LUCAS-NÜLLE

Communications Technology

Including Transmission, RF and Network Technology

Acquiring Practical and
Project-oriented Expertise

Contents

Contents

Qualifications Through Quality

Training Systems for Telecommunications Engineering

Technological Progress …

The ever-increasing amount of information being transmitted is pushing development in telecommunications engineering toward higher and higher operating frequencies, which permit considerably greater bandwidths and thus make faster data processing possible. The information itself is being conveyed via radio links, copper cables, fibre-optic cables, waveguides and microstrips.

… Is Having a Huge Impact on Training and Education

Due to the fact that telecommunications technology is becoming more and more complicated and sophisticated, it is necessary to find a way of dealing with this in training and education. This is the only way to ensure that trainees and students are constantly being prepared for tomorrow's complex world of work using state-of-the-art technology.

The UniTrain-I System – Combining Theory and Practice at the Same Time and Place

UniTrain-I – Multimedia Laboratory with 30 Communications Technology Courses

The multimedia-based experiment and training system UniTrain-I guides the student through experiments and theoretical sections with clearly structured course navigation and software that also includes texts, graphics, animations and tests.

In addition to the training software, the courses also contain experiment cards on which practical exercises are performed. Courses are included on such topics as "transmission lines", "antenna technology" and "digital signal processing" which convey all of the knowledge and skills needed for the understanding, configuration, trouble-shooting and deployment of modern telecommunications technology. With the aid of animations and a host of experiments on real modules and systems, the various courses explore the fundamentals, principles and component properties used in transmission and receiving technology, modulators and demodulators, AD and DA converters and permit the required measurements to be carried out.

Your benefits

- All the topics involving communications technology are available
- Theory and practice are combined at the same time and place
- High student motivation thanks to PC and modern media work environment
- Rapid learning success thanks to structured course navigation
- Quick understanding thanks to theory-supporting animation
- Acquisition of skills through own experimenting
- Continuous feedback thanks to comprehension questions and tests
- Guided trouble-shooting using an integrated fault simulator
- Safety guaranteed thanks to the use of extra-low voltage
- Sample solutions

UniTrain-I system

- Complete, portable laboratory
- Multimedia courses
- High-tech measurement and control interface
- Combines theory and practice at the same time

UniTrain-I interface with USB

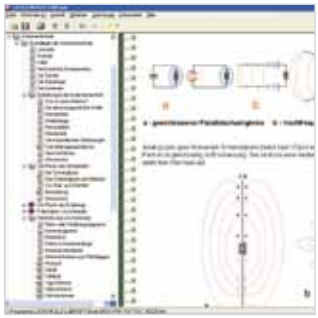
- Oscilloscope with 2 analog differential inputs
- Sampling rate 40 Msample/s
- 9 measurement ranges 100 mV – 50 V
- 22 time ranges 1 µs – 10 s
- 16 digital inputs and outputs
- Function generator up to 1 MHz
- 8 relays for fault simulation

UniTrain-I experimenter

- Receptacle for experiment cards
- Experimenter voltage ± 15 V, 400 mA
- Experimenter voltage 5 V, 1 A
- Variable DC and three-phase source 0 ... 20 V, 1 A
- IrDa interface for multimeter
- Additional serial interface for cards

Integrated measuring instruments and power supplies

- Multimeter, ammeter, voltmeter
- 2-channel storage oscilloscope
- Function and waveform generator
- Spectrum analyser
- Bode plotter
- ... and many more instruments besides



Training and experiment software LabSoft

- Large selection of courses
- Comprehensive theory
- Animations
- Interactive experiments with instructions
- Free navigation
- Documentation for measurement results
- Test

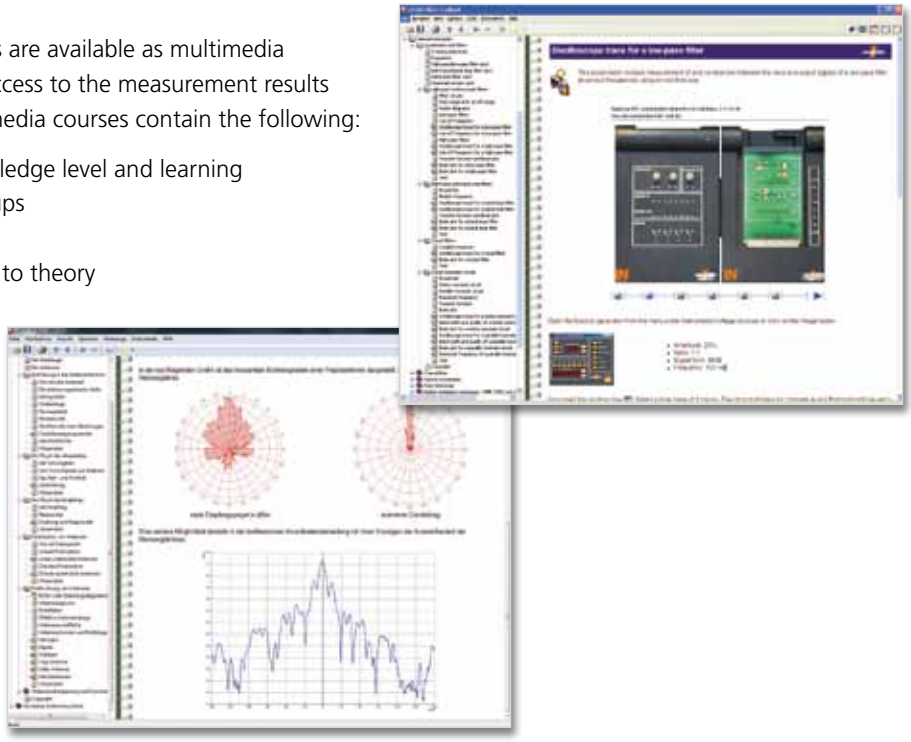
Animated Presentation of Complex Training Content

Project-oriented Training Media – Adaptable to Any Training System

Multimedia courses

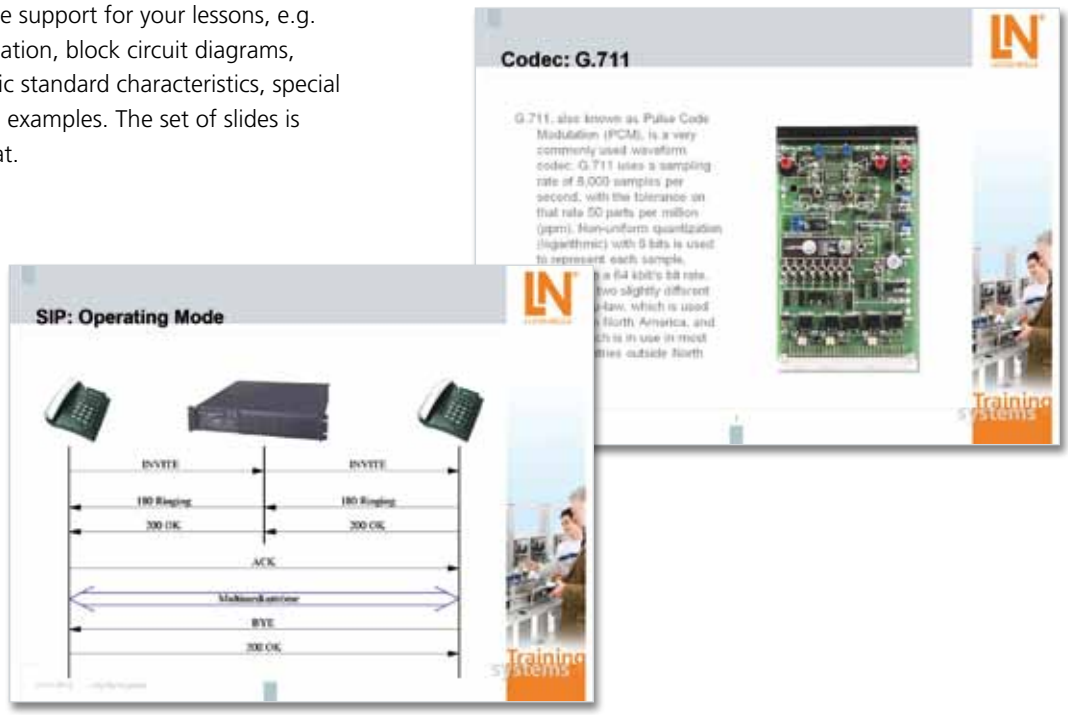
Many experiment instructions are available as multimedia courses. These allow direct access to the measurement results of various equipment. Multimedia courses contain the following:

- Questions to monitor knowledge level and learning
- Interactive experiment set-ups
- Navigation bars
- Animated sections devoted to theory



Presentation slides

Presentation slides can provide support for your lessons, e.g. supplying background information, block circuit diagrams, physical fundamentals, specific standard characteristics, special modifications and application examples. The set of slides is provided in PowerPoint format.



QuickCharts

These provide a quick overview of certain topics and work processes. Technical context is given brief and clear explanations.

Entire System at a Glance

Technical Practice Telecommunications Technology

TTT 1P / TTT 2P / TTT 4P / TTT 6P equipment sets
Installation of analog and digital telephone technology in the SOHO range

TPN1 equipment set
Installation of a CAT 5 network

Multimedia Courses Telecommunications Networks

Course SO2700-1B
Telecommunications networks

Course SO2700-1A
Telecommunications networks

Course SO2700-1C
ISDN

VoIP

SO3538-4W equipment set
VoIP-Trainer-Lite

LM9994 equipment set
Measurements and fault diagnostics in the VoIP network

Network Technology

Digital Signal Processing

Transmission and Receiving Technology

Course SO4204-9X
Complex antenna systems

Course SO4204-9W
Antenna technology

Course SO4204-9N
Transmission and receiving technology

Modulation Methods and Multiplexing Technology

Course SO4204-9J
Pulse modulation methods PAM/PCM/Delta modulation, AMI/HDB3 coding

Course SO4204-9K
Pulse modulation methods PWM, PPM

Transmission Lines

Course SO4204-9F
Four-wire lines

Course SO4204-9D
Coaxial lines

Basic Modules of Communications Engineering

Course SO4204-9A
Quadripoles and filters

Course SO4204-4K
Electromagnetic compatibility

TTK2020 equipment set
Installation of a WLAN wireless line

TTK2010 equipment set
Installation of a WLAN network

TTK1010 / TTK1011 equipment set
Putting a POTS-ISDN telecommunications system into operation,
Putting a VoIP telecommunications system into operation,
Smooth migration to VoIP

Course SO2700-1D
GSM

Course SO4204-9R
Network technology client integration

Course SO4204-9Q
Network technology TCP/IP

Course SO4204-6Q
Applied DSP

Course SO4204-6P
Digital signal processing

Course SO4204-9S
Data acquisition with RFID

Course SO4204-9L
Modem methods ASK, FSK, PSK

Course SO4204-9M
Analog modulation AM, DSB, SSB, FM

Course SO4204-9V
Waveguide components

Course SO4204-9E
Fibre-optic waveguides

Course SO4204-9Y
Microstrip lines

Course SO4204-9U
Microwave technology

Course SO4204-5M
Operational amplifiers

Course SO4204-6F
A/D and D/A converters

More Than Just a Training System

The Communications Technology Laboratory is a Complete Solution

Animated presentation of complex training content using modern media

Practical technical expertise Telecommunications technology

Laboratory communication systems
with networked workstations

Microwave technology

Multimedia-based training and
education using UniTrain-I

Antenna technology

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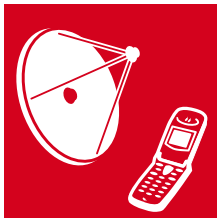
Basic Modules for Telecommunications Engineering



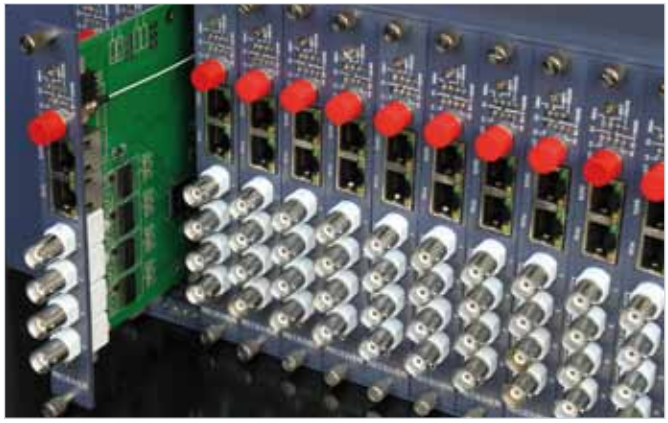
Basic Modules for Telecommunications Engineering

Basic Practice-oriented Know-how

A well-grounded training in the fundamentals of telecommunications is the prerequisite for understanding complex relationships found in various application areas. Our training systems are especially designed for the needs of practice-oriented training of both technicians and engineers. The fundamentals of telecommunications engineering are explored and graphically depicted using many examples, explanations, exercises and practical assignments.

Signal Processing and Conditioning
Modern signals in telecommunications technology consist of a broad spectrum of frequencies and are often subject to noise. In order to be able to recover the information from the signal, it has to be processed with filters and subsequently amplified.

Analog-digital and Digital-analog Conversion
Information transmission and processes normally take place in an analog world. The signals being transmitted and processed by modern telecommunications systems are for the most part digital. These systems need analog-digital and digital-analog converters to convert these signals.



Equipment Operates in a Reciprocal Context
More and more varied telecommunications equipment and modules are being used in ever more restricted space. This can lead to system interference and distortion.

Quadripoles and Filters

High-pass/Low-pass – Bandpass/Bandstop – Band Filters – Series and Parallel Resonant Circuits

In telecommunications technology, filter or filtering circuits are used in a wide range of applications in suppressing or attenuating frequency ranges in the signal. In expressing transfer response it is primarily the two quadripole parameters, transfer function and phase response, which are of interest.

Training contents

- Transfer function phase response and cut-off frequency
- Transfer function in the complex plane
- Transfer function, phase response and cut-off frequency of high- and low-pass filters with Bode plot
- Transfer function, bandwidth and medium frequency of band filters with Bode plot
- Resonant circuit: transfer function, bandwidth, determining quality and resonance frequency
- Analysis of resonant circuits with the aid of Bode diagrams
- Parallel resonant circuit with capacitance diode tuning

Electromagnetic Compatibility

EMC Models – Standards and Regulations – Coupling Mechanisms

Aspects of electromagnetic compatibility of a circuit play an important role in both circuit development and fault analysis. Most importantly this involves both coupling effects inside the circuit as well as interference, which can penetrate the circuit from outside or which emanates from the circuit itself.

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Training contents

- Introduction to EMC
- Basic terms and definitions
- EMC influence models
- Sources of distortion
- Standards and regulations
- Coupling mechanisms
- Remedial measures

Operational Amplifiers

Basic Circuitry – Precision Power Supply Sources – Active Filters

Operational amplifiers have come to play a significant role in analog electronics. As highly integrated and multi-functional components they constitute a critical component in electronics training.

Training contents

- Design and operation of operational amplifiers
- Circuit diagram and basic types of operational amplifier circuits
- Determination of the parameters and limiting values of an operational amplifier by means of measurement: frequency response, gain
- Investigation of typical analog computation circuits: adders, subtractors, integrators and differentiators
- Set-up and measurements on precision voltage sources and constant current sources
- Set-up and measurements on typical application circuits: impedance converter, precision rectifier, comparator and Schmitt trigger
- Investigation of active filter circuits
- Fault simulation

Converter Circuits

A/D and D/A Converters – f/U and U/f Converters

A/D and D/A converters form the interface between the real world and the world of digital data processing. They are deployed in almost every area of electrical engineering and electronics and thus have an important role in training and education.

Training contents

- Design and operation of D/A converters (R-2R network, weighted resistors)
- Static and dynamic recording of D/A converter characteristics
- Investigation of a D/A converter circuit of loudness control
- Design and operation of A/D converters (pulse-counting methods, dual-slope methods)
- Design and operation of U/f and f/U converters
- Measuring the internal signals and recording their characteristics
- Tuning the reference voltage for U/f and f/U converters
- Fault simulation


Ethernet
1000BASE-X SFP
ONLINE/OFFLINE
ACTIVITY
Link
PORT 3
Ethernet
1000BASE-X SFP
ONLINE/OFFLINE
ACTIVITY
Link
PORT 3
PORT 2

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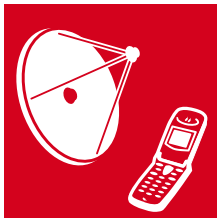
Transmission Lines



Transmission Lines

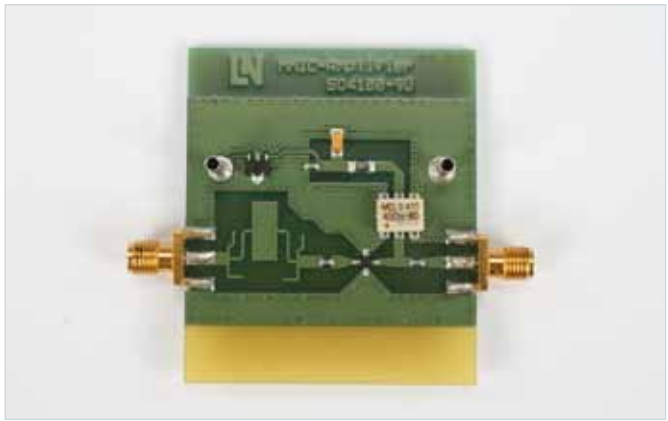
Are You Wired?

Transmission lines are the arteries of telecommunications systems. The technically appropriate design and the correct choice of components in a transmission line are paramount for the proper operation of the entire system. The functions and application areas of transmission lines are explored here with didactically adapted training systems using typical components as well as conventional cables and waveguide operating elements.

Copper Lines
Coaxial and four-wire lines are still very widely used and are often the best solution in terms of price for a transmission link. Our UniTrain-I course explores and explains what makes such transmission media so outstanding and in which applications optimum use can be made of them.

Optical Fibres
Ever-rising bandwidths and increasing clock frequencies require suitable transmission lines to be found. For these cases, clear preference goes to fibre-optic waveguides.

Radio Frequency Technology
The higher the frequency of a signal, the smaller the wavelength becomes and thus makes the deployment of conventional components and cables more complicated. Microstrip lines are being used more and more in efforts to pack integrated functionality onto the increasingly smaller spaces of printed circuit boards. Normally waveguides are used in order to convey signals of higher frequency at high power levels.



Four-wire Lines

Four-wire Lines – Backbone of Every Telecommunications Network – Quantities per Unit Length – Near and Crosstalk – Matching

The classic two- and four-wire line is still the most commonly used line for the connection and cabling of telecommunications networks. As a rule, be it an analog or a digital connection terminal, the last mile to the end user is a four-wire line.

Training contents

- Measuring the quantities of unit length at various frequencies using a measurement bridge
- Measuring pulse transit on the conductor pair as well the individual wires with respect to ground
- Demonstration of the pulse transmission or distortion in the case of faulty line termination
- Measuring the line's pulse reflection factor when the line has been incorrectly terminated

Coaxial Cables

Quantities per Unit Length – Characteristic Impedance – Matching – Reflections

By far the biggest volume of signal and data transmission goes via terrestrial media, i.e. via cables. In spite of relatively low technical complexity in comparison to wireless transmission, practical usage is still not free of problems which arise due to the wrong choice of cable materials or faulty matching at the coupling points.

Training contents

- Resistance, capacitance and inductance per unit length and characteristic impedance of a coaxial cable
- Determination of:
  - Resistance per unit length using a Wheatstone bridge
  - Capacitance per unit length using a Wien bridge
  - Inductance per unit length using a Maxwell bridge
  - Characteristic impedance of a coaxial cable
- Investigating reflections on a coaxial cable as a function of the line termination
- Terminating a line correctly so that no more reflections occur

Fibre-optic Waveguides

Optical Transmission Links – Fibre-optic Waveguides – Attenuations

The constantly expanding availability of information and data calls for ever-greater transmission rates. The result is that more and more fibre-optic transmission links are coming into use both in industrial applications as well as in communications engineering networks.

Training contents

- Principles of optical telecommunications
- Components used in optical telecommunications
- Advantages and disadvantages of optical transmission links
- Characteristics and frequency response of infra-red emitting diodes
- Modulation methods for analog and TTL signals
- Influence of different wavelengths on the transmission response
- Configuring a fibre-optic waveguide
- Influence of the receiver diode on signal recovery
- Determining the bandwidth of a fibre-optic transmission link
- Influence of the input capacitance on the bandwidth and the wavelength on attenuation
- Comparing properties of step index fibres and gradient index fibres

Microstrip Lines

From Outer Space to Your Cell Phone

The manufacture of integrated RF circuits on a semiconductor basis was only made possible by advances in microstrip technology. Planar waveguides have established themselves in a plethora of applications over the last two decades.

Training contents

- Design and operation of planar microstrip lines
  - Substrate materials
  - Calculation of line parameters
  - Line forms
  - Field distribution on the lines
- Microstrip components
  - Directional coupler and Wilkinson divider
  - Dispersion matrix
  - Standardisation
  - Recording the transfer function
- 90° and 180° hybrid coupler
  - Investigation of the transfer function
  - Measurement of the reflection factor
- Microstrip line filter
  - Low-pass of the 3rd and 5th order
  - Bandpass (edge-coupled filter)
  - Bandstop (butterfly element)
- Investigation of complex microstrip circuitry
  - Amplifier designed in MMIC technology
  - Low-noise FET amplifier

Microwave Technology

Simple to Operate Thanks to the Integrated Instrumentation

Whether it be radar technology, satellite technology or even in mobile radio, microwaves are critical to signal transmission. The signal feed to the transmission and receiving antenna is carried out for the most part using waveguides.

Training contents

- Line propagation theory and line parameters
- Gunn oscillator: recording the current-voltage characteristic
- Slotted lines
- Reflection, standing wave ratio and matching
- Measurement of wave propagation inside the waveguide, standing wave diagrams
- Waveguide dimensioning and operating frequency
- Shorting the waveguide termination, wavelengths
- Measuring the effects of dielectrics

Waveguide Components

Experimenting with Different Waveguide Components

To assemble the complex microwave circuits found in waveguide technology, special components such as couplers, circulators or multi-ports are required. Using these components the desired circuit function can be realised.

Training contents

- Become familiar with waveguide elements for changing direction: rotary coupling, E- and H-plane bends
- Determine the characteristic of a variable attenuator
- Design and operation of a waveguide phase shifter
- Measurement of the phase shift in the waveguide
- Measurement of the attenuation and insulation of a ferrite valve
- Measurement of the attenuation and reflection of cross-couplers, directional couplers and ferrite circulator
- Measurement of the insertion and coupling attenuation
- Modulation and demodulation of microwaves in waveguides
- Examining a PIN modulator by means of measuring instruments
- Line characterisation using the Smith chart
- Line matching using a slotted impedance adapter
- Investigating the microwave signal at the waveguide's open end

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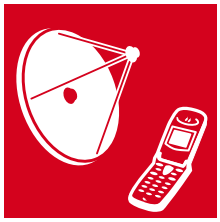
Modulation Methods and Multiplexing Technology



Modulation Methods and Multiplexing Technology

Analog and Digital Modulation – Coding – Time Division Multiplexing

Modulation methods and various types of signal coding form the basics of virtually every system in telecommunications. The most important of these are the digital forms of modulation. They have gone on to dominate a vast number of the most varied of areas – from wireless to radio transmission – satellite transmission or mobile radio.

Analog Modulation
Useful analog signals include, for example, voice, music or video signals. An essential property of analog modulation technologies is the continuity of the modulation both in terms of time as well as signal value. This is because analog modulation methods process the useful signal continuously, i.e. there is no digitisation of the transmitted signal into discrete values. Analog modulation methods can be broken down into two main groups: amplitude modulation and angle modulation (phase and frequency modulation or PM and FM)

Digital Modulation
Some digital modulation technologies correspond to their analog counterparts or have been derived therefrom. However, there are a multitude of digital modulation methods, which feature no direct analog equivalents, such as pulse width modulation, to name one example, which constitutes a special digital angle modulation and can be used to perform dynamic sampling of an analog signal.

Multiplexing
Multiplexing procedures are methods used in signal and message transmission in which several signals are bundled and transmitted simultaneously via a medium. The transmission media might take the form of a line, a cable or wireless link. Frequently, multiplexing methods are also combined to achieve even higher efficiency levels.

PAM / PCM / DELTA
Pulse Modulation Methods

PAM/PCM/Delta Modulation – Time Multiplexing – AMI/HDB3 Encoding

There are a host of benefits associated with the transmission of digital rather than analog data via communications channels. In addition to the higher quality and improved immunity to interference comes the added benefit of multiplexing several channels at once, which was a decisive advantage in getting this technique assimilated so quickly into telecommunications and signal transmission technologies.

Training contents

- Function of PAM/PCM/Delta modulation and time multiplexing methods
- Shannon's sampling theorem
- Signal curve measurements of PAM- and PCM-modulated signals
- Optimum filtering, anti-aliasing
- Quantisation of analog signals and determination of the quantisation interval
- Companding methods using A law and μ law; recording transmission characteristics
- Line codes: signal characteristic measurements of line-coded signals: AMI, HDB3 and modified AMI
- Clock signal recovery and phase jitter
- ISDN layer 1: investigating position and function in data frames and bits

PTM Pulse Modulation Methods

Pulse Width Modulation – Pulse Phase Modulation

In addition to pulse code modulation, pulse width modulation also plays a not insignificant role in transmission technology.

Training contents

- Principle of PWM modulation and demodulation
- Recording the signal characteristic at the output of the PWM modulator
- Investigating the output signal of the PWM demodulator and the influence of input signal's bandwidth
- Listing the advantages and disadvantages of PWM
- Become familiar with the principle of PPM modulation and PPM demodulation
- Recording the signal characteristic at the output of the PPM modulator
- Signal characteristic measurements of the demodulator's internal signals
- Listing the advantages and disadvantages of PPM

ASK / FSK / PSK Modem Methods

Amplitude Shift-keying – Frequency Shift-keying – Phase Shift-keying

When analog channels are utilised to transmit digital data, then this mostly involves performing so-called shift-keying on the sinusoidal carrier's parameters. This transmission method is standard for cable modems or telefax devices, but is also used in modern radio transmission methods.

Training contents

- Principle of ASK/FSK modulation for the transmission of digital signals via analog transmission lines
- Spectrum of an ASK-modulated signal
- Relationship between data transfer rates and required bandwidth
- Investigation of the spectrum of an FSK-modulated signal using measuring instruments
- Demodulation of FSK signals with the aid of a PLL loop
- Principle of PSK (DPSK) modulation, formation of a 2-PSK signal with different baud rates
- Principle of QPSK and DQPSK modulation
- Formation of Dibits
- Signal characteristic measurements at the output of the modulator and demodulator (ASK, FSK, (Q)PSK)

Modulation

Amplitude Modulation – Double-sideband Modulation DSB – Single-sideband Modulation SSB – Frequency Modulation

Thanks to their use in radio broadcasting, AM and FM modulation are by far the most widespread modulation methods for the radio transmission of audio signals.

Training contents

- Demonstrating the principle of amplitude modulation
- Recording the modulation trapezoidal at various modulation depths
- Demodulation of the signal: the diode detector
- Single-sideband modulation (SSB) and double-sideband modulation (DSB)
- Signal recovery using the integrated double balance mixer (SSB)
- Demonstrating the principle of FM modulation and demodulation
- Explanation of the terms "instantaneous frequency", "frequency deviation" and "modulation index" on the basis of the modulation signal
- Effect of LF amplitude and LF frequency
- Recovery of a modulation signal with the phase demodulator

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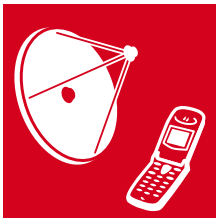
Transmission and Receiving Technology



Transmission and Receiving Technology

Transmitters and Receivers for Wireless Transmission Links – Complex Antenna Systems – RFID Technology

Radio transmission links are playing an ever-greater role in modern telecommunications. With mobile radio's coverage having spread across the entire globe during the Nineties, wireless communication to mobile terminal devices has become the biggest challenge of all in the telecommunications industry. Here, the huge increase in the number of users, and data volumes as well as ever-growing number of new applications such as RFID or Bluetooth demand highly efficient transmission and receiving systems to guarantee reliable and secure data transmission. Accordingly, adaptive antennas which point their signals in the direction of their users are indispensable for the interference-free operation of modern broadband wireless networks.

Antenna Technology
Wherever signals are transmitted without a line, then in the broadest sense we are talking about wireless transmission links. Accordingly, this is a transmission form in which the signal propagates to us freely through the surrounding space without having to use a line or cable. This requires special technical equipment that first radiates the desired signal into space and equipment that receives it from free space and ultimately converts it into a line-bound signal.

AM Transmission and Receiving Technology
Although it is primarily digital modulation methods which predominate today, an understanding of how classic analog transmission and receiving technology works provides a solid footing for entry into the complex modern world of communications engineering.

RFID
Nowadays, RFID applications are encountered almost every day: electronic article surveillance in department stores, door security in buildings, animal ID using transponder implants under the skin or electronic immobilisers in motor vehicles are just some examples of RFID system applications.

Antenna Technology

Three Frequency Variations Permit Simultaneous Operation of Several Workstations

Day-to-day existence without radio transmission lines and their associated antennas is inconceivable, ranging from radio and mobile telephony through to satellite navigation or air-space tracking. The three different frequency variants available for the simultaneous operation of several workstations lie between 8.5 and 9.5 GHz.

UniTrain SYSTEM

Training contents

- Antenna types and examples
- Physics of signal beams and reception
- Antenna impedance as well as matching
- Symmetry (Balun)
- Radiation characteristic in the near and far fields
- Formation of directional gain diagrams
- Measurement of directional gain diagrams of various antennas
- Investigation of:
  - Monopole and dipole antennas
  - Yagi antennas
  - Helix antennas
  - Patch and microstrip antennas

Antenna Rotary Platform with Wireless Transmission Link

There are three different frequency variants available between 8.5 and 9.5 GHz for the simultaneous operation of several work-stations in a single room.

Yagi

Yagi

Dipole

Helix

Linear patch

Folded dipole

Monopole

Circular patch

Complex Antenna Systems

Investigation of the Properties of Professional Antennas

This antenna technology course focuses our deliberations on the parameters and attributes of antennas, their properties as well as measurement configurations up to and including the recording of their directional gain characteristics.

Training contents

- Investigating how various antennas work
- Measurement of the directional gain diagrams of various antennas
- Distant field conditions
- Parabola reflectors
- Primary radiators
- Antenna arrays
- Phase relations in array antennas
- Reflections in radio transmission links
- Secondary radiation
- Passive radar transponder, Lüneberg lens

Broadband Measurement Interface and Professional Antennas

X-band measurement interface

Interactive "Complex Antenna Systems" course

Horn antenna, 20 dB

Horn antenna, 15 dB

Horn antenna, 10 dB

Passive radar transponder (Lüneberg lens)

Reflection disc

Microstrip antenna

Parabola antenna

Dielectric antenna

Helix antennas

Configurable slotted antenna

Patch antennas

Transmission and Receiving Technology

Oscillators – Modulators and Modulation Depth – Transmitters – Superheterodyne Receivers

Transmitters and receivers for radio transmission links continue to play a dominant role in communications engineering. This is equally true for both traditional radio transmission as well as for modern wireless transmission methods.

Training contents

- Design and operation of high-frequency oscillators: Hartley and Colpitts oscillators
- Investigation of oscillation condition (self-excitation)
- Design and investigation of an AM transmitter and receiver
- Tuned radio frequency receivers and superhet receivers
- Automatic gain control (AGC) and automatic frequency correction (AFC)
- Investigation of a phase discriminator
- Image selection (far-off selection) and close-in selection
- Determination of the image frequency in superhet receivers
- Investigating filter curves of RF input stages and IF amplifiers
- Design of a medium-wave AM single-stage superhet with full-range tuning

RFID

Non-contact Data Acquisition

Today RFID technology is being deployed in more and more systems and application areas. This technology permits the transfer of data to the most diverse objects without the need for physical contact.

Training contents

- Survey of RFID technology
- System components and variants
- Transformer principle
- Electrical resonant circuit
- Power link and range
- Auxiliary carrier modulation
- ISO 15693 standard
- Data encoding and transmission
- Standard commands
- Application potential


VIDEO OUT
Pb
DIGITA
OUT
Y
COMPONENT
Pr

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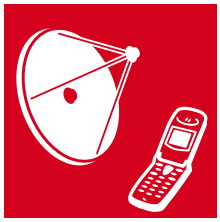
Digital Signal Processing



Digital Signal Processing

Signal Detection, Processing, Reproduction

The digital transmission of information has the advantage of being less sensitive to interference and information losses. Since the generation and storage of information is increasingly being performed digitally, there is an added advantage in that analog signal conversion can be omitted. This technology is being used more and more today for example in the broadcast of television signals, in digital radio and telephony.

Fourier Transformation
Fourier transformation is used to compute the frequency spectrum for dynamic signals such as voice or voltage characteristics. Signal analysis with the aid of a spectrum analyser is often based on this operation.

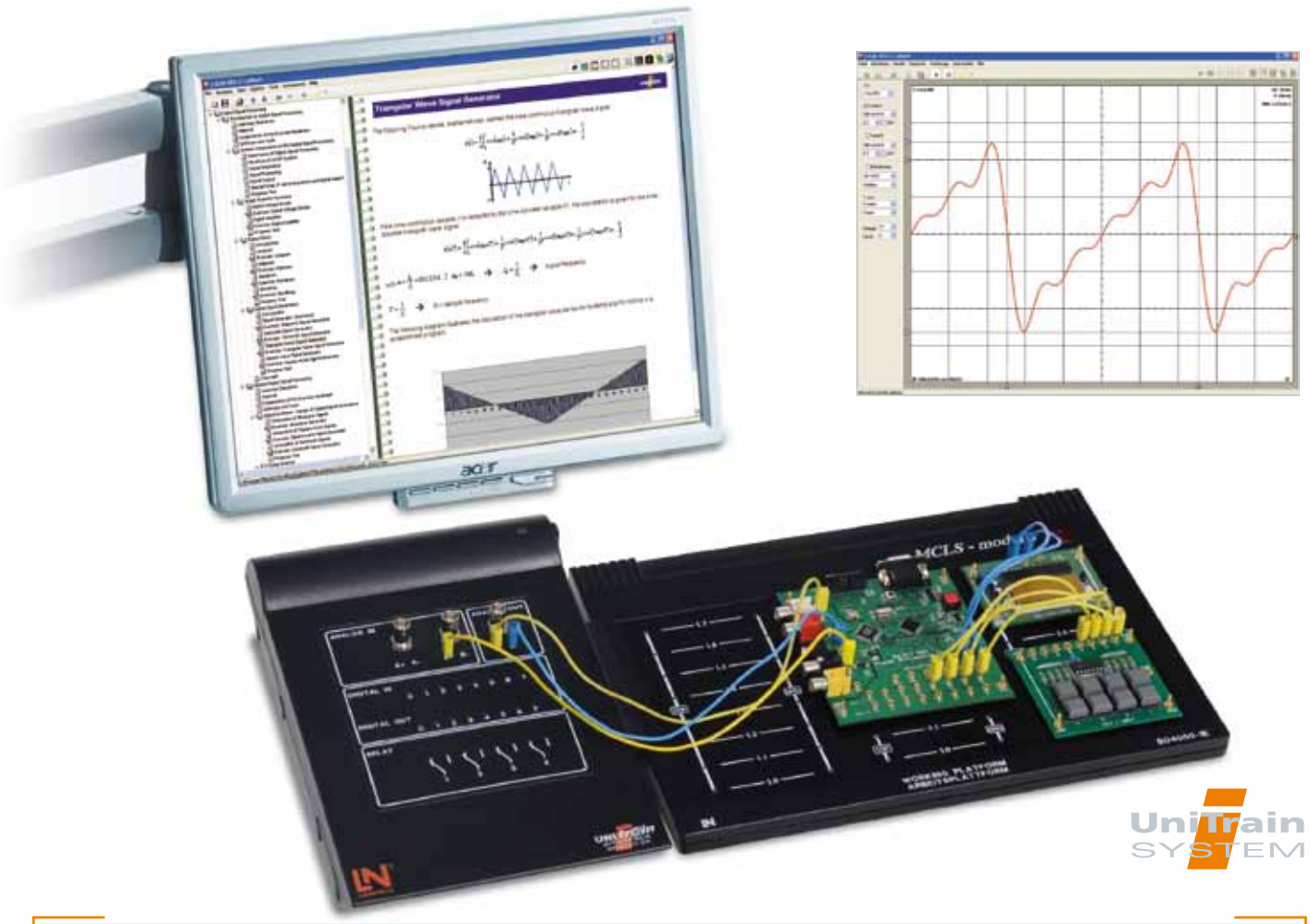
Digital Filters
Through signal processing involving digital filters, a level of flexibility is achieved that is not possible with analog filtering techniques. This flexibility is rooted in the fact that the filter is determined by a set of data which can be varied relatively easily. As such the desired filter type can be modelled without even changing the hardware.

Training Systems
Thanks to the modular design and the use of modern microcontrollers, our training systems are extremely flexible and permit a large host of interesting experiments to be conducted on the topic of signal processing.

Digital Signal Processing

System Components – LZI Systems – FIR and IIR Filters – Digital Signal Generation

Made possible by ever more powerful and faster microprocessors, digital signal processing of audio and video signals is gaining in significance. Methods of data reduction, filtering, signal generation as well as signal manipulation are common applications.



Training contents

- Design and operation of a DSP system
- Discrete transfer function
- Digital voltage divider and digital amplifier
- LZI systems
- FIR and IIR filters
- Digital signal generators
- Influence of algorithms on signal shape

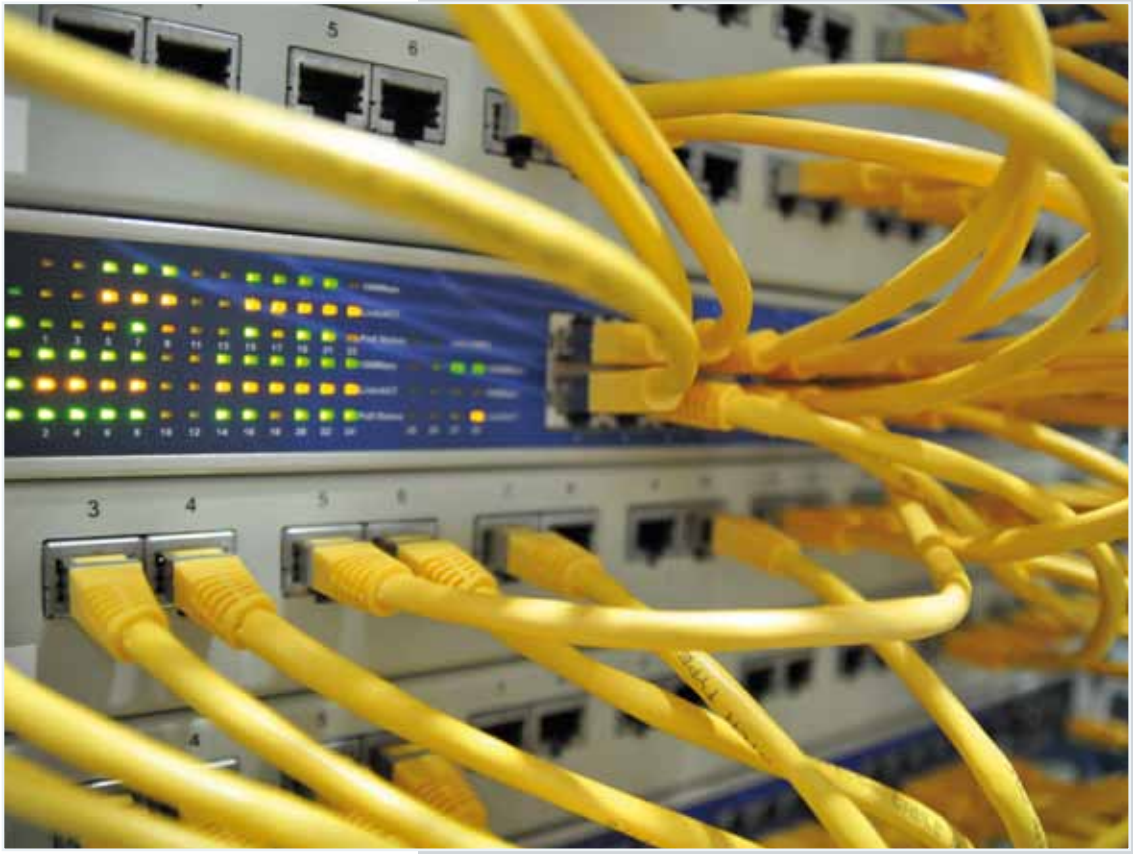
Applied Digital Signal Processing

Fourier Transformation – Signal Synthesis – Signal Processing – DSP Applications

Thanks to digital signal processing and with the aid of simple algorithms it is possible to determine the characteristics of filters and sound or image effects in a very selective manner. Suitable software tools permit cost-effective and flexible circuit development.

Training contents

- Synthesis of periodic signals using DSP systems
- Discrete Fourier transformation, Fast Fourier Transformation (FFT)
- Recursive and non-recursive LZI systems
- Methods of designing digital filters with different characteristics
- Sound effects



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Network Technology

Network Technology

Network Structures – Addressing – Protocols

The advantages of a network are the virtually unlimited communication, data exchange and messaging between the participants, centralised administration as well as the possibility to jointly access resources and data. Just how computer networks are assembled is shown step by step in our UniTrain-I courses.

Mini Network
To network two computers you only need a crossover cable. In order to configure a mini-network like this it is imperative to know what an IP address is, a sub-network mask and a gateway. If more than two computers are to be networked, an additional Ethernet switch comes into play.

Tabletop Server-Client System
The client-server model describes the possibility of distributing tasks and services within a network. The tasks are performed by programs, which are subdivided into clients and servers. For many reasons it is the so-called dedicated server model that is used most in practice.

Integrated Web Server
A web server is a computer which transmits documents to clients such as a web browser for example. Web servers are deployed locally, in company networks and primarily as WWW service in the internet. Documents can thus be created locally according to the purpose at hand and then made available inside the company and worldwide.

TCP/IP Network Technology

Ethernet – Network Structures – Protocols – Addressing

The triumph of the internet is thanks first and foremost to the associated transmission protocols and their pre-eminent importance for network technology. Without them computer networks simply do not work.

Training contents

- Network standards and the differences between LAN, MAN, WAN, GAN, OSI layered models
- Network interfaces and their tasks
- Network structures: Ethernet, TokenRing, TokenBus
- Assembly and individual components of an Ethernet network
- Principle of addressing (MAC addresses) in the local network
- Design and testing of a computer network in client-server and peer-to-peer configuration
- Become familiar with TCP/IP internet protocol family
- Addressing the IP, changing the network addresses of a computer
- Design of a sub-network with the aid of a sub-network mask
- Integration of several courses in an existing LAN possible

Network Technology Client-Integration

Network Connection – Configuration – Network Services

Today virtually every single computer is networked. Consequently, to connect up a new computer also means integrating it into a network and setting up interfaces and services.

Training contents

- Integration of a network adapter into a PC
- Line-side connection, cable
- OSI-layer 1, Manchester code
- Configuration of the network adapter (hardware) into the Windows XP operating system
- Configuration of the network interface and the corresponding drivers
- Integration into an existing network
- Utilising tools to test operation
- DHCP
- Name resolution in Windows networks (Host file, LMHOST file, WINS)
- Use of services (http, ftp)
- Creating releases

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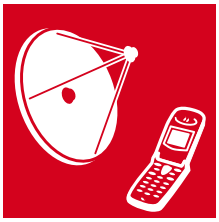
Voice over IP

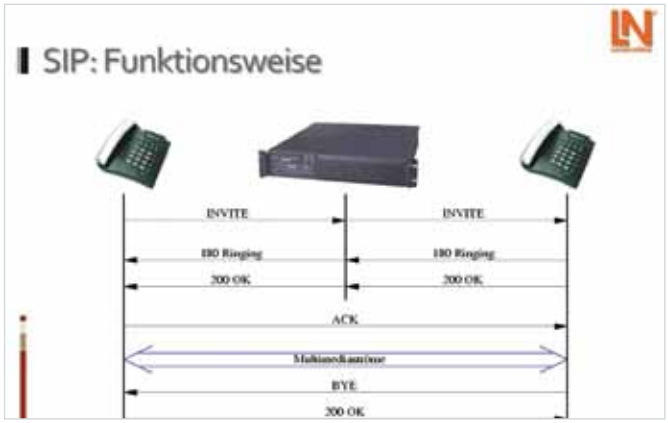


Voice over IP

Protocol – Codecs – Security

The internet has successfully attained the status of the "people's network". The idea to exploit it for telephony did not have long to wait. The result – Internet Protocol Telephony or Voice over IP – is a technology which permits the realisation of telephone service on IP infrastructure so that it can replace conventional telephone technology.

Smooth migration to VoIP
The existing analog and ISDN infrastructure can now be replaced by VoIP technology. In the transition phase it is possible for the two systems to coexist and frequently this is even preferred by customers for economic reasons.



Virtual soft telecom system
The VoIP telecom system is made available in the form of a "cage" by the virtualisation software, i.e. it is independent of any operating system and absolutely secure, and immune to wear and tear. And if a problem arises it can immediately be restored to its original condition.

Measurements and fault diagnosis
Both software tools as well as genuine diagnostic and measuring instruments are used for trouble-shooting, each permitting detailed information to be collected about events occurring inside the network.

Voice over IP

Faster and More Secure Introduction to VoIP

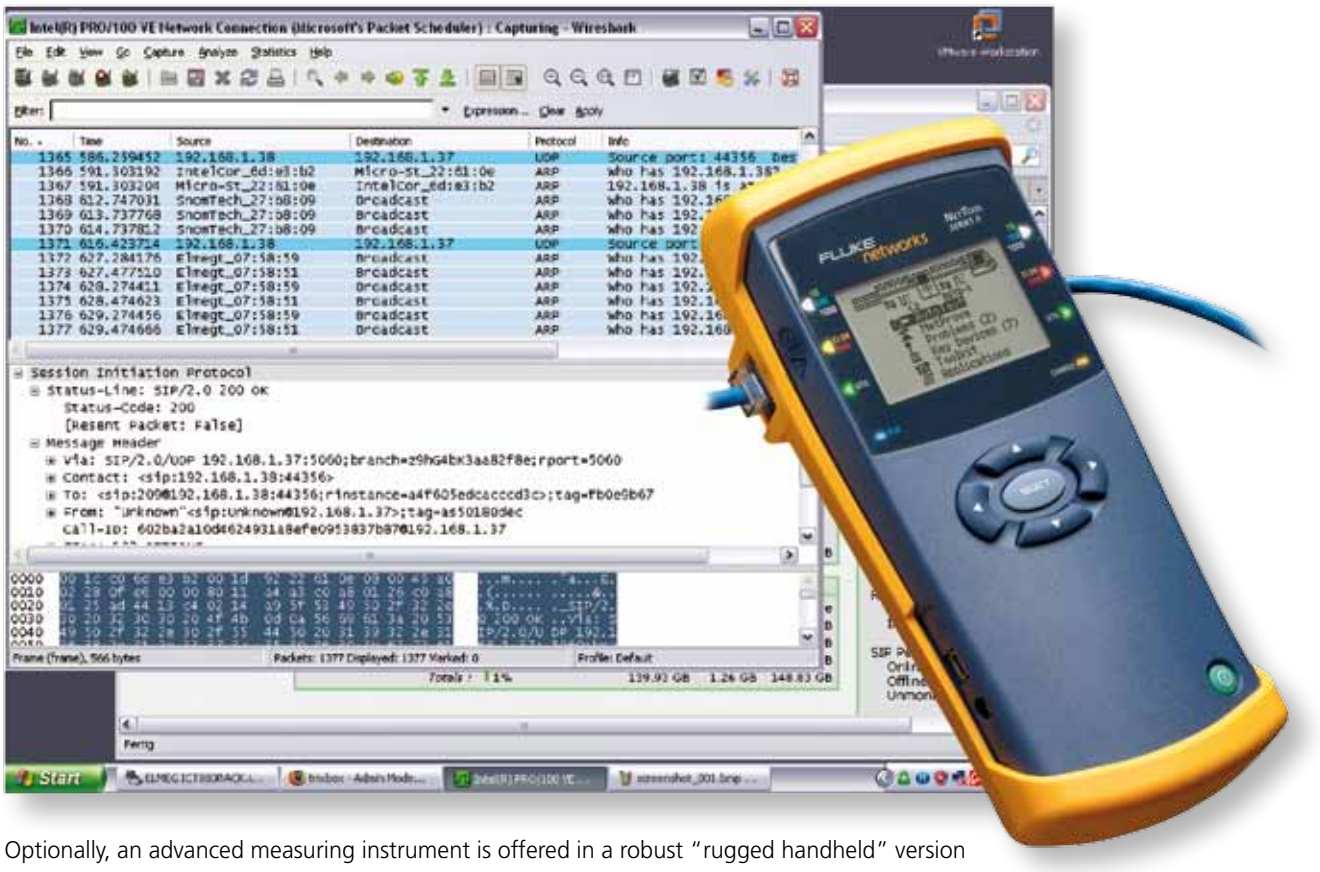
The internet made it possible – the convergence of modern telecommunications networks with data transmission networks. The product of this is VoIP – next generation telephony – a packet-switching service based on TCP IP.

Training contents

- TCP/IP
- Visualisation 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
- Investigating data packets

Measurements and Fault Diagnosis in a VoIP Network

In this course, all investigations involving protocols as well as diagnosis and trouble-shooting are performed with the aid of several software tools. They make it possible to trace in great detail what happens in the network during the connecting phase, connection in-place phase and disconnection phase of a VoIP call, including the editing and in-depth analysis of the data packets being exchanged.



Optionally, an advanced measuring instrument is offered in a robust "rugged handheld" version which makes the day-to-day work of a network technician considerably more comfortable.

Training contents

- SIP packet structure
- RTP design and operation
- Diagnosis and trouble-shooting with software tools
- Diagnosis and trouble-shooting with the network analyser
- VoIP security

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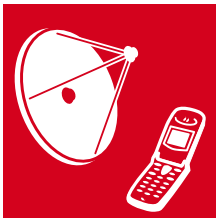
Technical Practice in Telecommunications Technology



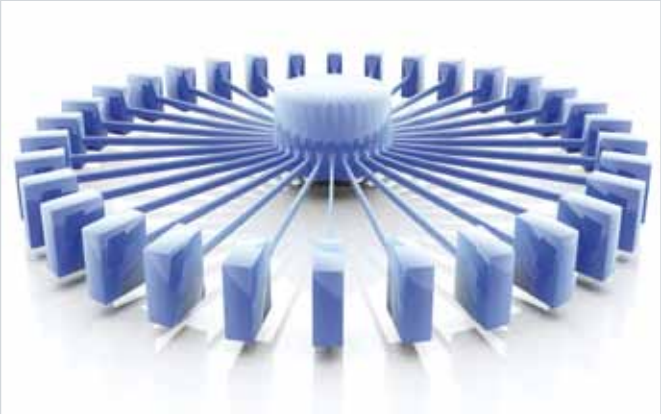
Technical Practice in Telecommunications Technology

Planning – Installation – Configuration – Customer Handover

Whether it be POTS, ISDN or an Ethernet network with VoIP, you can decide for yourself! What would you prefer? Copper, fibre-optics, WLAN? We can satisfy your heart's desire, no matter what it is. This is where you put into actual practice the fundamentals learned using the UniTrain courses.

Virtualisation

The primary objective here is to make an abstraction level available to the user, which isolates him/her from the actual hardware, computer power and memory. A logical layer is introduced between the user and the resources in order to conceal the physical realities of the hardware. In the process each user has the impression that he/she is the sole user of a resource. Several hardware resources are merged into a homogeneous platform.



Network convergence

By network convergence we mean the dissolution of single, individually separated networks into a larger system which takes over their tasks. Network convergence can be observed for example in telephony: classic telephone networks are increasingly being dissolved into so-called Next Generation Networks or Voice over IP networks.

Bridgelink

Laying cables is the most conventional method of connecting and networking computers and their peripheries – but this is frequently not the most economical and certainly not the most flexible solution. Particularly when offices are spread across several buildings or an external warehouse is being operated. In this case cable-bound networks are time-consuming to implement and consequently not economically viable.

Technical Practice in Telephony

Customer Order: Install Analog and Digital Telephone Technology in the SOHO Applications Area

In this series of experiments the modular and the TAE-system are described and explored. Learning how the system components operate and how to perform installation is covered in the form of practical experiments. The experiments are based on typical cases found in the context of a customised installation. They follow the standard three-stage process, i.e. customer requirements – installation proposal – implementation.

Training contents

- Planning a SOHO telecom system
- Installation and configuration of ISDN devices
- Installation and configuration of POTS devices
- Installation and configuration of VoIP devices
- Installation of intercom systems

Technical Practice on Networks

Customer Order:
Installation of a CAT5 Network

The content of this practice-oriented project is the learning of practical skills needed to install networks. This includes selecting the right components, materials and tools for the installation as well as acquiring knowledge of the topology to be implemented.

A focal point is the selection and operation of both straightforward as well as more complex testing instruments for checking functionality and performing fault finding in the communication system.

Training contents

- Components used for network installation
- Cables, plugs and sockets, design, deployment and function
- Use of general tools and measuring instruments needed for installation
- Network topology and importance for practical use of equipment

WLAN SOHO Trainer

Customer Order:
Installation of a WLAN Network

The content of this practice-oriented project is training practical skills in the installation and security of wireless networks.

This includes selecting the correct components, materials and tools for the installation as well as acquiring knowledge of the encryption to be implemented. A focal point here is the selection and operation both of simple as well as more sophisticated testing instruments to check the functionality and carry out trouble-shooting in the communications system.

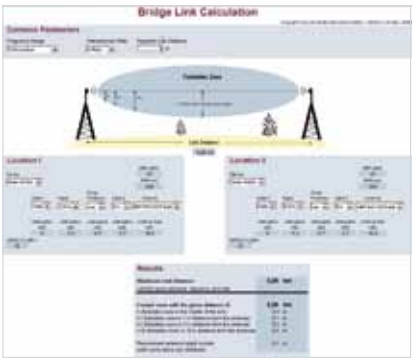
Training contents

- Installation of network components
- Configuration of the WLAN router
- Use of general tools and measuring instruments used for installation
- Network topology and importance for practical use of equipment

WLAN Bridgelink Radio Trainer

Customer Order:
Network Several Company Locations

With all new 802.11n technology the advantages of higher data transfer rates or greater distances can be exploited also for bridge-links, simply by having two data streams transmitted separately. To do this you need to use – in addition to N-Access Points – dual-polarising antennas, which can transmit two separate partial streams from one location to another.



Training contents

- Planning
- Calculating maximum radio bridge lengths, Fresnel zone and determining antenna height
- Installation of network components
- Configuration of WLAN routers
- Use of standard tools and measuring instruments for installation
- Network topology and importance for practical use of equipment

VoIP/ISDN/POTS Monolith Trainer

Customer Order:
Migration from a Conventional Telecom System to VoIP

This training system allows your telecommunications technology to be integrated perfectly into your training laboratory. Two different approaches are possible: set up a VoIP telecom system with only an Ethernet infrastructure or continue using the existing ISDN or POTS infrastructure with smooth migration to VoIP technology.

Also available as "Modular" single equipment set

Your benefits

- Customer order: Planning and installation of entire company infrastructure
  - Put a VoIP telecom system into operation with up to 5 extension lines
  - Installation and configuration of additional modules
- Automatic call answering machine, IVR, CLIP, CLIR, Music-on-Hold, conferencing etc.
  - Installation and configuration of VoIP terminal devices
  - Handover and introduction
- Customer order: Planning, installation of a VoIP telecom system for several decentralised locations
- Assembly project: install a network with several telecom systems
- Customer order: Put a conventional telecom system into operation
  - Installation of an ISDN network with up to 32 subscribers
  - Installation of an analog network with up to 16 subscribers
- Customer order: Migration of analog and ISDN telephone system to VoIP
- Up to 14 groups (virtual VoIP telecom systems) can carry out projects simultaneously on this system

VoIP/ISDN/POTS Modular Trainer

Dual Heart of the Monolith

VoIP "Multimaster" Trainer

Your benefits

- A perfect solution for equipping your instruction room with next-generation telecommunications services
- Seamless integration into the existing infrastructure
- Several virtual telecom systems operate simultaneously in parallel mode and can be networked with each other
- Each student group receives its "own" VoIP telecom system for experimenting

ISDN/POTS Trainer with VoIP Gateway

Your benefits

- Conventional telecom system in robust 19" model
- Makes experimenting possible with VoIP, ISDN and analog technology
- System supports ICT
- Can be integrated with the VoIP Multimaster Trainer

Decisive Product Benefits

… Ensure Long-term Customer Satisfaction

Vladimir I. Schepelew, Director of the State College in Moscow:

"The training systems from Lucas-Nülle play an important role in the training and educational activities of our college.

Both the faculty as well as our students appreciate the technical detail of the LabSoft courses and the elegant way in which it integrates the control and measurement interface of UniTrain-I.

Among other things, we are currently using a series of courses on the subject of microwave technology. With the aid of the multimedia-based teaching and training platform, we are providing instruction on the basics of analog and digital modulation, antenna systems and signal processing.

Apart from the system's high quality level, both in didactic and technical terms, they are also attractive because of their reliability and realistic measurement accuracy. For us it is a great advantage that the systems are also designed to be compact and flexible.

The software as well as the hardware components consist of modules that are connectible and interchangeable, and it has been our experience that they also incorporate state-of-the-art technology. Our students are therefore able to get a taste of industrial areas of application.

Thanks to these positives we opted for the Lucas-Nülle training systems, which in actual day-to-day practice never cease to prove that we really made the right decision."

The Whole is Greater than the Sum of its Parts

Individual Consultation with Lucas-Nülle

Do you require detailed advice or a specific quotation?

You can contact us as follows:

Phone: +49 2273 567-0

Fax: +49 2273 567-39

Lucas-Nülle is a byword for customized vocational training systems in the following areas:

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Power Electronics, Electrical Machines, Drive Technology


Electrical and Electronic Circuits


Communications Technology

Process Control


Electropneumatics, Hydraulics


Instrumentation


Microcontrollers


Automation Technology


Automotive Engineering


Lab Systems

Simply contact us for details. Our employees will be happy to advise you.

Lucas-Nülle training systems meet the highest safety and quality standards. Changes in areas like environmental protection, customer benefits, design and construction entail corresponding advancements to systems or components. This can lead to discrepancies between product details and relevant items in the scope of delivery.

Further information on our products can also be found at:

www.lucas-nuelle.com

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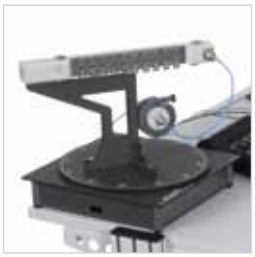

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Ref. No.: P5151 – Communications Technology – 12/10-1GB (Printed in Germany) – Subject to technical alterations.