

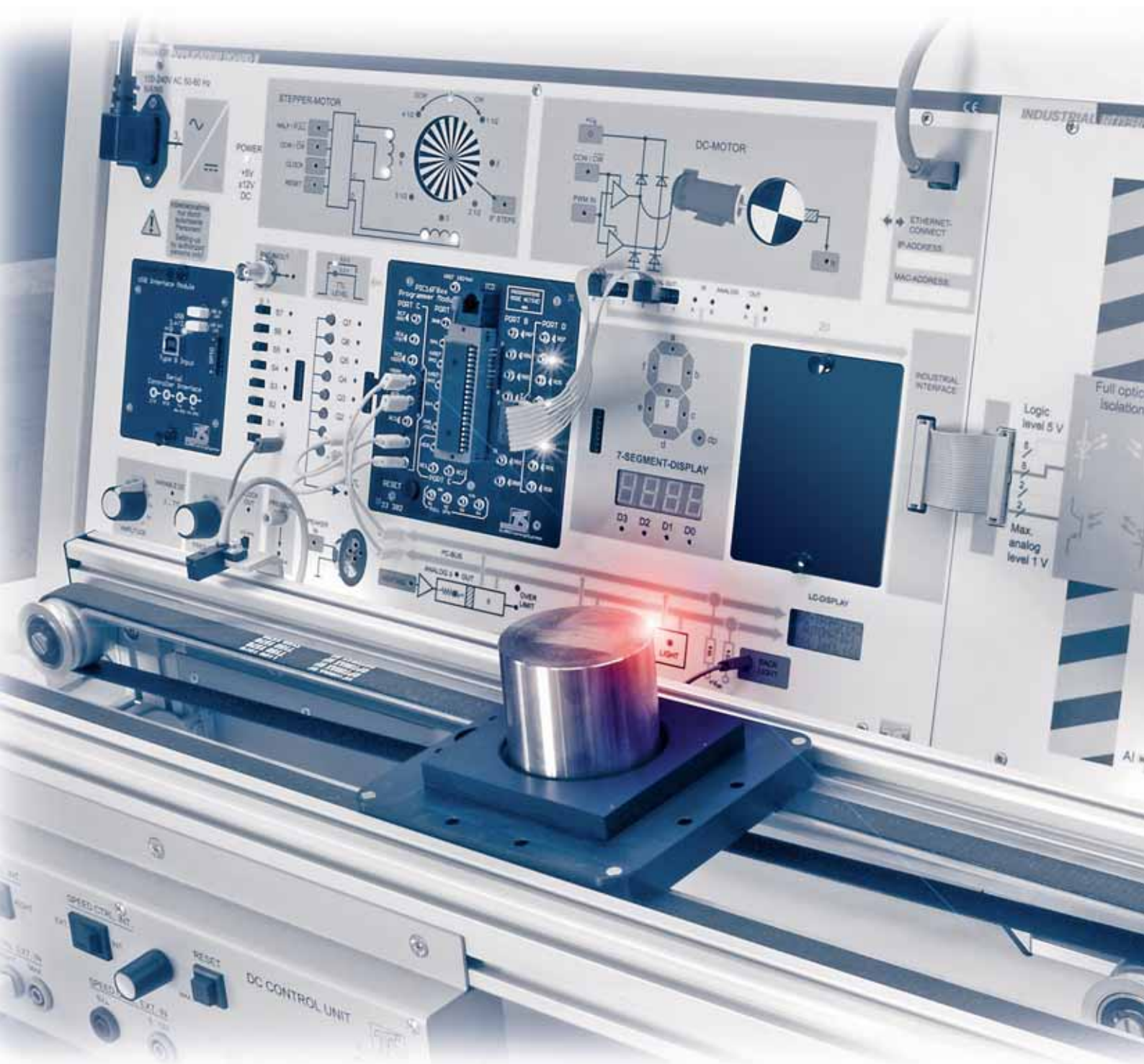


# Microcomputer Training System

## µ-Trainer



# MICROCOMPUTER TRAINING SYSTEM WITH

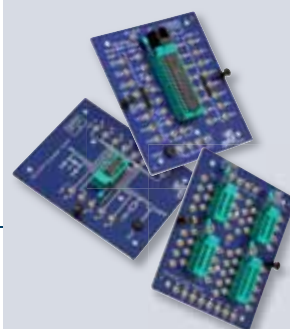


MICROCOMPUTER TRAINING SYSTEM



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HARDWARE / SOFTWARE



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PROJECTS



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INFORMATION AND CONSULTATION

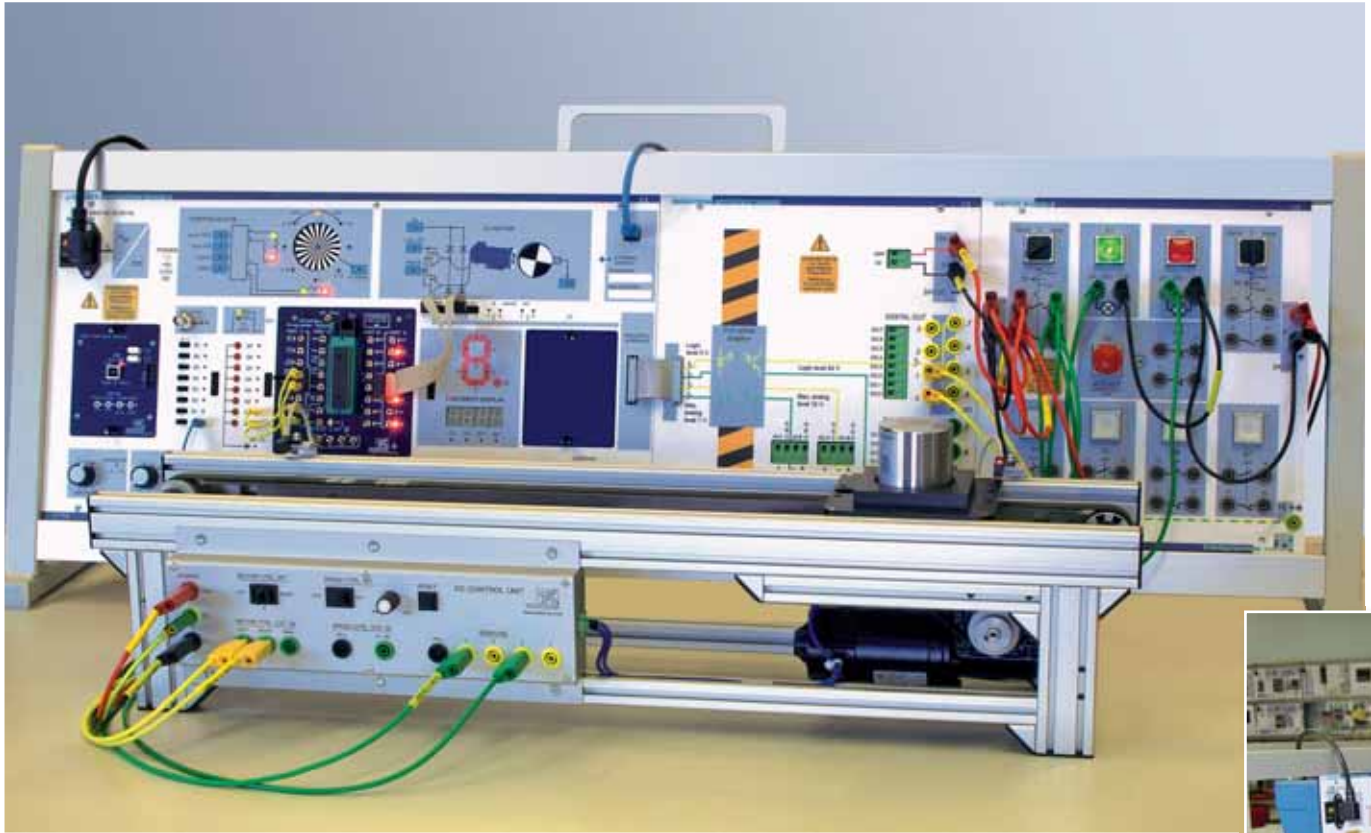


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# MICROCOMPUTER TRAINING SYSTEM

Configuring function groups with hard- and software



*Microcomputer training system with industrial interface*

The training system for microcomputer technology is designed mainly for use in vocational education.

- ✓ Fundamentals of digital technology
- ✓ Use of graphical programming methods
- ✓ Structure and function of microcontrollers, processors ...
- ✓ Data formats and their conversion
- ✓ Components of integrated development environments
- ✓ Programming in Assembler, C, ...
- ✓ Firmware generation
- ✓ Measuring of analog values such as voltage, temperature, pressure ...
- ✓ AD and DA converters
- ✓ Components with I<sup>2</sup>C bus like displays, brightness and temperature sensors
- ✓ DC and stepping motor control



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## Fundamentals of digital technology

- Methods of digital circuit analysis
- Methods of digital circuit synthesis
- Practical use of logic integrated circuits
- Designing a circuit with ICs
- Data from integrated circuits
- Measurement devices and methods
- Complex logic circuits and converters



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## Fundamentals of microcomputer technology

- Microcomputer and microcontroller
- Embedded systems
- Instruction set of the CPU
- Memory components
- Timer and interrupts
- Bus and ports

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## Using industrial development environments

- Installation
- Configuration
- Use for programming
- Structured programming
- Program graph
- Debugging and simulation of programs

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## Microcontroller integration in appliances

- Data formats
- Interfaces
- Bus systems
- Device types
- Clock generation
- Parallel and serial data transfer

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## Integration of external peripheral devices

- Analog sensors
- Intelligent sensors
- Displays
- Small motors

---

## Serial asynchronous communication

- Principle of the serial asynchronous transmission
- EIA232 interface
- USB interface
- Terminal communication
- Testing interfaces
- Data communication between controller and PC
- Controller boot loader
- Programming a controller with boot loader

---

## Control of industrial manufacturing systems

- The transition from the appliance to a system
- Industrial levels and safety measures
- Control circuits
- Electromechanical and pneumatic components
- Safety of systems through hard- and software

# HARDWARE

## µ-Trainer II system

Indication of active TTL level 5 V or 3.3 V  
(dep. of programmer module)

Control inputs for stepper motor

Power-ON indication

Wide range voltage supply  
110 V ... 240 V AC, 50 ... 60 Hz

Socket for connection  
of external measuring  
instruments e.g. oscil-  
loscope

Extension module

8 switches with  
2mm or bus connection

8 push buttons with  
2mm or bus connection

Interrupt pulse output

Adjustable DC voltage  
0 V ... TTL level

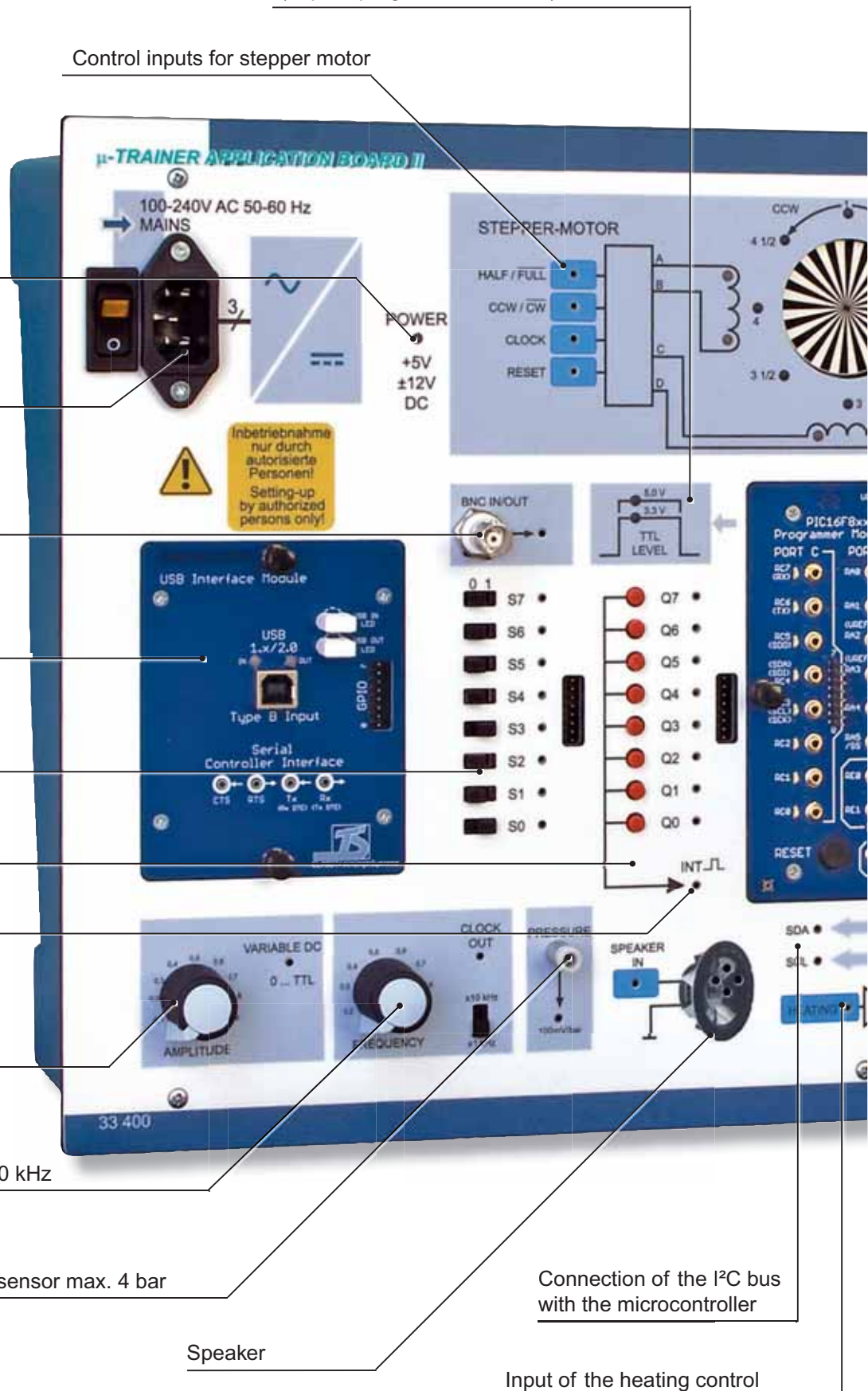
TTL clock generator 100 Hz ... 10 kHz

Connection for analog pressure sensor max. 4 bar

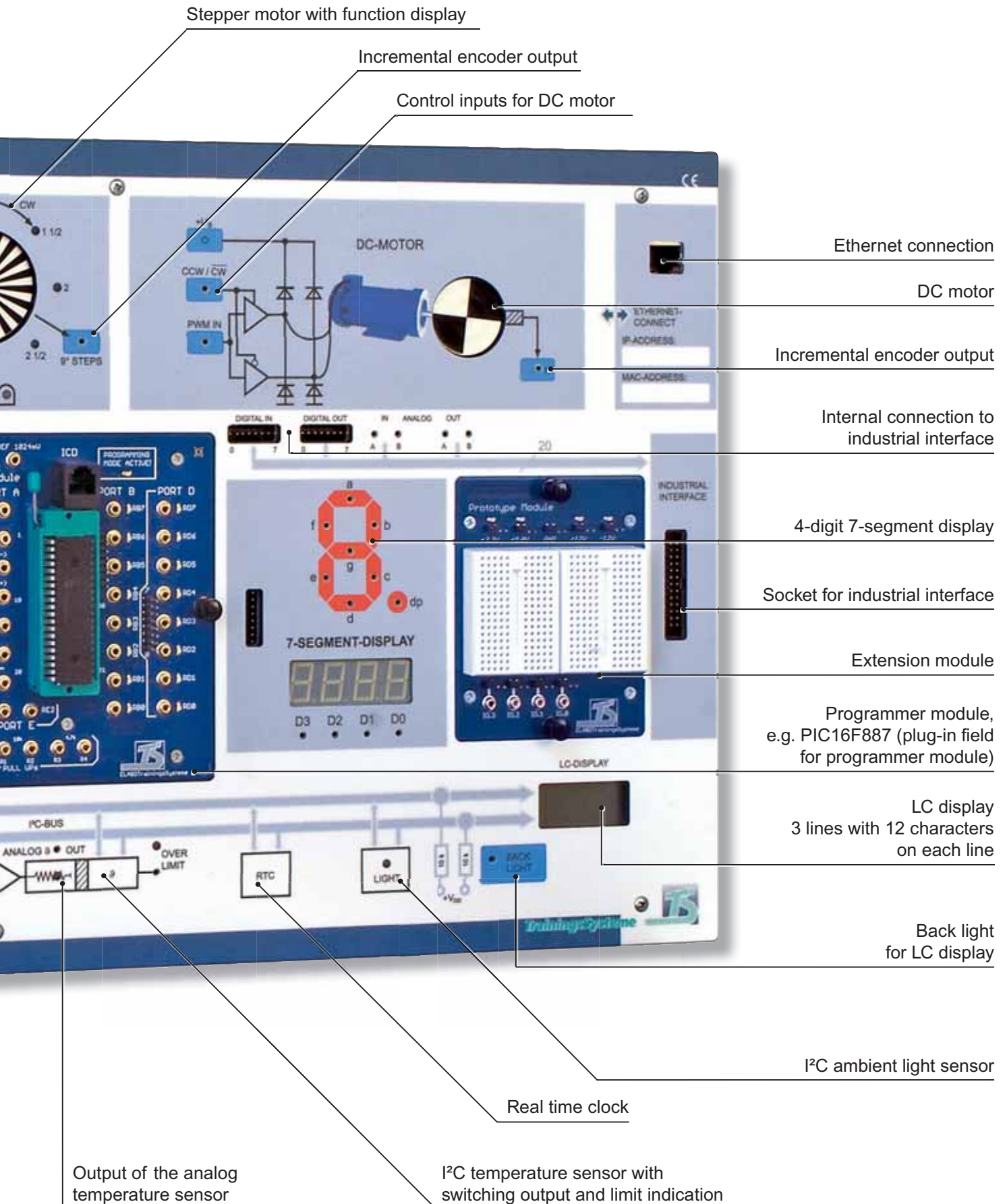
Speaker

Connection of the I<sup>2</sup>C bus  
with the microcontroller

Input of the heating control

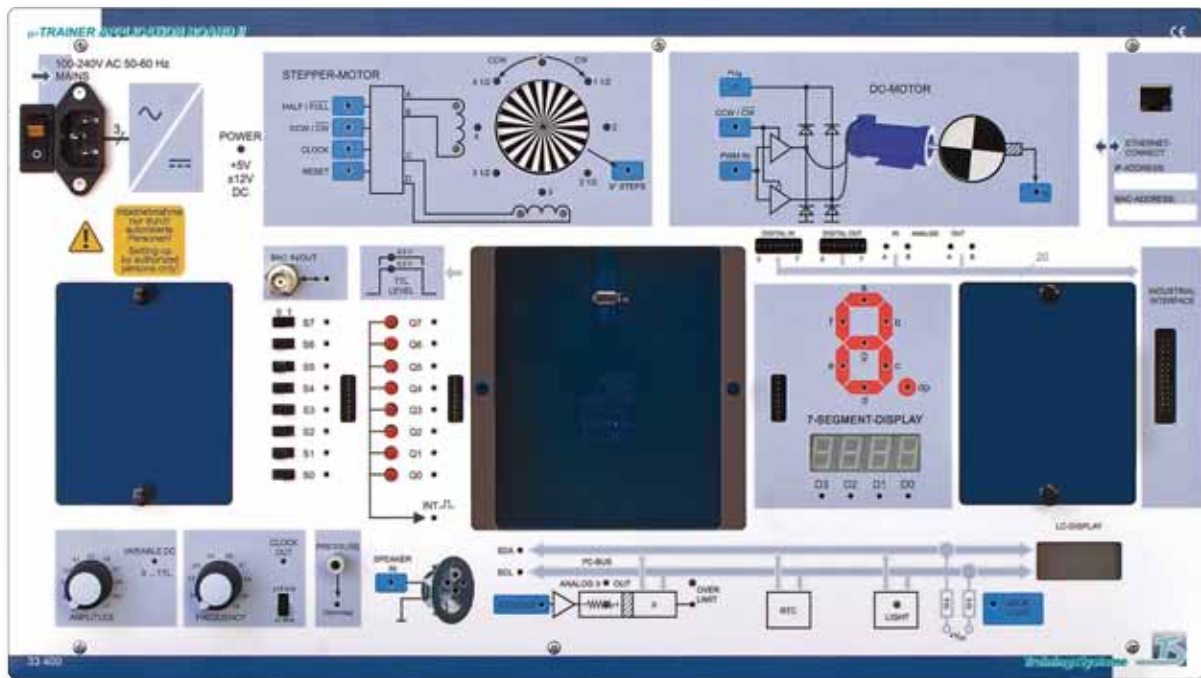






# HARDWARE/SOFTWARE

## $\mu$ -Trainer Application Board II



33 400  $\mu$ -Trainer Application Board II

The “ $\mu$ -Trainer Application Board II” is the basic module of the microcomputer training system “ $\mu$ -Trainer”. It has the following features and functions:

- 8 ON/OFF switches
- 8 push buttons
- 1 interrupt output
- 4 7-segment displays
- 1 heating module
- 1 I<sup>2</sup>C temperature sensor
- 1 I<sup>2</sup>C real time clock
- 1 I<sup>2</sup>C ambient light sensor
- 1 I<sup>2</sup>C LC display with back light
- 1 analog pressure sensor up to 4 bars
- 1 analog temperature sensor up to 100°C
- 1 bipolar stepper motor, 0.9° incremental motion
- 1 DC motor with motor driver and speed sensor
- 1 speaker
- 1 adjustable DC voltage level: 0 ... TTL level
- 1 clock generator 100 Hz ... 10 kHz, TTL level
- 1 BNC socket for adapting measuring instrument inputs to 2mm connections
- 1 plug-in field for programming modules
- 2 plug-in fields for expansion modules
- 1 industrial interface connection with 8 digital inputs, 8 digital outputs, 2 analog inputs, 2 analog outputs

### Technical Data

#### 33 400 $\mu$ -Trainer Application Board II

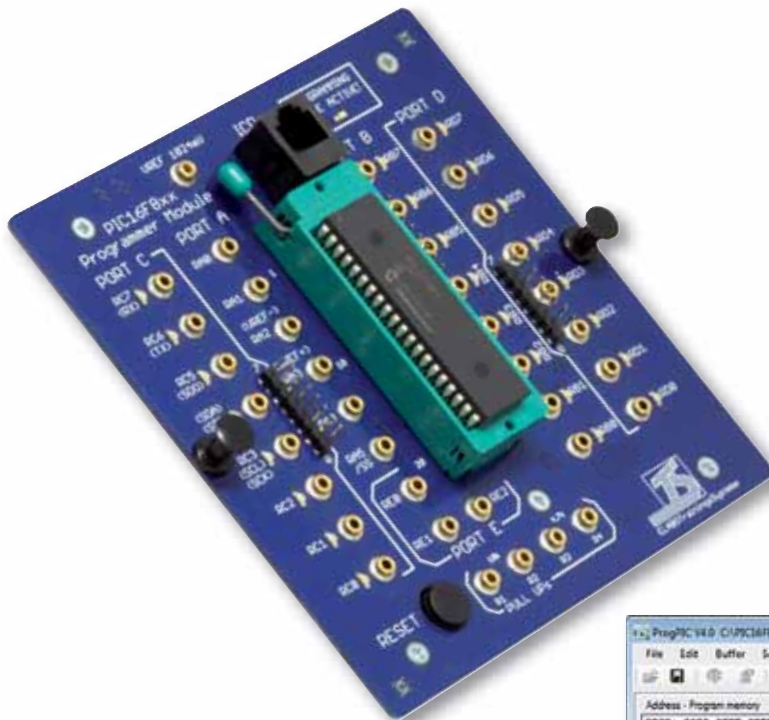
- Computer interface via Ethernet
- 2mm connectors or bus connectors (8-pin, 1:1, ribbon cable)
- Power supply 110 ... 240 V AC, 50 ... 60 Hz
- Internal operating voltages 3.3 V; 5.0 V; +/-12.0 V
- Logic level 3.3 V or 5.0 V
- Central on/off switch
- Dimensions 532 x 297 x 85 mm
- Desk housing device

#### The “ $\mu$ -Trainer Application Board II” is delivered with:

Application Board, CD-ROM with driver software, power cord, Ethernet connecting cable 2 m, 1 bus cable 10 cm, 1 bus cable 20 cm, 1 bus cable 30 cm, 1 bus cable 50 cm, 1 adapter bus cable 20 cm, operating instructions.



## PIC16F8xx Programmer Module



The PIC16F8xx Programmer Module is an integrated test and programming module for the training system "µ-Trainer". It serves for programming of PIC16F8xx microcontrollers with 40-pin PDIP housing and for using the microcontroller in the training system.

33 402 PIC16F8xx Programmer Module

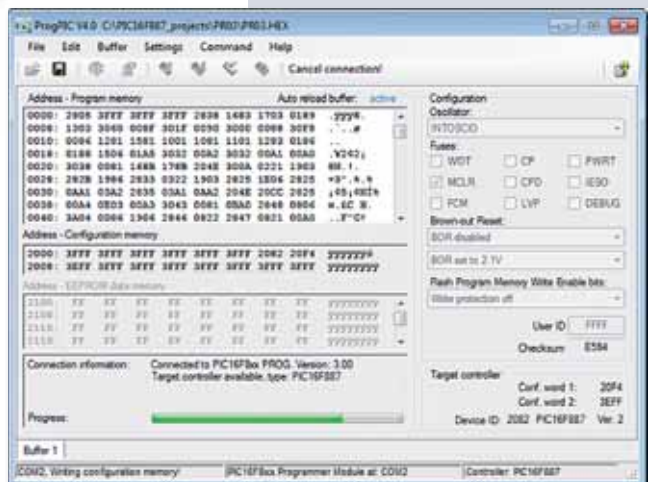
### Technical Data

#### 33 402 PIC16F8xx Programmer Module

- ZIF socket, 40-pin, for inserting the controller PIC16F887 (optional: PIC16F884, PIC16F877, PIC16F874)
- Clock generation, external with quartz 16 MHz (oscillator type HS)
- Clock generation, internal up to 8 MHz
- Ports A, B, C, D and Port E have 2mm connectors
- Ports B, C and D have bus connectors in addition
- LED per port pin at the Ports B, C and D indicating the logical level
- Integrated ADC (Port A, B and E) 14 channels, 10 Bit
- Internal and external reference voltage
- Reference voltage source  $U_{REF} = 1024 \text{ mV}$
- Programmer circuit, in series, ISP
- In Circuit Debugging Interface over ISP interface
- Programming voltage +12 V
- Internal operating voltage: +5 V / +5 V logical level

#### Delivery scope:

PIC16F8xx Programmer Module, CD-ROM with programming software\*\* and industrial software developing environment (project management, source code editor, Assembler, C-Compiler, Simulator), operating instructions.



\*System requirements:

Windows XP SP2,  
Frame Network 4.x,  
Windows Vista SP1,  
Windows 7 (32 Bit/64 Bit)

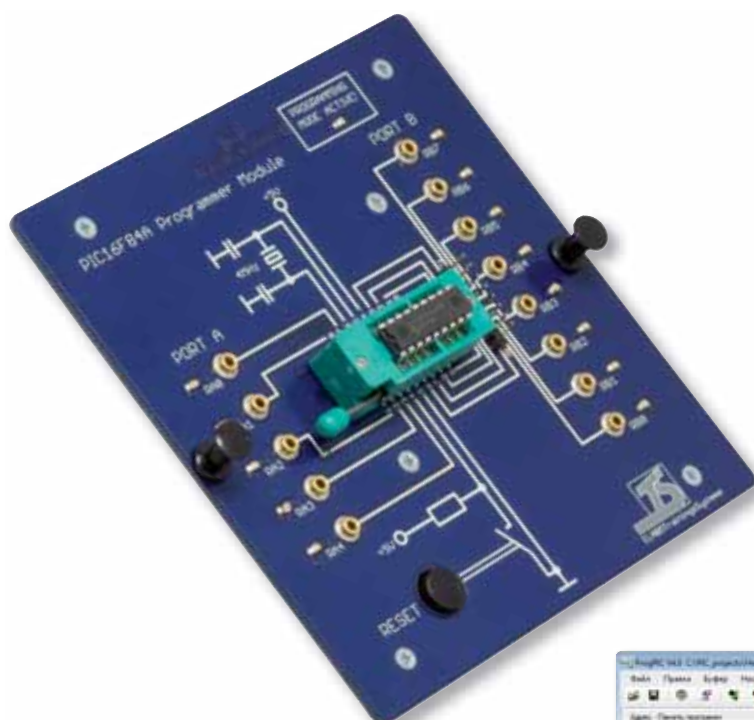


\* Windows is a registered trademark of the Microsoft Corporation.

\*\* software also in Russian language available

## HARDWARE/SOFTWARE

## PIC16F84A Programmer Module



The PIC16F84A Programmer Module is an integrated test and programming module for the training system "μ-Trainer". It serves for programming of PIC16F8x microcontrollers with 18-pin PDIP housing (PIC16F84, PIC16F84A, PIC16F87 and PIC16F88).

The microcontrollers are programmed and used in the training system.

33 401 PIC16F84A Programmer Module

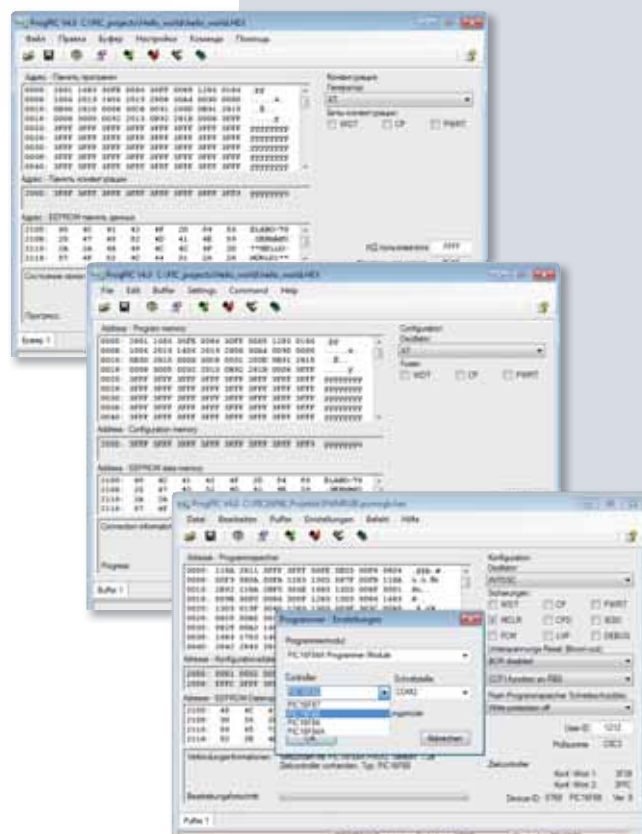
## Technical Data

## 33 401 PIC16F84A Programmer Module

- ZIF socket, 18-pin, for inserting the controller PIC16F84A (optional: PIC16F84, PIC16F87, PIC16F88)
- Clock generation with quartz 4 MHz
- Port A (0 ... 4) and port B (0 ... 7) have 2mm connectors, port B has a bus connector in addition.
- LED per port pin indicating the logical level
- Programmer circuit, in series, ISP
- Internal operating voltage: +5 V
- +5 V logical level
- Dimensions 125 x 120 x 32 mm

## Delivery scope:

PIC16F84A Programmer Module, CD-ROM with programming software\*\* and industrial software developing environment (project management, source code editor, Assembler, C-Compiler, Simulator), operating instructions.



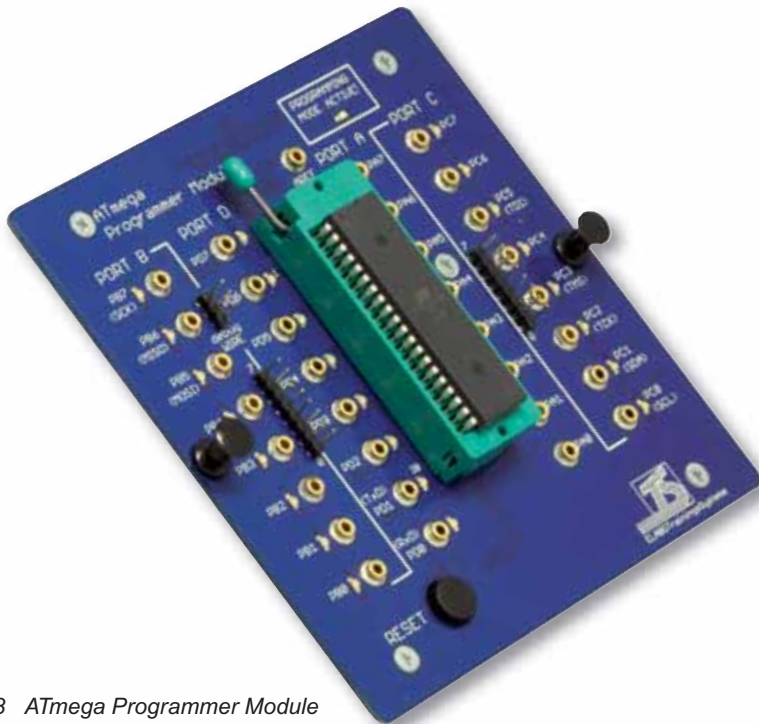
## \*System requirements:

Windows XP SP2,  
Frame Network 4.x,  
Windows Vista SP1,  
Windows 7 (32 Bit/64 Bit)

\* Windows is a registered trademark of the Microsoft Corporation.

\*\* software also in Russian language available

## ATmega Programmer Module



33 403 ATmega Programmer Module

### Technical Data

#### 33 403 ATmega Programmer Module

- ZIF socket, 40-pin, for inserting the controller ATmega16 (optional: ATmega32 or ATmega8535)
- Clock generation internal 1 MHz, 2 MHz, 4 MHz and 8 MHz or external with quartz 16 MHz
- Ports A, B, C and Port D (0 ... 7) have 2mm connectors, ports B and C have bus connectors in addition
- LED per port pin at the Ports B, C and D indicating the logical level
- Integrated ADC (Port A) 8 channels, 10 Bit, internal and external reference voltage
- External reference voltage input for the ADC up to  $U_{REF} = 5\text{ V}$
- On-Chip-Debugging Interface JTAG and Debug Wire for future applications
- Programmer circuit, in series, ISP
- Internal operating voltage: +5 V
- +5 V logical level
- Dimensions 125 x 120 x 35 mm

\* System requirements:  
Windows XP SP2,  
Frame Network 4.x,  
Windows Vista SP1,  
Windows 7 (32 Bit/64 Bit)

#### Delivery scope:

ATmega Programmer Module, CD-ROM with programmer software and industrial software developing environment (project management, source code editor, Assembler, Simulator), C-Compiler, operating instructions.

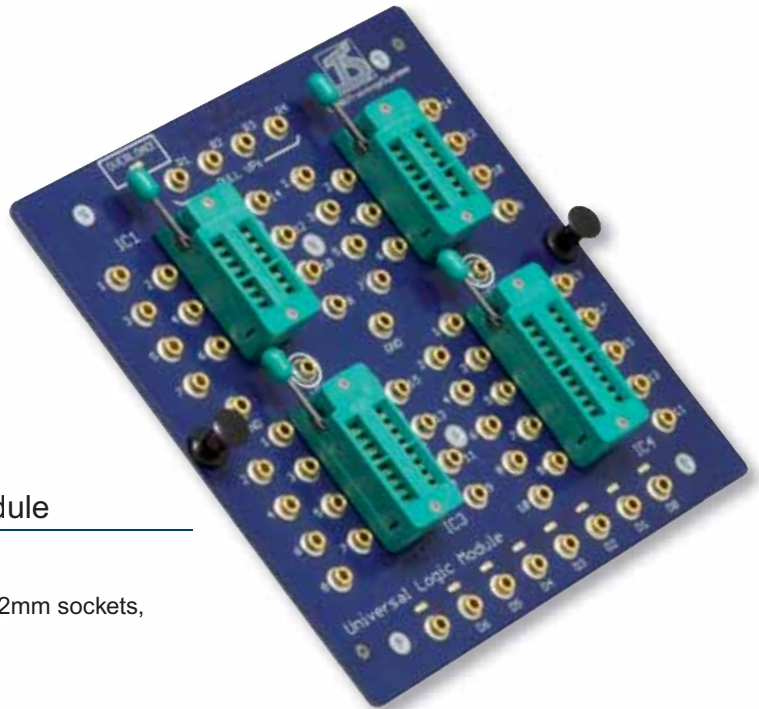
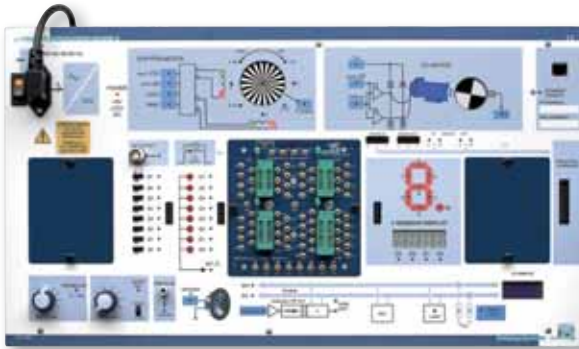
The ATmega Programmer Module is an integrated test and programming module for the training system "µ-Trainer". It serves for programming of ATmega controllers with 40-pin PDIP housing (ATmega16, ATmega32 or ATmega8535). The microcontrollers are programmed and used in the training system.





# MICROCOMPUTER/DIGITAL TECHNOLOGY

## Universal Logic Module



### Technical Data 33 406 Universal Logic Module

- 4 ZIF sockets, all pins can be optionally connected via 2mm sockets,
  - 2 x ZIF sockets 14 pin
  - 1 x ZIF socket 16 pin
  - 1 x ZIF socket 20 pin
- 8 x LED with separate inputs for display of logic levels, buffered
- 4 x Pull-Up resistors 10 k $\Omega$
- Logic level: +5 V TTL
- Operating voltage, short-circuit protected,  $I_{max} \leq 1,3 A$
- Overload display by bright blue LED
- Dimensions 125 x 120 x 30 mm

33 406 Universal Logic Module

The Universal Logic Module (33 406) is a complete extension module to Microcomputer Training System "μ-Trainer" for free experimenting and examination of logical integrated circuits.

## Component set „Logic Integrated Circuits“



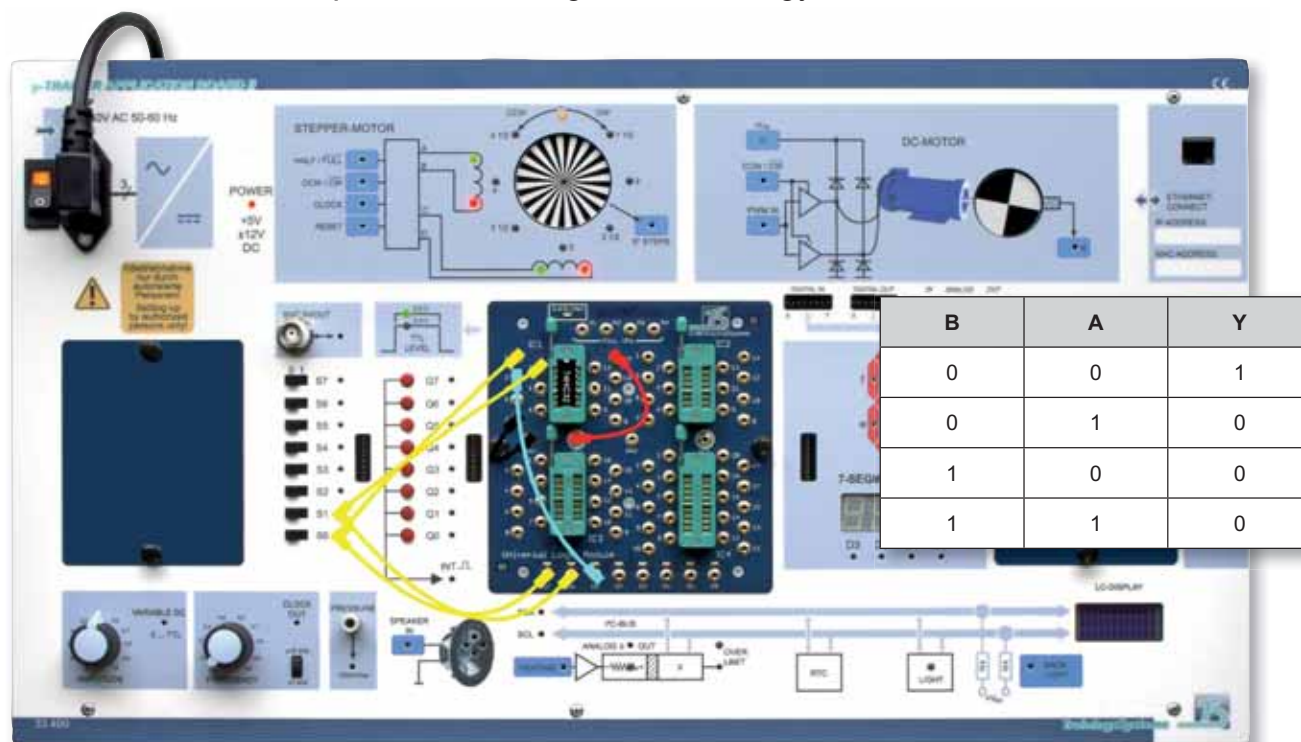
33 390 Basic Set Logic ICs

### Technical Data 33 390 Basic Set Logic ICs

- 2 pcs. 4xNAND gate, each with 2 inputs
- 2 pcs. 2xNAND gate, each with 4 inputs
- 2 pcs. 2xAND gate, each with 4 inputs
- 2 pcs. 4xNOR gate, each with 2 inputs
- 2 pcs. 4xOR gate, each with 2 inputs
- 2 pcs. 4xXOR gate, each with 2 inputs
- 2 pcs. 6xinverter
- 2 pcs. 2xD-flipflop
- 2 pcs. 2xJK-flipflop
- 2 pcs. 2xJK-flipflop with preset and delete
- 2 pcs. synchronous 4-bit counter BCD
- 2 pcs. up-down counter, binary
- 1 pc. GAL programmed as a 7-segment decoder
- 1 pc. GAL programmed as a divider

Component set in robust assortment box made of unbreakable plastic with 18 compartments and 26 circuits.

## Fundamentals of and Experiments in Digital Technology



### LEARNING OBJECTIVES

- ✓ Introduction in digital technology
- ✓ Basic logic circuits
- ✓ Logic ICs in practice
- ✓ Boolean switching algebra
- ✓ De Morgan's Laws
- ✓ Circuit synthesis
- ✓ Disjunctive normal form
- ✓ Conjunctive normal form
- ✓ Karnaugh map
- ✓ Codes and code converters
- ✓ Adder and subtractor
- ✓ Comparators
- ✓ Flipflops
- ✓ Monostable multivibrators
- ✓ Astable multivibrators
- ✓ Counters
- ✓ Shift registers
- ✓ Multiplexer and demultiplexer
- ✓ Analog-to-digital converter
- ✓ Digital-to-analog converter



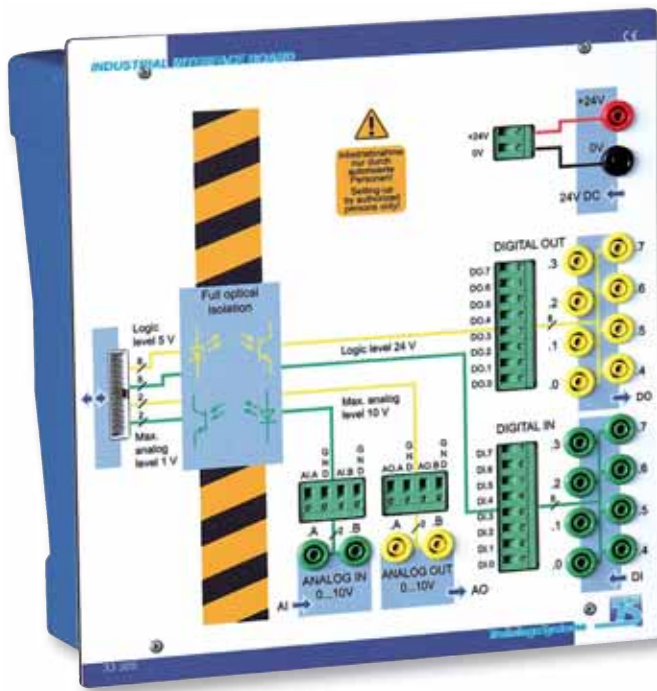
### The manuals:

- Description of theory and guided practical experiments
- Edition for trainees or students with tasks
- Edition for the teacher with solutions and method leads
- Unrestricted copying license for educational institutions
- Manual incl. CD-ROM

**E33 100CD** Fundamentals of and Experiments in Digital Technology – Tasks  
**E33 101CD** Fundamentals of and Experiments in Digital Technology – Solutions

## HARDWARE/SOFTWARE

## Industrial Interface



The Industrial Interface Board adapts and couples industrial peripheral devices to the “ $\mu$ -Trainer Application Board”. It converts device levels to industrial levels and provides device safety and nonexistence of electronic potential by complete optical decoupling of all signals.

33 305 Industrial Interface Board

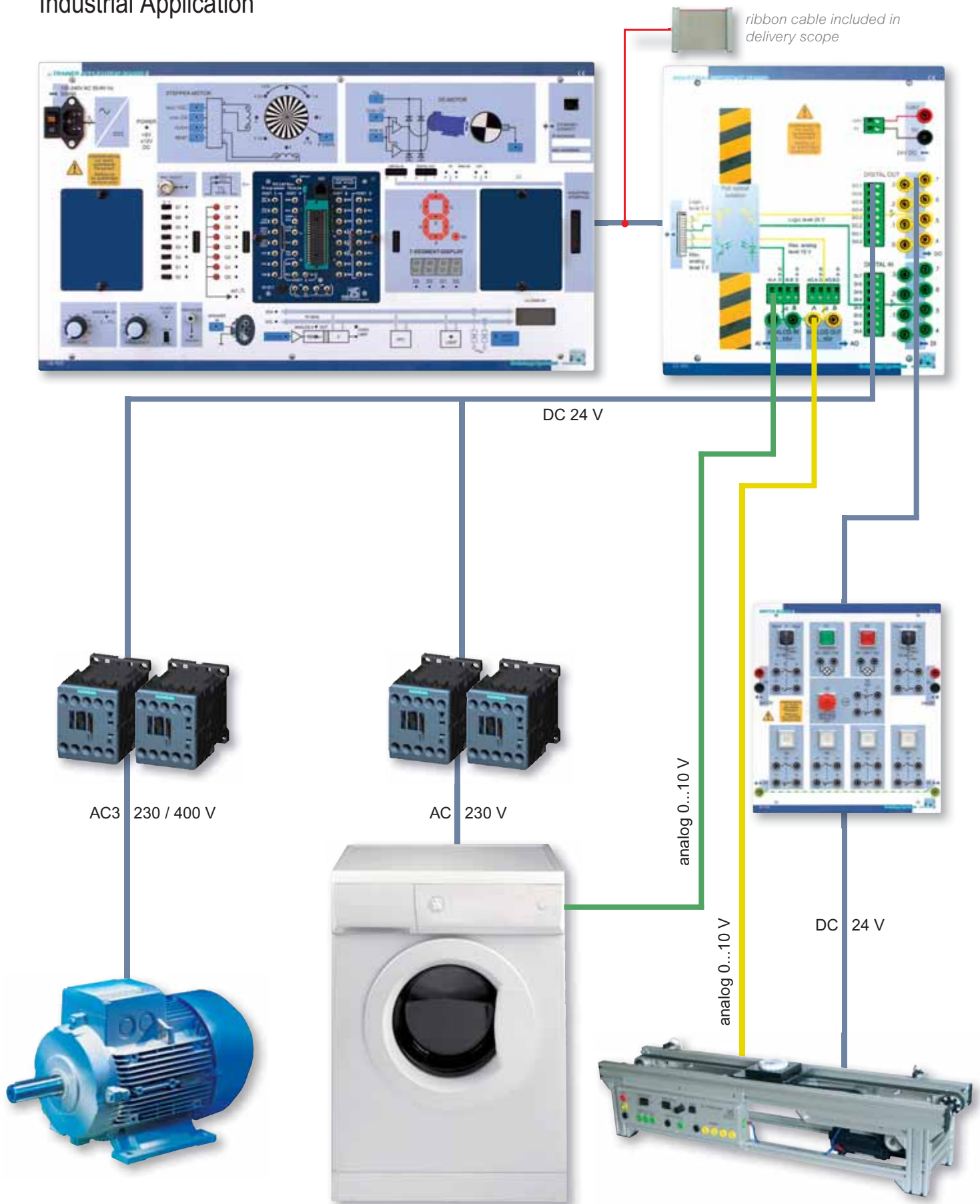
## Technical Data

**33 305 Industrial Interface Board**

- Absolute optical decoupling of all in- and outputs
- Level conversion of the digital signals from TTL to +24 V
- Level conversion of the analog signals from +/-1 V (amplitude) to +/-10 V
- 8 digital outputs, for loads up to 0.5 A per output
- Permissible total load of the digital outputs  $\leq 2$  A
- 8 digital inputs
- 2 analog outputs
- 2 analog inputs
- External operating voltage: +24 V
- 4mm safety socket and industrial Phoenix screw terminal connection per in- and output
- Dimensions 266 x 297 x 85 mm
- Desk housing device
- Delivered with operating instructions, connection cable to “ $\mu$ -Trainer Application Board”

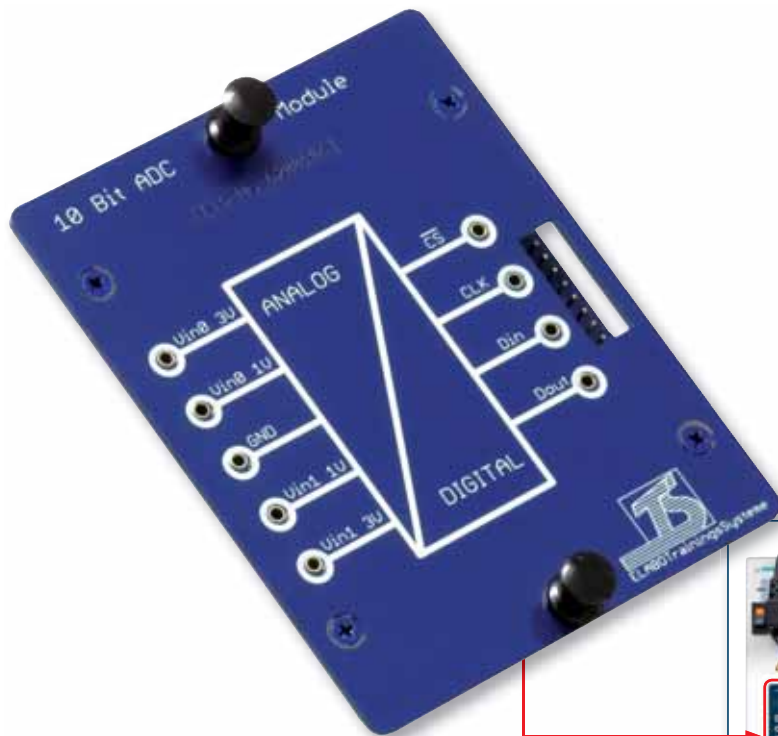


## Industrial Application

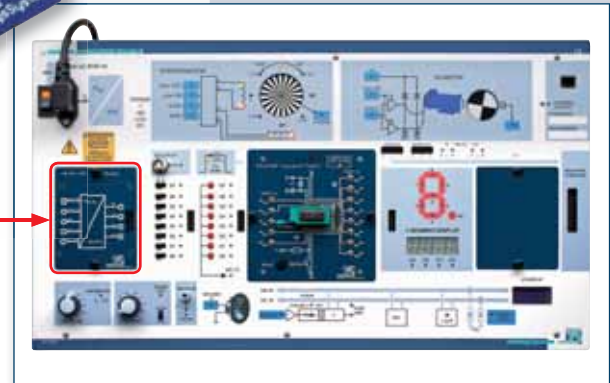


# MICROCOMPUTER/DIGITAL TECHNOLOGY

## 10 Bit ADC Module



The 10 Bit ADC Module is an integrated extension module for the Microcomputer Training System “ $\mu$ -Trainer” containing a 2-channel analog-to-digital converter with a 10-bit resolution.



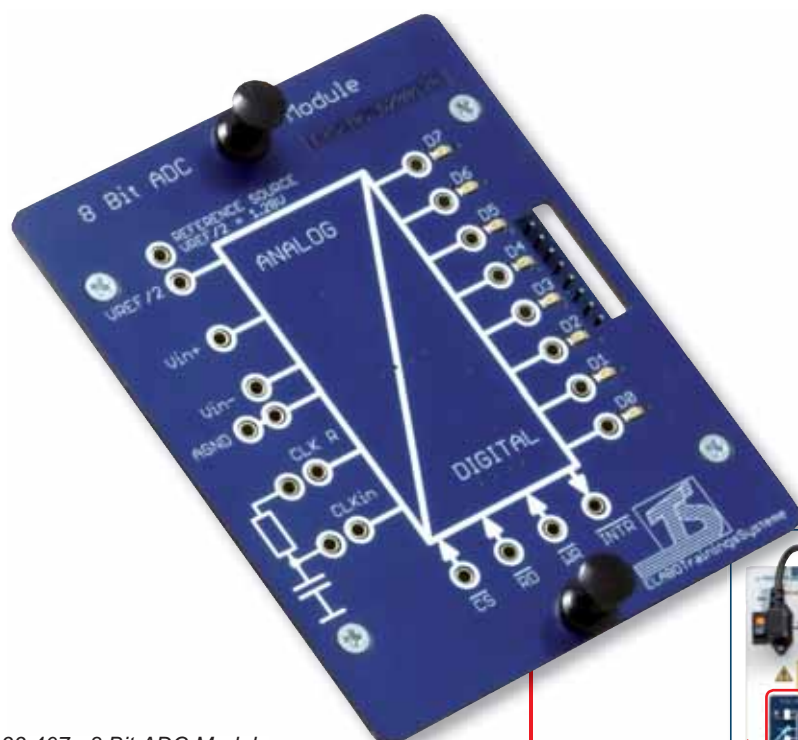
33 404 10 Bit ADC Module

### Technical Data

#### 33 404 10 Bit ADC Module

- 2-channel analog-to-digital converter
- Reference voltage 1 V or 3 V
- Maximum conversion speed up to  $250 \text{ ksample} \cdot \text{s}^{-1}$
- Recommended maximum conversion speed of the module  $25 \text{ ksample} \cdot \text{s}^{-1}$  while using 2mm cables for connecting the SPI interface
- Analog inputs with 2mm sockets
- Output with 2mm sockets and additional bus connector
- SPI controller interface
- +3.3 V or +5 V logic level depending on the settings of the Programmer Module
- Dimensions 78 x 97 x 30 mm
- Delivered with operating instructions

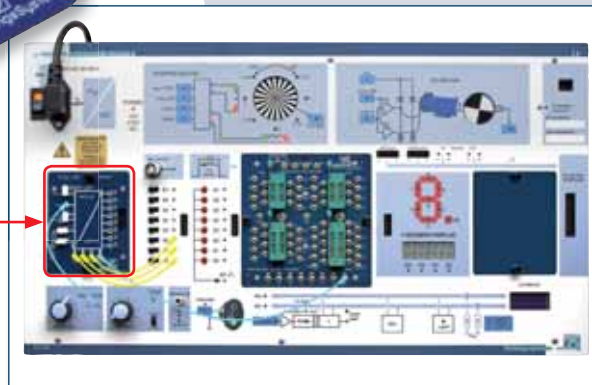
## 8 Bit ADC Module



33 407 8 Bit ADC Module

The 8 Bit ADC Module  
is a complete extension module for the  
Microcomputer Training System “μ-Trainer”.

The 8 Bit analog-to-digital converter can be used either with static control signals or via microcontroller to examine the functional principle of an analog-to-digital converter.



## Technical Data

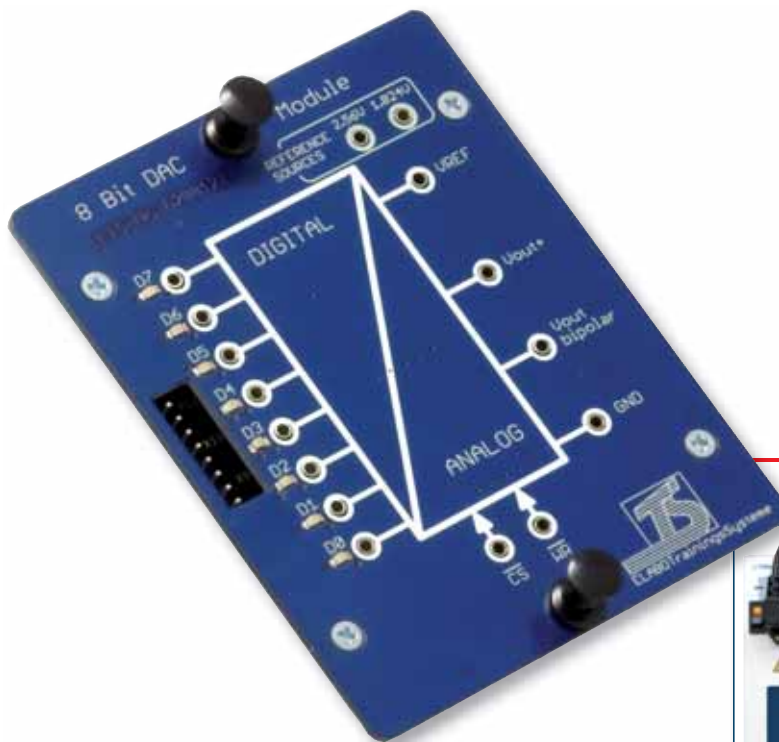
### 33 407 8 Bit ADC Module

- 1-channel analog-to-digital converter
- Reference voltages: 2.56 V,  $V_{CC}$  internal or external, upto max. 5 V  
NOTE: The reference voltage input level is  $0.5 \times V_{REF}$  !
- Differential input at 2mm sockets
- 8 outputs at 2mm sockets and bus connector
- 4 control inputs and outputs at 2mm sockets
- Logic level: +3.3 V or +5 V depending on the settings of the Programmer Module
- Dimensions 78 x 95 x 32 mm
- Delivered with programming examples on CD-ROM and operating instructions



# MICROCOMPUTER/DIGITAL TECHNOLOGY

## 8 Bit DAC Module



The 8 Bit DAC Module is a complete extension module for the Microcomputer Training System "µ-Trainer".

The 8 bit digital-to-analog converter can be used either with static control signals or via microcontroller to examine the functional principle of a digital-to-analog converter.

33 408 8 Bit DAC Module



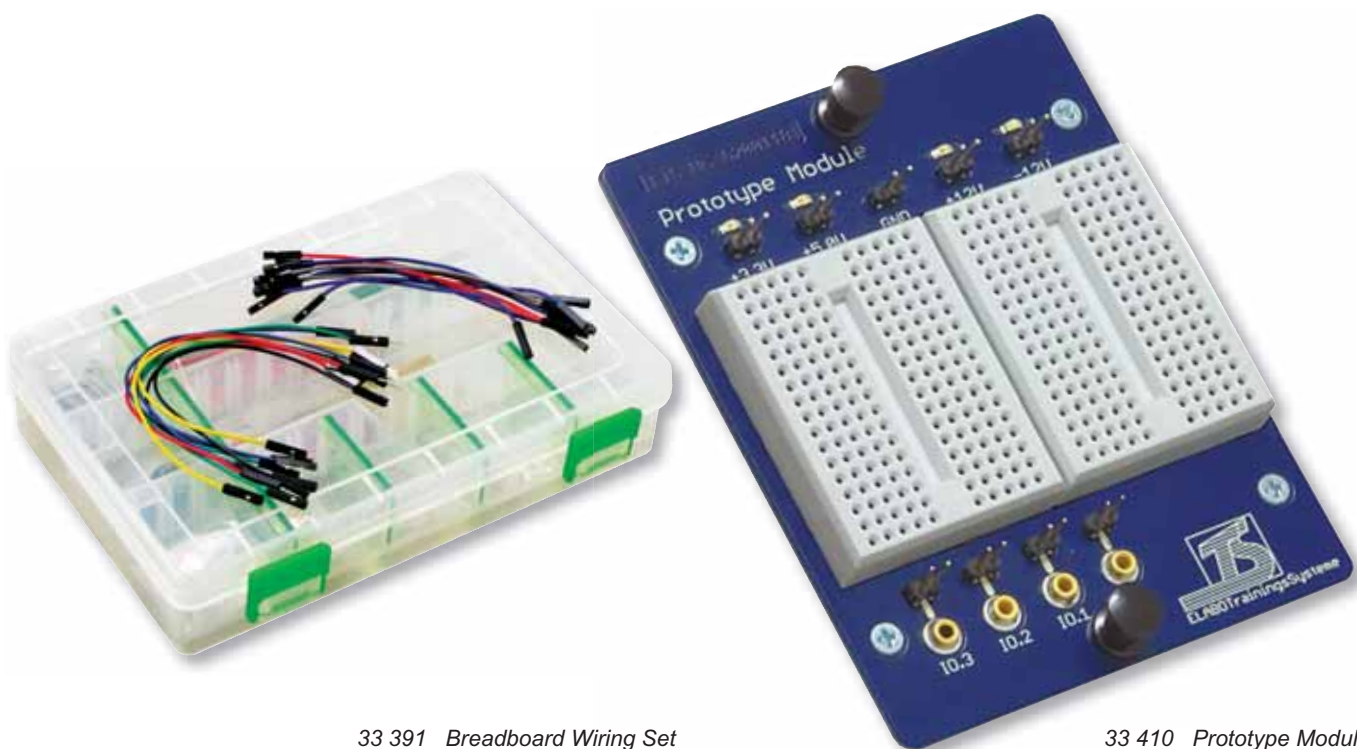
## Technical Data

### 33 408 8 Bit DAC Module

- 1-channel digital-to-analog converter
- Reference voltages: 2.56 V, 1.024 V or external up to max. 4.2 V
- 8 inputs at 2mm sockets and bus connector
- 1 output at a 2mm socket, unipolar
- 1 output at a 2mm socket, bipolar
- 2 control inputs at 2mm sockets
- Logic level: +3.3 V or +5 V depending on the settings of the Programmer Module
- Dimensions 78 x 95 x 32 mm
- Delivered with programming examples on CD-ROM and operating instructions

# EXTENSION MODULE

## Prototype Module



33 391 Breadboard Wiring Set  
*A useful complementary equipment to the Prototype Module*

33 410 Prototype Module

The Prototype Module is a complete extension module for the Microcomputer Training System "μ-Trainer". The Prototype Module allows the additional assembly and free construction of digital circuits with a breadboard system.

## Technical Data

### 33 410 Prototype Module

- 2 breadboard patch panels, 10x17 pins
- 4 control inputs at 2mm sockets and pin
- 4 operating voltage outputs at pins: 3.3 V, 5.0 V, +12 V and –12 V
- Operating voltages 3.3 V and 5.0 V, short-circuit protected,  $I_{\text{nom}} \leq 1.3 \text{ A}$
- Operating voltages +12 V and –12 V, short-circuit protected,  $I_{\text{nom}} \leq 0.3 \text{ A}$  (permanent load)
- Indication of ready state by LED
- Dimensions 78 x 95 x 32 mm
- Delivered with operating instructions

## MICROCOMPUTER/DIGITAL TECHNOLOGY

## Serial Interface Module



33 480 Serial Interface Module

The Serial Interface Module is a complete extension module for the Microcomputer Training System "µ-Trainer".

The serial interface can be used either with static control signals or via microcontroller to examine the functional principle of the communication between controller and PC via the EIA232 interface.

## Technical Data

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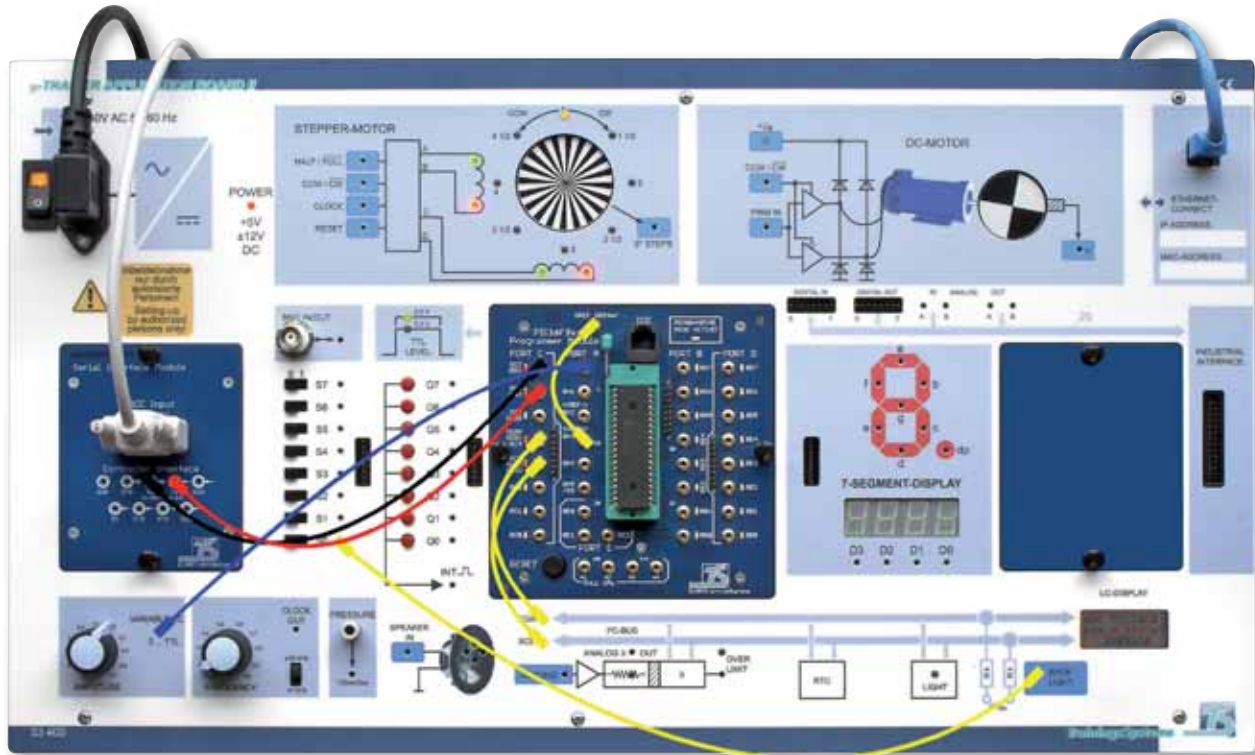
### 33 480 Serial Interface Module

- EIA232 interface, 9-pole, DCE socket
- 9 control inputs and outputs on the controller side, at 2mm sockets
- Logic level: +3.3 V or +5 V depending on the settings of the Programmer Module
- Dimensions 78 x 95 x 32 mm
- Delivered with programming examples, computer applications and tools on CD-ROM and operating instructions



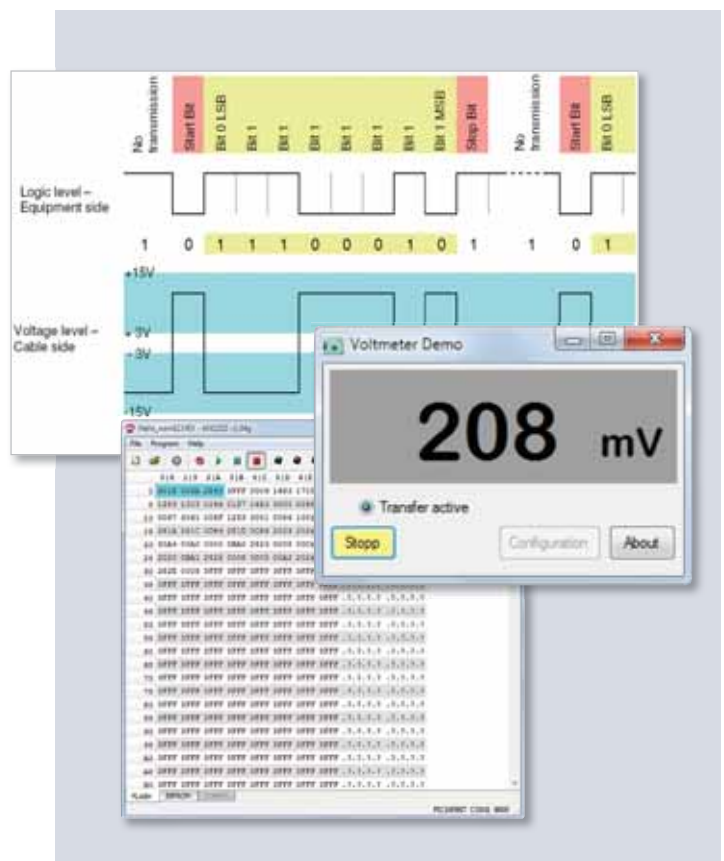
# EXTENSION MODULE

Serial asynchronous communication between controller and PC



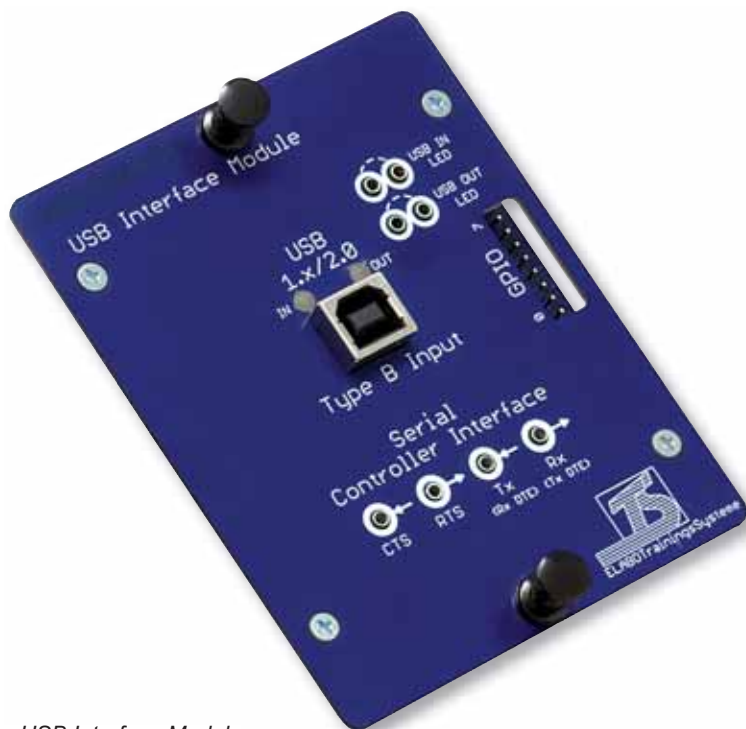
## LEARNING OBJECTIVES

- ✓ Principle of the serial asynchronous transmission
- ✓ EIA232 interface
- ✓ Terminal communication
- ✓ Testing interfaces
- ✓ Data communication between controller and PC
- ✓ Controller boot loader
- ✓ Programming PIC16F887 or ATmega16 controllers with boot loader via EIA232



## MICROCOMPUTER/DIGITAL TECHNOLOGY

## USB Interface Module



33 481 USB Interface Module

The USB Interface Module is a complete extension module for the Microcomputer Training System "µ-Trainer".

The USB interface can be used either independently or via microcontroller to examine the functional principle of USB communication.

The USB interface is freely configurable and allows communication as a real USB 1.0 or USB 2.0 interface or as a serial port emulator via software driver.

## Technical Data

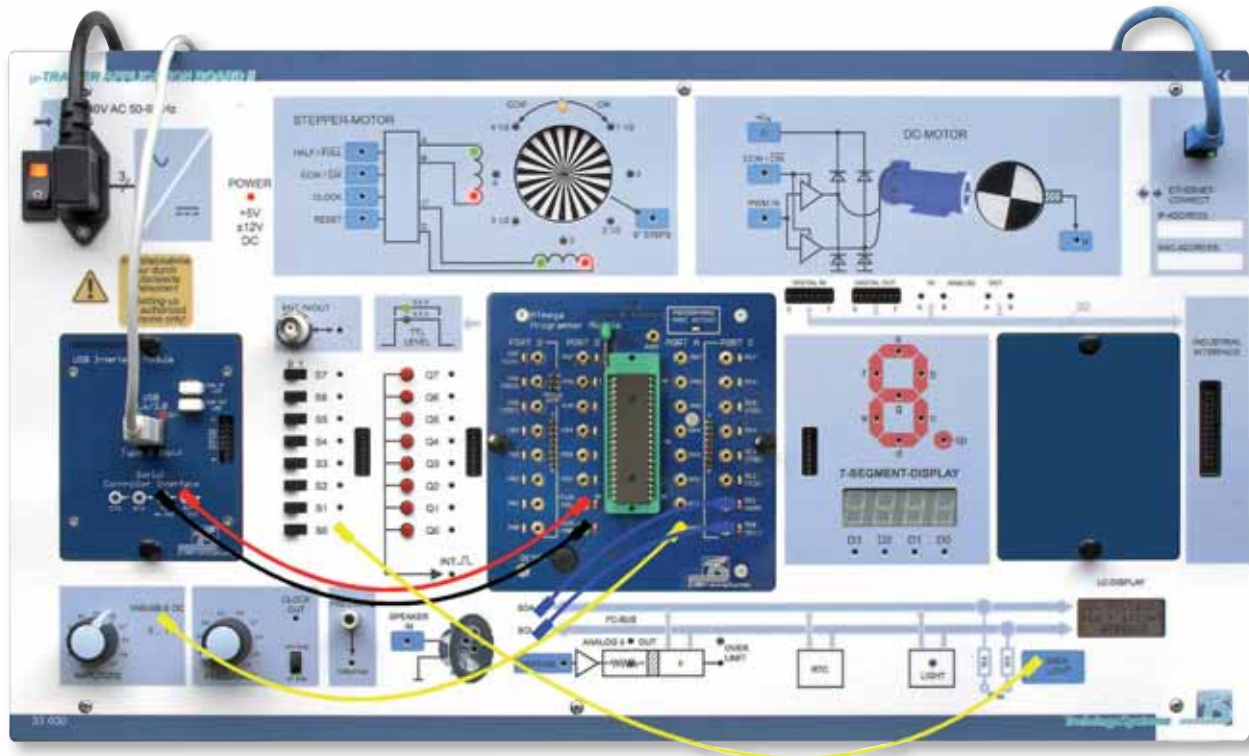
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### 33 481 USB Interface Module

- USB standard 1.0 / 2.0
- USB connection type B
- 4 inputs and outputs on the controller side, at 2mm sockets
- Parallel input and output via 8-bit bus connection
- Optional display of data traffic via 2 LEDs
- Logic level: +3.3 V or +5 V depending on the settings of the Programmer Module
- System requirements: Win XP, Vista, Windows7 (32 bit / 64 bit)
- Dimensions 78 x 95 x 32 mm
- Delivered with programming examples, computer applications, drivers and tools on CD-ROM and operating instructions

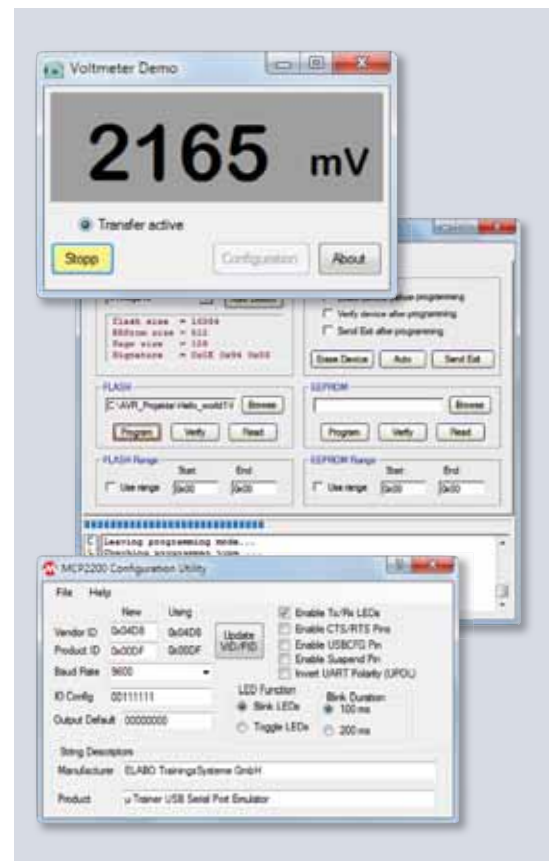
# EXTENSION MODULE

## USB communication between controller and PC



### LEARNING OBJECTIVES

- ✓ Principle of the serial asynchronous transmission
- ✓ USB interface
- ✓ Adaptation and configuration
- ✓ Emulation of an EIA232 interface
- ✓ Terminal communication
- ✓ Testing USB interfaces
- ✓ Data communication between controller and PC
- ✓ Controller boot loader
- ✓ Programming PIC16F887 or ATmega16 controllers with boot loader via USB





# TEACHWARE

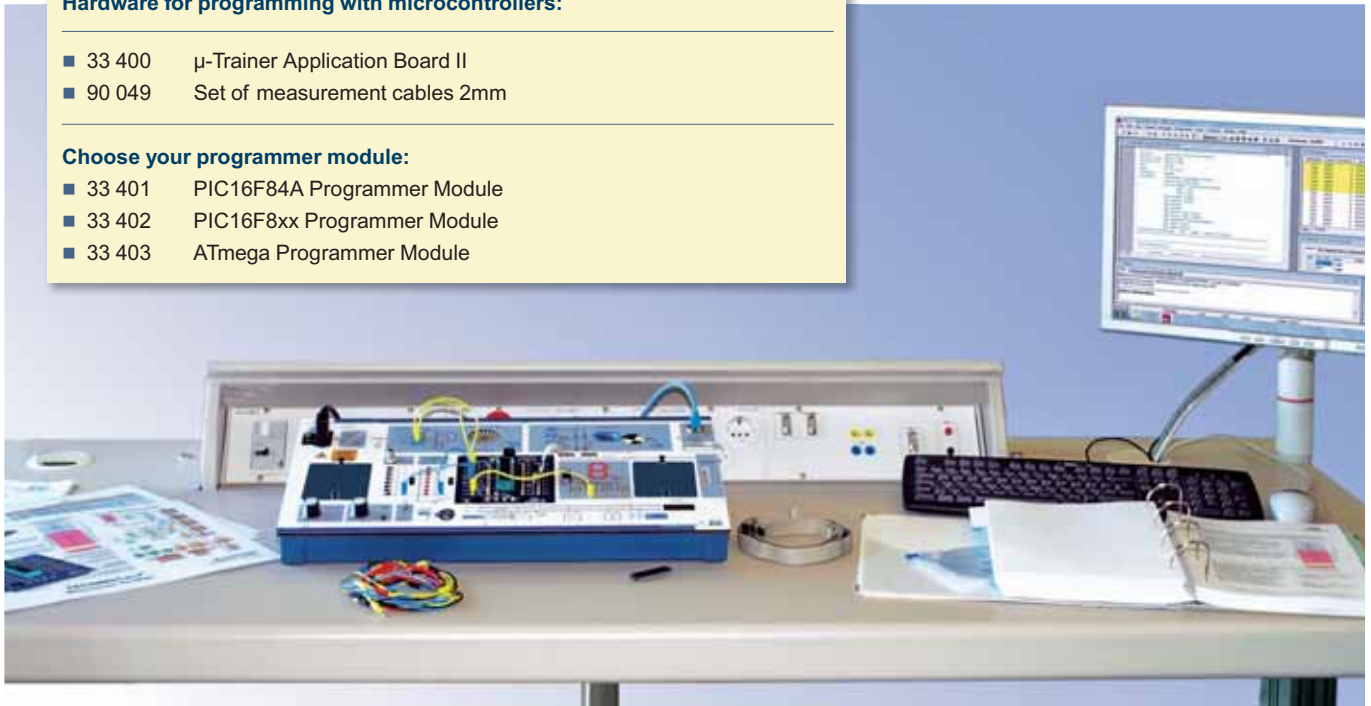
## Programming with microcontrollers

### Hardware for programming with microcontrollers:

- 33 400      $\mu$ -Trainer Application Board II
- 90 049     Set of measurement cables 2mm

### Choose your programmer module:

- 33 401     PIC16F84A Programmer Module
- 33 402     PIC16F8xx Programmer Module
- 33 403     ATmega Programmer Module



## LEARNING OBJECTIVES

### Part 1

- Microcomputers, introduction
- Introduction to the industrial developing environment
- Working with the development tools Editor, Assembler, C-Compiler, Simulator and Programmer
- Structure and function of microcontrollers (internal structure)
- The programming interface
- The periphery of a microcontroller (ports, clock, timing, ADC, reset)
- How does a microcontroller work (register, ALU, I/O ports)
- Memory structure and instruction set of the microcontroller
- Programming of a microcontroller in Assembler
- Parallel I/O ports
- BCD coding
- Displaying values to LED lines and 7-segment display
- Timer and interrupt
- Control of stepping and DC motors

### Part 2

- Serial data transmission
- I<sup>2</sup>C bus
- ADC and measuring of analog values
- Transferring values to an I<sup>2</sup>C display
- Voltage measurement
- Temperature measurement
- Pressure measurement
- Measuring of temperature and brightness with intelligent sensors
- Date and time recording with RTC
- On-chip debugging



Printed and digital!

## The manuals

### Tasks for trainees or students

- Description of theory and guided practical experiments
- Edition for trainees/students with tasks
- Unrestricted copying license for educational institutions
- Grayscale print
- Manual incl. CD-ROM

### Solutions for teachers

- Description of theory and guided practical experiments
- Edition for the teacher with solutions and method leads
- Color print
- Manual incl. CD-ROM



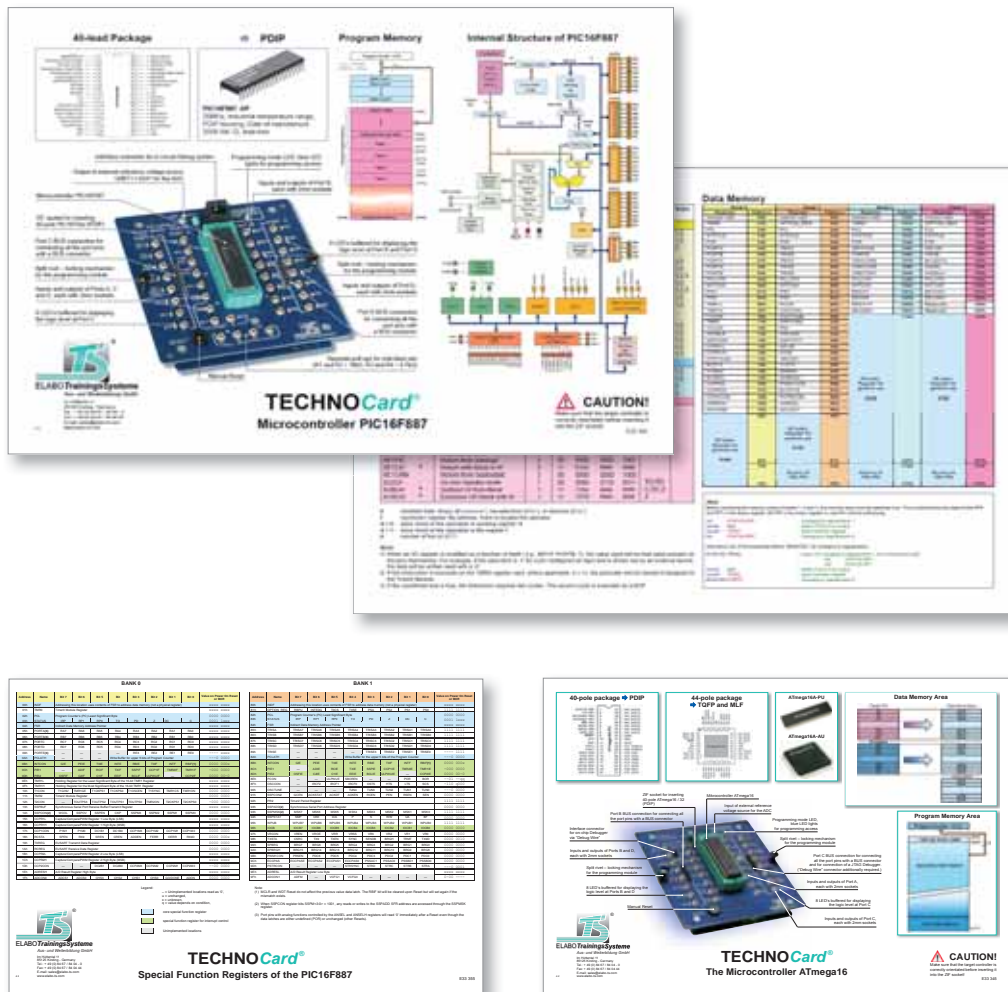
**All the source code listings from the examples and for the exercises are to be found on the teach ware CD-ROM!**

### Order nos. of the manuals

Manual	PIC16F84A	PIC16F887	ATmega16
"Programming with microcontrollers" Part 1 Tasks	E33 320CD	E33 350CD	E33 340CD
"Programming with microcontrollers" Part 1 Solutions	E33 321CD	E33 351CD	E33 341CD
"Programming with microcontrollers" Part 2 Tasks	E33 334CD	E33 352CD	E33 342CD
"Programming with microcontrollers" Part 2 Solutions	E33 335CD	E33 353CD	E33 343CD

# TEACHWARE

## TECHNOCards® the compact knowledge store



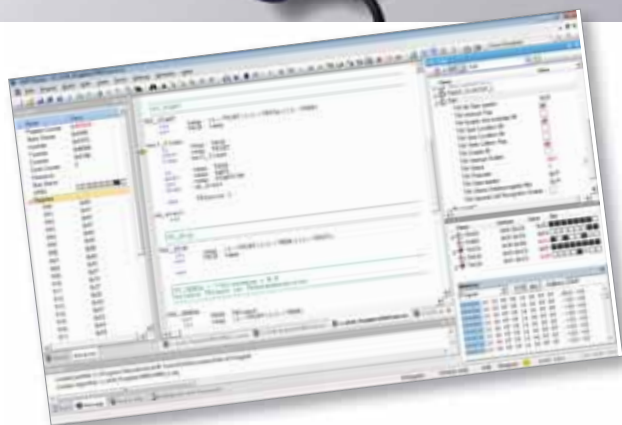
The TECHNOCards are a very useful complement to the training system. They are a kind of compact, clearly laid-out knowledge store for reference during practical experimenting.

- Display sheets in format 303 mm x 426 mm
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TECHNOCard®	Use for			
	PIC16F84A	PIC16F887	ATmega16	Logic Module
Digital technology with the µ-Trainer Application Board (E33 103)				■
Use of the Application Board II (E34 423)	■	■	■	■
The integrated development environment MPLAB® from Microchip (E33 324)	■	■		
Microcontroller PIC16F84A (E33 322)	■			
Microcontroller PIC16F887 (E33 354)		■		
Special function registers of the PIC16F887 (E33 355)		■		
The Controller ATmega16 (E33 345)			■	
The AVR instruction set (E33 346)			■	
The integrated development environment AVR Studio® from Atmel (E33 347)			■	
Voltage measurement and display (E33 327)	■			
Industrial control with microcontrollers (E33 330)	■	■	■	



## Useful helpers for fault finding



The "On-Chip Debug System" is a powerful development tool for On-chip Debugging of all ATmega controllers with IEEE 1149.1 compliant JTAG interface or debugWIRE Interface.

### 33 311 On-Chip Debug System for ATmega Controllers

- Complete AVR Studio® operated
- Full emulation of all analog and digital functions
- Supports multiple devices in a JTAG scan chain
- USB or RS-232 interface to PC
- Full support of Assembler and high level languages
- On-Chip-Debug interface JTAG and Debug Wire
- Program and data breakpoints
- All operations and breakpoints are real time inclusive of external RESET

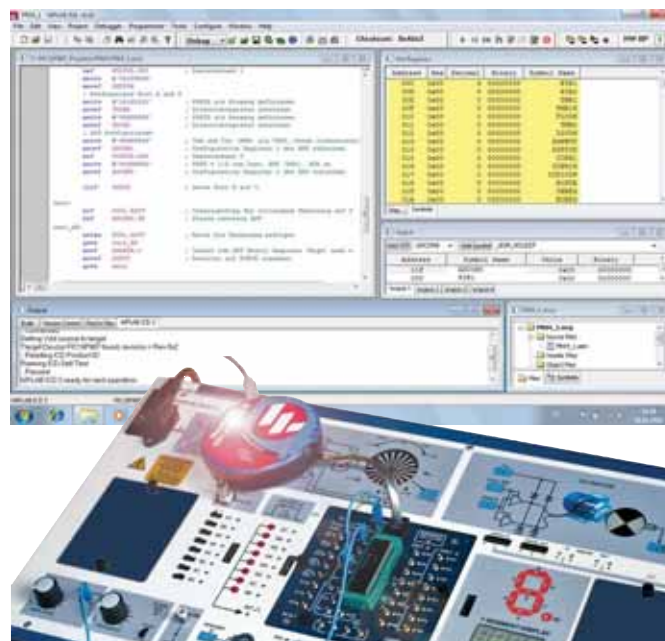
\*Atmel, AVR and AVR Studio are registered trademarks of Atmel Corporation or its subsidiaries in the United States and other countries.

\*MPLAB is a registered trademark of Microchip Corporation.

The In-Circuit-Debugger System is a development tool for On-chip Debugging of all Microchip Controllers over ISP interface.

### 33 313 In-Circuit-Debugger System for PIC16Fxxx Controllers

- Software control and display completely integrated in software development environment
- Emulation of analog and digital functions of the controllers
- USB or RS-232 interface to PC
- Support of Assembler and high level languages
- In Circuit Debug interface ISP
- Breakpoints for program memory

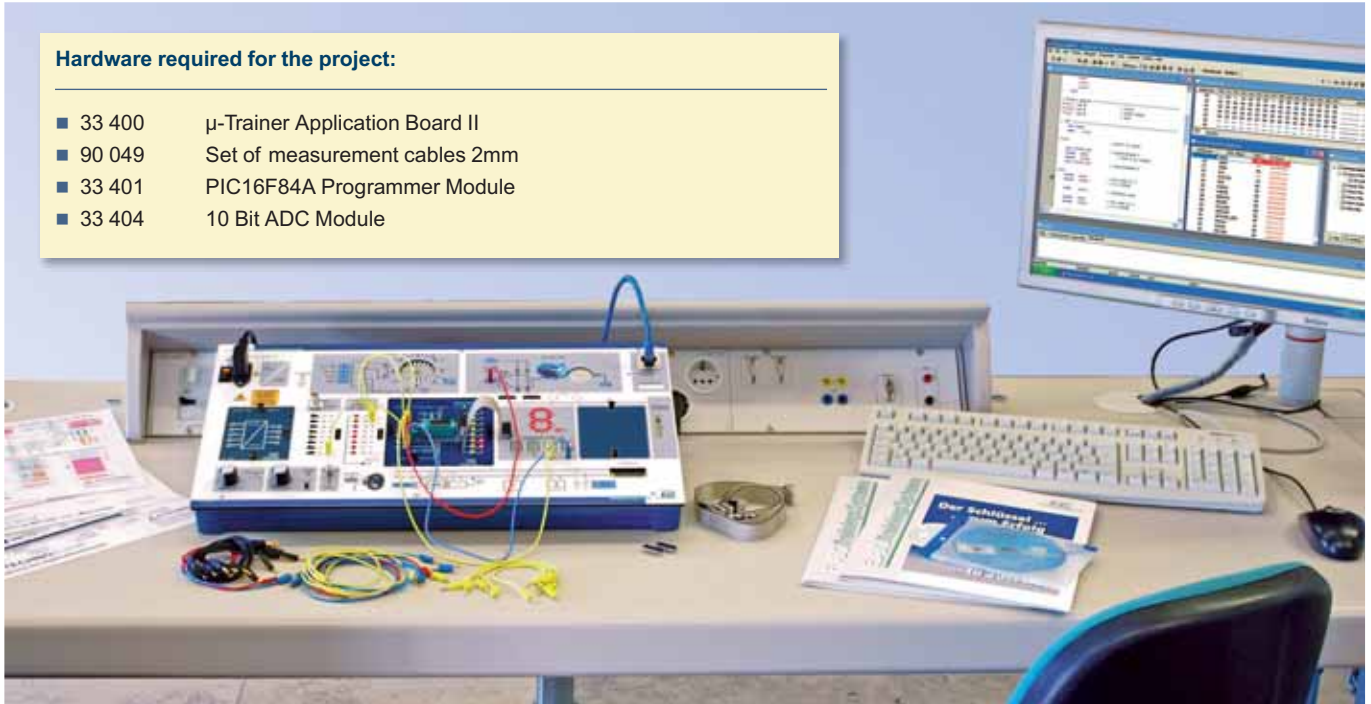


# PROJECTS

## Project: Voltage measurement and display (only PIC16F84A)

### Hardware required for the project:

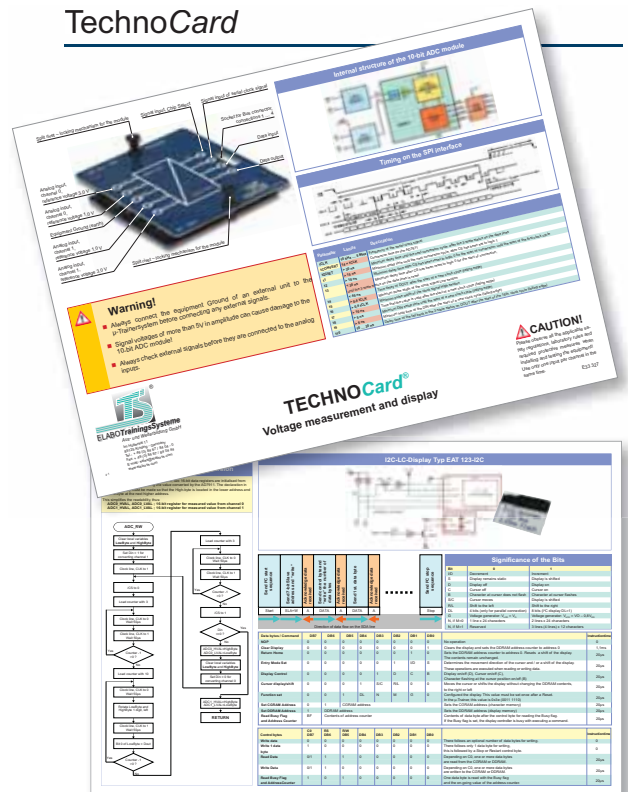
- 33 400       $\mu$ -Trainer Application Board II
- 90 049      Set of measurement cables 2mm
- 33 401      PIC16F84A Programmer Module
- 33 404      10 Bit ADC Module



### LEARNING OBJECTIVES

- ✓ Project task
- ✓ Analysis and structure draft
  - required periphery
  - connections
  - block diagram
  - circuit diagram
- ✓ Step-by-step implementation of the program sections
  - Connection of AD converter
  - Voltage calculation
  - Cyclical output of the measured values
  - Integration of the I<sup>2</sup>C bus
  - Display on LCD
  - Analysis and presentation
- ✓ Instructions for realization / summary

### TechnoCard



## Manual

### E33 325CD Tasks for trainees or students

- Instructions for project work with theoretical explanations and prepared documentation
- Unrestricted copying license for educational institutions
- Edition for trainees/students with tasks
- Grayscale print
- Manual incl. CD-ROM

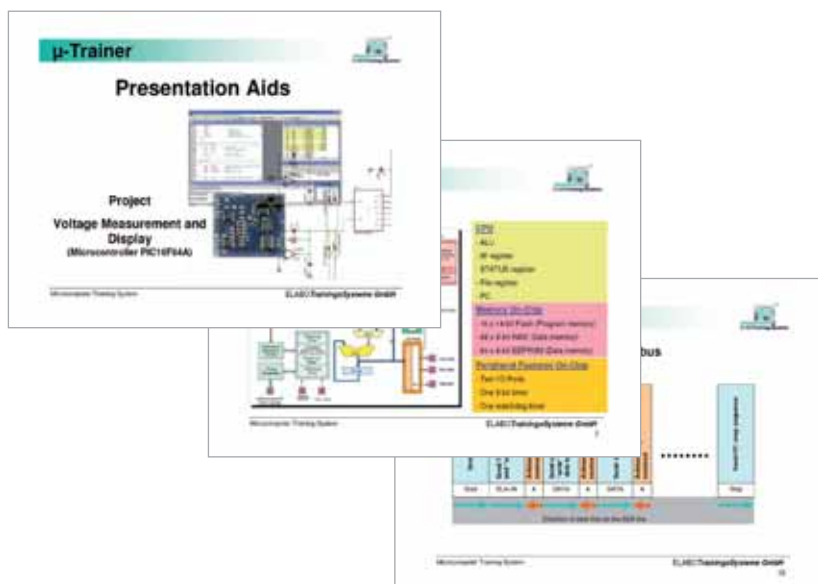
### E33 326CD Solutions for teachers

- Instructions for project work with theoretical explanations and prepared documentation
- Edition for the teacher with solutions and method leads
- Color print
- Manual incl. CD-ROM



**Printed and digital!**

## E33 331 Presentation aids for the project "Voltage Measurement and Display"



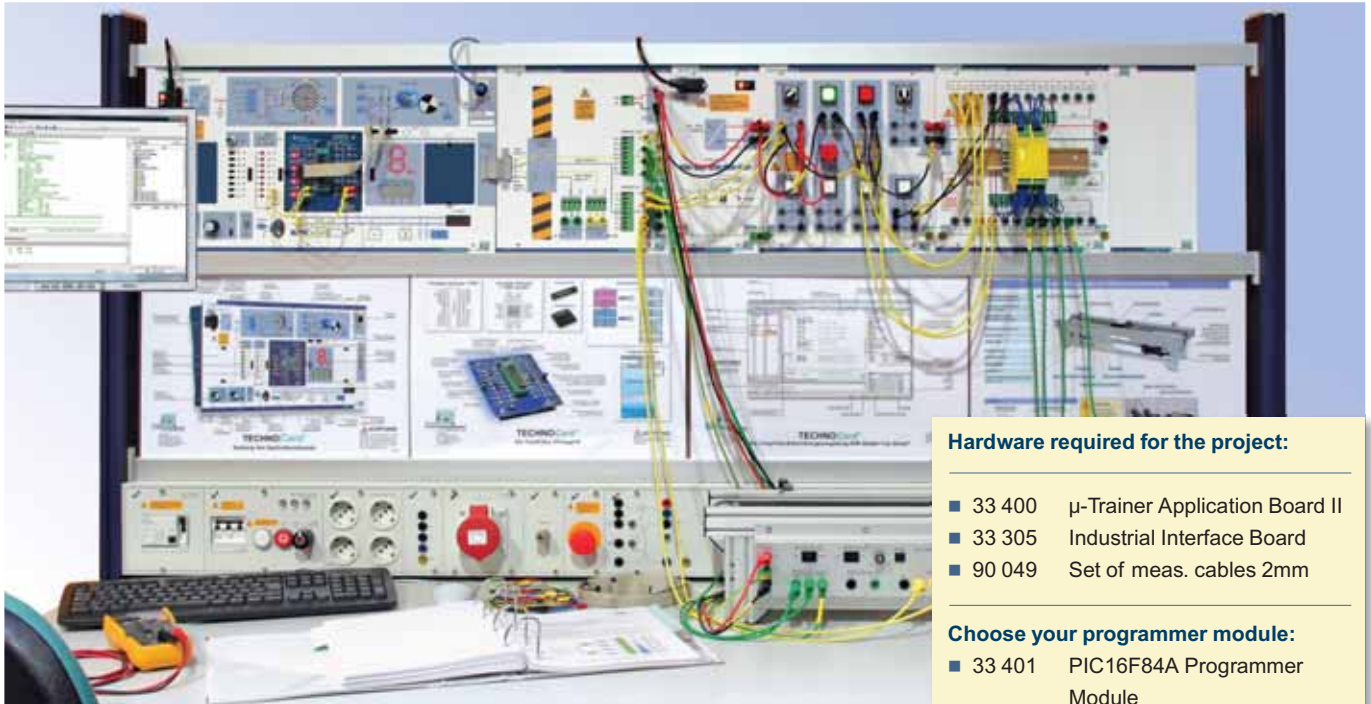
### PowerPoint presentation for the project

- Templates for the students for presenting their work results
- Unlimited copying license for educational institutions
- 23 transparencies
- On CD-ROM



# PROJECTS

## Project: Industrial control with microcontrollers



### Hardware required for the project:

- 33 400  $\mu$ -Trainer Application Board II
- 33 305 Industrial Interface Board
- 90 049 Set of meas. cables 2mm

### Choose your programmer module:

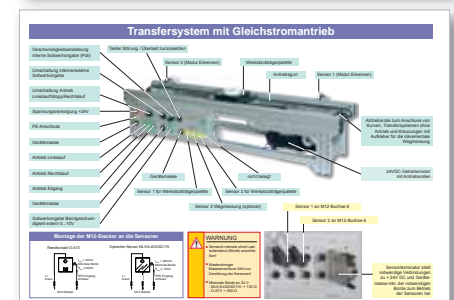
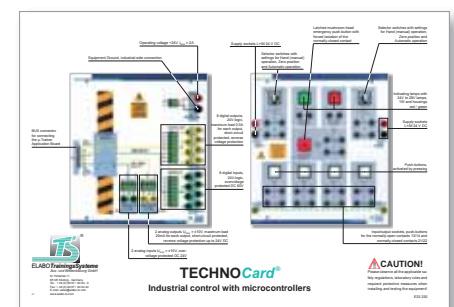
- 33 401 PIC16F84A Programmer Module
- 33 402 PIC16F8xx Programmer Module
- 33 403 ATmega Programmer Module

Project environment on request!

### LEARNING OBJECTIVES

- ✓ Project task
  - Introduction to automated production systems
  - Control systems with controllers
  - Catching sensor signals with polling and interrupt
  - PWM generation with timer
  - Speed control (open and closed loop)
- ✓ Analysis and structure draft
  - required periphery
  - connections
  - block / circuit diagram
- ✓ Solution
  - Display on LCD
  - Function keys and display of function
  - Soft start and braking
  - Control of direction
  - Positioning
  - Safety of machinery
  - Risk analysis
  - Emergency stop integration
- ✓ Summary
  - Analysis and presentation

### TechnoCards



E33 330 TechnoCard  
Industrial control with microcontrollers

## Manual

### Tasks for trainees or students

- Instructions for project work with theoretical explanations and prepared documentation
- Unrestricted copying license for educational institutions
- Edition for trainees/students with tasks
- Grayscale print
- Manual incl. CD-ROM

### Solutions for teachers

- Instructions for project work with theoretical explanations and prepared documentation
- Edition for the teacher with solutions and method leads
- Color print
- Manual incl. CD-ROM



Printed and digital!

Order nos. of the teach ware			
Manuals	PIC16F84A	PIC16F887	ATmega16
"Industrial control with microcontrollers" Tasks	E33 328CD	E33 356CD	E33 348CD
"Industrial control with microcontrollers" Solutions	E33 329CD	E33 357CD	E33 349CD
<b>Presentation aids</b>			
"Industrial control with microcontrollers"	E33 332	E33 358	E33 344

## Presentation aids for the project "Industrial control with microcontrollers"



### PowerPoint presentation for the project

- Templates for the students for presenting their work results
- Unlimited copying license for educational institutions
- 26 transparencies
- On CD-ROM

# INFORMATION AND CONSULTATION

## CONSULTANCY

---

- Design of customer oriented solutions
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- 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

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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)



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## WE ASSIST YOU

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- Warranty and maintenance
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- Qualification, advanced training, workshops
- Comprehensive product documentation
- Detailed courseware for trainers and students

## YOUR INQUIRY

**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**

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Order no.	Description / Title	Page	Qty
<input type="checkbox"/> 33 400	µ-Trainer Application Board II	8	
<input type="checkbox"/> 33 401 *)	PIC16F84A Programmer Module	10	
<input type="checkbox"/> 33 402 *)	PIC16F8xx Programmer Module	9	
<input type="checkbox"/> 33 403 *)	ATmega Programmer Module	11	
<input type="checkbox"/> 33 404 *)	10 Bit ADC Module	16	
<input type="checkbox"/> 33 305	Industrial Interface Board	14	
<input type="checkbox"/> 33 406 *)	Universal Logic Module	12	
<input type="checkbox"/> 33 407 *)	8 Bit ADC Module	17	
<input type="checkbox"/> 33 408 *)	8 Bit DAC Module	18	
<input type="checkbox"/> 33 410 *)	Prototype Module	19	
<input type="checkbox"/> 33 480 *)	Serial Interface Module	20	
<input type="checkbox"/> 33 481 *)	USB Interface Module	22	
<input type="checkbox"/> 33 390	Basic Set Logic ICs	12	
<input type="checkbox"/> 33 391	Breadboard Wiring Set	19	
<input type="checkbox"/> 90 049	Set of measurement cables 2mm	24	
<b>Debugging systems</b>			
<input type="checkbox"/> 33 311	On Chip Debug System for ATmega Controller	27	
<input type="checkbox"/> 33 313	In-Circuit-Debugger System for PIC16Fxxx Controller	27	
<b>TECHNOCards</b>			
<input type="checkbox"/> E33 103	TECHNOCard "Digital technology with the µ-Trainer Application Board"	26	
<input type="checkbox"/> E33 423	TECHNOCard "Use of the Application Board II"	26	
<input type="checkbox"/> E33 322	TECHNOCard "Microcontroller PIC16F84A"	26	
<input type="checkbox"/> E33 324	TECHNOCard "The integrated development environment MPLAB® from Microchip"	26	

\*) **Note:** If you would like to order controller or extension modules for the previous µ-Trainer Application Board (33 300), please use **33 3xx** in the order no.

## YOUR INQUIRY

Order no.	Description / Title	Page	Qty
<input type="checkbox"/> E33 327	TECHNOCard "Voltage measurement and display"	26	
<input type="checkbox"/> E33 354	TECHNOCard "Microcontroller PIC16F887"	26	
<input type="checkbox"/> E33 355	TECHNOCard "Special Function Registers of the PIC16F887"	26	
<input type="checkbox"/> E33 345	TECHNOCard "The Microcontroller ATmega16"	26	
<input type="checkbox"/> E33 346	TECHNOCard "AVR® Instruction Set"	26	
<input type="checkbox"/> E33 347	TECHNOCard "The integrated development environment AVR Studio® from Atmel®"	26	
	<b>Manuals</b>		
<input type="checkbox"/> E33 320CD	Programming with the MC PIC16F84A Part 1, Tasks for trainees or students	25	
<input type="checkbox"/> E33 321CD	Programming with the MC PIC16F84A Part 1, Solutions for teachers	25	
<input type="checkbox"/> E33 334CD	Programming with the MC PIC16F84A Part 2, Tasks for trainees or students	25	
<input type="checkbox"/> E33 335CD	Programming with the MC PIC16F84A Part 2, Solutions for teachers	25	
<input type="checkbox"/> E33 325CD	Project "Voltage measurement and display", Tasks for trainees or students	29	
<input type="checkbox"/> E33 326CD	Project "Voltage measurement and display", Solutions for teachers	29	
<input type="checkbox"/> E33 331	Presentation aids for the project "Voltage measurement and display"	29	
<input type="checkbox"/> E33 340CD	Programming with the MC ATmega16 Part 1, Tasks for trainees or students	25	
<input type="checkbox"/> E33 341CD	Programming with the MC ATmega16 Part 1, Solutions for teachers	25	
<input type="checkbox"/> E33 342CD	Programming with the MC ATmega16 Part 2, Tasks for trainees or students	25	
<input type="checkbox"/> E33 343CD	Programming with the MC ATmega16 Part 2, Solutions for teachers	25	
<input type="checkbox"/> E33 350CD	Programming with the MC PIC16F887 Part 1, Tasks for trainees or students	25	
<input type="checkbox"/> E33 351CD	Programming with the MC PIC16F887 Part 1, Solutions for teachers	25	
<input type="checkbox"/> E33 352CD	Programming with the MC PIC16F887 Part 2, Tasks for trainees or students	25	
<input type="checkbox"/> E33 353CD	Programming with the MC PIC16F887 Part 2, Solutions for teachers	25	
	<b>Additional equipment for project „Industrial control with microcontrollers“</b>		
<input type="checkbox"/> 63 526	Power Supply 24 V DC	30	
<input type="checkbox"/> 80 590	Transfer system 24 V DC	30	
<input type="checkbox"/> 80 618	Workpiece Carriage	30	
<input type="checkbox"/> 80 619	4-Bit Ident System	30	
<input type="checkbox"/> 80 589	Sensor Terminator	30	
<input type="checkbox"/> 40 000	Switch Board II	30	
<input type="checkbox"/> 40 050	Safety Universal Relay Board	30	
<input type="checkbox"/> 40 053	Safety Relay I	30	
<input type="checkbox"/> 90 050	Set of safety cables 4mm for project "Industrial control with microcontroller"	30	
<input type="checkbox"/> E33 330	TECHNOCard "Industrial control with microcontrollers"	30	
<input type="checkbox"/> E33 328CD	Project "Industrial control with microcontroller PIC16F84A", Tasks for trainees	31	
<input type="checkbox"/> E33 329CD	Project "Industrial control with microcontroller PIC16F84A", Solutions for teachers	31	
<input type="checkbox"/> E33 332	Presentation aids for the project "Industrial control with microcontroller PIC16F84A"	31	
<input type="checkbox"/> E33 348CD	Project "Industrial control with microcontroller ATmega16", Tasks for trainees	31	
<input type="checkbox"/> E33 349CD	Project "Industrial control with microcontroller ATmega16", Solutions for teachers	31	
<input type="checkbox"/> E33 344	Presentation aids for the project "Industrial control with microcontroller ATmega16"	31	
<input type="checkbox"/> E33 356CD	Project "Industrial control with microcontroller PIC16F887", Tasks for trainees	31	
<input type="checkbox"/> E33 357CD	Project "Industrial control with microcontroller PIC16F887", Solutions for teachers	31	
<input type="checkbox"/> E33 358	Presentation aids for the project "Industrial control with microcontroller PIC16F887"	31	



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