LUCAS-NÜLLE

COMMUNICATIONS TECHNOLOGY

Acquiring Practical and Project-oriented Expertise

3rd Edition

CONTENTS

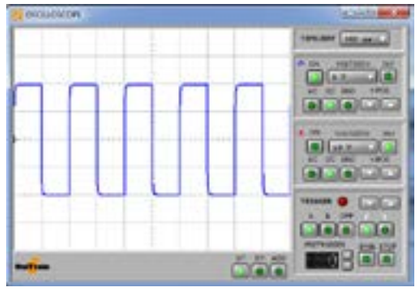
UNITRAIN – DESIGNED FOR MOTIVATIONAL LEARNING

One system covers all technical vocational training

Knowledge and the know-how to operate technical systems continue to make quantum leaps in complexity in ever shorter time frames. This is the daunting challenge facing the vocational training of today and tomorrow. To meet this challenge, the UniTrain system helps with its computer-assisted, multimedia experiment and training system for vocational training in electrical engineering and electronics.

The linking of learning programs with a fully fledged electrical laboratory in a single mobile interface permits theory and practice to be taught anywhere and at any time.

3 LabSoft course
Over 130 learning programs with experiment hardware from all areas of electrical engineering



2 Virtual instruments
120 virtual instruments available to control the interface.

1 UniTrain interface
Measurement and control interface: Analog / digital measurement inputs and
Voltage sources for the experiments.

Integrated WiFi module

4 Experimenter
Accommodates experiment cards and additional voltage outputs (three-phase current)

Benefits

- Universal training system
- Mobile and deployable anywhere
- Promotes individual learning
- Building skills through hands-on experiments
- Motivational boost thanks to a variety of challenges
- Safe experimentation thanks to safety extra-low voltage
- Learning programs combine theory and practice
- Covers the entire field of electrical engineering

Product video
Convince yourself of the benefits

LABSOFT– THE MULTIMEDIA TRAINING PLATFORM

All from a single source

LabSoft is the convenient user interface for displaying the learning programs and controlling the instruments. The navigation window provides free and direct access to all course content. The UniTrain interface is controlled via the integrated virtual instruments.

All measurement results and answers compiled in the experiments are automatically stored for each individual user. This also makes it easy to track learning progress.

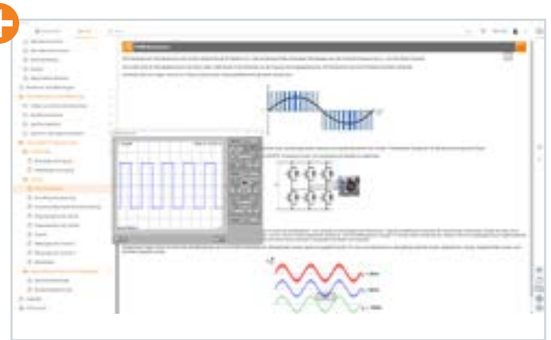
LabSoft, a system with various installation options: Local, online, or in connection with a learning management system.

Benefits

- Direct access to complete course content through the navigation tree
- Control of the interface via virtual instruments
- User-specific login and results storage
- Storage of measurement results and curves
- The system can operate locally, online, or in combination with a learning management system
- Broad language capability: All HTML-supported languages

With Desktop, Laptop or Tablet PC

The navigation window provides free and direct access to all course content. Users can save their measurement results right there in the course.



The integrated virtual instruments are used to control the UniTrain interface or other connected devices.

SAVING TIME FOR WHAT MATTERS MOST

LabSoft Classroom Manager – Administration, customisation, testing and analysis

The LabSoft Classroom Manager is a comprehensive administration software for the UniTrain system and all LabSoft courses. The Classroom Manager's programs are optimised for the specific use and help organise day-to-day routines.

Benefits

- Intuitive operation through graphic user interface
- Easy installation
- No additional database or server systems required
- Use in local network or intranet

Manager – Minimising administrative work

- Everything under control: Administer trainees, trainee groups and content
- The right content at all times: Provide only the courses required for the specific trainee group

Reporter – Continuous overview

- Monitor training progress: Call up advancement status and exam results
- Focus: Evaluations for users, groups, tests or courses

Editor – Individually adapting learning content

- Customisation: Adapt courses to meet own needs
- Be innovative: Create new courses

Questioner – Preparing questions and measurement tasks

- Monitor progress: Prepare measurement tasks and knowledge questions for courses and exams
- Many types of questions: Single choice, multiple choice, fill-in-the-blank, and more

TestCreator – Monitoring trainees' knowledge and skills

- Determine learning level: Compile exams or tests from lists of questions
- Optional: Many pre-compiled collections of exercises with questions and measurement tasks

ControlCenter – Effective supervision of learning groups

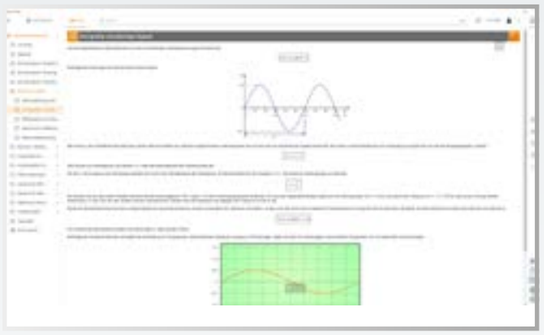
- Monitor the screens in the classroom
- Maintain an overview of current learning progress in the course

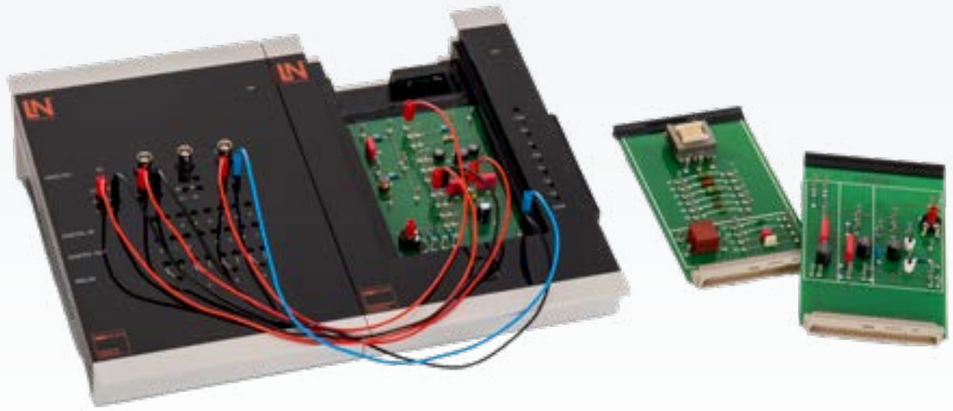
BASICS

Well-grounded training in the fundamentals of telecommunications is the prerequisite for understanding complex relationships in the selection and use of modern communication systems. With many examples, explanations, exercises and hands-on work, these courses clearly convey the basic circuits used in telecommunications, such as filters, amplifiers and AD and DA converters. The training systems are specifically designed to meet the needs of practically oriented education.

AC TECHNOLOGY

including troubleshooting





UNITRAIN
SYSTEM

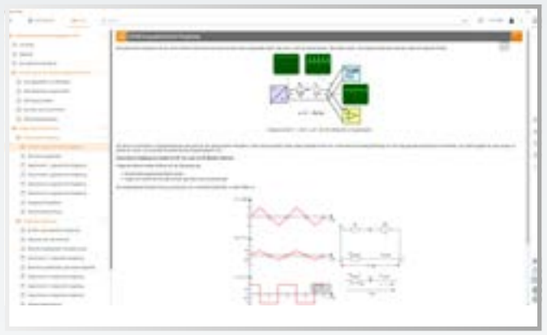
Understanding telecommunication systems requires solid knowledge of AC technology. The course uses many experiments to illustrate abstract terms such as frequency, phase, cut-off frequency,
resonance frequency, Q factor and amplitude response, and to help students "make sense" of them.

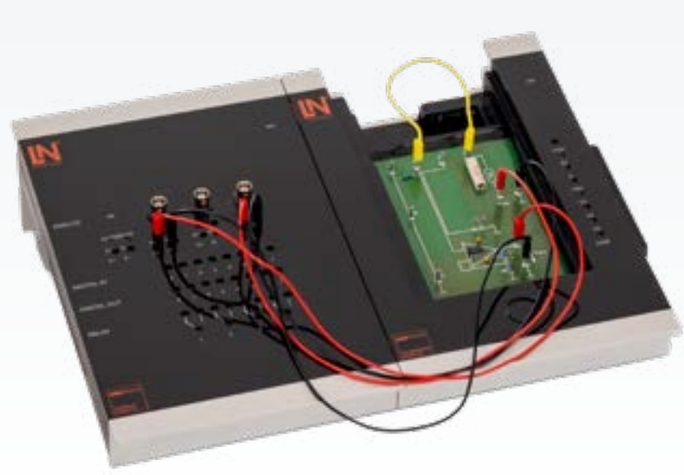
Training content

- Parameters of periodic and sinusoidal signals
- Working with vector diagrams
- Experimental determination of reactance for coils and capacitors
- Explaining active, reactive and apparent power
- Determining the frequency response of simple filter circuits
- Electric resonance circuits: resonance, Q factor, bandwidth and cut-off frequency
- Measurement of frequency response of series and parallel oscillating circuits
- Load, no-load and short-circuit measurements
- Frequency response of transformers
- Troubleshooting

Order no. CO4204-4F

ELECTROMAGNETIC COMPATIBILITY





UNITRAIN
SYSTEM

Minimising the effects of interference on the information being transmitted is one of the main objectives in telecommunications. That's why electromagnetic compatibility (EMC) is particularly important here.

This course conveys fundamental knowledge concerning EMC in both theory and practice. Practical investigation of coupling mechanisms (galvanic, inductive and capacitive) form the focus of the course.

Training content

- Introduction to EMC
- EMC influence models
- Basic terminology and definitions
- Coupling mechanisms
- Galvanic coupling
- Inductive coupling
- Capacitive coupling
- Mitigation measures

Order no. CO4204-4K

OPERATIONAL AMPLIFIERS

including troubleshooting

UNITRAIN
SYSTEM

As highly integrated and versatile components, operational amplifiers have become extremely important. In telecommunications, they are often used in amplifier or filter circuits.

This course covers the properties of many operational amplifier circuits in practical experiments. Through hands-on experience, students acquire extensive knowledge of the operating principles and possible applications of operational amplifiers.

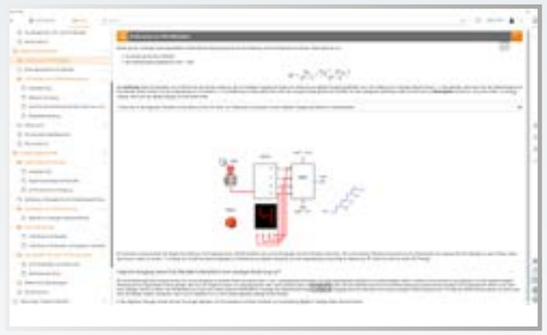
Training content

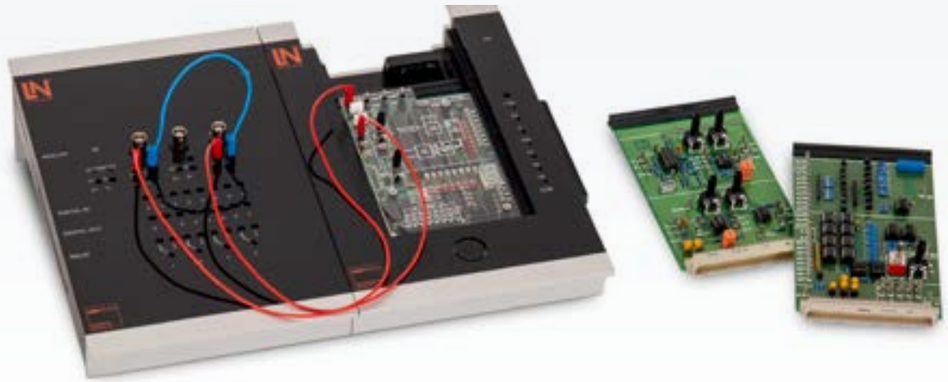
- Design and operating principles of operational amplifiers
- Circuit diagram and basic types of operational amplifier circuits
- Metrological determination of the characteristic and threshold values of an operational amplifier: frequency response, amplification
- Analysis of typical analog computer circuits: adders, subtractors, integrators and differentiators
- Design and measurement of precision voltage sources and constant current sources
- Analysis of typical application circuits: impedance converters, precision rectifiers, comparators, Schmitt triggers
- Troubleshooting

Order no. CO4204-5M

CONVERTER CIRCUITS

including troubleshooting





UNITRAIN
SYSTEM

A/D and D/A converters form the interfaces between the real and the digital world. Because in most cases today information is transmitted digitally, they are indispensable in the transmission of image and audio signals.

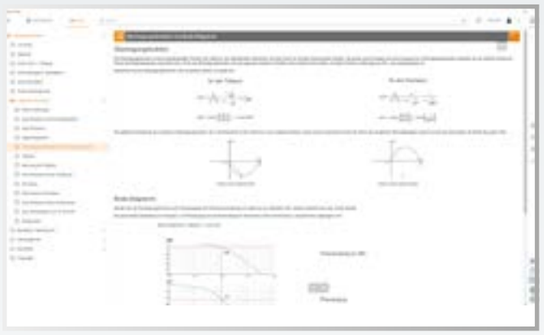
The course provides insight into the various methods of A/D and D/A conversion. The operating principles and the advantages and disadvantages of the various methods are explored in clear, practical experiments.

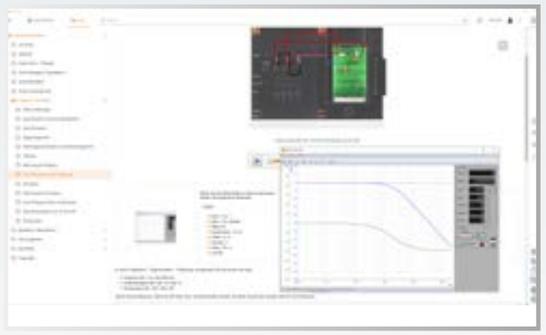
Training content

- Design and operating principles of D/A converters (R-2R network, valued resistors)
- Recording static and dynamic characteristics of D/A converters
- Analysis of a D/A converter circuit for acoustic volume
- Fundamentals of AD conversion (sampling rate, quantisation, resolution, conversion time)
- Design and operating principles of A/D converters (flash, approximation, single/dual slope, delta-sigma converters)
- Design and operating principles of V/F and F/V converters
- Characteristic recording and measurement of internal signals
- Troubleshooting

Order no. CO4204-6B

QUADRIPOLES AND FILTERS





UNITRAIN
SYSTEM

Filter circuits are used in many areas of telecommunications to suppress and/or attenuate undesirable frequency ranges in the signal. The transfer response of a filter is described by the transfer function. It is used to determine the output signal according to amplitude and phase.

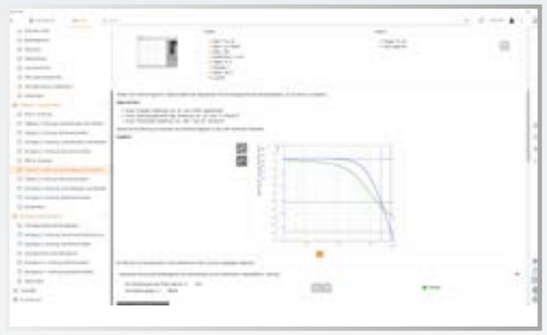
In the course, the transfer response of various filters and resonance circuits are analyzed in the time and frequency domain. Numerous measurements with oscilloscope and Bode plotter are used to explore the characteristics of the different filters and to teach measurement techniques.

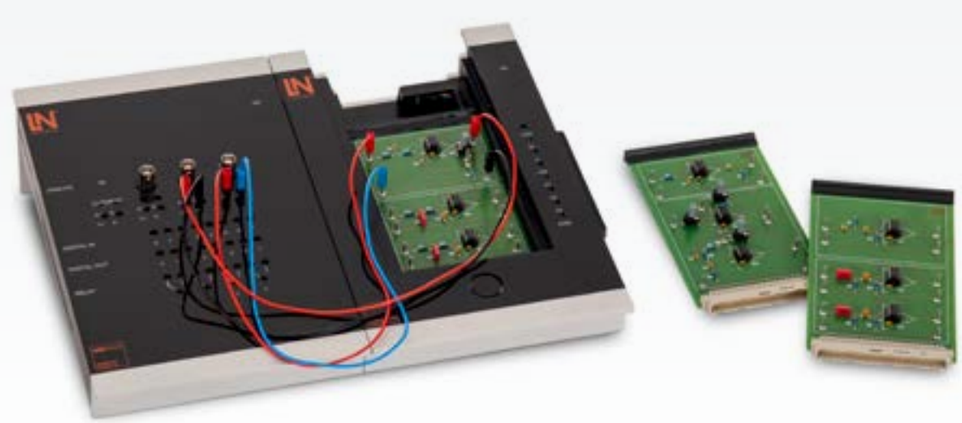
Order no. CO4204-9A

Training content

- Characterisation of four-poles by means of the transfer function
- Familiarisation with the terms amplitude response, phase response, and cut-off frequency
- Representation of the transfer function in the complex plane
- Using the oscilloscope to analyse filter circuits in the time domain
- Recording amplitude and phase response of high-pass and low-pass filters with the Bode plot
- Determining the transfer function, bandwidth and centre frequency of
- band filters by means of Bode plots
- Resonant circuits: determining the transfer function, bandwidth, Q factor and resonance frequency
- Using the Bode plot to analyse resonance circuits
- Analysing parallel resonance circuits with variable capacity diode tuning

ACTIVE FILTERS WITH OPERATIONAL AMPLIFIERS





UNITRAIN
SYSTEM

As a general rule, an active filter is an operational amplifier connected to a network consisting of capacitors and resistors. Unlike passive filters, active filters can be used not only to dampen signals, but also to selectively amplify frequency ranges. In this way, cascading multiple filter stages makes it easy to create a higher order filter.

In the course, various filters of different orders are configured and their frequency response is determined by means of Bode plots. The characteristic values (cut-off frequency, centre frequency, transconductance) of the filter are determined from the measurements.

Order no. CO4204-9B

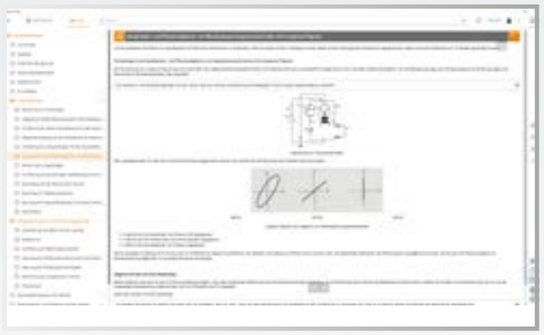
Training content

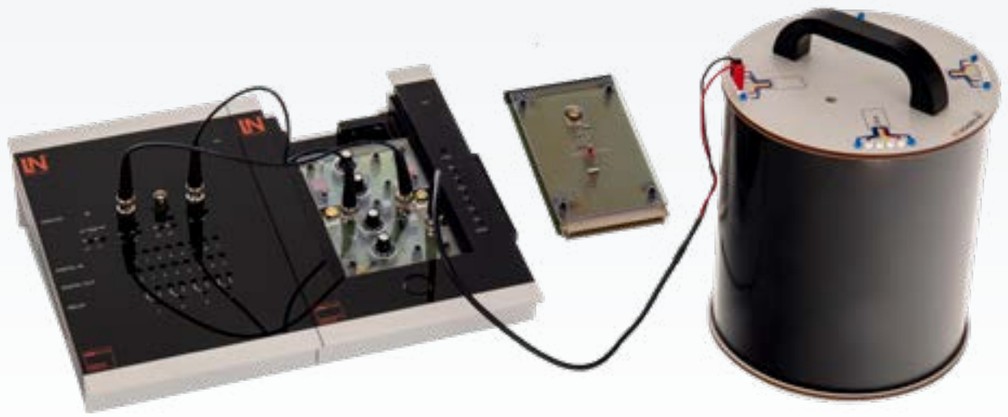
- Familiarisation with the design of higher order active filters
- Evaluation of filters: transconductance, phase shift, upper and lower cut-off frequency, ripple and attenuation
- Familiarisation with various filter approximations: Bessel, Butterworth and Chebyshev filters
- Determining characteristics in the time domain: delay time, rise time, transient range, stationary range
- Using measuring techniques to analyze 2nd-order and 4th-order filters: frequency response and phase response, cut-off frequency, transconductance
- Using measurement techniques to determine resonance frequency, bandwidth, Q factor and the resonance amplification of 2nd-order band pass and band-stop filters

TRANSMISSION LINES

Transmission lines are the arteries of a telecommunication system. The proper design and correct selection of transmission line components contribute considerably to the operation of the overall system. Didactically prepared training systems use typical components and conventional cables and optical waveguides to convey the functions and application areas of transmission lines.

FOUR-WIRE LINES





UNITRAIN
SYSTEM

The classic two-wire or four-wire cable is still the most frequently used cable type for connecting devices in telecommunication networks. Whether analog or digital connection - the "last mile" of the device connection is generally still a four-wire cable, even if the share of fibre optic cable is continuously growing.

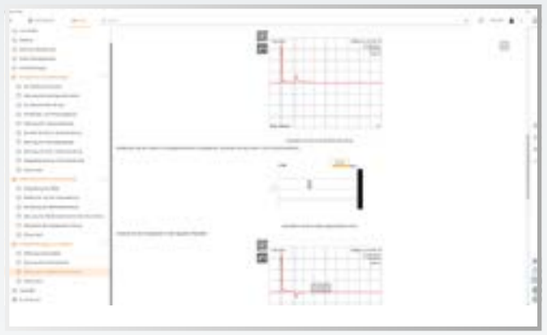
In the course, students experimentally determine the typical parameters and limit values of the four-wire cable. In so doing, they also investigate the effect of mismatch on signal transmission along the cable.

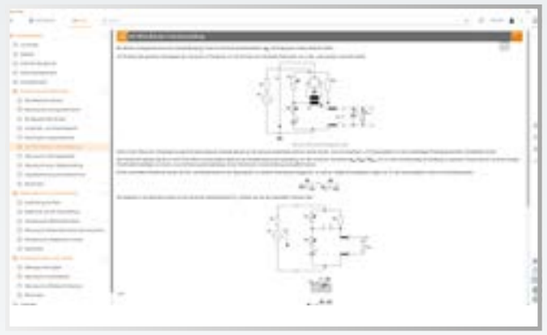
Training content

- Design and parameters of four-wire cables
- Measurement of primary line constants with various measurement bridges
- Measurement of wave impedance, phase velocity and attenuation
- Measuring pulse transit time on conductor pairs and individual wires with respect to ground
- Measurement of the pulse reflection factor of the line with different faulty terminations
- Measuring cross-talk between a four-wire line's conductor pairs

Order no. CO4204-9F

COAXIAL CABLES





UNITRAIN
SYSTEM

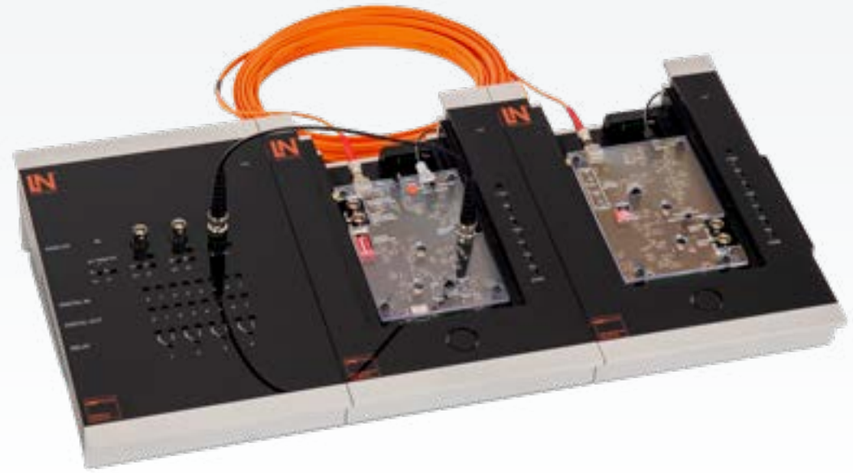
The vast majority of signal and data transmissions take place over fixed media, i.e. along wires. Although they are technically easier to implement than wireless transmission, their practical applications frequently encounter difficulties due to incorrect wire material selection or mismatched couplings.

Training content

- Primary line constant, loop resistance, insulator capacitance, loop inductance and wave impedance of a coaxial cable
- Determination of
  - loop resistance using a Wheatstone bridge
  - insulator capacitance using a Wien bridge
  - loop inductance using a Maxwell bridge
  - wave impedance of a coaxial cable
- Measurement of pulse transit times
- Analysis of reflections on a coaxial cable as a function of line termination
- Reflection-free line termination

Order no. CO4204-9G

OPTICAL FIBRES FOR WAVELENGTHS 650 NM / 820 NM



UNITRAIN
SYSTEM

The ever increasing volume of available information requires ever higher transmission rates. As a result, more and more fibre optic transmission lines are used in both industrial and telecommunication networks. Along with significantly higher transmission rates, glass fibre cables are also characterised by their low attenuation.

Along with the technical fundamentals of optical data transmission, the course also covers the connection methods and the design of optical transmission lines.

Training content

- Familiarisation with the principles of optical telecommunication
- Explaining dispersion, numerical aperture and attenuation in fibre optics
- Designation of fibre optic transmission line components
- Advantages and disadvantages of plastic and glass fibres
- Comparison of step-index and gradient-index fibre properties
- Modulation methods for analog and digital signals
- Analysing the effect of different wavelengths and fibre optic cable material on transfer response
- Configuring a fibre optic cable
- Setting up a fibre optic transmission line and putting it into operation
- Transmission of analog and digital signals by fibre optic cable

Order no. CO4205-4E

OPTICAL FIBRES FOR WAVELENGTHS 1300 NM

UNITRAIN
SYSTEM

Most transmission over long distances uses single-mode fibres. They exhibit significantly less attenuation than multi-mode fibres do. However, the small core diameter requires the use of expensive laser diodes as a light source.

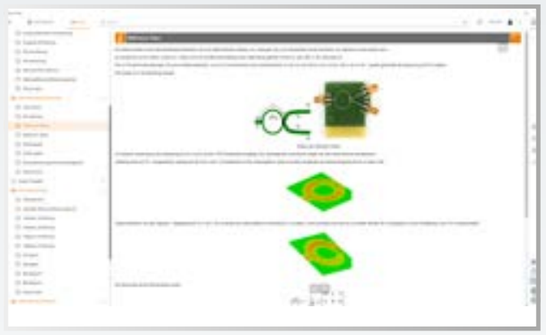
The course teaches students how to handle the individual components safely, especially the laser diodes. Transmission lines are set up and their properties are analysed.

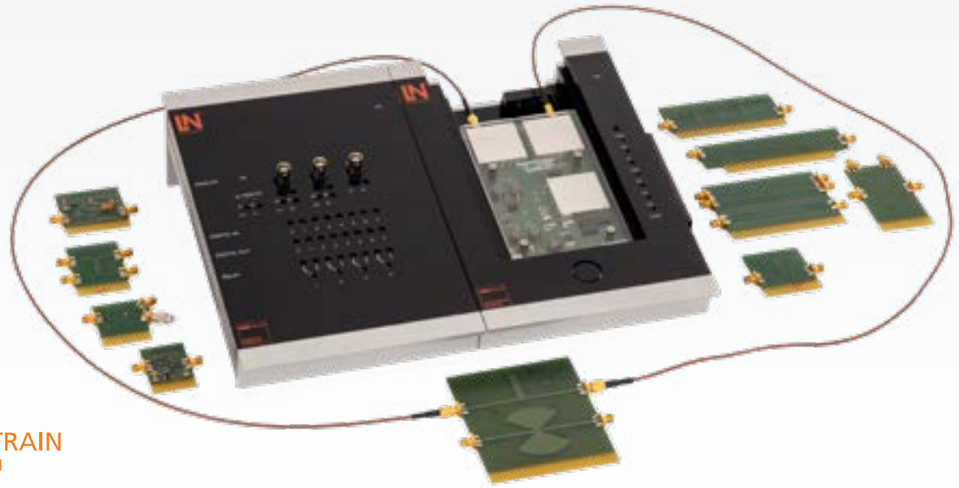
Training content

- Analysing dispersion, numerical aperture and attenuation in glass fibres
- Advantages and disadvantages of plastic and glass fibres
- Differences between multi-mode and single-mode fibres
- Setting up a transmission line with single-mode fibres and laser transceivers with a wavelength of 1300 nm
- Use of measuring techniques to investigate the transmission line
- Determination of the bandwidth and dynamic range of the transmission line

Order no. CO4205-4F

MICROSTRIP LINE TECHNOLOGY





UNITRAIN
SYSTEM

The production of semiconductor-based high-frequency integrated circuits was not possible until the development of microstrip technology. Over the past two decades, the use of planar waveguides has become established practice in a large range of application areas.

Along with the design and operation of microstrips, this course particularly focuses on the analysis of the transfer response of various microstrips and components.

Training content

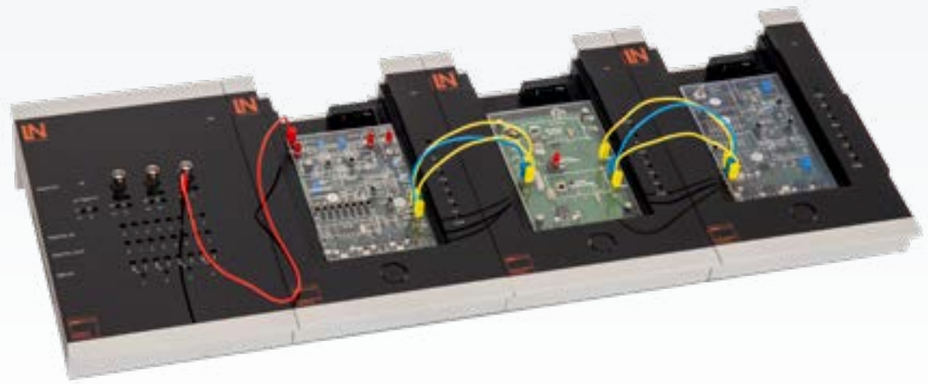
- Design and operation of planar microstrips
- Ability to identify substrate materials
- Calculation of line characteristics
- Familiarisation with field distribution of various line types
- Recording of the transmission function of various lines
- Measurements on different microstrip components
  - directional couplers and Wilkinson power dividers
  - 90° and 180° hybrid couplers
  - microstrip line filters
- Measurement of the reflection factor
- Analysis of complex microstrip circuits
  - MMIC and FET amplifiers

Order no. CO4204-9Y

MODULATION METHODS AND MULTIPLEXING TECHNOLOGY

Modulation methods and various types of signal encoding form the basis of nearly all telecommunication systems. Digital processes are particularly significant in this regard. Across the board, they have conquered an extremely wide variety of areas, including microwave, radio, satellite transmission and mobile telephony.

PULSE MODULATION METHODS: PAM, PCM, DELTA



UNITRAIN
SYSTEM

The transmission of digital data in place of analog data via communication channels provides a wide range of advantages. Along with higher quality and noise immunity, the multiplexing of multiple channels is a key criterion that has promoted the rapid introduction of this technology in communication and signal transmission technology.

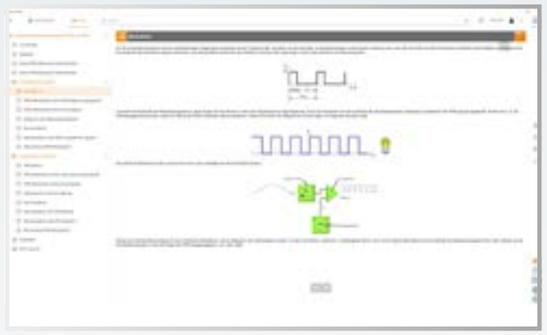
This courses covers the necessary steps for digital transmission from voice to digital telephone channels, ranging from sampling to companding and encoding to multiplexing.

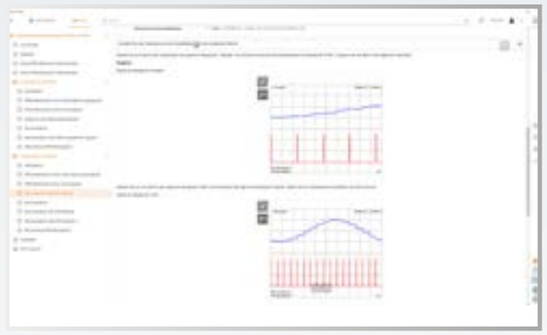
Training content

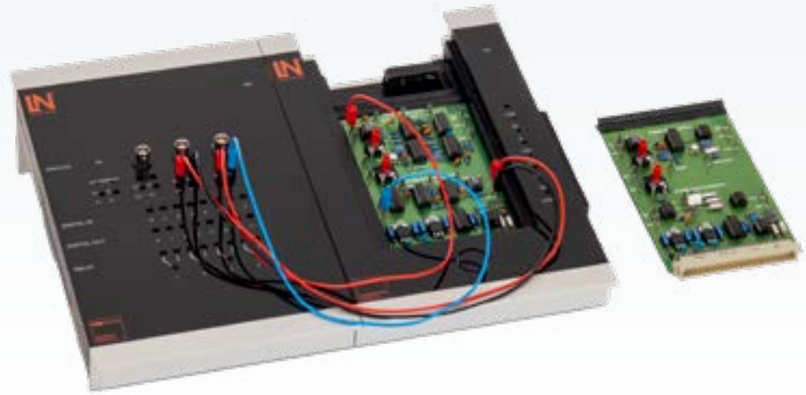
- Operating principles of PAM/PCM/delta modulation and time-division multiplexing
- Shannon sampling theory
- Signal response measurements of PAM/PCM-modulated signals
- Optimal filtering, antialiasing
- Quantisation of analog signals and determination of quantisation intervals
- Companding according to A law and μ law; recording of transmission characteristics
- Line codes: signal response measurements of line-coded signals
- Clock recovery and phase jitter
- Analysis of the data frame on layer 1 (physical layer) using the example of ISDN

Order no. CO4204-9J

PULSE MODULATION METHODS: PWM, PPM







UNITRAIN
SYSTEM

Along with pulse modulation, pulse time modulation also plays
a non-negligible role in transmission technology. Pulse width modulation is once again gaining particular significance in digital switching amplifiers (class D amplifiers).

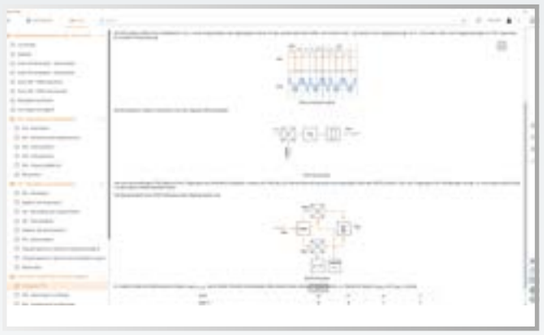
In numerous experiments, the course covers the operating principles of PWM and PPM and presents their advantages and disadvantages.

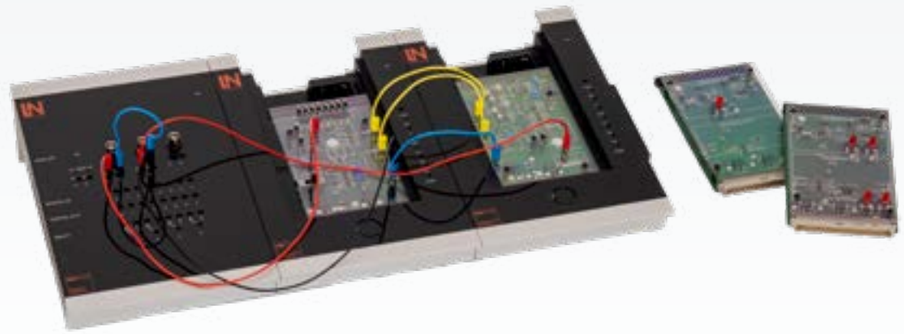
Training content

- Principles of PWM modulation and demodulation
- Principles of PWM modulation and demodulation
- Analysis of the output signal of the PWM demodulator, effect of bandwidth of the input signal
- List of PWM's advantages and disadvantages
- Familiarisation with the principles of PPM modulation and demodulation
- Recording the signal waveform at the output of the PPM modulator
- Signal waveform measurements on internal signals of the demodulator
- List of PPM's advantages and disadvantages

Order no. CO4204-9K

DIGITAL MODULATION METHODS: ASK, FSK, (Q)PSK





UNITRAIN
SYSTEM

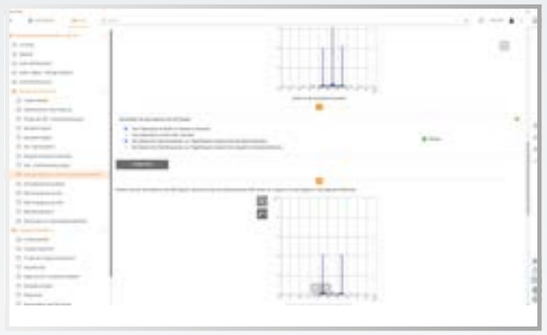
When analog channels are used to transmit digital data, in most cases the parameters of the sinusoidal carrier undergo so-called "shift keying." In the past, these transmission processes were used with cable modems or fax machines. Today (Q)PSK plays an important role in the radio transmission of digital signals. Using many experiments and measurements, the principles of digital modulation are clearly presented. The required bandwidth of the processes is determined using the spectra and the quality of the demodulated signal.

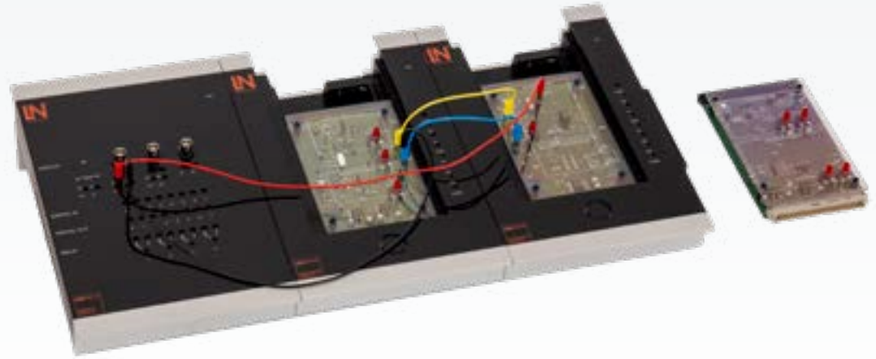
Training content

- Principles of ASK/FSK modulation for the transmission of digital signals over analog lines
- Use of measuring techniques to investigate the spectra of an ASK- and FSK-modulated signal
- Relationship between data transmission rate and required bandwidth
- Signal waveform measurements on the output of modulators and demodulators
- Demodulation of FSK signals using a PLL loop
- Principles of PSK (DPSK) modulation, formation of a 2-PSK signal with different baud rates
- Principles of QPSK adn DQPSK modulation, formation of dibits

Order no. CO4204-9L

AM/FM MODULATION/DEMODULATION





UNITRAIN
SYSTEM

Because of their decades-long use in radio, AM and FM remain by far the best-known modulation processes for the radio transmission of audio signals. Today, AM and phase modulation are found in quadrature amplitude modulation (QAM), which is used in mobile telephone networks, for example. Although largely replaced by digital processes today, AM and FM provide clear examples for understanding the principles of modulation.

Training content

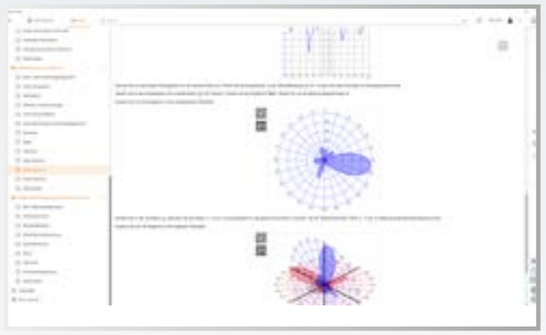
- Presentation of the principle of amplitude modulation
- Recording of the modulation trapeze at different modulation degrees
- Demodulation of the signal using a diode detector
- Single-sideband modulation (SSB) and double-sideband modulation (DSB)
- Signal reconstruction by means of an integrated double balanced mixer (SSB)
- Representation of the principle of FM modulation and demodulation
- Determining the "frequency hub" and "modulation index" in the modulation signal
- Measuring the effect of LF amplitude and LF frequency
- Reconstruction of a modulation signal using the phase demodulator

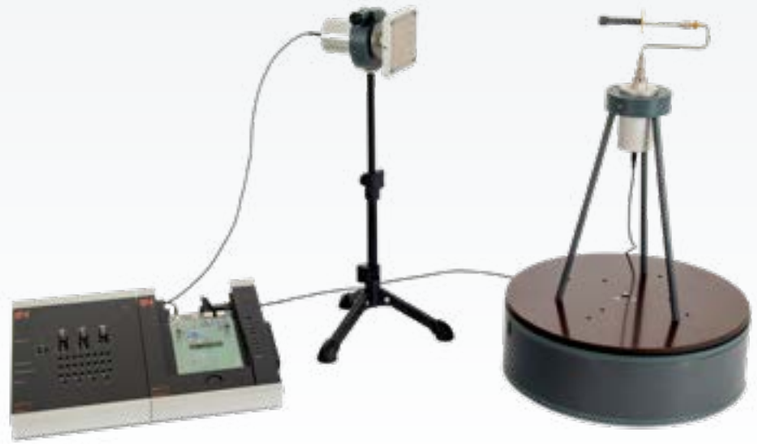
Order no. CO4204-9M

TRANSMISSION AND RECEIVING TECHNOLOGY

Radio transmission lines are of paramount importance in modern telecommunications.
With the worldwide spread of mobile telephony, wireless communication to mobile end devices has become one of the most significant challenges in telecommunications. The dramatic increase in the number of devices and the volume of data along with a continuous series of new technologies such as RFID and Bluetooth require highly efficient transmission and reception equipment to ensure secure data transfer. Accordingly, adaptive antennas that beam their signals directly to the devices and regulate transmission power are indispensable for trouble-free operation of modern broadband radio networks.

ANTENNA TECHNOLOGY





UNITRAIN
SYSTEM

Antennas constitute the start and end of every radio transmission line.
They exist in an extremely wide range of designs and sizes, adapted to the application area and frequency range.

The antennas used in the course work with small outputs and a frequency of 9 GHz. This enables risk-free use in the laboratory. Along with the fundamentals of radio transmission, the course focuses on the practical analysis of various antennas.

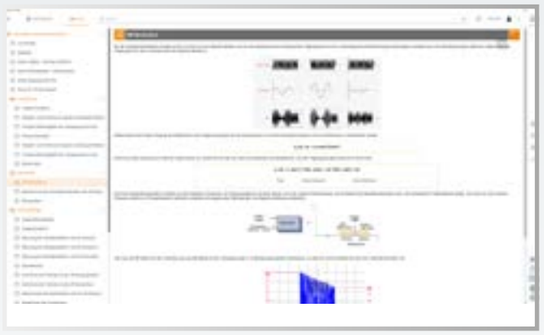
Training content

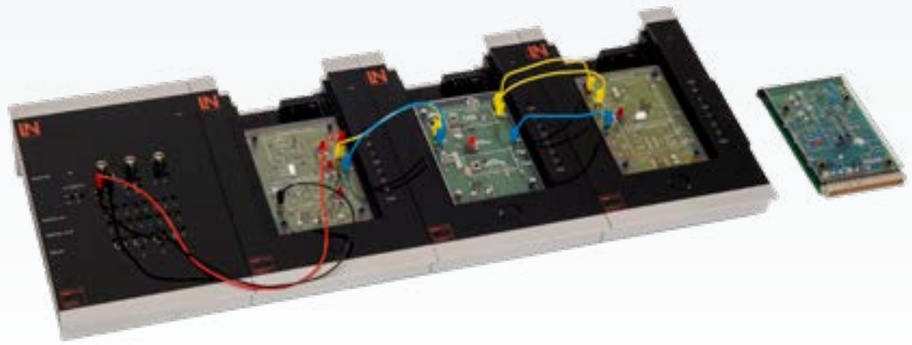
- Propagation of electromagnetic waves and polarisation
- Physics of radiation and reception
- Near-field and far-field radiation characteristics
- Characterisation of antennas: directionality, gain,effective length
- Tuning and balancing
- Measuring the directivity pattern of various antennas
  - monopole and dipole antennas
  - Yagi antennas
  - helical antennas
  - patch and microstrip antennas

Order no. CO4204-9T

Easy antenna replacement with QMA connector

AM TRANSMISSION AND RECEIVING TECHNOLOGY





UNITRAIN
SYSTEM

Transmitters and receivers for radio transmission lines continue to play a dominant role in communication technology. Although traditional, analog radio broadcasting has been largely replaced by digital processes today, AM transmitters and receivers serve as a good example to clearly illustrate the principle of radio transmission.

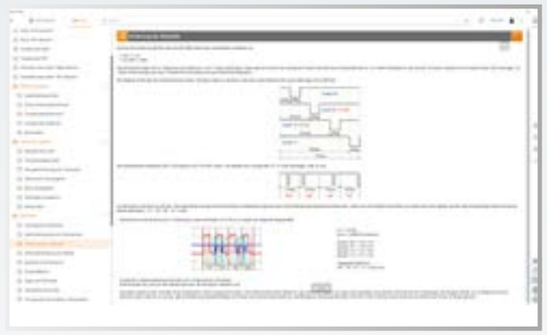
Through experimentation, the course explores the operating principles of the individual subassemblies of an AM transmitter/receiver. Assembly of a complete AM transmitter and receiver circuit demonstrates clearly how they interact.

Training content

- Design and operation of Hartley and Colpitts oscillators
- Properties of tuned radio frequency and superhet receivers
- Determining the operating principles of AGC and AFC experimentally
- Analysis of a phase discriminator
- Mirror selection and near selection, determination of mirror frequency
- Analysis of the filter curves of HF input stage and IF amplifiers
- Design of a medium-wave AM single-conversion superhet with full-range tuning

Order no. CO4204-9N

DATA ACQUISITION USING RFID AND NFC



UNITRAIN
SYSTEM

We encounter non-contact data acquisition applications day in and day out:
electronic article surveillance, building access control, animal identification and the electronic immobilizer in the car are just a few examples of the use of RFID systems.
For the fast and simple transmission of small amounts of data between devices in close proximity, NFC is used.

The course uses experiments to clarify the operating principles of both processes.
Various NFC and RFID transponders are presented, the communication protocols are analyzed, and data are written to and read from transponders.

Training content

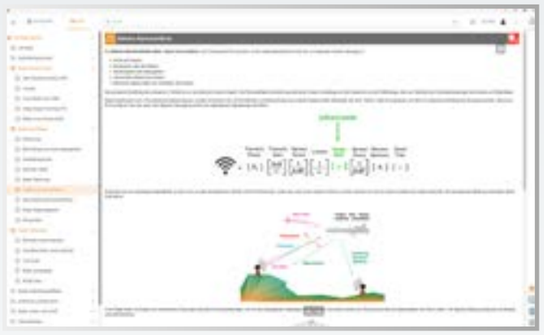
- Overview of the technologies (RFID/NFC)
- Presentation of system components and variants
- Principle of inductive coupling for the physical connection between components
- Analysis of the energy connection and range of NFC and RFID
- Analysis of communication protocols
- Data encoding and transmission (ISO 15693)
- Writing to and reading from transpoders

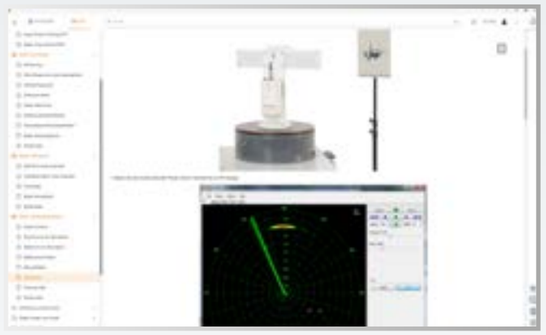
Order no. CO4205-4S

RADAR TECHNOLOGY

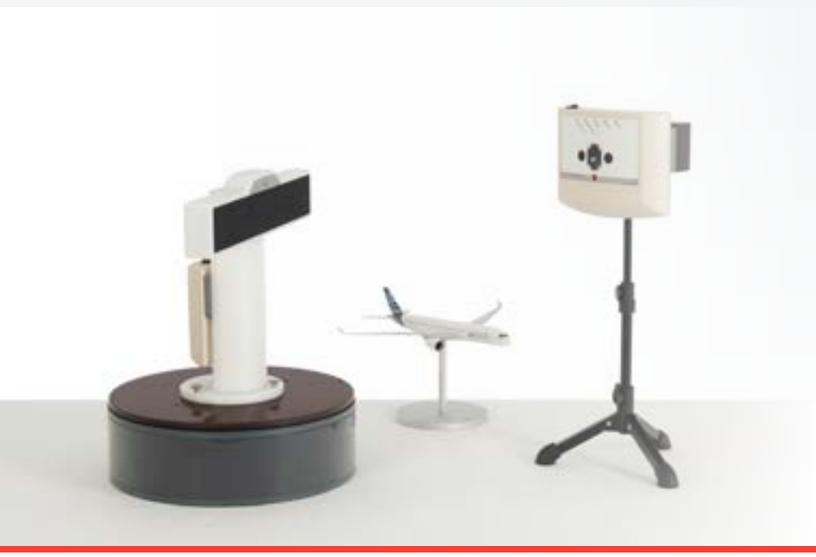
"Radio Detection and Ranging" is known as radar and refers to a process that uses radio to measure position and distance based on the propagation measurement of electromagnetic waves reflected by the object.
Originally a strictly military application, radar technology has since been the object of further development and is now also used in the fields of air traffic control, coast guard, motor vehicle traffic control, security and adjacent application areas.

RADAR TRAINER





Includes various targets!



The target is placed on the telescopic stand in the room

The radar technology training system is intended for the education of technicians, engineers and users from the areas of air traffic control, coastguard services, motor vehicle traffic control, security and adjacent application areas. The course covers radar-specific topics ranging from the fundamentals to current technologies, in theory and practice. The central component of the training system is a radar base station with a fan-beam antenna.

Echoes from ultrasonic pulses are digitised and transmitted via a wireless interface to a computer. The targets are then displayed on a screen in real time. The secondary radar transponder in the system supports mode A (identification) and mode C (altitude).

Order no. CO3538-6A

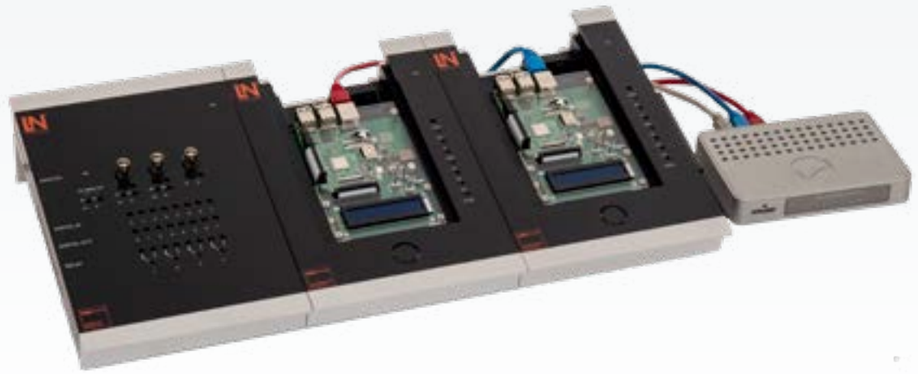
Training content

- Familiarisation with the operating principle and design of a radar system
- Familiarisation with the definition and properties of electromagnetic waves
- Radar equation and reflection on objects
- Familiarisation with the concept of effective radar cross section (RCS)
- Experimental analysis of the radar cross section of a model aeroplane
- Identifying types of radar systems (pulse, CW, FMCW radar)
- Conducting radar distance measurements using A-scope
- Calculating the radio horizon
- Metrological analysis of reflection and absorption of various targets
- Familiarisation with resolution limits of radar systems and measuring them: ranging and azimuth resolution
- Familiarisation with causes and generation of interference signals and detecting them experimentally
- Ability to explain the terms radar clutter and radar chaff
- Familiarisation with the design and operating principles of secondary radar
- Understanding secondary radar interrogation and reply messages
- Experimental measurement of a transponder target in mode A and mode C
- Familiarisation with radar operating modes for target tracking
- Experimental target tracking using TWS (track while scan) and STT (single target tracking)

NETWORK TECHNOLOGY

The advantages of a network are the virtually unlimited communication, the exchange of data between devices, the central administration, and the ability to access resources and data jointly. Our UniTrain courses explain step by step how a computer network is set up.

NETWORKING AND CYBER SECURITY



UNITRAIN
SYSTEM

The transmission protocols associated with the internet owe their tremendous significance in network technology to the triumphant success of the worldwide web. No computer network works without them.

Training content

- Network standards; differences between LAN, MAN, WAN, GAN
- Familiarisation with the OSI model
- Design and components of an Ethernet network
- Design and testing of a computer network
- Familiarisation with the TCP/IP internet protocol family
- Addressing of the IP, modifying the network address of a computer
- Setting up a subnet using a subnet mask
- Setting up a subnet using a subnet mask
- Set-up and analysis of services: FTP, SSH, HTTP, streaming
- Data security: the significance of open ports
- Secure and unsecure connection types
- Using encryption methods and analysing data traffic
- Simulating DDoS attacks (multiple training systems)

Order no. CO4205-4Q

SOHO WIFI TRAINER

What this practical hands-on system seeks to achieve is to train students in the skills needed for installation and ensuring security of wireless networks. This includes selection of the correct components, materials and tools for an installation, as well as knowledge of the encoding system to be implemented. One key aspect is the choice and operation of test equipment, either simple or complex,
for the purpose of testing functionality and troubleshooting for faults in the communications system.

Training content

- Installation of network components
- Configuration of WiFi routers
- Use of professional tools and measuring instruments in an installation
- Practical implementation of network topology and devices

Order no. Equipment set TWT1

VOIP LITE

The internet made it possible – the convergence of modern telecommunications networks with data transmission networks. The product of this is VoIP – next generation telephony – a packet-switching service based on TCP IP.

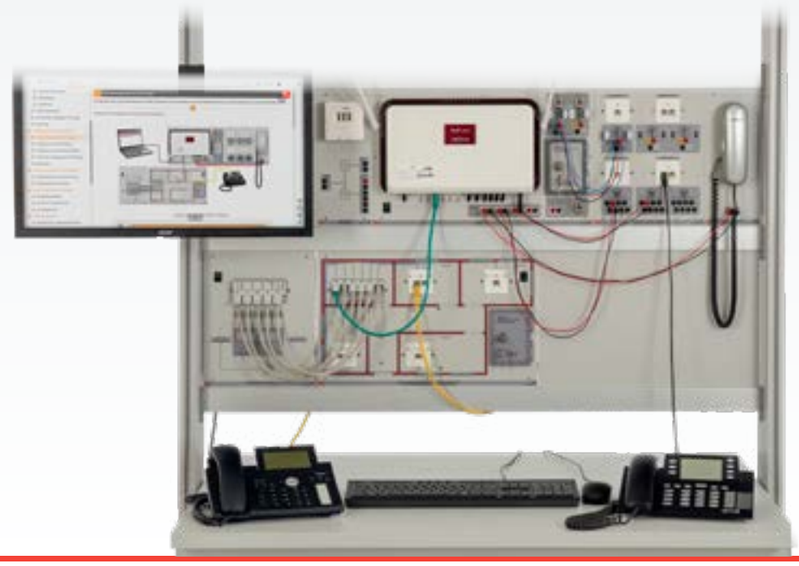
Training content

- TCP/IP
- Virtualisation fundamentals
- SIP, RTP, RTCP, RTSP protocols
- Design and operation of a VoIP soft telecom system
- Configuration of the telecom system
- Installation and configuration of VoIP terminal devices
- Installation and configuration of a soft phone
- Analysis of data packets

Order no. Equipment set TVP1

TRAINING PANEL SYSTEM: TELECOM NETWORK IN THE OFFICE

including troubleshooting



This training system allows you to install, commission and configure a typical office telecommunications structure and also troubleshoot for faults. The equipment set can either be used stand-alone or be incorporated into an existing telephone system or local network.

Training content

- Installation and configuration
- Putting the system into operation
- Installation and configuration of analog (terminal) devices
- Installation and configuration of ISDN (terminal) devices
- Installation and configuration of VoIP (terminal) devices
- Hand-over and instruction
- Troubleshooting

Order no. Equipment set TTK1

LUCAS-NÜLLE

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