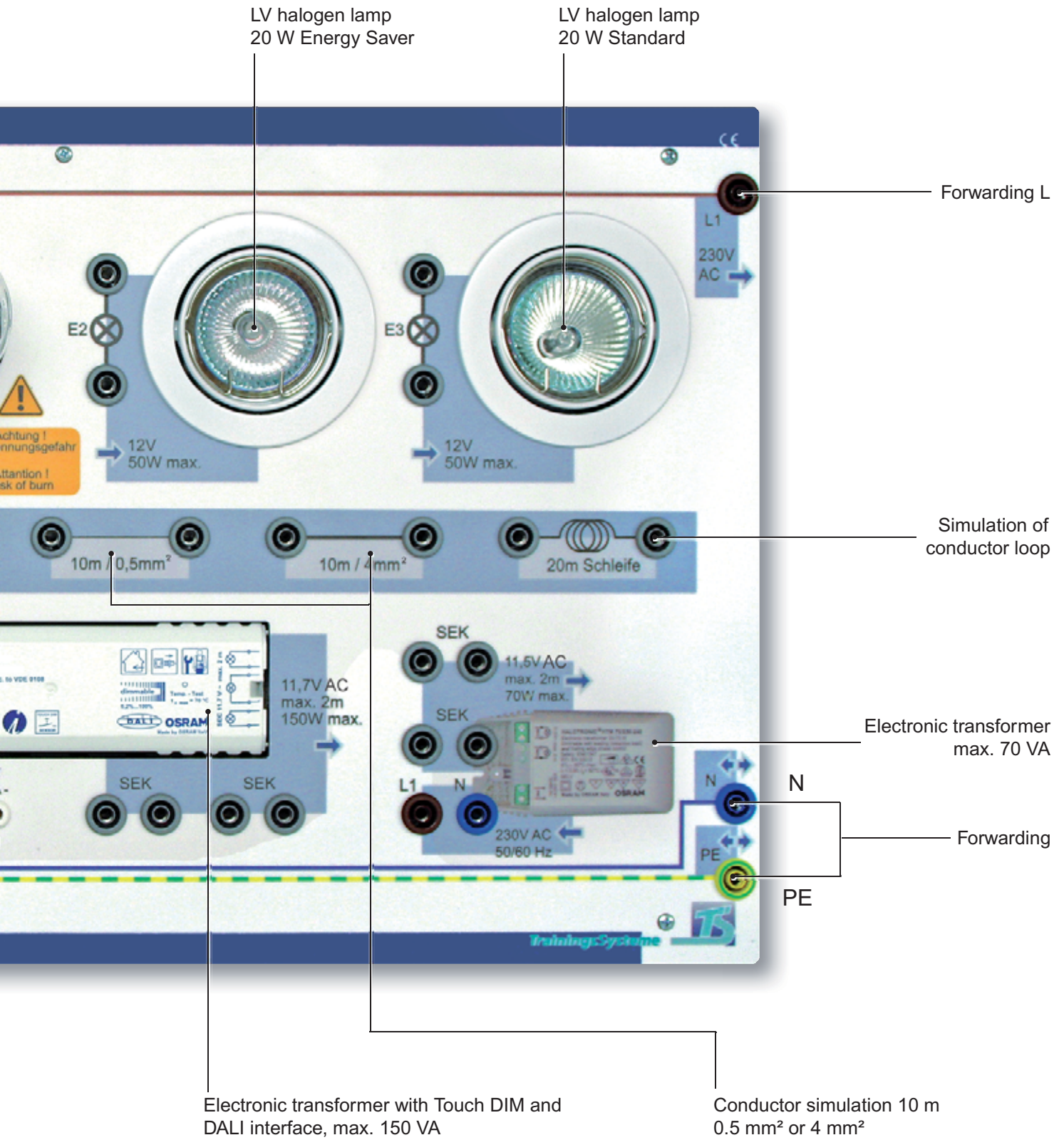


**NOTE:**  
 Never use Touch DIM and DALI at the same time.  
 Operating voltage Touch DIM: **230 V**  
 Operating voltage DALI: **approx. 14 V – 30 V**

Pushbutton for TOUCH DIM function

DALI / Touch DIM input of the electronic transformer





# COURSEWARE

## Manual

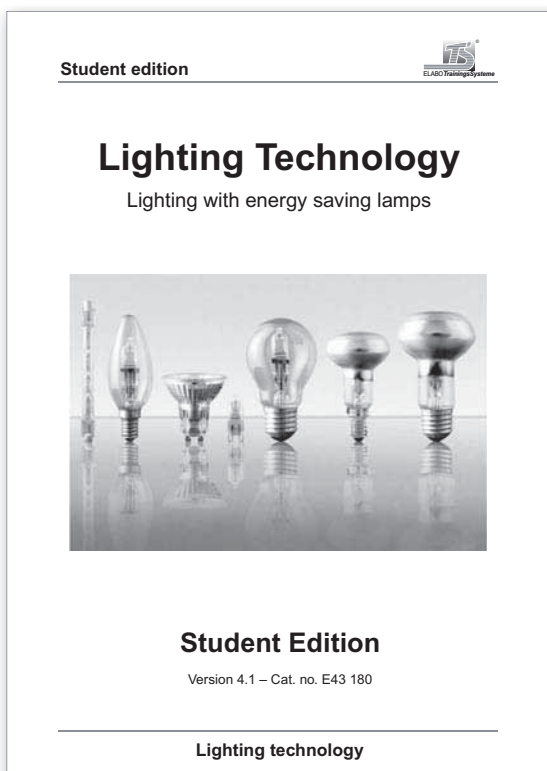


*Printed and digital!*

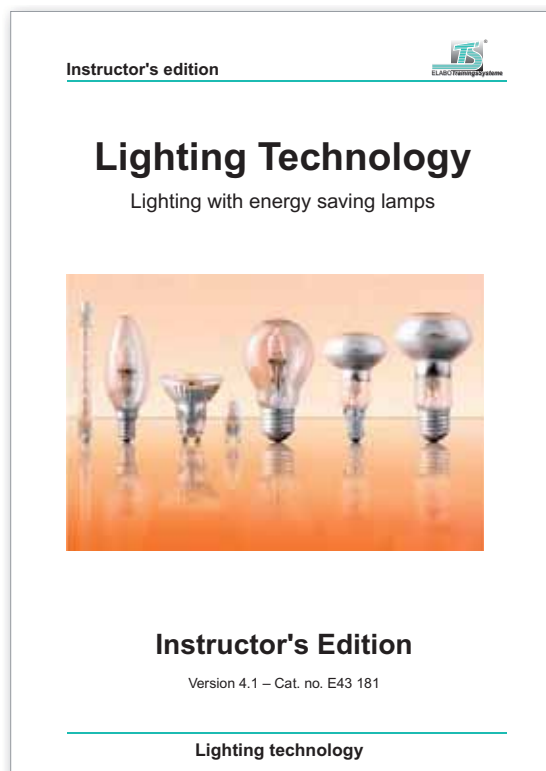
## Manual – Contents

- Customer inquiry
- Customer consulting
- Order analysis
- Order planning
- Selection of the components
- Work sequence and work preparation
- Construction plan
- Commissioning
- Technical documentation

- **Project 1:**  
Lighting of a corridor with incandescent lamps
- **Project 2:**  
Lighting of a living room with LV halogen lamps
- **Project 3:**  
Planning a lighting system in a hotel corridor



*E43 180CD Manual: Lighting technology  
Energy saving lamps – Student edition*



*E43 181CD Manual: Lighting technology  
Energy saving lamps – Instructor's edition*

Transparency set



# Lighting Technology

Lighting with energy saving lamps



## Transparency Set

Version 4.1 – Cat. no. E43 183

Lighting technology

## Transparency set – Contents

- Lamp Circuit Board II
- Definition of light
- Light is not equal to light
- Photometric data
- Lighting current  $\Phi V$
- Light intensity IV
- Solid angle  $\Omega$
- Luminance intensity EV
- Light density LV
- Light yield  $\eta$
- Degree of reflection  $\rho$
- Light intensity distribution curve
- Room utilisation factor  $\eta R$
- Room utilisation factor table
- Lighting efficiency  $\eta B$
- Room index  $k$
- Maintenance factor WF
- Calculation of the required lamps
- Glare
- Light colour or colour temperature
- Colour reproduction
- Lighting types
- Efficiency of light sources
- Light generation
- Incandescent lamps
- LV halogen reflector lamp
- Cold light reflector lamp
- The halogen circuit process
- Types of HV halogen lamps
- Types of LV halogen lamps
- Structure of a conventional LV halogen transformer
- Structure of an electronic LV halogen transformer



E43 183CD Manual: Lighting technology  
Energy saving lamps – Presentation aids/transparency set

Printed and digital!

Commissioning and troubleshooting



# Lighting Technology

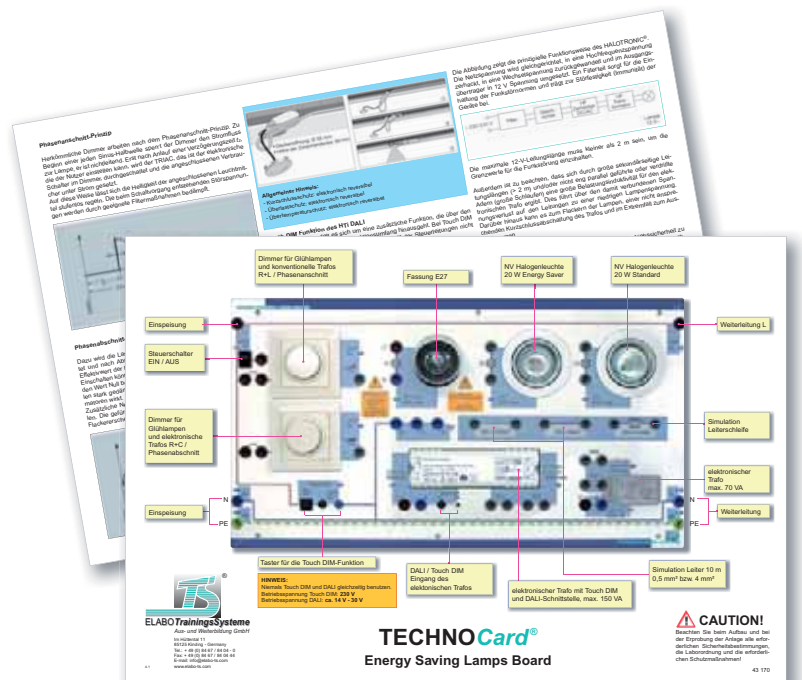


## Commissioning and Troubleshooting

Version 4.1 – Cat. no. E43 182

Lighting technology

## TECHNOCard®



**TECHNOCard®**  
Energy Saving Lamps Board

**CAUTION!**  
Beachten Sie beim Aufbau und bei der Entladung der Anlage alle elektrischen Sicherheitsbestimmungen, die Lichterzeugung und die elektrischen Schutzmaßnahmen!

E43 182CD Manual: Lighting technology  
Commissioning and troubleshooting

E43 170 TECHNOCard® Energy Saving Lamps Board



# FLUORESCENT LAMPS

## Fluorescent Lamps Board A and B



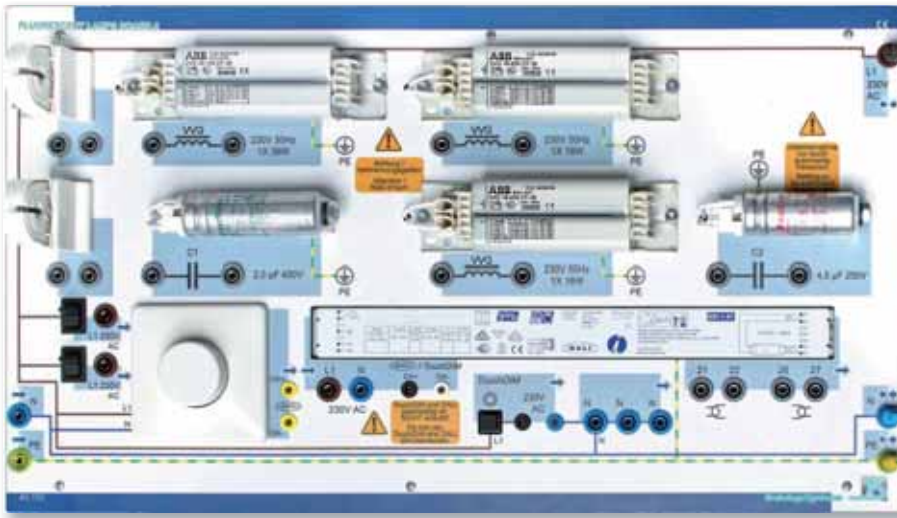
43 112 Fluorescent Lamps Board A

43 113 Fluorescent Lamps Board B

### LEARNING OBJECTIVES

- ✓ Principles of lighting technology, lighting current, light intensity, luminance intensity, efficiency, light density
- ✓ Use of discharge lamps
- ✓ Lamp operating devices, low-loss ballast, electronic ballasts
- ✓ Circuits of lamp operating devices – series connection, parallel connection (duo / tandem) and their compensation
- ✓ Dimming lamps
- ✓ Evaluation of applications
- ✓ Calculations of lighting systems
- ✓ Metrological investigation of lamps
- ✓ Networking of operating devices via DALI
- ✓ Control and diagnosis of operating devices via DALI





43 112 Fluorescent Lamps Board A



43 113 Fluorescent Lamps Board B

### Technical data 43 112

- 2 low-loss ballasts 18 W
- 1 low-loss ballast 36 W
- 2 compensation capacitors 2  $\mu$ F and 4.5  $\mu$ F
- 1 electronic ballast with DALI-Interface and TOUCH DIM function
- 2 bases for T8 fluorescent tubes
- 1 digital dimmer for DALI interfaces
- 2 sets of lamps and starters
- 2 fluorescent lamps T8, shatterfree
- 2 starters 230 V
- 1 starter for series connection
- 1 electronic starter
- All the required connections via 4mm and 2mm safety sockets

### Technical data 43 113

#### Fluorescent Lamps Board B (required for the operation of Fluorescent Lamps Board A)

- 2 bases for T8 fluorescent tubes
- 2 holders for starters
- 3 safety bridge plugs 4 mm  
(br, ye-gr, bl)

### 43 125 Lamp assortment in storage case

#### Plastic case containing the following spare lamps:

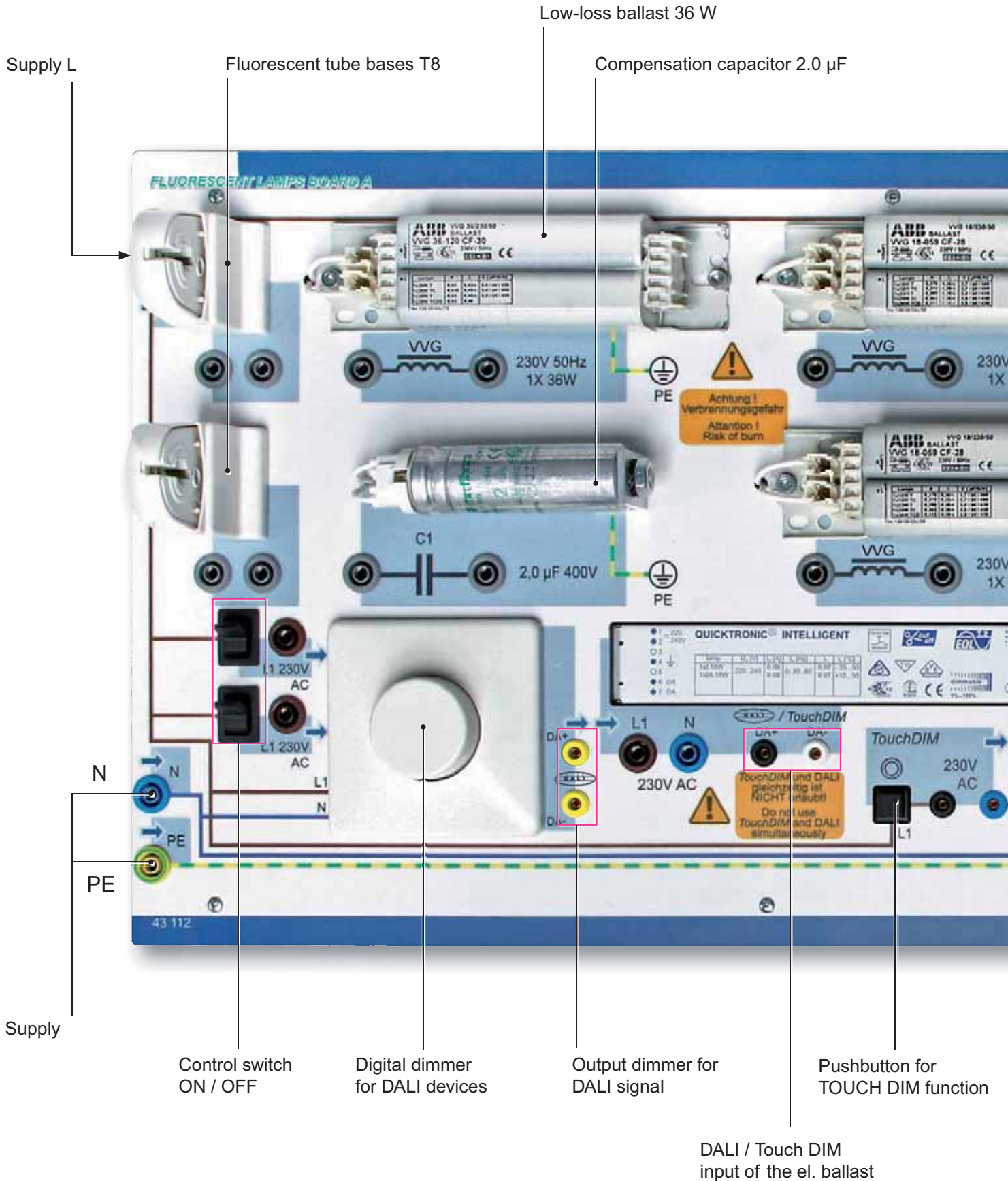
- Low voltage halogen reflector lamp, standard
- Low voltage halogen reflector lamp, ECO
- High voltage halogen lamp, E27 / 28 W, bulb shape
- Energy saving lamp, 5 W
- LED lamp, E27 / 8 W
- Fluorescent lamps, 18 W, shatterfree
- High-pressure sodium lamp, 70 W
- Metal halide lamp, 70 W
- Starters (2 for single, 2 for series operation, 1 electronic)



43 125 Lamp assortment in storage case

# FLUORESCENT LAMPS

## Fluorescent Lamps Board A and B

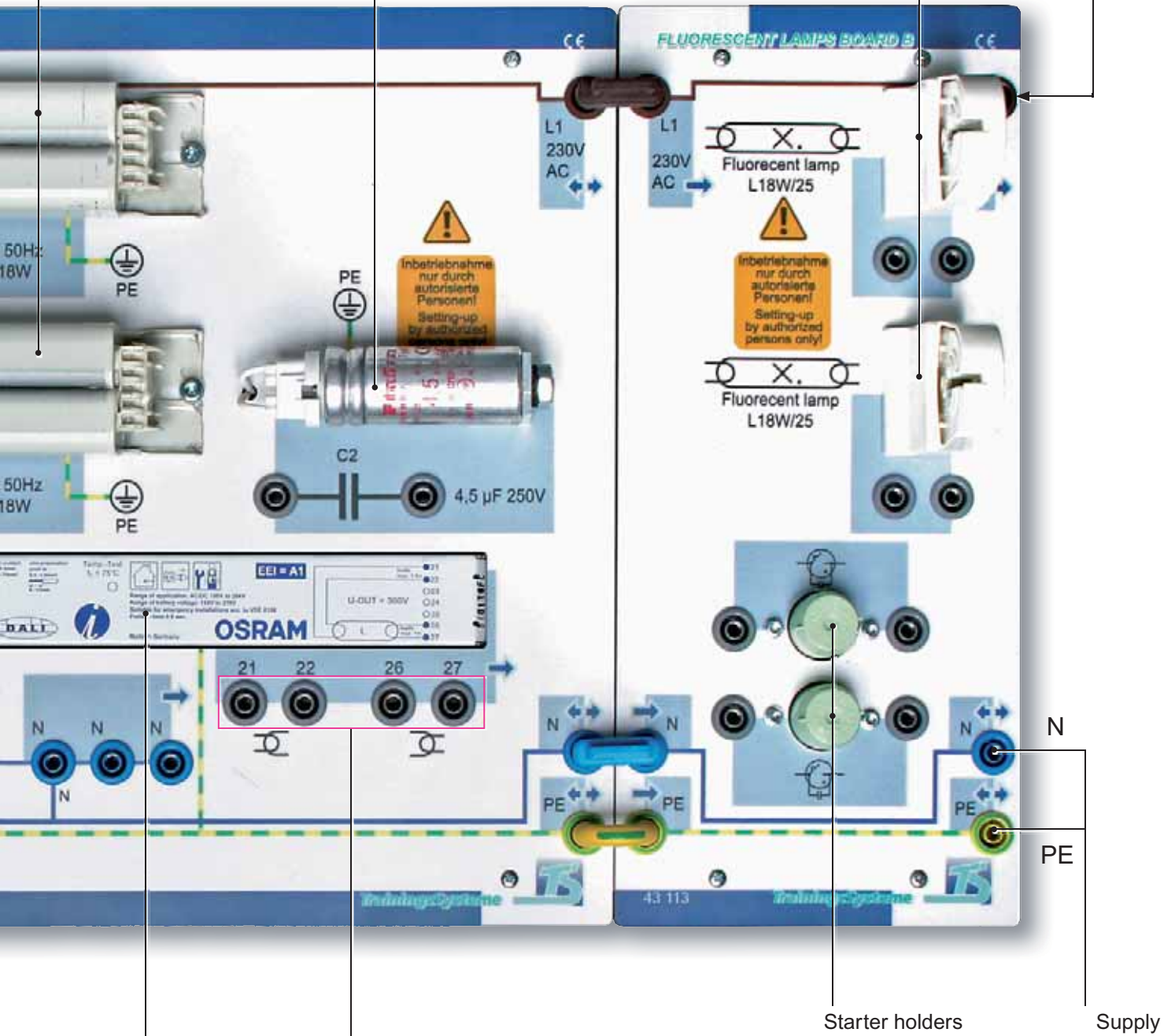


Low-loss ballast 18 W

Compensation capacitor 4.5  $\mu\text{F}$

Fluorescent tube bases T8

Forwarding L



EI. ballast with Touch DIM and DALI interface

Connection sockets for fluorescent lamps

Starter holders

Supply

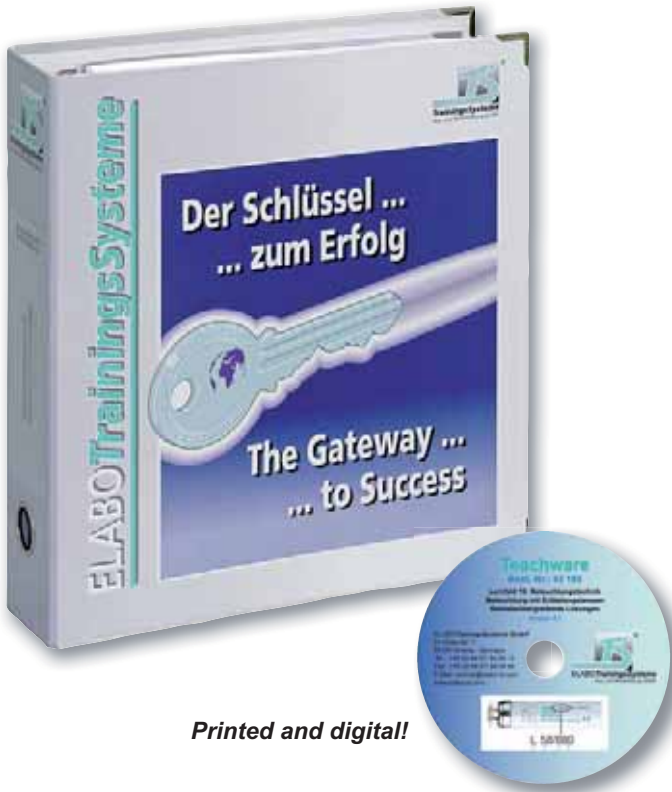
**NOTE:**

Never use Touch DIM and DALI at the same time.  
 Operating voltage Touch DIM: 230 V  
 Operating voltage DALI: **approx. 14 V – 30 V**



# COURSEWARE

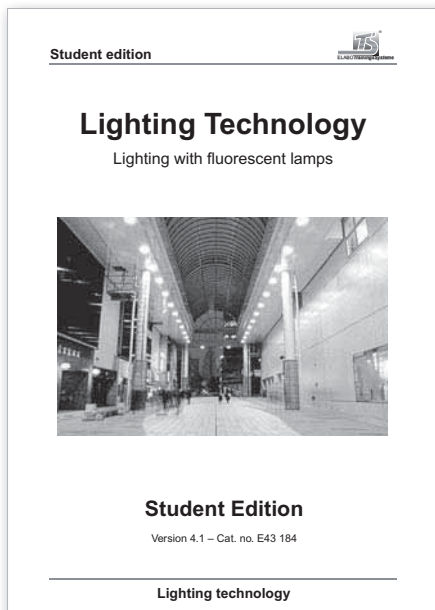
## Manual



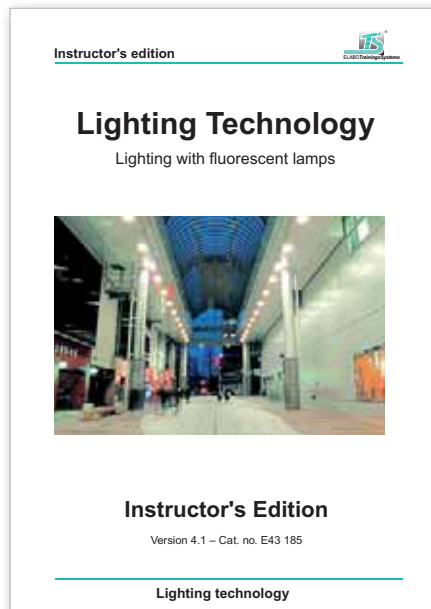
Printed and digital!

### Manual – Contents

- Customer inquiry
- Customer consulting
- Order analysis
- Order planning
- Selection of the components
- Work sequence and work preparation
- Construction
- Commissioning
- Technical documentation
  
- **Project 1:**  
Lighting of a corridor with louvred luminaires
  
- **Project 2:**  
Lighting of a corridor with LV halogen lamps
  
- **Project 1:**  
Planning a lighting system in a hotel corridor



E43 184CD Manual: Lighting technology  
Fluorescent lamps  
Student edition



E43 185CD Manual: Lighting technology  
Fluorescent lamps  
Instructor's edition



E43 186CD Manual: Lighting technology  
Fluorescent lamps  
Presentation aids / transparency set



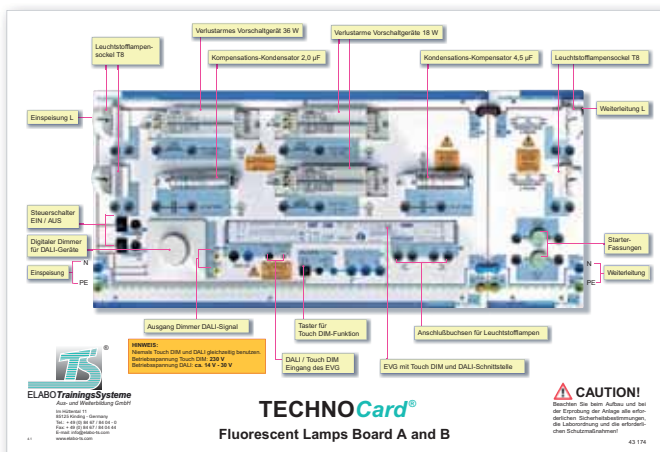
## Transparency set – Contents

- Discharge lamps
- Definition of light
- Light is not equal to light
- Photometric data
- Lighting current  $\Phi_V$ , light intensity IV
- Solid angle  $\Omega$
- Luminance intensity EV
- Light density LV, light yield  $\eta$
- Degree of reflection  $\rho$
- Room utilisation factor  $\eta_R$
- Room indexk
- Room utilisation factor table
- Lighting efficiency  $\eta_B$
- Operating efficiency  $\eta_{LB}$
- Light intensity distribution curves
- Lighting current distribution of lamps
- Spatial depiction of lighting current distribution
- Maintenance factor
- Determining the maintenance factor
- New value / maintenance value
- Calculation of the required lamps
- Degrees of reflection and required luminance ratio in workplaces
- "Range" of the visual task
- Glare UGR (Unified glare rating)
- Determination of the UGR values
- Instructions for determining the UGR value from a table
- Direction of viewing
- UGR value table
- Colour reproduction
- Light colour or colour temperature
- Lighting types
- Efficiency of light sources
- Light generation
- Structure of a fluorescent lamp
- Starter for a fluorescent lamp
- Energy balance of a fluorescent lamp
- Designations on a fluorescent lamp
- Quantities (mechanical) of a fluorescent lamp
- Element of an energy-saving lamp / Compact fluorescent lamp
- Types of energy-saving lamps
- Structure of an electrode-less high-power fluorescent lamp
- Lamp control gear
- Structure of a conventional ballast for fluorescent lamps
- Inductive base circuit of a fluorescent lamp
- Tandem circuit of a fluorescent lamp
- Duo-circuit of a fluorescent lamp
- Structure of an el. ballast
- Operation of a fluorescent lamp on an electronic ballast
- Advantages of the operation of fluorescent lamp with el. ballast
- Possibilities of savings through the use of el. ballast
- Lamp Circuit Boards A + B



Printed and digital!

## TECHNOCard®



E43 174 TECHNOCard® Fluorescent Lamps Board A and B



E43 182CD Manual: Lighting technology Commissioning and troubleshooting

# BUILDING SYSTEM TRAINER

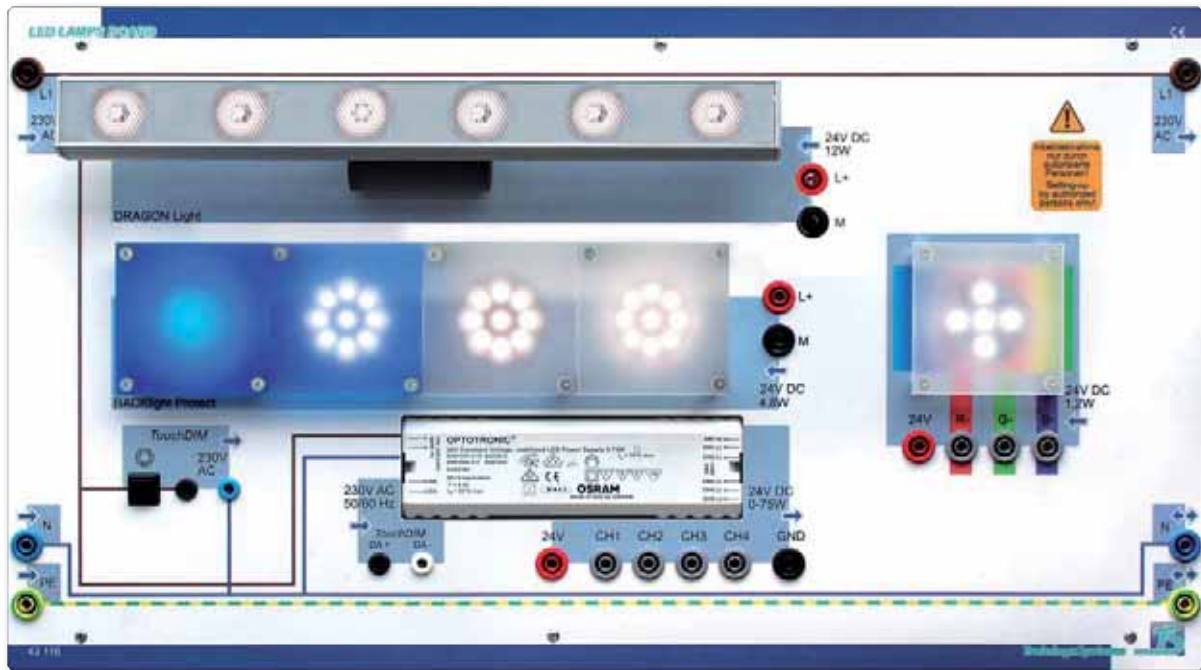
## Installation circuits





# LIGHTING WITH LED

## LED Lamps Board



43 116 LED Lamps Board

### LEARNING OBJECTIVES

- ✓ Selecting lamp control gear
- ✓ Generation of "white" light via LED
- ✓ Efficiency of LEDs
- ✓ Dimming LEDs
- ✓ Controlling LEDs
- ✓ Control and diagnosis of operating devices via DALI
- ✓ Networking of operating devices via DALI

### Technical data

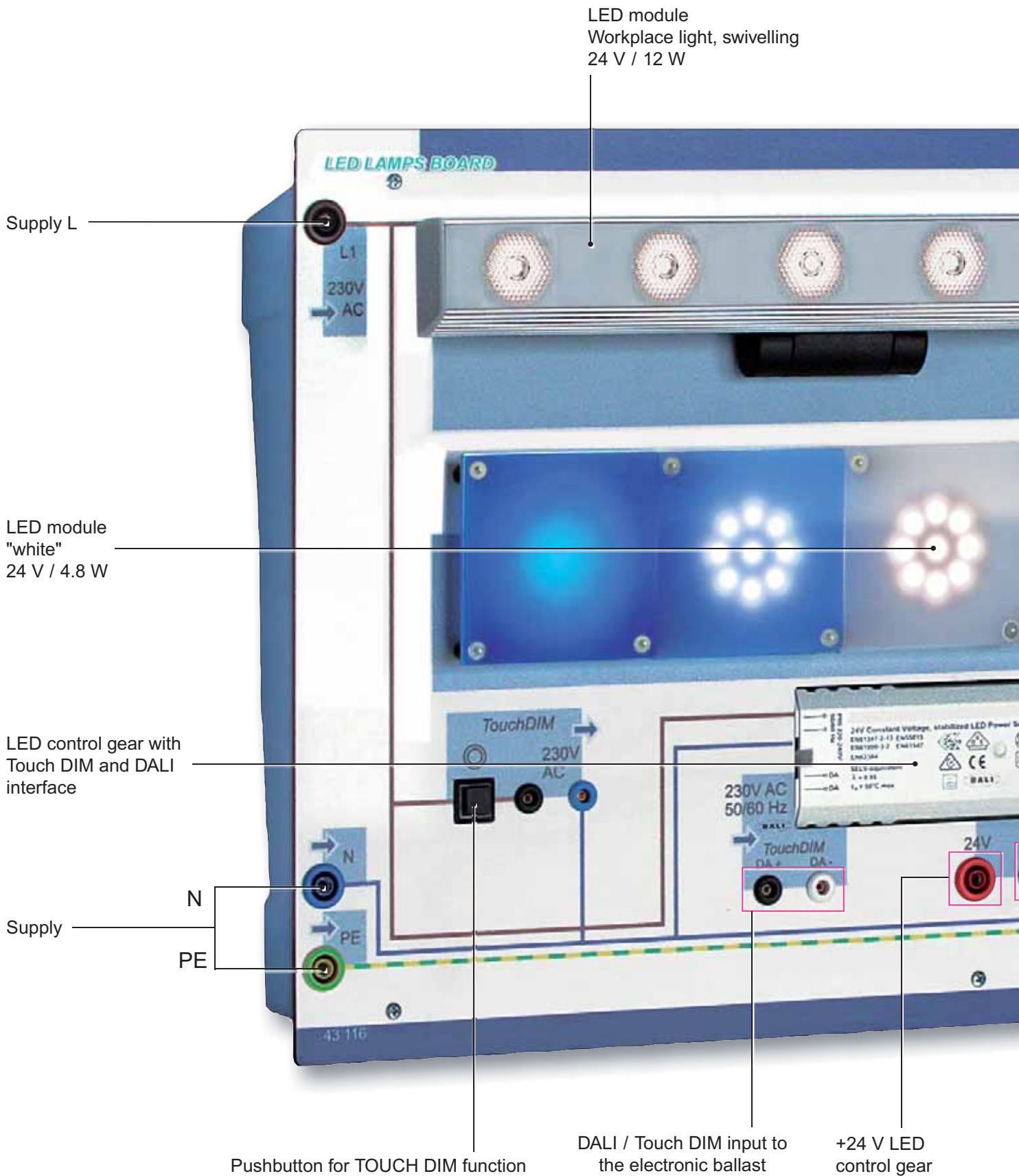
- Input voltage 230 V / 50 Hz
- LED converter 230 V / 24 V DC 4-channel 75 W
- DALI interface
- Touch DIM pushbutton
- Touch DIM function
- LED light strip 24 V DC / 12 W white
- 4 LED modules 24 V DC à 1.2 W
- LED module RGB 24 V DC (red, green, blue) 1.2 W



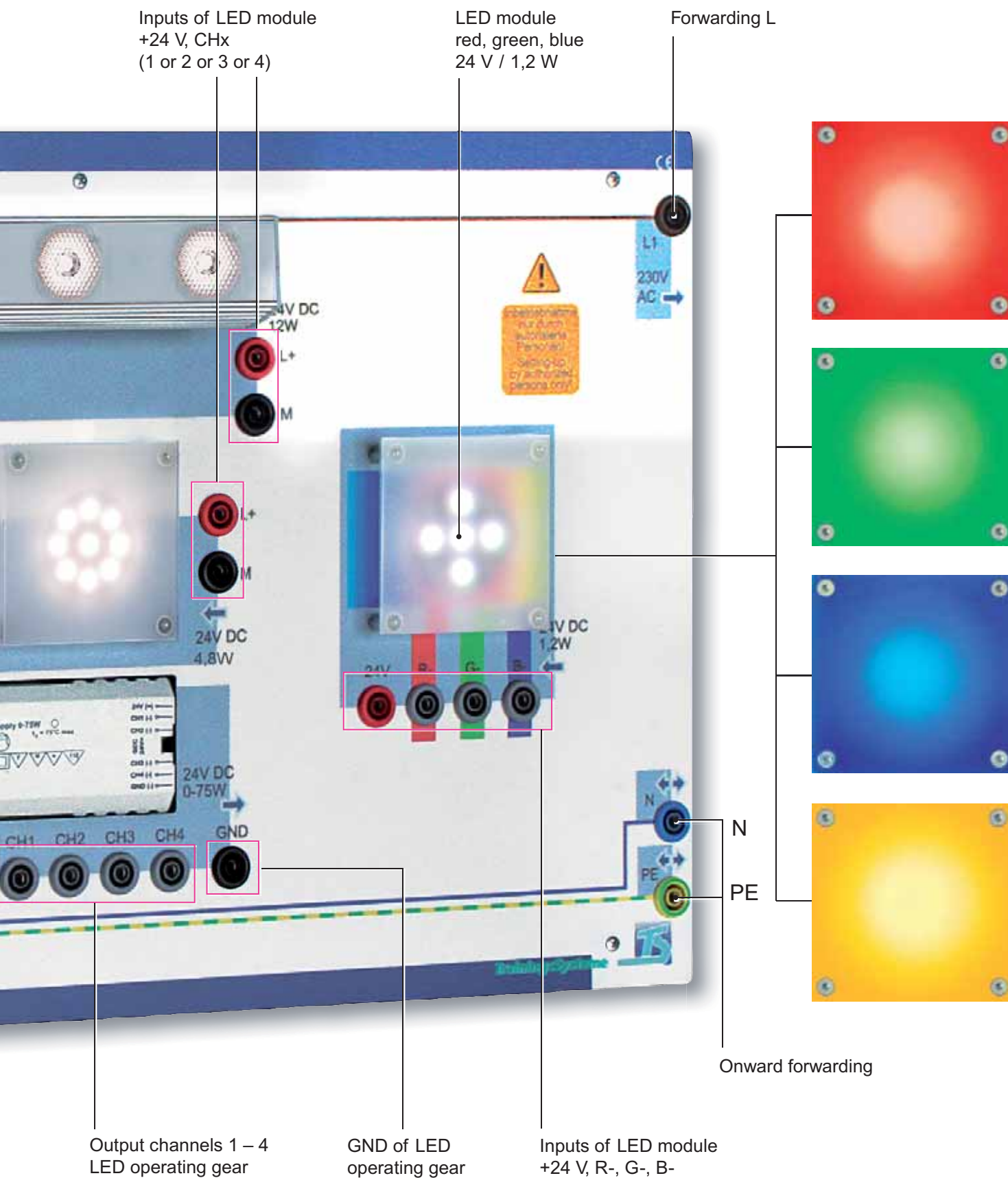


# LIGHTING WITH LED

## LED Lamps Board







## COURSEWARE

## Manual

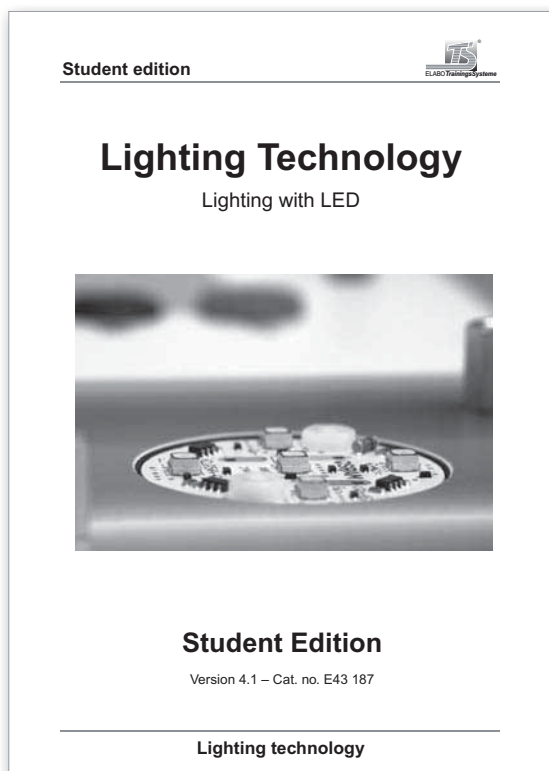


*Printed and digital!*

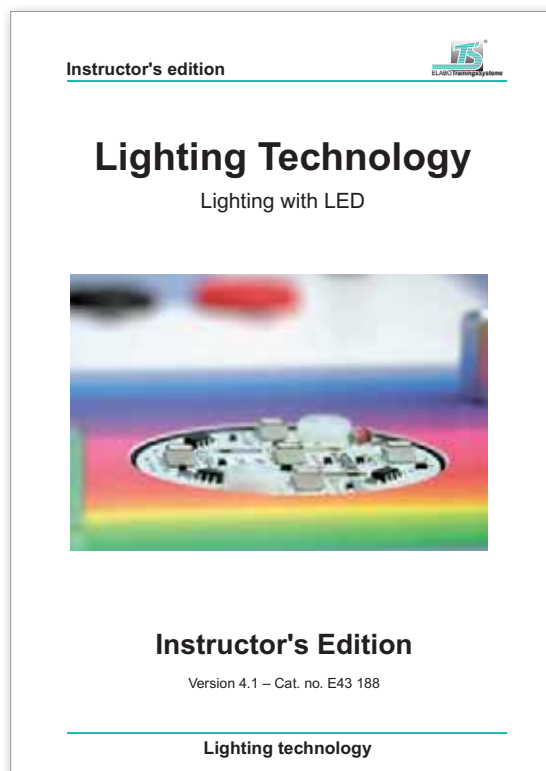
### Manual – Contents

---

- Customer inquiry
  - Customer consulting
  - Order analysis
  - Order planning
  - Selection of the components
  - Work sequence and work preparation
  - Construction
  - Commissioning
  - Technical documentation
- **Project 1:**  
Installation of a retail shelf lighting system
  - **Project 2:**  
Installation of an advertising board lighting system
  - **Project 3:**  
Creation of premises lighting



*E43 187CD Manual: Lighting technology  
Lighting with LED – Student edition*



*E43 188CD Manual: Lighting technology  
Lighting with LED – Instructor's edition*



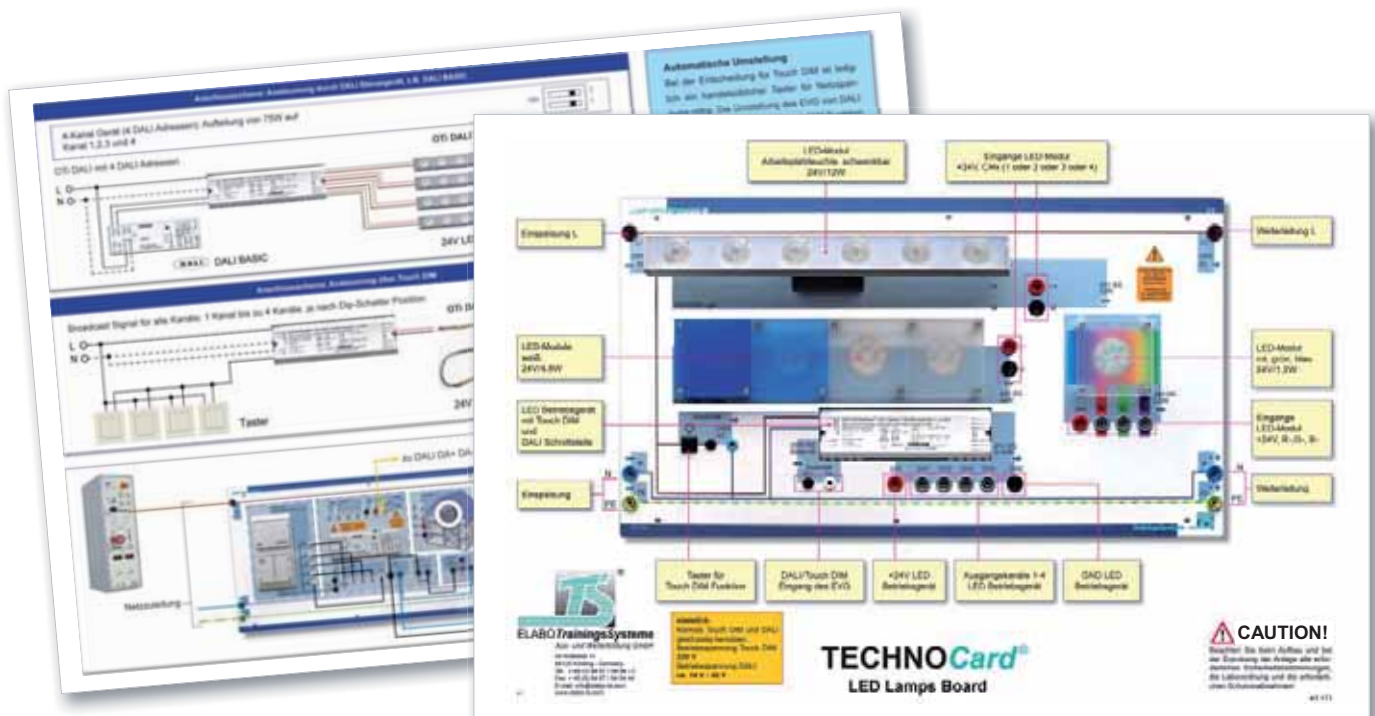
## Transparency set – Contents

- LED
- "White" LED
- OLED
- Binning of LEDs
- Principle of construction, LED
- Principle of construction, "white" LED
- Method of working of LED
- LED and heat
- Dimming of LEDs
- Temperature behaviour
- Control and operation of LED modules
- Schematic construction of a control device
- DALI control of a control device
- Efficiency of LEDs
- LED module
- Temperature and life
- The way to lighting
- Life of LEDs



E43 189CD Manual: Lighting technology  
Lighting with LEDs – Transparency set

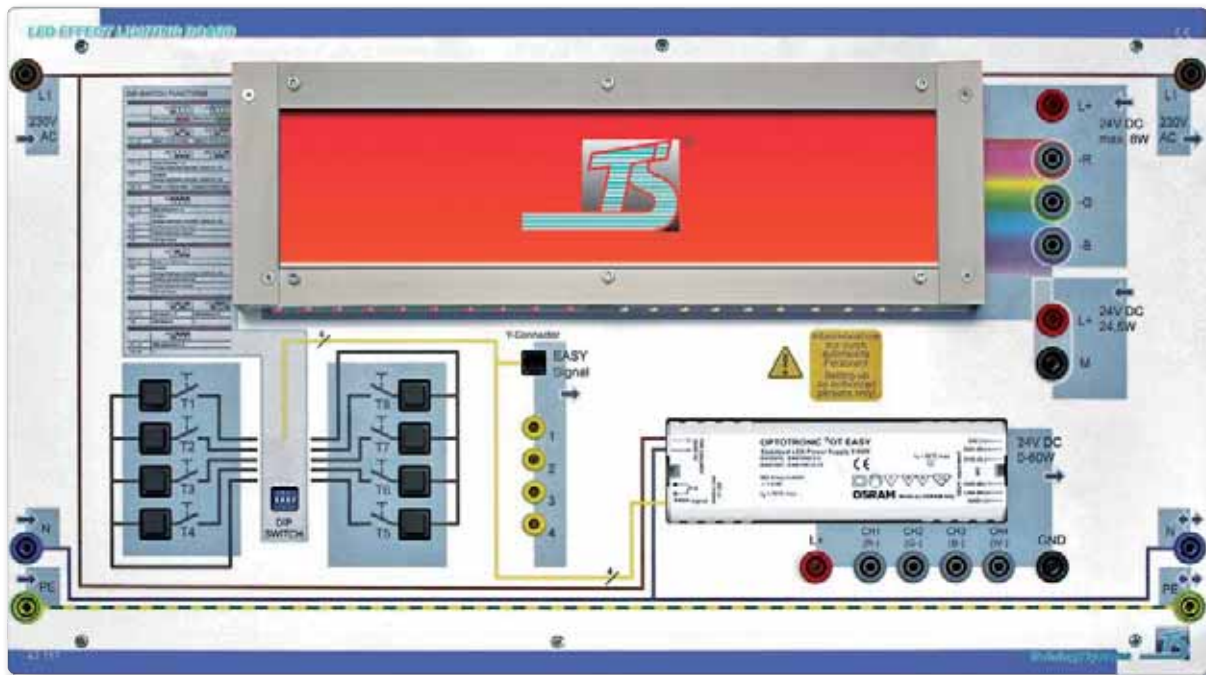
## TECHNOCard®



E43 171 TECHNOCard® LED Lamps Board

## LED LIGHT MANAGEMENT SYSTEMS

## LED Effect Lighting Board



43 117 LED Effect Lighting Board

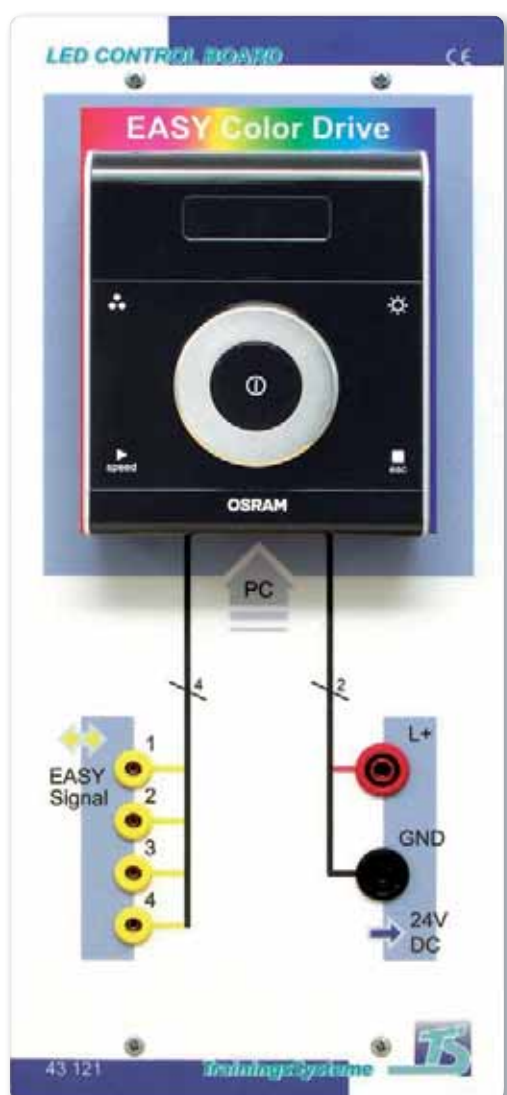
## LEARNING OBJECTIVES

- ✓ Commissioning RGB applications with LED
- ✓ Dynamic light solutions with LEDs
- ✓ Using configuration software
- ✓ Wiring and commissioning operational of light controls

## Technical data

- 1 electronic ballast for EASY control interface
- 1 button coupling module with 8 operating buttons for EASY control
- 1 LED module, red, green, blue
- 1 LED module, white
- 1 plate for mounting frame for lighting with the LED modules
- 1 PC / USB adapter on EASY controller with parameterising and operating software
- All the required connections via 4mm and 2mm safety sockets

## LED Control Board



43 121 LED Control Board

### LEARNING OBJECTIVES

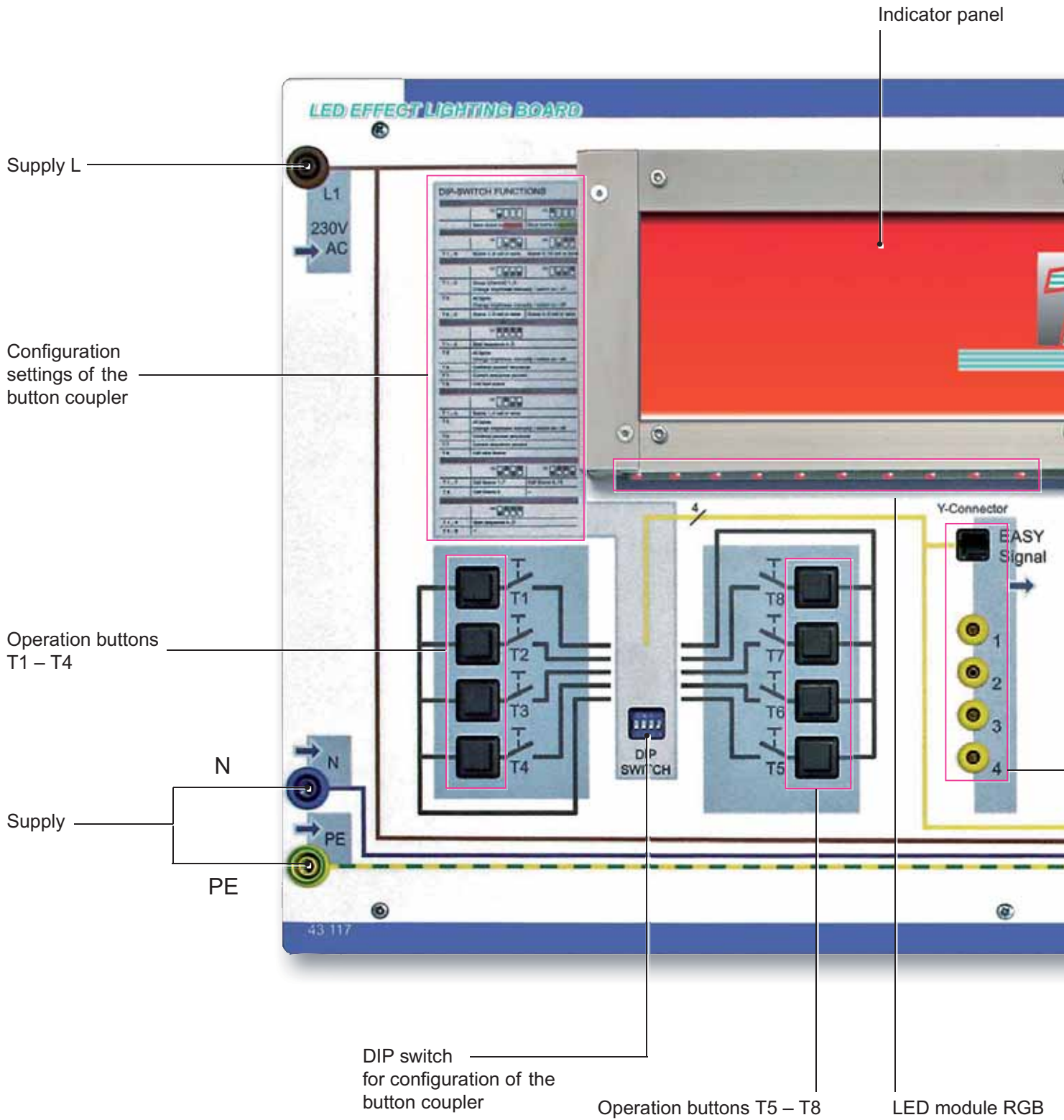
- ✓ Dynamic light solutions –  
commissioning with hand operating devices
- ✓ Saving and calling scenes
- ✓ Saving and calling sequences

### Technical data

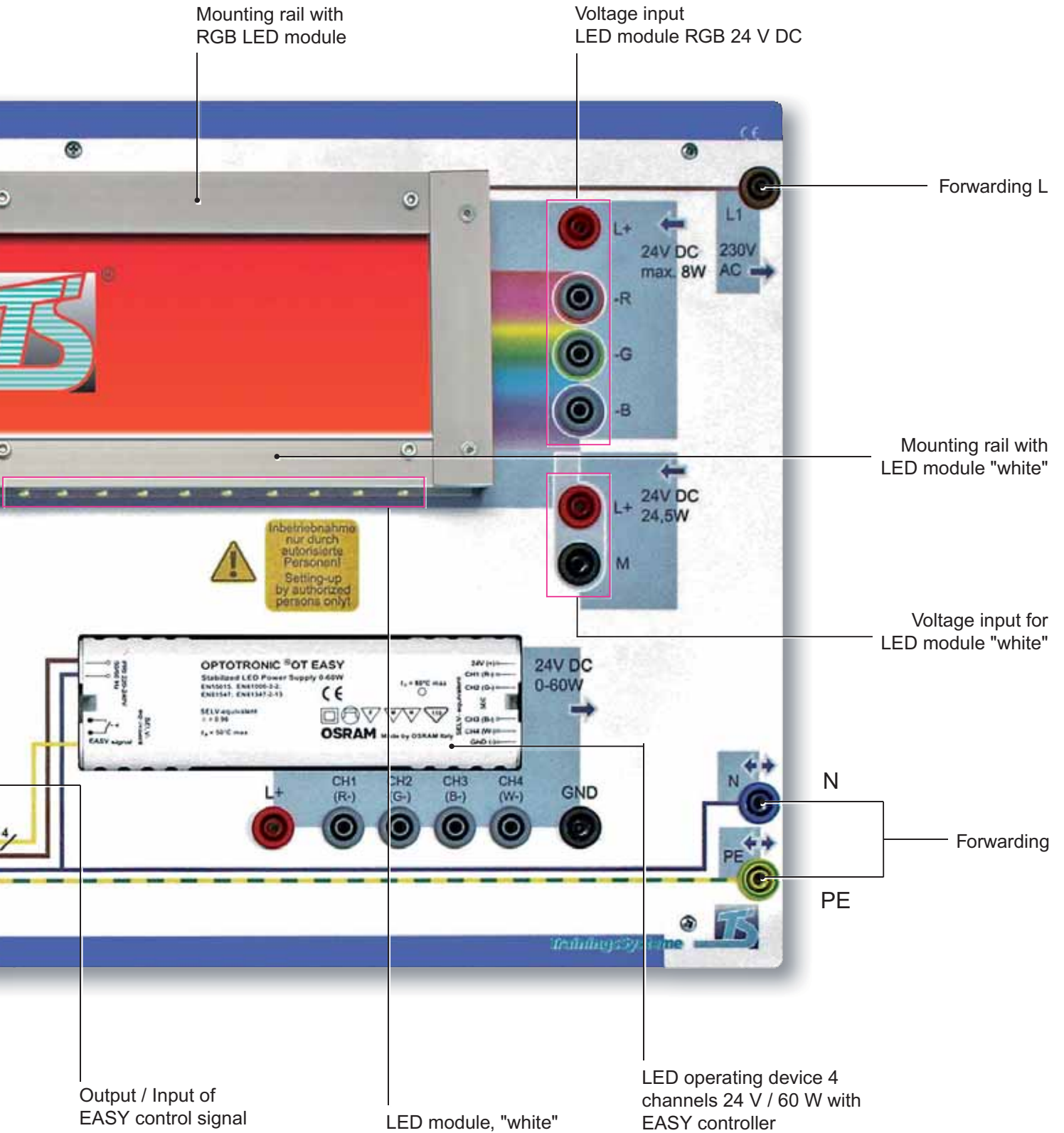
- Wall operating device with EASY controller
- Connection for PC / USB EASY adapter
- All the required connections via 4mm and 2mm safety sockets

# THE NEW TRAINING SYSTEM IN LIGHTING

## LED Effect Lighting Board

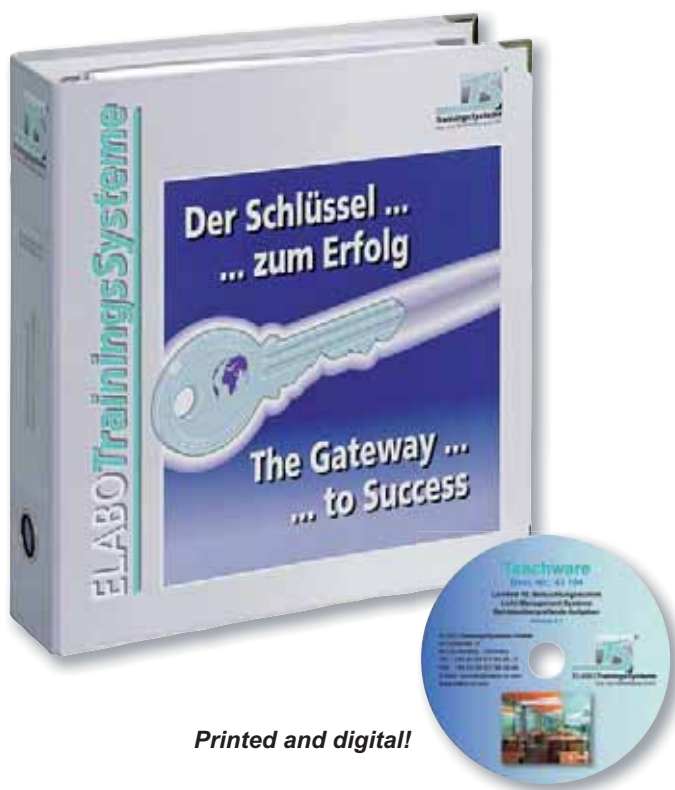






# COURSEWARE

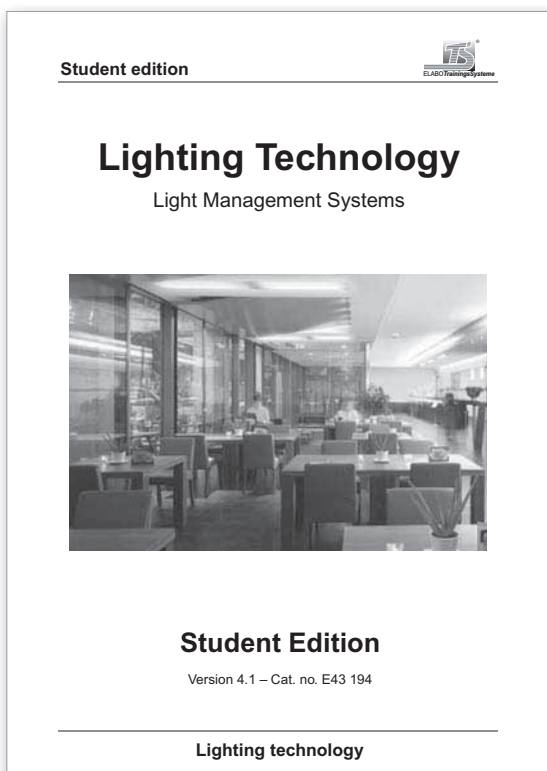
## Manual



*Printed and digital!*

### Manual – Contents

- Customer inquiry
- Customer consulting
- Order analysis
- Order planning
- Selection of the components
- Work sequence and work preparation
- Construction plan
- Commissioning
- Technical documentation
  
- **Project 1:**  
Lighting of a reception lobby with LED effect lighting
  
- **Project 2:**  
Control of an office lighting system via DALI
  
- **Project 3:**  
Constant light and presence-dependent control of an office lighting system



Student edition



## Lighting Technology

Light Management Systems



**Student Edition**

Version 4.1 – Cat. no. E43 194

Lighting technology

*E43 194CD Manual: Lighting technology  
Light management systems – Student edition*



Instructor's edition



## Lighting Technology

Light Management Systems



**Instructor's Edition**

Version 4.1 – Cat. no. E43 195

Lighting technology

*E43 195CD Manual: Lighting technology  
Light management systems – Instructor's edition*

Transparency set



Course 10

# Lighting Technology

Light Management Systems



## Transparency Set Presentation Aids

Version 4.1 – Cat. no. E43 197

Lighting technology

E43 197CD Manual: Lighting technology  
Light management systems  
Transparency set / Presentation aids

## Transparency set – Contents

- Reasons for LMS systems
- DALI: brief description
- Light planning with DALI
- DALI system description
- Lighting control via DALI with digital dimmers
- Digital dimmer DALI
- DALI principle circuit diagram
- DALI single room control
- Control of operating devices
- DALI control device
- System and error messages
- Functions of the control device
- Safety instructions
- Light and motion sensor
- Assembly of the sensor
- Operation of the control device
- Energy saving through LMS
- DALI topologies
- Lighting control
- Lighting control DALI
- Touch DIM
- Applications EASY Color Control
- Setting of light scenes
- Setting dynamic sequences
- EASY Color Control system overview
- Dynamic RGB light control with LED
- Dynamic RGB light control with fluorescent lamps
- Daylight simulation via EASY Color Control
- Light scene control
- DMX-DALI system structure



Printed and digital!

Commissioning and troubleshooting



# Lighting Technology

Light Management Systems



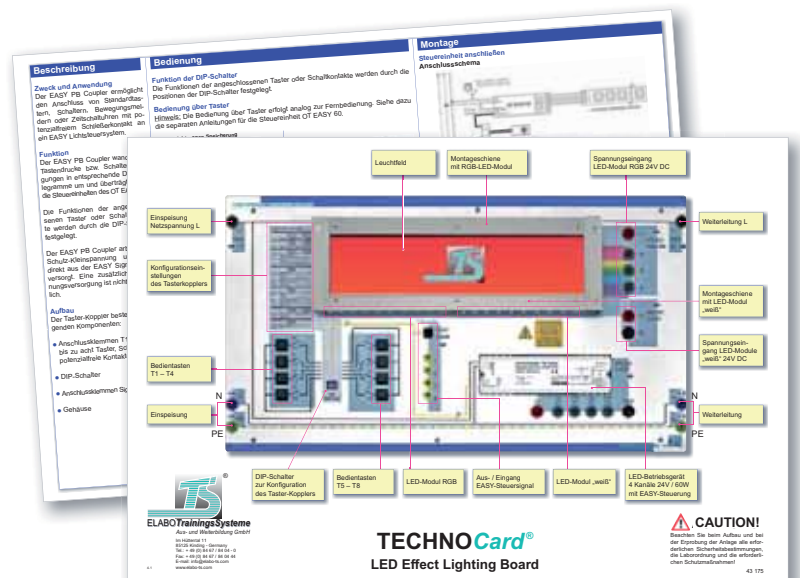
## Commissioning and Troubleshooting

Version 4.1 – Cat. no. E43 196

Lighting technology

E43 196CD Manual: Lighting technology  
Commissioning and troubleshooting

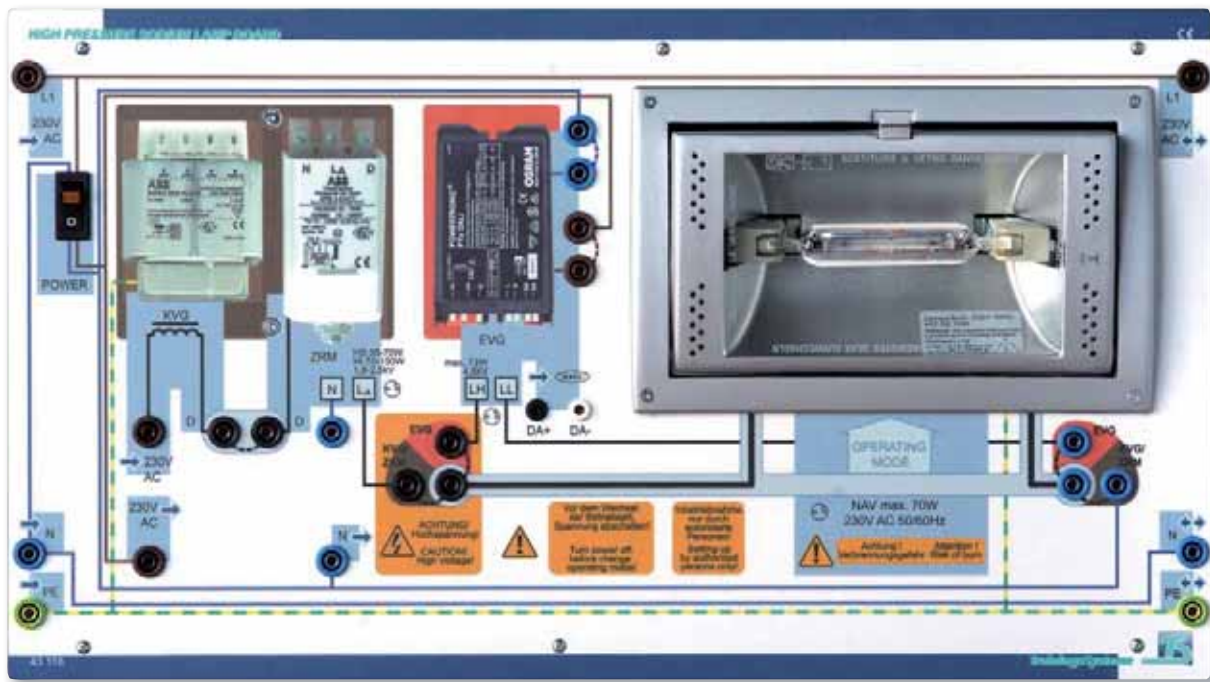
## TECHNOCard®



E43 175 TECHNOCard® LED Effect Lighting Board

## SPECIAL LAMPS

## High Pressure Sodium Lamp Board



43 118 High Pressure Sodium Lamp Board

## LEARNING OBJECTIVES

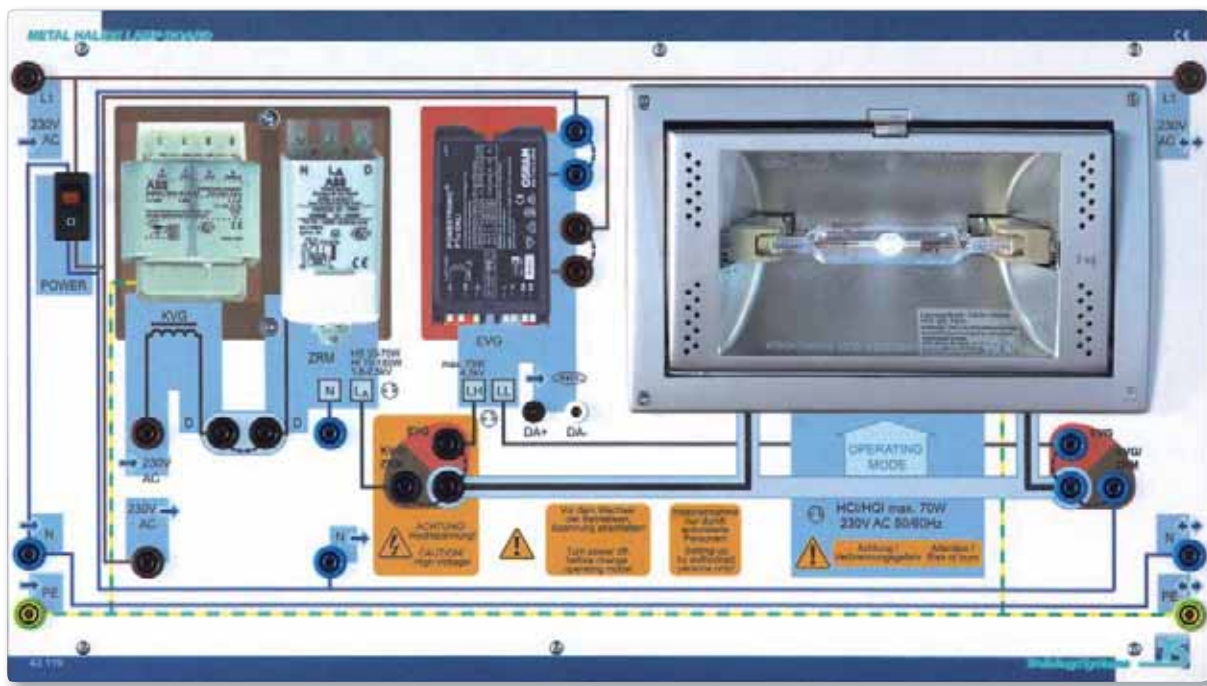
- ✓ Principles of lighting technology, lighting current, light intensity, luminance intensity, efficiency, light density
- ✓ Circuits of lamp control gear and firing devices
- ✓ High-pressure discharge lamps with el. ballast
- ✓ Dimming lamps
- ✓ Assessing the applications
- ✓ Calculations of lighting systems
- ✓ Metrological investigation of lamps
- ✓ Control and diagnosis of operating devices via DALI
- ✓ Networking of operating devices via DALI

## Technical data

- Conventional ballast
- Digital safety firing device
- Electronic ballast with DALI interface
- Swivelling integrated lamp for high-pressure discharge lamps, with UV filter and protective glass
- High pressure sodium lamp 70 W
- Switch on / off
- All the required connections via 4mm and 2mm safety sockets
- The wiring of the lamp circuits is done with special HV measuring cables and the respective sockets



# Metal Halide Lamp Board



43 119 Metal Halide Lamp Board

## LEARNING OBJECTIVES

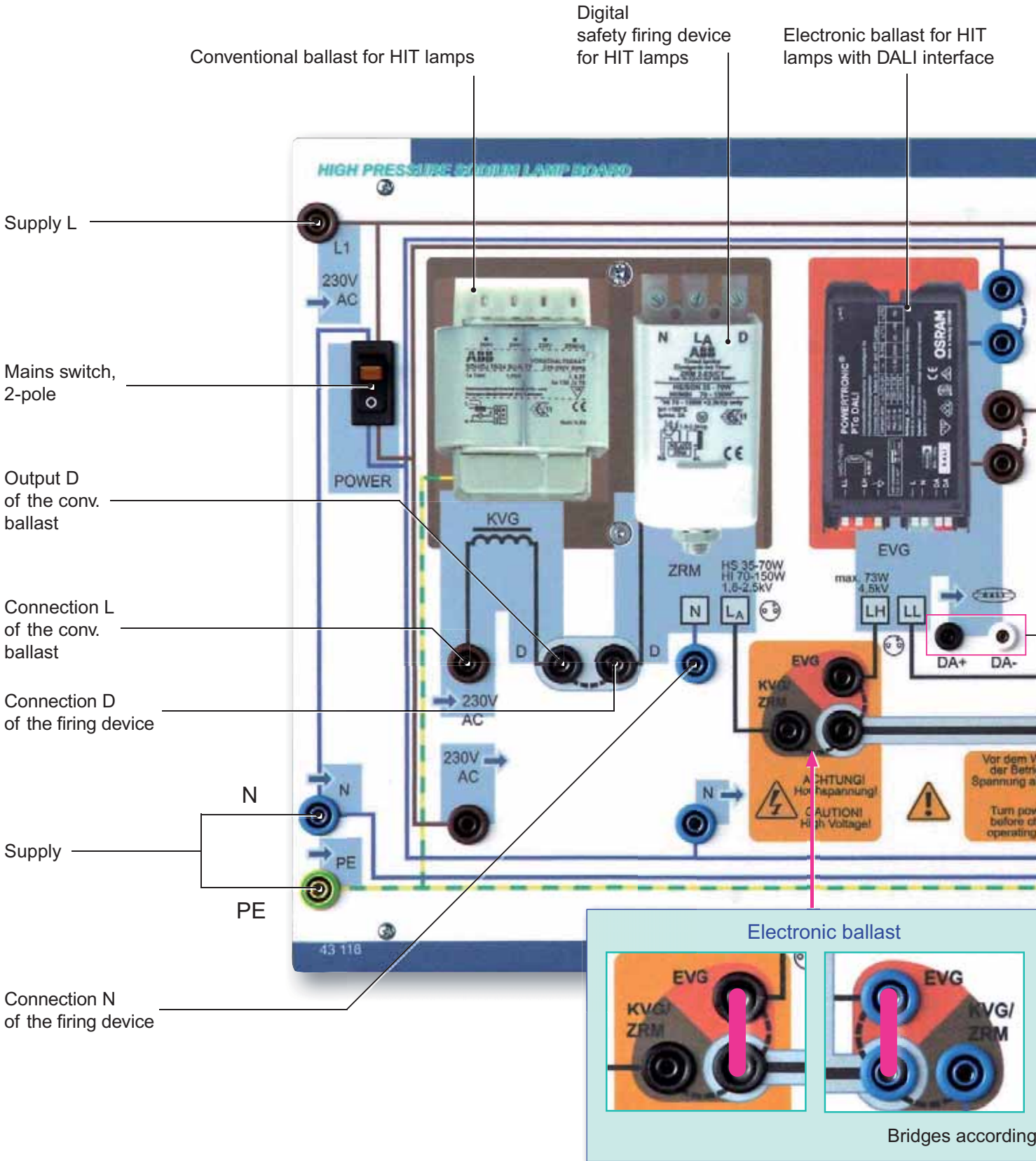
- ✓ Principles of lighting technology, lighting current, light intensity, luminance intensity, efficiency, light density
- ✓ Circuits of lamp control gear and firing devices
- ✓ High-pressure discharge lamps with el. ballast
- ✓ Dimming lamps
- ✓ Assessing the applications
- ✓ Calculations of lighting systems
- ✓ Metrological investigation of lamps
- ✓ Control and diagnosis of operating devices via DALI
- ✓ Networking of operating devices via DALI

## Technical data

- Conventional ballast
- Digital safety firing device
- Electronic ballast with DALI interface
- Swivelling integrated lamp for high-pressure discharge lamps, with UV filter and protective glass
- Metal halide lamp 70 W
- Switch on / off
- All the required connections via 4mm and 2mm safety sockets
- The wiring of the lamp circuits is done with special HV measuring cables and the respective sockets

# SPECIAL LAMPS

## High Pressure Sodium Lamp Board

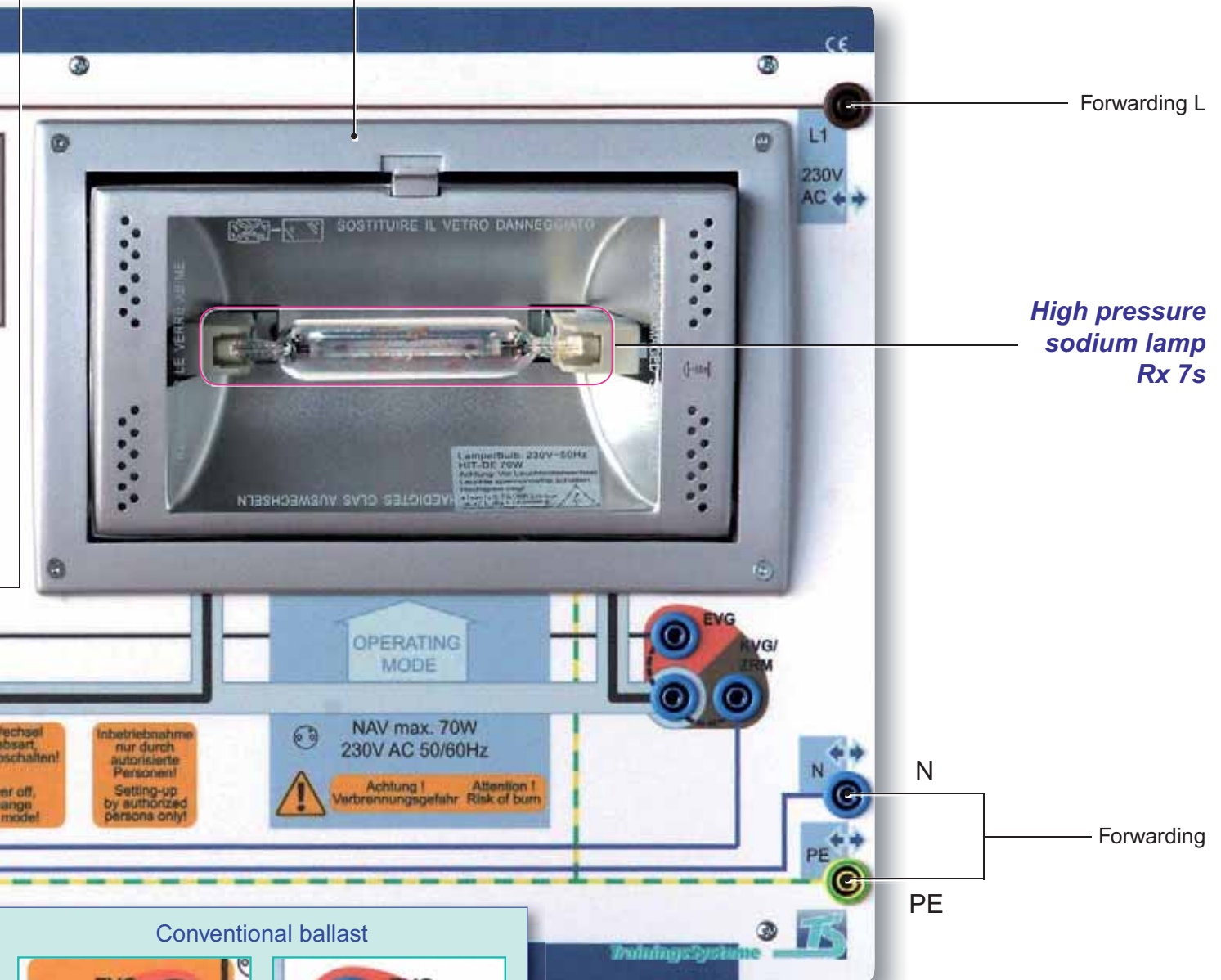


DALI input of the el. ballast

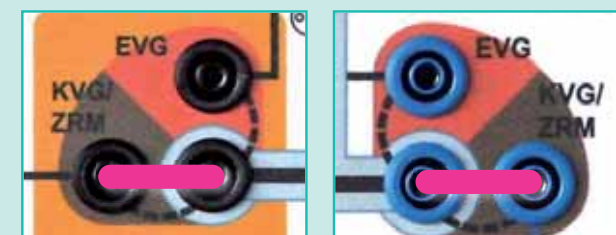
Integrated lamp with HIT lamps

Forwarding L

High pressure sodium lamp  
Rx 7s



Conventional ballast



to the ballast used



# COURSEWARE

## Manual

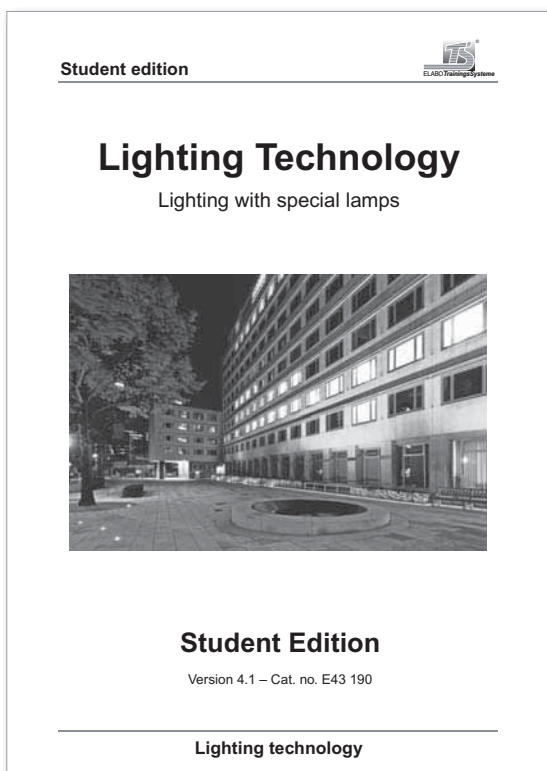


*Printed and digital!*

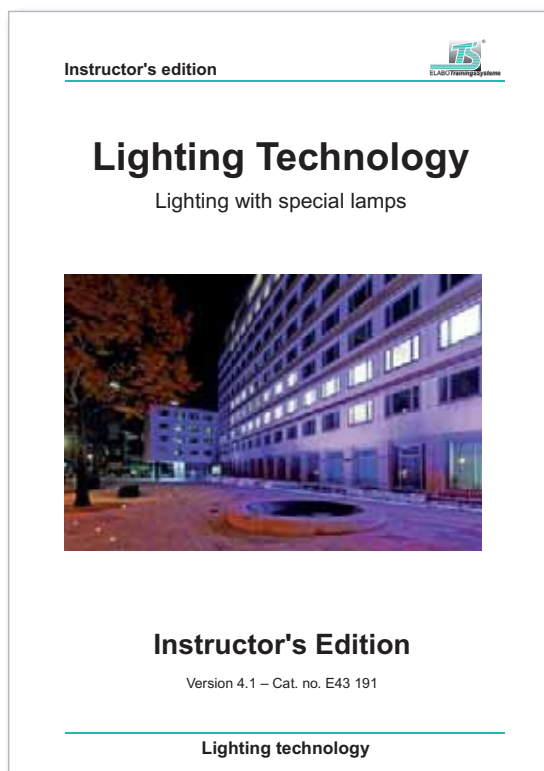
## Manual – Contents

- Customer inquiry
- Customer consulting
- Order analysis
- Order planning
- Selection of the components
- Work sequence and work preparation
- Construction plan
- Commissioning
- Technical documentation

- **Project 1:**  
Lighting of a sales floor with downlights
- **Project 2:**  
Lighting of a walkway in the premises of a company



*E43 190CD Manual: Lighting technology  
Special lamps – Student edition*



*E43 191CD Manual: Lighting technology  
Special lamps – Instructor's edition*



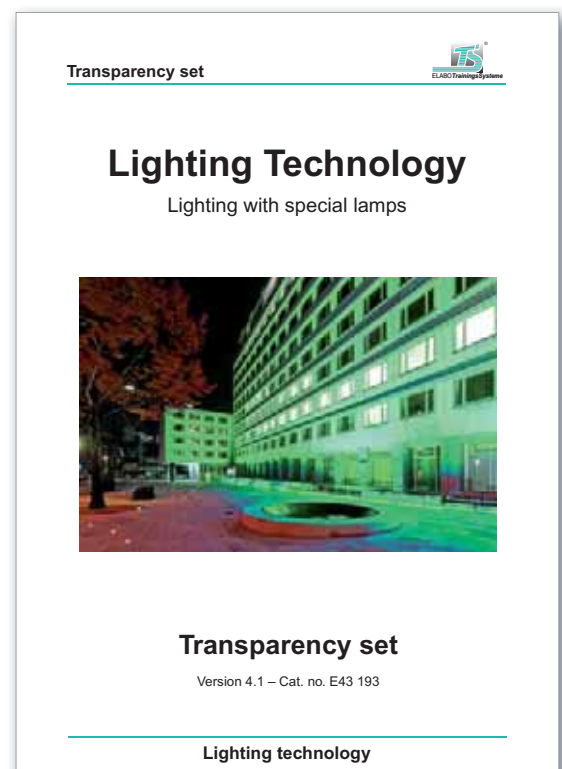
## Transparency set – Contents

- Light generation
- Mercury vapour high-pressure lamp
- Structure of a sodium vapour lamp
- Structure of a sodium vapour high-pressure lamp
- Typical light colour of a sodium vapour lamp
- Colour properties of a sodium vapour high pressure lamp
- Structure of a halogen metal vapour lamp
- Halogen metal vapour lamp
- Electric arc of a halogen metal vapour lamp
- Starting behaviour of a halogen metal vapour lamp with different ballasts
- Flow of the light-technical parameters of a halogen metal vapour lamp
- Colour properties of a halogen metal vapour lamp
- Structure of an electrode-less high-power fluorescent lamp
- Structure of a mercury tungsten lamp
- Lamp control gear
- Conventional ballast for mercury vapour lamps
- Conventional ballast for mercury vapour high-pressure lamps
- Conventional ballast for halogen metal vapour lamps
- Digital ignition device for sodium and halogen metal vapour high-pressure lamps
- Principles of circuits of HIT lamps
- Electronic ballast for HIT lamps
- Efficiency of light sources

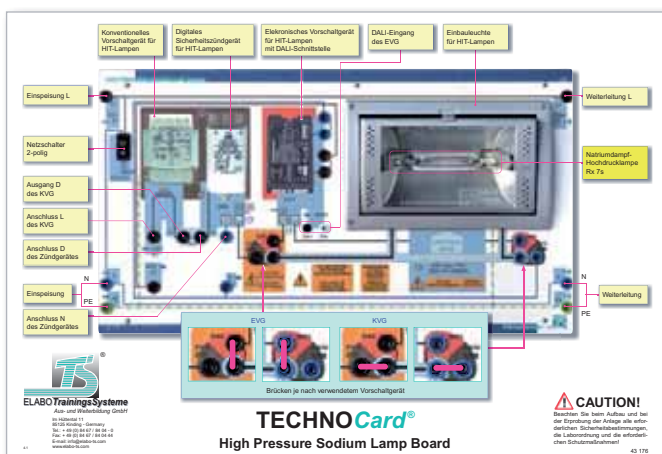


Printed and digital!

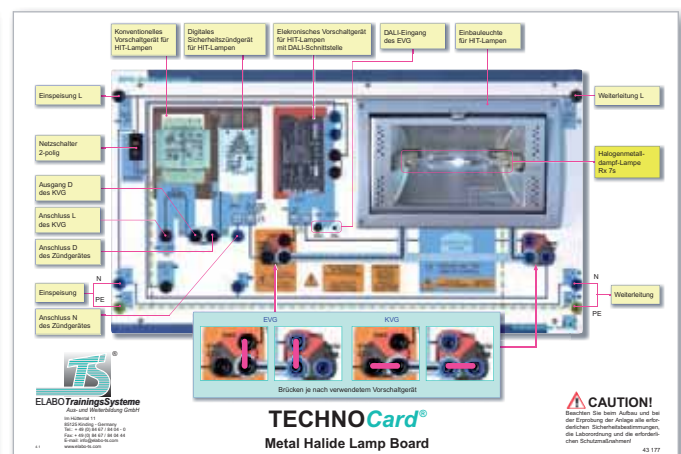
E43 193CD Manual: Lighting technology  
Special lamps – Transparency set



## TECHNOCards®



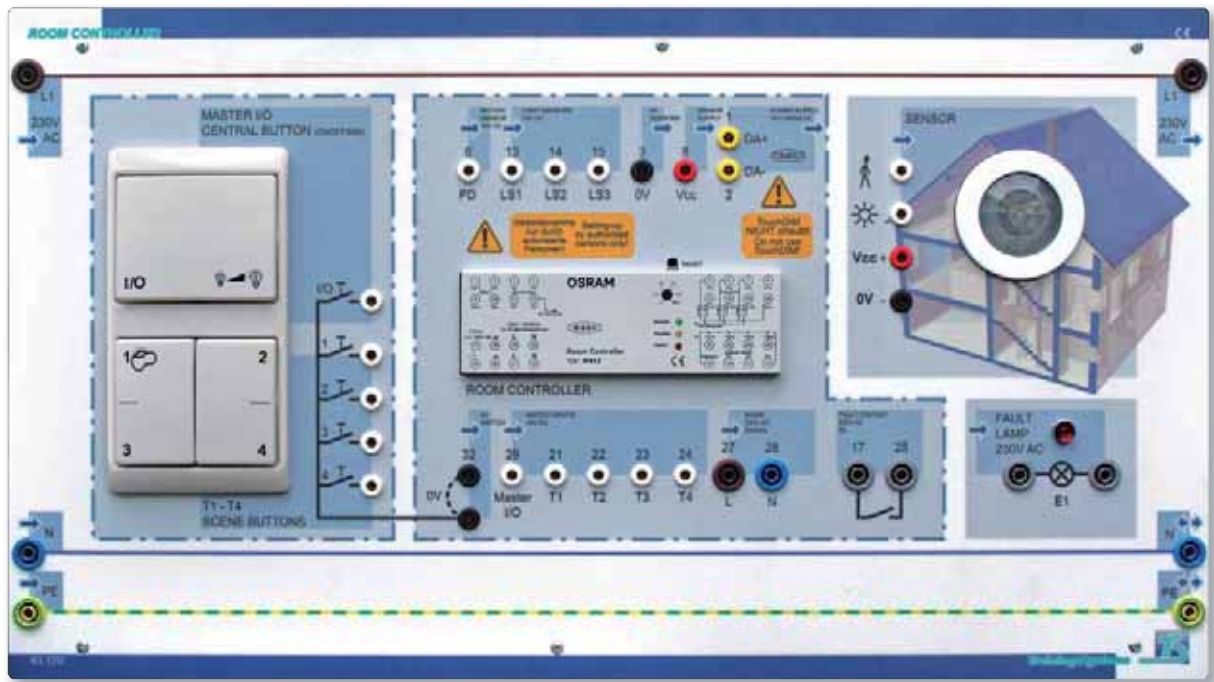
E43 176 TECHNOCard® High Pressure Sodium Lamp Board



E43 177 TECHNOCard® Metal Halide Lamp Board

# DALI CONTROLLERS

## DALI Room Controller



43 120 Room Controller DALI

### LEARNING OBJECTIVES

- ✓ Getting familiar with the principles of the DALI system
- ✓ Structure of DALI controllers
- ✓ Commissioning and troubleshooting
- ✓ Integration of sensors (e.g. light and motion) in DALI systems

### Technical data

- 1 light control system DALI
  - Constant light control
  - Scene control with 4 scenes
  - Presence-dependent light control
  - Providing the DALI operating voltage for 64 DALI devices
- 1 operating point with 5 control buttons
- 1 light and motion sensor
- 1 LED for fault indication
- All the required connections via 4mm and 2mm safety sockets

TECHNOCard®

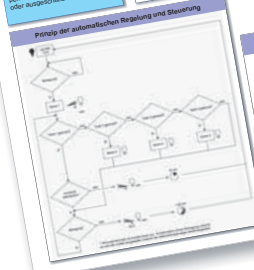
**Funktion**

**Lichtsteuerung**  
Die Steuerung ermöglicht die variable Blending von 4 Leuchtgruppen mit zwei individuellen Fotogegenständen in einem Raum eingestellt und gespeichert werden können.

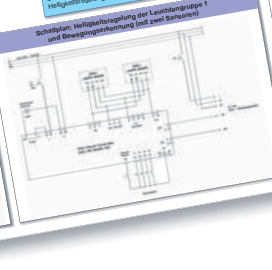
**Notlichteinstellung**  
In einem Raum bis zu 3 Leuchtgruppen durch ihre Auslastung und Lichtsensoren (DALI LS Basic) in der richtigen Menge herabgesetzt in den richtigen Bereich und können durch die bewegliche Hauptgruppe zurück zur Standardleistung einstellbar sein.

**Bewegungssteuerung**  
Durch die Festlegung von kombinierten Licht- und Bewegungssensoren (DALI LS2) können Räume ohne alle Leuchtgruppen per anwesenheitsabhängig oder ausschaltbar werden.

**Prinzip der automatischen Regelung und Steuerung**



**Schaltplan: Notlichteinstellung der Leuchtgruppe 1 und Bewegungssteuerung (mit zwei Sensoren)**



**System- und Fehlermeldungen**

System- und Fehlermeldungen werden über die im Gerät befindlichen LEDs optisch durch über eine an den Frontpanel angeordnete Leuchtleuchte angezeigt oder an ein übergeordnetes System weitergegeben.

LED	Auslast.	Beleuchtung
Grüne LED (Status)	Pluchert	Stromverbrauch ist hellgrün.
Rote LED (Fehler)	blinkt	Kein DALI-Talknehmer, ungenügendes, ungenügendes DALI-Leuchten oder Kurzgeschlossen. Der Fehlerzustand schaltet im gleichen Takt mit im gleichen Takt mit.
Weiße LED (Fehler)	Pluchert	Lampe eines eingestellten DALI-LENG ist defekt. Der Fehlerzustand ist gespeichert.

**Grundeneinstellung (Reset) durchführen**

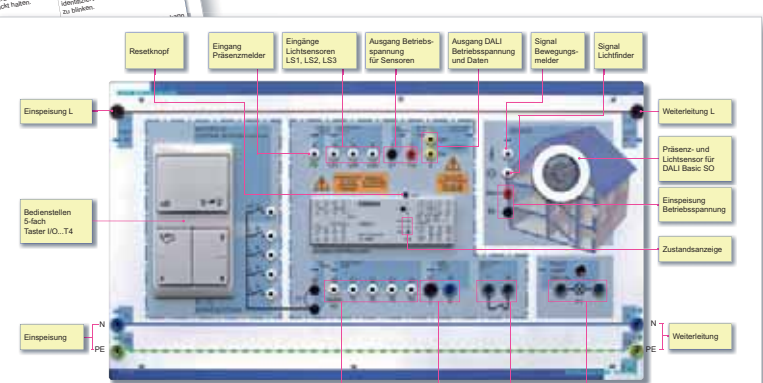
In der Grundeneinstellung sind alle Leuchten der Leuchtgruppe 1 zugewiesen und die Szenen 1 bis 4 sind einbelegt.

**Hinweise:**  
In folgenden Fällen führt die Steuerung die Grundeneinstellung beim Anlegen der Netzspannung automatisch durch:  
- Bei der Erstinbetriebnahme  
- Wenn zuvor noch keine Leuchte einer Leuchtgruppe zugewiesen war.

Schritt	Vorgang	Ergebnis
1	Netzspannung der Steuerung trennen und einrichten und 'Defekt' freisetzen.	
2	Netzspannung bei gedrückter Reset-Taste wieder einschalten.	Alle Gruppenzugehörigkeiten und Szenen-Einstellungen sind gelöscht.
3	Sobald die rote LED wieder erloschen ist, die vorher erloschen ist, die Reset-Taste drücken.	

**Leuchtgruppen festlegen**

**Hinweise:**  
Die Lichtsensoren (LS1 bis LS3) sind in die Steuerung integriert. Die Lichtsensoren (LS1 bis LS3) sind in die Steuerung integriert. Die Lichtsensoren (LS1 bis LS3) sind in die Steuerung integriert.




**Resetelement**  
Eingang Präsenzmelder  
Eingänge Lichtsensoren LS1, LS2, LS3  
Ausgang Betriebsspannung für Sensoren  
Ausgang DALI Betriebsspannung und Daten  
Signal Bewegungsmelder  
Signal Lichtfinder

**Empfänger L**  
**Weiterleitung L**  
**Präsenz- und Lichtsensoren für DALI Basic SO**  
**Einspeisung Betriebsspannung**  
**Zustandsanzeige**

**Empfänger IO...T4**  
**Bedienstation Taster IO...T4**  
**Einspeisung**  
**PE**  
**Weiterleitung**

**Eingänge Steuertaster IO...T4**  
**Einspeisung L und N DALI-Room Controller**  
**Ausgang Fehler**  
**Anzeigeleuchte 230V**



ELABOTrainingsSysteme  
Ausschulungszentrum  
43172 Essen  
Tel. +49 (0) 20 34 27 14 04 1  
Fax +49 (0) 20 34 27 14 04 4  
Email: info@elabo-tr.com  
www.elabo-tr.com

**TECHNOCard®**  
Room Controller

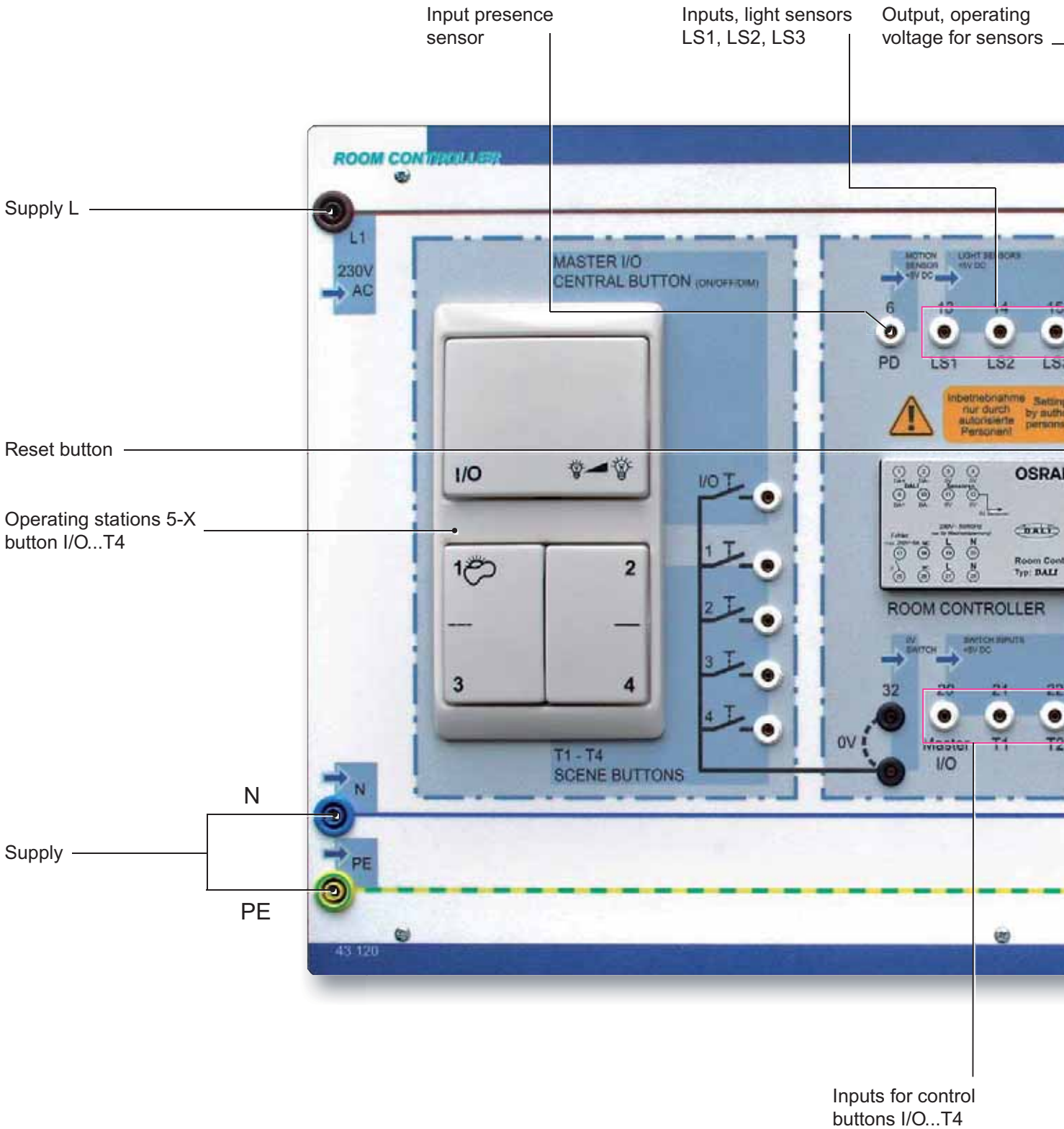
**CAUTION!**  
Beachten Sie beim Aufbau und bei der Erprobung der Anlage alle erforderlichen Sicherheitsbestimmungen, die Laborordnung und die erforderlichen Schutzmaßnahmen!

43 172

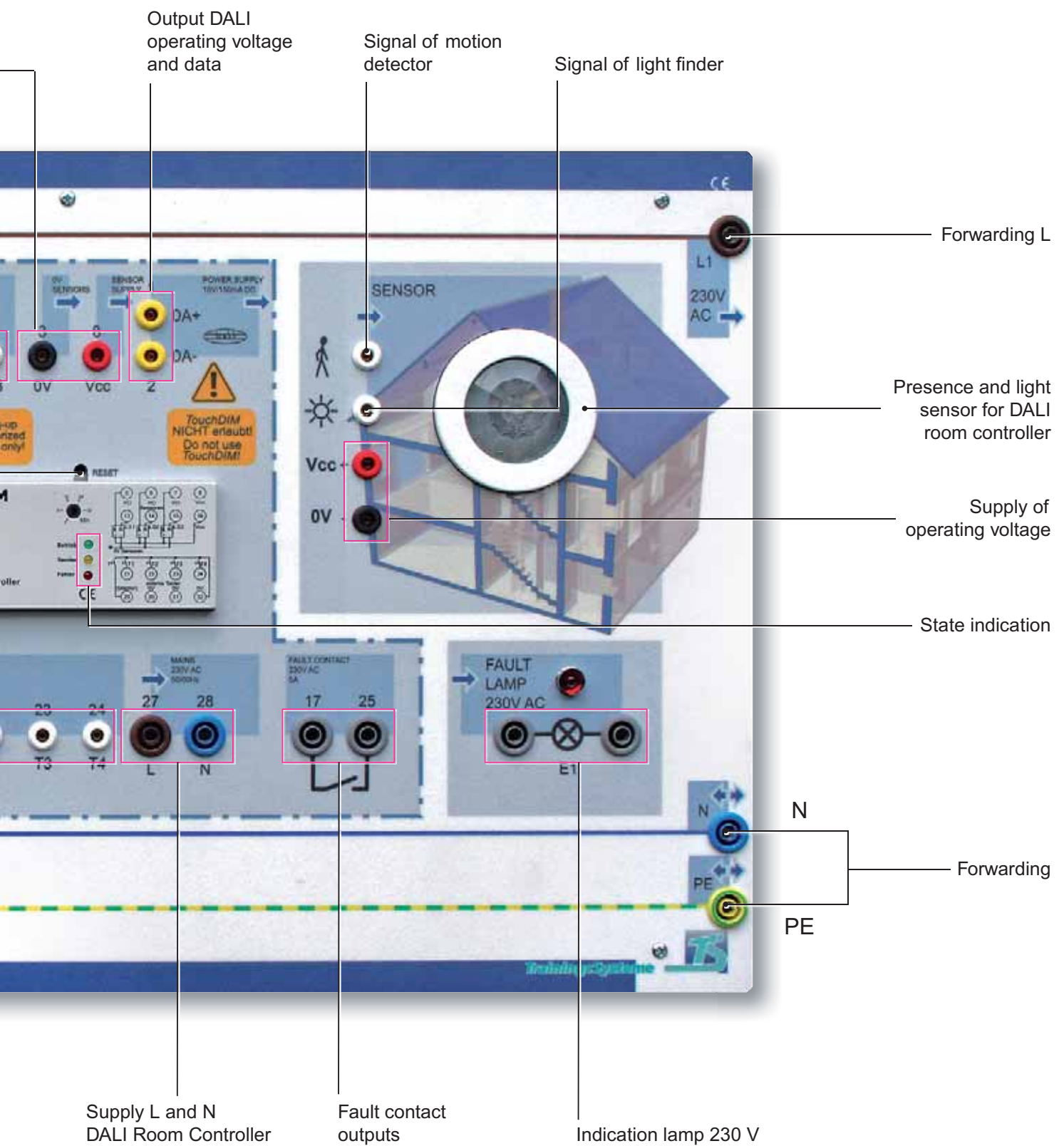
E43 172 TECHNOCard® Room Controller

# DALI CONTROLLERS

## DALI Room Controller

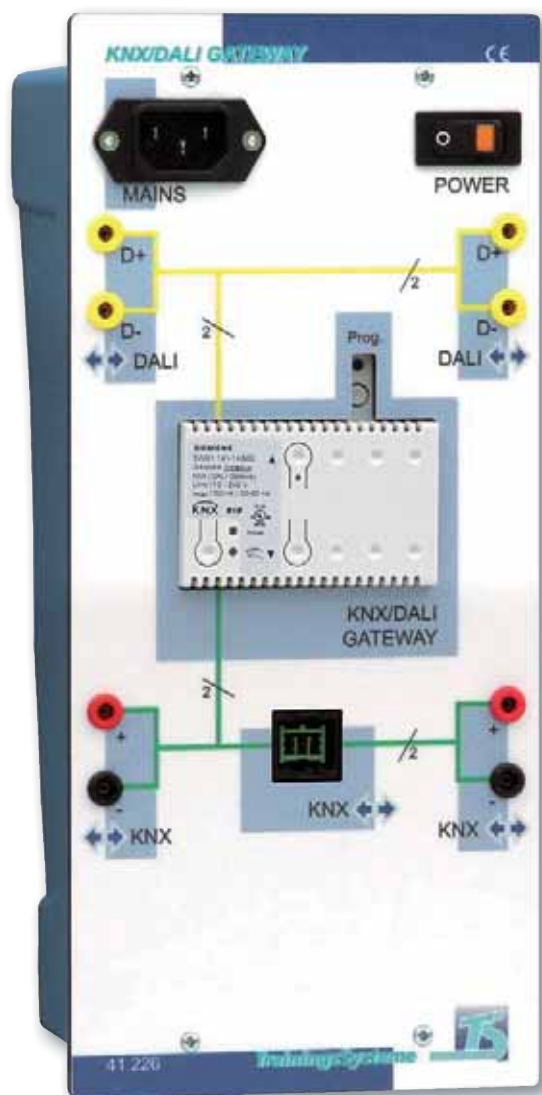






# DALI CONTROLLERS

## KNX/DALI Gateway



### LEARNING OBJECTIVES

- ✓ Projection of KNX systems
- ✓ Commissioning and troubleshooting
- ✓ Commissioning a DALI bus system
- ✓ Integration of the DALI bus system in a KNX system
- ✓ Documentation and maintenance

41 226 KNX/DALI Gateway

### Technical data

- DALI interface for max. 64 DALI devices
- DALI bus voltage DC approx. 19 V DC
- KNX bus connection
- Mains voltage: 110 V – 240 V AC 50 / 60 Hz
- Connection of all the inputs and outputs via safety sockets (2 mm)

# WHAT IS DALI?

Innovation in lighting technology

## Digital Addressable Lighting Interface



**DALI** was jointly created by the leading manufacturers of control units and electronic control gears as a non-proprietary standard to satisfy all the demands that are placed on a modern light management.

Approved by almost all luminaire and control equipment manufacturers, DALI has become the new standard in lighting industry. DALI was designed mainly for room lighting control. Ease of use of the lighting systems and their components has

always been in the focus. As an interface standard, DALI provides the means to configure complete light management systems for rooms such as DALI room controllers or KNX-DALI gateways.

### FEATURES

- **Simple installation**  
DALI and power supply wires can be handled in a single, common cable. Any wiring topology can be used, such as line, star or mixed.
- **Stable dimming function**  
Precise dimming values are achieved from digital signals which are insensitive to interferences.
- **Flexibility**  
The assignment of the luminaires to the light groups and the operating buttons are defined after the installation, thus offering easy planning even after start-up.
- **Polarity of wiring irrelevant**  
Wiring errors can almost be excluded.

### Innovation in lighting technology

The configuration of situation-dependent light settings requires lighting systems allowing to group luminaires and to save the light values of individual groups as light scenes. There are further requirements for the integration of lighting systems in building management with centralized switch control and status reporting.

### Benefit for installers

Changing the use of a room does not require rewiring as in 1...10 V systems. The complete lighting can be software-controlled over a single gateway.

### DALI is bus-capable

Light switching and dimming is only one function of DALI. It can also be used to control colourful light scenes, fluorescent lamps or metal halide lamps. DALI furthermore allows complex programming for setting up constant light control circuits.

# INFORMATION AND CONSULTATION

## CONSULTANCY

---

- Design of customer oriented solutions
- Presentation, product demonstration and on-site consultation
- Assistance in the choice of products complying with syllabuses
- Customized products according to requirements
- Development of room concepts
- Design of ergonomic workplaces
- Turnkey projects



## CONTACT

---

ELABO *TrainingsSysteme GmbH*

Service-Center

Im Hüttental 11

85125 Kinding / Germany

Tel.: + 49 (0) 84 67 / 84 04 - 0

Fax: + 49 (0) 84 67 / 84 04 44

[sales@elabo-ts.com](mailto:sales@elabo-ts.com)

[www.elabo-ts.com](http://www.elabo-ts.com)



## EXPERIENCE

---

- Design and manufacturing of technical training systems
- Comprehensive range of innovative products, systems and solutions – MADE IN GERMANY
- Quality service from first consultation to delivery and beyond
- Trainer seminars onsite or inhouse
- References worldwide
  - Industrial training institutions
  - Vocational schools / technical schools
  - Chambers of crafts
  - Technical colleges
  - Universities / Universities of Applied Sciences



## WE ASSIST YOU

---

- On-site installation and commissioning
- Technical support
- Warranty and maintenance
- Briefing and training
- Qualification, advanced training, workshops
- Comprehensive product documentation
- Detailed courseware for trainers and students

# YOUR ENQUIRY



## ELABOTrainingsSysteme Aus- und Weiterbildung GmbH

Im Hüttental 11  
85125 Kinding / Germany

Tel.: +49 (0) 84 67 / 84 04 - 0  
Fax: +49 (0) 84 67 / 84 04 44

Name, Position		
Company / Institution / Government agency		
Street, Post Box		
ZIP Code, City, Country		
Phone	Fax	E-mail

We would like to receive:

- |   |  |
|---|--|
| <input type="checkbox"/> Contact by telephone             | <input type="checkbox"/> On-site consultancy |
| <input type="checkbox"/> Additional technical information | <input type="checkbox"/> Offer               |

Ord. No	Description / Title	Qty	Ord. No	Description / Title	Qty
<b>Installation engineering</b>			<input type="checkbox"/> E43 186CD Manual: Fluorescent Lamps, presentation aids/transparency set		
<input type="checkbox"/> 43 109	Installation Switch Board I		<input type="checkbox"/> E43 182CD	Manual: Lighting Technology, commissioning and troubleshooting	
<input type="checkbox"/> E43 136CD	Manual: Installation Engineering, student edition		<b>Lighting wit LED</b>		
<input type="checkbox"/> E43 135CD	Manual: Installation Engineering, instructor's edition		<input type="checkbox"/> 43 116	LED Lamps Board	
<input type="checkbox"/> E43 137CD	Manual: Installation Engineering, transparency set		<input type="checkbox"/> E43 171	TECHNOCard® LED Lamps Board	
<input type="checkbox"/> E42 202CD	Manual: Installation Engineering, commissioning and troubleshooting incl. technical documentation		<input type="checkbox"/> E43 187CD	Manual: Lighting with LED, student edition	
<input type="checkbox"/> E43 168	TECHNOCard® Installation Switch Board I		<input type="checkbox"/> E43 188CD	Manual: Lighting with LED, instructor's edition	
<b>Experiment modules</b>			<input type="checkbox"/> E43 189CD	Manual: Lighting with LED, presentation aids / transparency set	
<input type="checkbox"/> 20 196	13-part module set		<b>LED light management systems</b>		
<input type="checkbox"/> 20 191	Storage tray for 10 experimental modules		<input type="checkbox"/> 43 117	LED Effect Lighting Board	
<input type="checkbox"/> 90 009	Set of safety measuring leads, 4 mm, 30 parts		<input type="checkbox"/> 43 121	LED Control Board	
<b>Installation circuit components</b>			<input type="checkbox"/> E43 194CD	Manual: Light Management Systems, student edition	
<input type="checkbox"/> 20 020	Installation circuit components		<input type="checkbox"/> E43 195CD	Manual: Light Management Systems, instructor's edition	
<b>Accessories to the experimental modules and electrical installation components</b>			<input type="checkbox"/> E43 196CD	Manual: Light Management Systems, commissioning and Troubleshooting	
<input type="checkbox"/> 89 210	Grid patchboard, to be fit to an experiment frame		<input type="checkbox"/> E43 197CD	Manual: Light Management Systems, presentation aids / transparency set	
<input type="checkbox"/> 89 215	Grid patchboard, free-standing with T-shaped leg, 1200 mm		<input type="checkbox"/> E43 175	TECHNOCard® LED Effect Lighting Board	
<b>Energy saving lamps</b>			<b>Special lamps</b>		
<input type="checkbox"/> 43 114	Energy Saving Lamps Board		<input type="checkbox"/> 43 118	High Pressure Sodium Lamp Board	
<input type="checkbox"/> E43 180CD	Manual: Energy Saving Lamps, student edition		<input type="checkbox"/> 43 119	Metal Halide Lamp Board	
<input type="checkbox"/> E43 181CD	Manual: Energy saving lamps, instructor's edition,		<input type="checkbox"/> E43 176	TECHNOCard® High Pressure Sodium Lamp Board	
<input type="checkbox"/> E43 182CD	Manual: Lighting Technology, commissioning and troubleshooting		<input type="checkbox"/> E43 177	TECHNOCard® Metal Halide Lamp Board	
<input type="checkbox"/> E43 183CD	Manual: Energy saving lamps, presentation aids / transparency set		<input type="checkbox"/> E43 190CD	Manual: Special lamps, student edition	
<input type="checkbox"/> E43 170	TECHNOCard® Energy Saving Lamps Board		<input type="checkbox"/> E43 191CD	Manual: Special lamps, instructor's edition	
<b>Fluorescent lamps</b>			<input type="checkbox"/> E43 193CD	Manual: Special lamps, presentation aids / transparency set	
<input type="checkbox"/> 43 112	Fluorescent Lamps Board A		<input type="checkbox"/> E43 182CD	Manual: Lighting Technology, commissioning and troubleshooting	
<input type="checkbox"/> 43 113	Fluorescent Lamps Board B		<b>DALI controllers</b>		
<input type="checkbox"/> 43 174	TECHNOCard® Fluorescent Lamps Board A / B		<input type="checkbox"/> 43 120	Room controller DALI	
<input type="checkbox"/> E43 184CD	Manual: Fluorescent Lamps, student edition		<input type="checkbox"/> E43 172	TECHNOCard® Room Controller	
<input type="checkbox"/> E43 185CD	Manual: Fluorescent Lamps, instructor's edition		<input type="checkbox"/> 41 226	KNX/DALI Gateway	
			<input type="checkbox"/> 91 404	Set of ring binders	

# YOUR ENQUIRY



## ELABOTrainingsSysteme Aus- und Weiterbildung GmbH

Im Hüttental 11  
85125 Kinding / Germany

Tel.: +49 (0) 84 67 / 84 04 - 0  
Fax: +49 (0) 84 67 / 84 04 44

Name, Position \_\_\_\_\_

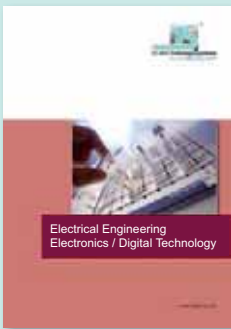
Company / Institution / Government agency \_\_\_\_\_

Street, Post Box \_\_\_\_\_

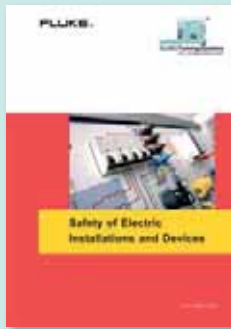
ZIP Code, City, Country \_\_\_\_\_

Phone \_\_\_\_\_ Fax \_\_\_\_\_ E-mail \_\_\_\_\_

Please send us the following catalogue(s)



Electrical Engineering  
Electronics I  
Digital Technology



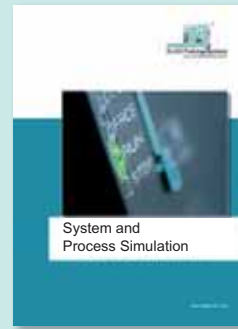
Safety of Electric  
Installations and  
Devices



AS-i Fieldbus  
Technology



Control Technology



System and  
Process Simulation



Control Engineering



Practical Training in  
Sensor Technology



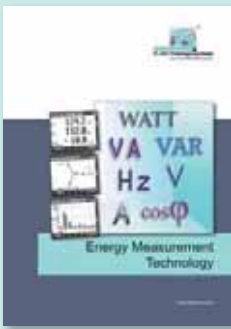
UPDATE  
2012/2013



KNX Installation  
Bus System



Gear Unit  
Technology



Energy Measurement  
Technology



Bus-Capable  
Intercoms



Drive System  
Engineering



Microcomputer  
Training System



Safety Engineering

ELABO *TrainingsSysteme GmbH*

Im Hüttental 11

85125 Kinding / Germany

Tel.: +49 (0) 84 67 / 84 04 - 0

Fax: +49 (0) 84 67 / 84 04 44

E-mail: [sales@elabo-ts.com](mailto:sales@elabo-ts.com)

Internet: [elabo-ts.com](http://elabo-ts.com)