Microcontroller Technology
Microcontroller training system with industrial interface
Microcontroller Training System

Configuring function groups with hard- and software

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

- 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 I²C bus like displays, brightness and temperature sensors
- DC and stepping motor control
Fundamentals of microcomputer technology

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

Using industrial development environments

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

Microcontroller integration in appliances

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

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

Integration of external peripheral devices

- Analog sensors
- Intelligent sensors
- Displays
- Small motors
**Hardware/Software**

**μ-Trainer Application Board**

The "μ-Trainer Application Board" is the basic module of the microcomputer training system "μ-Trainer". It has the following features and functions:

- 8 ON/OFF switches
- 8 pushbuttons
- 1 interrupt output
- 4 7-segment displays
- 1 heating module
- 1 I²C temperature sensor
- 1 I²C real time clock
- 1 I²C ambient light sensor
- 1 I²C LC display with back light
- 1 analog pressure sensor up to 5 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 function generator 50 Hz … 10 kHz, TTL level
- 1 BNC socket for adapting measuring instrument inputs to 2 mm 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**

**33 300 μ-Trainer Application Board**

- Computer interface via Ethernet
- 2 mm connectors or bus connectors (8-pin, 1:1, ribbon cable)
- Power supply 110 … 240 V AC, 50 … 60 Hz
- Internal operating voltage 3.3 V; 5.0 V; +/-12 V
- Logic level 3.3 V or 5 V
- Central on/off switch
- Dimensions 532 x 297 x 85 mm
- Desk housing device

The "μ-Trainer Application Board" is delivered with:

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

**33 301  PIC16F84A Programmer Module**

- ZIF socket, 18-pin, for inserting the controller PIC16F84A (PIC16F84)
- Clock generation with quartz 4 MHz
- Ports A (0 … 4) and ports B (0 … 8) have 2 mm connectors, ports B have bus connectors in addition.
- LED per port pin indicating the logical level
- Programmer circuit, in series, ISP
- Internal operating voltage: +5 V (VDD)
- +5 V logical level
- Dimensions 125 x 120 x 32 mm

*System requirements: Windows XP SP2, Windows Vista SP1, Frame Network 3.5*

The "PIC16F84A Programmer Module" is delivered with:

CD-ROM with programmer software (D, GB, RUS) and industrial software developing environment (project management, source code editor, Assembler, Simulator, GB), operating instructions.

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10 Bit ADC Module

The "10 Bit ADC Module" is an integrated extension module for the training system "μ-Trainer" containing a 2-channel analog digital converter with a 10-bit resolution.

Technical Data

- 2-channel analog digital converter
- Reference voltage 1 V or 3 V
- Maximum conversion speed 250 ksample*s⁻¹
- Recommended maximum conversion speed of the module 25 ksample*s⁻¹ while using 2 mm cables for connecting the SPI interface
- Analog inputs with 2 mm sockets
- Outputs with 2 mm sockets and additional bus connector
- SPI controller interface
- +3.3 V or +5 V logic level in dependence of programmer module
- Dimensions 78 x 97 x 30 mm
- Delivered with operating instructions
The "Industrial Interface Board" adapts and couples industrial peripheral devices to the "μ-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 +/- 1V (amplitude) to +/- 10 V
- 8 digital outputs, for loads up to 0.5 A per output
- Permissible total load of the digital outputs <2 A
- 8 digital inputs
- 2 analog outputs
- 2 analog inputs
- External operating voltage: +24 V
- 4 mm 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 "μ-Trainer Application Board"
Hardware/Software

- **Socket for connection of external measuring instruments e.g. oscilloscope**
- **Wide range voltage supply**
  110 V ... 240 V AC, 50 ... 60 Hz
- **Extension module**
  8 switches with 2 mm or bus connection
  8 pushbuttons with 2 mm or bus connection
- **Adjustable DC voltage**
  0V ... TTL level
- **Power-ON indication**
- **Indication of TTL level**
  5 V or 3.3 V (dep. of programmer module)
- **Control input for stepper motor**
- **Stepper motor with function display**
- **TTL pulse generator**
  100 Hz ... 10 kHz
- **Connection for analog pressure sensor**
- **Connection of the I²C bus with the microcontroller**
- **Speaker**
- **Input of the heating control**
- **Interrupt pulse output**
- **Connection of the PC bus with the microcontroller**
Teachware

Manual

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

Learning Objectives

Part 1

- Microcomputers, introduction
- Introduction to the industrial developing environment
- Working with the development tools Editor, Assembler, Simulator, Programmer
- Structure and function of microcontrollers (internal structure)
- The programming interface
- The periphery of a microcontroller (ports, clock, timing, 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

- Editing values to LED lines and 7-segment display
- Timer and interrupt
- Control of stepping and DC motors

Part 2

- Serial data transmission
- SPI Interface
- I²C bus
- Measuring of analog values
- Transferring values to an I²C display
- Voltage measurement
- Temperature measurement
- Pressure measurement
- Measuring of temperature and brightness with intelligent sensors
- Date and time recording with RTC
Technical Data

**E33 320CD**  Manual Microcontroller Technology
PIC16F84A "Configuring function groups with hard- and software"

**E33 321CD**  Manual Microcontroller Technology
PIC16F84A "Configuring function groups with hard- and software"

**E33 334CD**  Manual Microcontroller Technology
PIC16F84A part 2 "Extended peripherals"

**E33 335CD**  Manual Microcontroller Technology
PIC16F84A part 2 "Extended peripherals"

### 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
- 122 pages
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### Solutions for teachers
- Description of theory and guided practical experiments
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- 166 pages incl. documentation of the components
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### TechnoCards

#### Technical Data

**E33 333**  Set of TechnoCards

- PIC16F84A (E33 322)
- Use of the Application Board (E33 323)
- The integrated development environment MPLAB from "Microchip" (E33 324)
Project "Voltage measurement and display"

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 I²C bus
  - Display on LCD
  - Analysis and presentation

- Instructions for realization / summary

E 33 327 TechnoCard "Voltage measurement and display"
ELABO TrainingsSysteme

E33 325CD  Tasks for trainees or students

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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
- 102 pages incl. documentation of the components
- Manual incl. CD-ROM

E33 331 Presentation aids

Project "Voltage measurement and display"

- Templates for the students for presenting their work results
- Unlimited copying license for educational institutions
- 23 transparencies
- On CD-ROM
Project "Industrial control with the microcontroller PIC16F84A"

Learning Objectives

- **Project task**
  - Introduction to automated production system
  - Control systems with controllers
  - Acquiring sensor signals with polling and interrupt
  - PWM generation with timer
  - Speed control (open and closed loop)

- **Analysis and structure draft**
  - required periphery
  - connections
  - block diagram / circuit diagram

- **Solution**
  - Display on LCD
  - Function keys and display of function
  - Speed control
  - Soft start and braking
  - Control of direction
  - Positioning
  - Safety of machinery
  - Integration of an emergency stop

- **Summary**
  - Analysis and presentation

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E33 328CD  Tasks for trainees or students

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

E33 329CD  Solutions for teachers

- Instructions for project work with theoretical explanations and prepared documentation
- Edition for the teacher with solutions
- Color print
- 84 pages incl. documentation of the components
- Manual incl. CD-ROM

E33 332  Presentation aids

Project "Industrial control with the microcontroller PIC16F84A"

- 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
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