FACULTY OF ELECTRICAL
ENGINEERING
UNIVERSITY OF WEST BOHEMIA

RICE

RESEARCH AND DEVELOPMENT INSTRUMENTAL EQUIPMENT SERVICE OFFER

Faculty of Electrical
Engineering
University of West Bohemia

Regional Innovation Centre
for Electrical engineering

NEW IDEAS
NEW CHALLENGES

NOVÉ MYŠLENKY
NOVÉ VÝZVY

University of West Bohemia

Faculty of Electrical Engineering

THE HISTORY OF THE FACULTY OF ELECTRICAL ENGINEERING

The original Institute of Technology was founded in Plzeň in the autumn of 1949 as part of the Czech Technical University in Prague. In 1950 it obtained the status of an independent faculty and in 1953, as the College of Mechanical and Electrical Engineering (VŠSE), it embarked on a period of rapid growth. At that time, to answer the demands of the regional industrial development, the Department of Electrical Engineering was formed.

Since 1960, the Institute of Mechanical and Electrical Engineering consisted of two faculties: the Faculty of Mechanical Engineering and the Faculty of Electrical Engineering (FEE). In the early 1960s, FEE embraced modern technological disciplines such as power engineering, electronics and computers.

Since 28 September 1991, the foundation date of the University of West Bohemia, the Faculty of Electrical Engineering has been one of its key parts. At present FEE comprises five departments and one research centre: Department of Applied Electronics and Telecommunication (KAE), Department of Electrical Power Engineering and Environmental Engineering (KEE), Department of Technologies and Measurement (KET), Department of Electromechanics and Power Electronics (KEV), Department of Theory of Electrical Engineering (KTE), and Regional Innovation Centre for Electrical Engineering.

Regarding educational activities, the faculty provides university-level education in bachelor, master and doctoral study programmes.

In the field of research, development and innovation, the faculty has been engaged in a wide range of basic and applied research projects. The faculty staff have gained valuable experience from solving various national and international grant projects as well as contracted research projects. Special attention is being paid to the practical outputs of the scientific activities, to the ability to apply the research and development results in specific industrial and commercial projects.

THE INNOVATION CENTRE RICE

The origin of RICE (the Regional Innovation Centre for Electrical Engineering) can be attributed to the Faculty of Electrical Engineering as part of the University of West Bohemia, their long-term business relationships with important commercial partners, the faculty staff experience in research and development activities and the financial support from the Operational Program Research and Development for Innovation. The RICE laboratories today are equipped with cutting-edge equipment and unique technologies.

The equipment installed in the largest laboratory makes it possible to test electric vehicles and equipment with rated voltage up to 31kV and rated power up to 4MW. ABB UNIGEAR Digital switchboards and General Electric MV6000 high-voltage inverters have a world premiere there in a fully recuperative design. Available to RICE research teams also are other highly specialised test room equipment and infrastructure such as power electronic and intelligent drive laboratories, special microscope laboratories, clean rooms, X-ray diagnostic laboratories and microelectronic laboratories intended to support work on challenging space research projects.

As part of FEE, the centre organises national and international conferences, lectures and seminars.

In a few years of its existence, RICE have achieved a lot of outstanding results. These include several national and European patents, awards from international conferences and exhibitions, and articles published in leading scientific and technological journals. In collaboration with industrial partners, the RICE staff have developed commercially successful products such as the REMCS modular control system, pixel detectors or smart firefighter suits and gloves.

The RICE research teams have established working relationships with leading international organisations, research centres and universities, and work on joint projects with major commercial entities.

The centre co-operation activities come off in a wide range of international and national projects, contracted research, student or doctoral theses.

RICE primarily focus on the following research areas:

- New drive concepts and sophisticated technologies for latest-generation transportation systems
- Material research primarily focused on organic-based electronics, smart sensors and multi-sensor systems
- Control systems for transport and power engineering, and complex systems for automated testing of equipment functionality and reliability
- New facilities and technologies to increase the efficiency of electricity and heat generation, raw material extraction and industrial technologies, and the development of advanced nuclear power technologies
- Development of advanced nuclear technologies including, for example, special detectors used in nuclear power engineering and space research
- System diagnostics and identification - research and development of new diagnostic methods and procedures and sophisticated testing systems
- Mathematical modelling and computations of complex physical processes, research and development of new methods of solving physical fields and their interactions

CONTENT

FACULTY OF ELECTRICAL
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HALL LABORATORY FOR TESTING HIGH VOLTAGE ELECTRONIC AND TRANSPORT SYSTEMS

The Power Electronics and Drives team use this unique laboratory to test equipment with rated parameters up to 31kV and 4MW. The activities of this team are focused on development of new drive concepts and sophisticated technologies for latest-generation transport systems, and on research of new equipment and technologies for increasing efficiency and optimising the power and heat generation processes, raw material extraction and industrial technologies. The Hall Laboratory facilities make possible measurements and testing of high voltage electrical equipment, research and diagnostics in the area of partial discharges, or the study of the effects of electrical equipment operation on the condition of the power supply network.

The laboratory has been designed as a compact unit with individual workplaces adjustable to suit the demands of specific research and development projects. These comprise R&D and testing (including accredited tests) of power converters, power drives, electric machines and systems for transport technology, electricity and heat generation processes and mining technology (especially experimental research on high-voltage semiconductor converters and drives). Part of the laboratory premises is equipped with wall partitions allowing to change the size and position of the experimental stands. The air-conditioning system provides for removal of the dissipated heat and exhaust fumes, while control and safety systems ensure undisturbed operation of various laboratory equipment.

The laboratory technology consists of equipment, devices and complete systems intended to facilitate a wide range of experimental and testing activities. There are, among other equipment, separate high and low voltage distribution systems, independent power sources, air conditioning and cooling systems, load semiconductor converters, electric machines and machine sets, and sophisticated control systems.

HALL LABORATORY SERVICES



POWER ELECTRONICS AND DRIVES

SERVICES

- Research, development, experimental, prototype and production tests of power semiconductor equipment, converters, electric machines, drives and mechatronic systems
- Rated DUT power up to 4MW
- Maximum dissipated heat (power loss) 500kW
- Tests of hybrid electric devices with combustion engines of rated power up to 500kW
- Electric motor and converter diagnostics
- Measurements and tests of the effects of electrical equipment operation on the power grid

EQUIPMENT

- Traction catenaries:
  — AC 25kV / 50 / 60 Hz (max. voltage 31.5kV)
  — AC 15kV / 16.7Hz (max. voltage 19kV)
  — DC 600V and 750V (max. voltage 1,250V)
  — DC 1.5kV and 3kV (max. voltage 5.5kV)
- 3-phase power supply systems with fixed voltage and frequency:
  — 22kV / 50Hz, 10kV / 50Hz, 6kV / 50Hz, 3kV / 50Hz, 690V / 50Hz, 400V / 50Hz
- Programmable power supplies:
  — AC 0 to 11.5kV / 40 to 120Hz,
  — AC 0 to 690V / 0 to 120Hz
  — DC 0 to 15kV
- 2 middle-voltage test beds, reconfigurable low-voltage test area up to 4 test beds
- Middle-voltage and low-voltage pits with loading motors (IM, PMSM)
- High-speed high-precision measurements (50µs sampling rate)
- IR cameras with event trigger capability
- Direct torque measurement on motors up to 20kN
- High-grade instrumentation - scopes, analysers, loggers, power meters and other devices
- Crane with loading capacity 12,500kg

CONTACT

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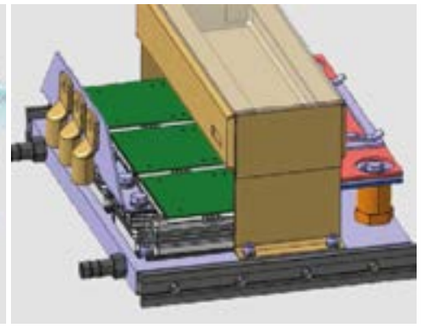
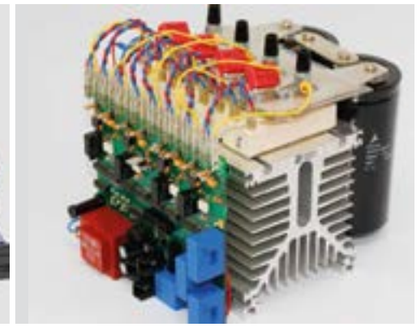
DESIGN OF SEMICONDUCTOR POWER CONVERTERS

POWER ELECTRONICS AND DRIVES

SERVICES

- Specific design areas regarding semiconductor power converters (topology, semiconductor component selection, driver circuits, control algorithms, measurement of electrical quantities)
- Modelling, simulation and testing of equipment of rated parameters up to 31kV / 4MW
- Design of DC/DC converters, voltage and current source converters, medium voltage and other types of converter
- New generation of power supply and charging systems, energy storage and uninterruptible power supply systems
- Wireless power transfer research
- Parallel and serial connections of converters
- Design of converters with IGBT, IGCT and MOSFET power components
- Experimental development of converters with new types of semiconductor such as SiC or GaN
- Development of converters for unconventional applications such as active filters, ground current compensation or photovoltaics
- EMC of semiconductor converters
- Consulting and counselling services in the field of semiconductor converters

EQUIPMENT

- *Instruments and devices*
  — power analysers ZIMMER LMG500, 8 channels
  — oscilloscopes Tektronix MSO4104B, Tektronix MDO3034 including voltage and current probes
  — electronic load AC/DC H&H ZSAC
- *Software*
  — Matlab, Simulink, Plecs, Dymola, DSpace, LabView, Code Composer, SolidWorks
- *Testing motor sets*
  — with IM 4 to 15kW, 1,500rpm and 3,000rpm
  — with WRSM 11kW, 1,500rpm
  — with PMSM 4 to 10kW, 1,500rpm and 3,000rpm
  — with IPMSM 4.5kW, 1,500rpm
  — with RSM 11kW, 1,500rpm
  — with DCM 5.8kW and 9.8kW, 1,580rpm and 1,470rpm
- *Power converters for motor sets intended for development and testing activities*
  — Sinamics S120 with AFE
  — SINAMICS DCM 6RA80 (420V, 60A)
  — ABB converter models ACS800 and ACS880 (up to 300kW)
  — universal 3f and 4f power converters
- *Power supply systems*
  — DC power supply 0 to 800V, 25kW and 50kW
  — Programmable AC+DC power supply Ametek MX30 and CSW5500
  — Auxiliary power supply equipment (see Hall laboratory)

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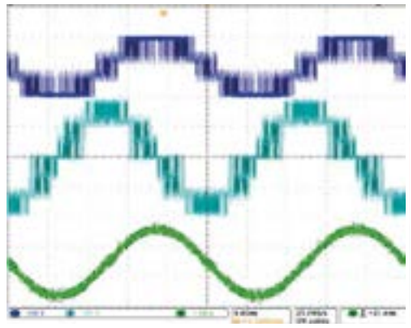
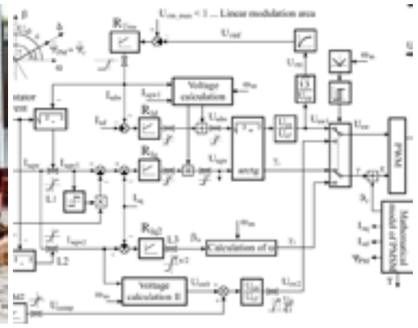
DEVELOPMENT OF TRANSPORT SYSTEMS





POWER ELECTRONICS AND DRIVES

SERVICES

- Consulting and counselling services regarding selection of the optimum electric drives for automotive, industrial, traction and power engineering applications
- Design of high-power range of drives (with rated power up to several MW)
- Simulation of steady-state and transient conditions of complex drive chains
- Development and design of standard and special control algorithms for electric drives
- Implementation of control algorithms within REMCS control systems or controllers based on DSP/FPGA/CPLD
- Design of drive diagnostic systems
- Construction of functional drive prototypes (of rated power up to several MW)
- Tests on electric drives under specific transient conditions and tests with loads up to 4MW
- Consulting and counselling services regarding newly developed or existing electric drives

EQUIPMENT

- Instruments and measuring devices
  — power analysers ZIMMER LMG500, 8 channels
  — oscilloscopes Tektronix MSO4104B and Tektronix MDO3034 including voltage and current probes
  — electronic load AC/DC H&H ZSAC
- Software
  — Matlab, Simulink, Plecs, Dymola, DSpace, LabView, Code Composer, SolidWorks
- Testing motor sets
  — with IM 4 to 15kW, 1,500rpm and 3,000rpm
  — with WRSM 11kW, 1,500rpm
  — with PMSM 4 to 10kW, 1,500rpm and 3,000rpm
  — with IPMSM 4.5kW, 1,500rpm
  — with RSM 11kW, 1,500rpm
  — with DCM 5.8kW and 9.8kW, 1,580rpm and 1,470rpm
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  — SINAMICS DCM 6RA80 (420V, 60A)
  — ABB converter models ACS800 and ACS880 (up to 300kW)
  — universal 3f and 4f power converters
- Power supply systems
  — DC power supply 0 to 800V, 25kW and 50kW
  — Programmable AC+DC power supply Ametek MX30 and CSW5500
  — Auxiliary power supply equipment see *Hall laboratory*

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DEVELOPMENT OF TRANSPORT SYSTEMS

POWER ELECTRONICS AND DRIVES

SERVICES

- Complete design of electric drives for transport systems
- Complete of power semiconductor converters for transport systems (topology, choice of semiconductor devices, excitation circuits, control algorithms, measurement of electrical quantities)
- Complete of control, electronic and communication systems for transport applications
- Modelling, simulation and prototyping of control, electricalelectric and mechatronic systems offor modern vehicles and transport systems
- Equipment development, modelling, simulation, and testing (rated parameters up to 31kV and 4MW)

EQUIPMENT

- Instruments and measuring devices
  — power analysers ZIMMER LMG500, 8 channels
  — oscilloscopes Tektronix MSO4104B and Tektronix MDO3034 including voltage and current probes
  — electronic load AC/DC H&H ZSAC
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DEVELOPMENT OF SEMICONDUCTOR POWER SYSTEMS FOR POWER GENERATION AND INDUSTRIAL APPLICATIONS

POWER ELECTRONICS AND DRIVES

SERVICES

- Research and development of electronic power systems and components for distribution networks, with special regard to medium-voltage applications
- Control of network power flow
- Protection devices installed in power distribution networks; especially new generation of devices for compensation of ground faults in isolated or reactance-grounded networks
- Electric energy quality control equipment (active filters, compensators)
- Development of hybrid medium-voltage equipment
- Research and development of electronic power systems and components for home-consumption at thermal power stations
- Research on electric drives and high-power converters
- Research on power semiconductors for renewable energy sources

EQUIPMENT

- Instruments and devices
  — power analysers ZIMMER LMG500, 8 channels
  — oscilloscopes Tektronix MSO4104B and Tektronix MDO3034 including voltage and current probes
  — electronic load AC/DC H&H ZSAC
- Software
  — Matlab, Simulink, Plecs, Dymola, DSpace, LabView, Code Composer, SolidWorks
- Testing motor sets
  — with IM 4 to 15kW, 1,500rpm and 3,000rpm
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  — with IPMSM 4.5kW, 1,500rpm
  — with RSM 11kW, 1,500rpm
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  — universal 3f and 4f power converters
- Power supply systems
  — DC power supply 0 to 800V, 25kW and 50kW
  — Programmable AC+DC power supply Ametek MX30 and CSW5500
  — Auxiliary power supply equipment

see *Hall laboratory*

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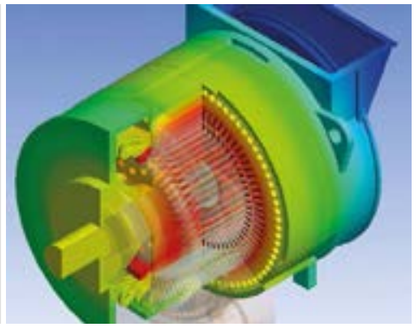
DESIGN, SIMULATION AND TESTING OF ELECTRIC MACHINES



POWER ELECTRONICS AND DRIVES

SERVICES

- Design of modern mechatronic systems; electromagnetic, thermal and ventilation analyses
- Design verification using Finite Element Method (FEM)
- Creation of 2D and 3D FE models
- Multiphysics simulations and modelling in ANSYS
- Type tests of mechatronic systems
- Measurements of motor torque, speed and loading characteristics
- Measurement of mechatronic system efficiency
- Mechatronic system transient state analyses
- Electric machine positioning and coupling
- Measurement of static and dynamic torques
- Torque ripple measurement
- Measurement of electric quantities at both transient and steady-state conditions
- Technical documentation and CAD drawings

EQUIPMENT

- Measurement and test equipment
  — synchronous generator 3x400V, 30, 50 and 90A
  — dynamo 0 to 230V, 58 and 95.5A
  —dynamo 0 to 440V, 68, 80 and 80A
  — autotransformer 3x(0 to 380V), 45A
  — phase-shifting transformer (booster) – 3x(30 to 600V), 30A
  —phase-shifting transformer (booster) – 3x(30 to 600V), 11A
  — dynamometer 500W to 30kW
  — torsion torque sensor 200Nm, 10,000rpm
- Software
  — ANSYS
  — Matlab
  — SolidWorks

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POWER SUPPLY GRID STATUS EMULATION



POWER ELECTRONICS AND DRIVES

SERVICES

- Research, development, measurement and test methods applied to equipment connected to the power grid
- Research, development, measurement and test methods applied to equipment connected to DC or AC traction power line
- Emulation of the behaviour of single and three-phase power supply systems
- Harmonic analysis of power supply voltage, detection of higher harmonics in the frequency spectrum
- Emulation of the grid defects or extraordinary operational conditions such as overvoltage, low voltage, shutdown/ failure on the line, frequency options, grid asymmetry and others

EQUIPMENT

- Power sources installed at the RICE laboratories
- California Instruments MX30
  - single- and three-phase outputs
  - output frequency range 16.2-400Hz
  - phase voltage 0 to 400V, phase-to-phase voltage 0 to 690V
  - output power up to 30kVA
  - DC and AC options
  - harmonic generator with up to 50 signal components (user defined signals)
  - regulation at output terminals for a constant power
- California Instruments CSW5550
  - single- and three-phase outputs
  - output frequency range 40 to 5,000Hz
  - phase voltage 0 to 230V, phase-to-phase voltage 0 to 400V
  - output power up to 5.5kVA
  - DC and AC options
  - harmonic generator with up to 50 signal components (user defined signals)
  - regulation at output terminals for a constant power

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DEVELOPMENT AND TESTING OF POWER SUPPLY AND CHARGER SYSTEMS



POWER ELECTRONICS AND DRIVES

SERVICES

- Device for limiting the power supplied to the system under test to approx. 1kW
- Measurement of static and dynamic parameters of linear and switching power supply systems
- Measurement of charging and discharging characteristics of NiCd, NiMH, Pb, Li-ion, Li-pol, Li-Fe-Po, RAM and other types of battery
- Battery measurements and tests
- Design and simulation of the operation of electronic power supply and charger systems
- Design of power supplies for industrial and consumer electronic systems
- Development and design of charging systems
- Power-supply circuit connection and function verification throughout the design process including the prototype stage
- Tests on uninterruptible power supply systems (UPS) and similar converter-based equipment
- Measurement, calculation and analysis of transformer parameters
- Development and tests of power supply systems for automotive industry
- Development and tests of DC/AC and DC/DC converters

EQUIPMENT

- Desktop precision multimeters Agilent 34401A
- Desktop precision multimeters ESCORT 3146A
- Desktop precision multimeters FLUKE 8808A
- Oscilloscope Tectronix TDS3032B
- Oscilloscope AGILENT including FFT 54622 modules
- Oscilloscope AGILENT MSO6454A
- Programmable generators Agilent 33250
- Programmable power supplies ITECH IT8833, IT8834
- Power supplies STATRON +/-80V/5A, 35V/24A
- DC power supply MANSON DPD3030
- Programmable electronic loads ITECH 8512C, 8512B
- Isolated AC power supplies METREL MA4804
- Wattmeters HAMEG HM8115-2
- Precision RLC bridges TESLA and TOPWARD 5030
- Miliohmmeter INSTEK
- Autotransformers and transformers
- AC voltage regulator

CONTACT

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SMART CLOTHES AND ACCESSORIES

ELECTRONICS

SERVICES

- Applied research focused on protective clothing, e.g. for firemen, and special textile products for patients, convalescents, seniors and people requiring increased care
- Protective professional clothing with integrated special-purpose electronic systems for gas concentration monitoring, temperature and humidity measurements, active lighting, acoustic alarm, position detection or wireless data transmission
- Protective gloves and footwear with integrated special-purpose electronic systems for ambient and remote temperature measurements, voltage presence indication, wireless data and power transmission and active lighting
- Underwear including electronic sensors measuring ECG, heartbeat rate and breathing frequency, temperature, humidity and heating
- Packaging and integration of electronic functional blocks into textiles
- Determination of DC and AC electronic component and material characteristics including HF characteristics up to 3GHz.

EQUIPMENT

- Bernina 750 QE including embroidery unit with dual feeding of sewn material to create basic, elastic, overlock, plastic and quilting stitches:
  — 872 types of stitch
  — 11 needle positions
  — the stitching speed controlled smoothly up to 1,000 stitches per minute
  — the maximum size of a single embroidery is 40×26cm
- Coverlock and overlock 5-thread sewing machine with jet-air threading
- Keithley DC measuring equipment (SMU, fA, nV, multichannel DMM)
- RF Measurement:
  — Agilent RLC meter (frequency range 1MHz to 3GHz)
  — Agilent spectral analyser with tracking generator (frequency range 9kHz to 3GHz)
  — Agilent high-frequency generator (frequency range 9kHz to 3GHz
  — signal integrity analyser (frequency range from DC up to 30GHz)
- EKRA E2 semi-automatic screen-printing machine
- Nicomatic crimping system
- Sunko 709a resistance welding station

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DIAGNOSTIC TESTS OF ELECTRONIC ASSEMBLIES, COMPONENTS AND PCBS

ELECTRONICS

SERVICES

- Electronic unit assessment in reference to IPC-A-610 Acceptability of Electronic Assemblies Criteria
- PCB assessment in reference to IPC-A-600 Acceptability of Printed Board Criteria
- Diagnostics of active and passive electronic components
- Integrated circuit decapsulation
- Solder joint diagnostics
- Solderability testing of PCBs and electronic components (Dip and Look Test, Wetting Balance Test, Area of Spread Test; equipment for vapour phase soldering)
- Measurement of ionic contamination on bare or assembled PC boards
- Measurement of ionic contamination on components
- Diagnostics tests of mechanical defects (fractures, cracks)
- X-ray inspection and computer tomography (CT) used for analysis of electronic assemblies, components and PCBs

EQUIPMENT

- Solderability tester Multicore MUST II
- Laboratory equipment for vapour phase soldering Vapor ASSCON Quicky 300
- Contaminometer (Concoat CM11): measuring range 0.01 to 30 NaCl/cm2, maximum board dimensions 300 x 250 x 30mm, minimum PCB surface area 100 cm2
- GE phoenix v|tome|x s240: high-resolution system for 2D X-ray inspection, 3D computer tomography (micro-ct and nano-ct) and 3D metrology
  Regarding other equipment, see *Microscopy and Materialography*

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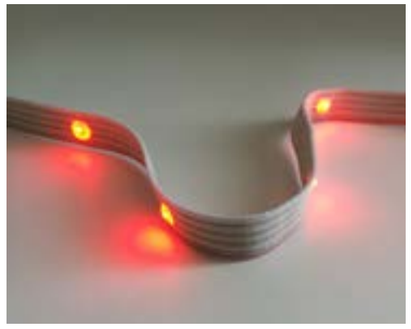
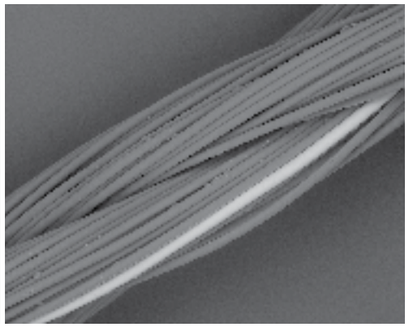
SMART TEXTILE ELEMENTS AND INTEGRATION TECHNOLOGIES





ELECTRONICS

SERVICES

- Applied research and development focused on textile-based electronic elements and technologies enabling integration of such electronic elements into carrier textiles:
  — controls elements (buttons and switches with LED status indication)
  — pressure and temperature sensors
  — heaters
  — conductive flexible coupling elements
  — aerials and inductances
- Research and development in the area of assembling/connecting textile-based electronic elements by resistance and ultrasonic welding, soldering, bonding and crimping
- Production of smart bed linen with two-zone moisture detection
- Production of textile rehabilitation aids with integrated pressure and tension sensors for treating conditions like bedsore, swelling of leg ulcer
- Determination of AC and DC characteristics of textile elements including HF characteristics
- Maintenance and mechanical testing of textile-based electronic components and systems

EQUIPMENT

- Bernina 750 QE including embroidery unit with dual feeding of stitched material to create basic, elastic, overlock, plastic and quilting stitches
- EKRA E2 semi-automatic screen-printing machine
- Nicomatic crimping system
- Sunko 709a resistance welding station
- Equipment LABORECH 3.030 for precision measurement of mechanical properties up to 1kN
- Bend tester to assess resistance of textile specimens to cyclic mechanical stress
- Semi-professional Whirlpool washing machine and dryer
- Keithley DC measuring equipment (SMU, fA, nV, multichannel DMM)
- RF-range measurements:
  — Agilent RLC meter (frequency range 1MHz to 3GHz)
  — Agilent spectral analyser with tracking generator (frequency range 9kHz to 3GHz)
  — Agilent high frequency generator (frequency range 9kHz to 3GHz)
  — Signal integrity analyser (frequency range from DC to 30GHz)

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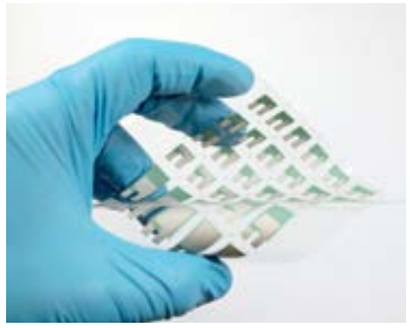
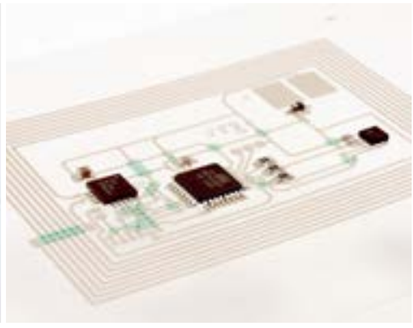
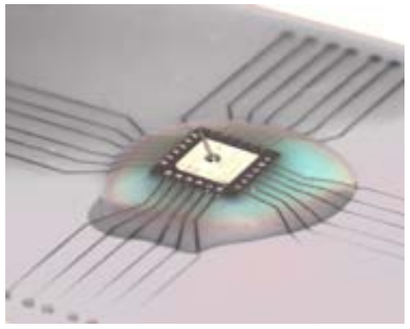
PRINTED, FLEXIBLE AND HYBRID ELECTRONIC COMPONENTS

ELECTRONICS

SERVICES

- Selective deposition of functional materials using Aerosol Jet Printing (AJP) equipment, screen printing and stencil printing technologies
- Plasma and ozone treatment of surfaces prior to material deposition (surface tension adjustment, cleaning, surface functionalisation and activation)
- Research on flexible printed sensors (vapor and gas, temperature, humidity, leakage and resin hardening sensors), printed interconnection structures, passive and active components (aerials, R, L, C, OECT - electrochemical transistors)
- Development of hybrid electronic circuits on flexible substrates
- Research on hybrid component assembly techniques and methods of contacting the printed functional structures onto flexible substrates (low-temperature soldering, conductive and non-conducting bonding, mechanical crimping and welding technologies)
- Research on electronic elements and sensors based on conductive carbon nanomaterials (CNT, graphene)
- Research on environment-friendly electronic systems (organic functional materials, cellulose substrates, energy-saving and cost-effective production processes)
- Determination of AC and DC characteristics of various electronic components including HF characteristics (up to 3GHz)
- Design of planar components and circuits, simulation of their functions, signal transmission analysis and design optimisation methods

EQUIPMENT

- Aerosol Jet Printing (Optomec AJ300) equipment
- EKRA E2 semi-automatic screen-printing machine
- Plasmabrush PB3 plasma surface treatment system (Relyon plasma)
- Laboratory furnaces for heat treatment and curing of technological materials
- Vötsch climatic chambers for environmental stress testing (temperature, humidity, shock, vibration, corrosion resistance tests)
- Keithley DC measuring equipment (SMU, fA, nV, multichannel DMM)
- RF-range measurements:
  — Agilent RLC meter (frequency range 1MHz to 3GHz)
  — Agilent spectral analyser with tracking generator (frequency range 9kHz to 3GHz)
  — Agilent high frequency generator (frequency range 9kHz to 3GHz
  — signal integrity analyser (frequency range from DC to 30GHz)
  — functional generator (frequency range up to 120MHz)
- Simulation tools:
  — Ansoft Designer (simulation of parameters of conductive interconnections, materials and technological modifications, parametric analysis)
  — HyperLynx (identification of critical PCBs including design solutions, LineSim and BoardSim, EMC design)

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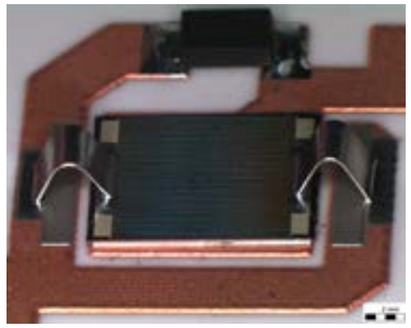
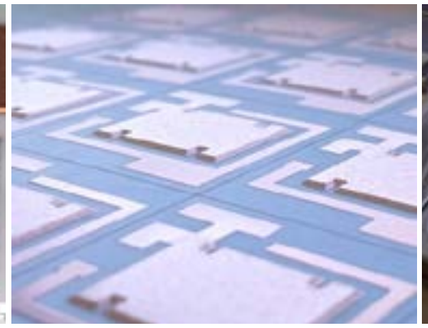
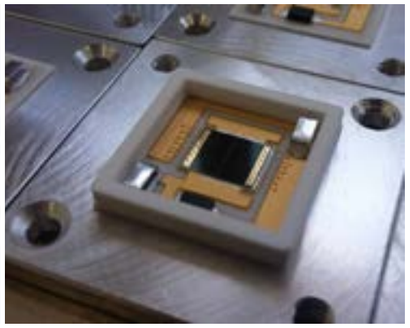
PRINTED ELECTRONIC COMPONENTS FOR POWER APPLICATIONS

ELECTRONICS

SERVICES

- Research and development focused on special substrates for power applications and component contacting technology
- Nitrogen or argon-protected sintering at temperatures up to 1,100°C.
- Design and fabrication of substrate samples with a ceramic base on which a thick copper layer is formed*
- Design and optimisation of direct printing of thick copper layers on ceramic substrates (TPC technology)
- Research and development of alternative technologies for contacting high-performance semiconductor chips (Cu ribbon soldering, contacting printing, sintering)
- Testing of copper layer adhesion and delamination
- Testing of copper layer solderability and bondability
- Quality analysis of cavity-free soldering of large-area semiconductor components
- Metallographic analysis

* The processes used to form thick copper films are mainly DBC and TPC. The conductive layers so formed can be several hundred µm thick.

EQUIPMENT

- Muffle furnace with gas-tight retort
- EKRA E2 semi-automatic screen-printing machine
- Lauda PROLINE PJL 12 calibration thermostat including a DLK 45 cooling unit
- Multicore solderability tester MUST II
- Semi-automatic bonding station K & S 4700
- LABORTECH 3.030 mechanical tester for measuring layer adhesion (up to 1kN)
- Thermal shock test chamber (fast temperature changes between -80°C and +220°C)
- 180-litre climatic chamber (temperature range -70°C to +180°C, relative humidity 10 to 98%)
- 600-litre climatic chamber (temperature range -70°C to +180°C, relative humidity 10 to 98%, vibration test table)
- Corrosion test chamber (condensation and salt mist tests)
- Microbial X-ray inspection system for 3D CT (CT) including standard 2D GE Phoenix inspection v|tome|x s240
- Olympus LEXT OLS5000 laser confocal microscope
- Phenom PROX SEM microscope with EDX element analysis capability
- Keithley DC measuring equipment (SMU, fA, nV, multichannel DMM)

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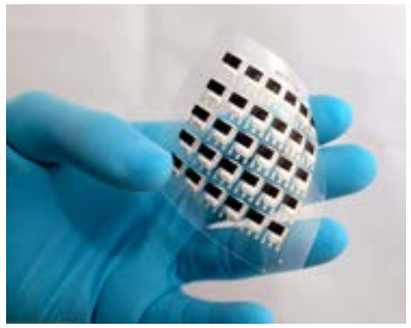
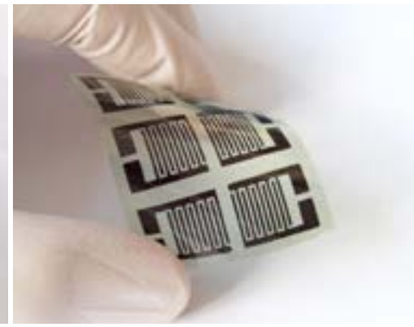
CHEMICAL SENSOR RESEARCH AND DEVELOPMENT


ELECTRONICS

SERVICES

- Research and development in the field of chemo-sensitive gas sensors (for gases such as NO2, NH3 or CO) based on organic materials and carbon nanostructures
- Research and development in the field of electrochemical gas sensors (e.g. NO2, NH3, C2H4) based on polymeric electrolytes
- Testing and development of sensors for detecting heavy metals in water
- R&D in the field of fully-printed sensor elements
- Design of electrode structure topology for sensor elements
- Deposition of electrode structures and sensor layers
- Determination of AC and DC characteristics of sensor elements and selected technological materials including HF characteristics (up to 3GHz)
- Development of electronic sensor testers

EQUIPMENT

- Computer-controlled gas mixing apparatus consisting of seven mass flow controllers (Sierra Instruments)
  — climatic chambers to test sensors in the environments with relative humidity ranging from 20 to 80%, temperature 0 to +100°C, analyte flow rate 0.2-1.5 litre per minute, analyte concentration from hundreds of ppb to hundreds of ppm
- PGSTAT204 multichannel potentiostat/galvanostat including electrochemical impedance spectroscopy (EIS) capability (EIS)
- Measuring instruments for AC (up to 3GHz) and DC (SMU, fA, nV, multichannel DMM) signals
- Equipment for additive deposition of functional materials:
  — EKRA E2 screen printing
  — Aerosol Jet Printing equipment Optomec AJ300
  — Airbrush Colany
- Electric contacting and bonding equipment:
  — soldering (hand-operated microsoldering station, continuous reflow furnace, condensation soldering)
  — conductive and non-conductive bonding (thermal and UV curing)
  — Nicomatic crimping system
  — Sunko 709a resistance welding station

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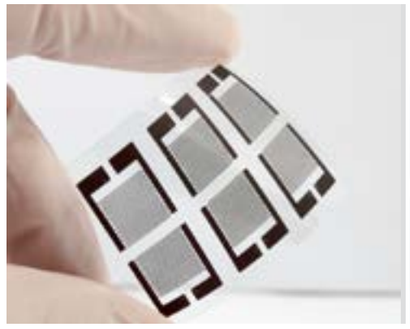
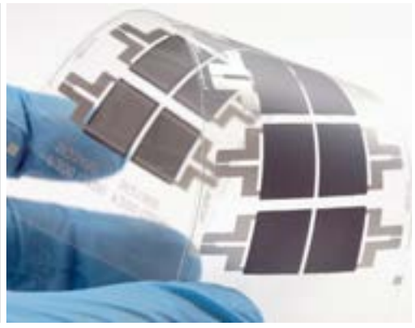
RESEARCH AND DEVELOPMENT OF TEMPERATURE, HUMIDITY AND LEAK SENSORS





ELECTRONICS

SERVICES

- Research and development of printed and textile-based sensor elements for temperature and relative humidity measurements
- Research and development of large-area liquid leak sensors for construction, agriculture and industrial applications
- Research and development of soil temperature and humidity sensors for agricultural applications and nutrient detection
- Design of electrode structure topology for sensor elements
- Selective deposition of electrode structures and sensor layers on flexible and rigid substrates including large-format substrates
- Research of sensor elements based on carbon nanoparticle materials (CNT, graphene)
- Determination of AC and DC characteristics of sensor elements and selected technological materials including HF characteristics (up to 3GHz)
- Development of sensor testers

EQUIPMENT

- Lauda PROLINE PJL 12 calibration thermostat including a DLK 45 cooling unit
- Vötsch climatic chambers for environmental stress testing (temperature, humidity, temperature shock, vibration and corrosion resistance tests)
- Laboratory furnaces for long-term temperature stress testing
- Keithley DC measuring equipment (SMU, fA, nV, multichannel DMM)
- RF measurements:
  — Agilent RLC meter (frequency range 1MHz to 3GHz)
  — Agilent spectral analyser with a tracking generator (frequency range 9kHz to 3GHz)
  — Agilent high frequency generator (frequency range 9kHz to 3GHz)
  — signal integrity analyser (frequency range from DC to 30GHz)
  — functional generator (frequency range up to 120MHz)
- Equipment for additive deposition of functional materials:
  — EKRA E2 screen printing system
  — Aerosol Jet Printing equipment (Optomec AJ300)
  — Airbrush Colany
- Electric contacting and bonding equipment:
  — soldering (hand-operated microsoldering station, continuous reflow furnace, condensation soldering)
  — conductive and non-conductive bonding (thermal and UV curing)
  — Nicomatic crimping system
  — Sunko 709a resistance welding station

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MEASUREMENT AND ANALYSIS OF RADIO FREQUENCY SYSTEMS

ELECTRONICS

SERVICES

- Frequency spectrum analysis up to 7GHz, power measurement of RF and impulse signals up to 18GHz
- Receiver parameter measurements, sensitivity weighted by SNR, SINAD, BER or another parameter, interference and adjacent channel immunity measurements
- Measurements of transmitter parameters, amplitude modulation index, frequency deviation, measurement of parasitic products up to 7GHz
- Analysis of information and interference signals up to 7GHz, identification of modulation type, vector signal analysis, analysis of signal distortion, analysis of interfering signal emission
- Recording of radio frequency signals, offline signal analysis, analysis of signal parameter changes, error rates, correlation analysis of records, protocol analysis
- Test generation and measurement of arbitrary signals up to 3GHz
- Vector analysis of impedance and transfer function properties of devices up to 8GHz, analysis in time and spectral domains, reflectance analysis in time window
- Analysis of impedance and transfer function of antennas, aerial gain and directivity, parasitic emission
- Measurement of noise figure up to 13GHz, phase noise analysis of oscillators and signal generators

EQUIPMENT

- Vector signal analyser Rohde & Schwarz FSIQ-7; frequency range 20Hz to 7GHz
- Vector network analyser Rohde & Schwarz ZVB-8; frequency range 300kHz to 8GHz
- Spectral analyser Agilent EXA N 9010A; frequency range 10Hz to13.6GHz with noise figure measurement and noise generator
- Vector network analyser Anritsu MS420B; 10Hz to 30MHz
- Spectral analyser Agilent ESA E 4402B; 100kHz to 3GHz; TG
- Spectral analyser Agilent ESA E 4402B; 5kHz to 3GHz; high resolution
- RF generator Rohde & Schwarz SMY-01; 9kHz to 1.04GHz
- RF generator Rohde & Schwarz SM300; 9kHz to 3GHz
- Baseband generator Rohde & Schwarz AM300; 100MS/s
- RF generator Panasonic VP8194D; testing of radio broadcast receivers including RDS
- Signal recorder and generator Eiden 4405A-001, 4222A-001, 5212B-002, 4406A-002
- Software defined transceivers Ettus Research and National Instruments USRP N-200, NI USRP 2920, E100

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ANALYSIS OF AERIAL SIGNAL DISTRIBUTION

ELECTRONICS

SERVICES

- Measurement of antenna signal distribution for DVB systems (terrestrial, satellite, cable)
- Measurements of passive and active device characteristics regarding signal distribution
- Measurements of BER, MER, QEF, C/N in signal distribution
- Analysis of constellation diagrams and signal quality in specific OFDM subcarriers
- Measurement of set-top boxes and television sets under various signal level and quality conditions

EQUIPMENT

- DVB analyser Promax Explorer II+ (DVB-T, S, S2, C, analog TV and FM broadcasts)
- Programable generator for Promax RP-200 carriers
- Signal analyser Rohde & Schwarz FSIQ7
- Vector network analyser Rohde & Schwarz ZVB8
- Laboratory test bed of DVB antenna signal distribution
- Auxiliary devices for the laboratory test bed of antenna signal distribution (noise generators, amplifiers, attenuators, multi-switchers EMP Centauri)
- DekTec DVB-T/T2 and DVB-S/S2 laboratory generators
- Alitronika AT780USB DVB laboratory receivers

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DIGITISATION AND RESTORATION OF HISTORICAL AUDIO RECORDINGS

ELECTRONICS

SERVICES

- Complete process of restoring historic audio gramophone recordings
- Thorough cleaning of the audio recording carrier, verification of its mechanical parameters
- Picking-up historical recordings with a suitable pick-up system, digitisation of gramophone records with appropriate equalisation of the recording characteristics in reference to standards IEC S78 or RIAA where the speed of rotation of the gramophone record can be set at any value in the range of 16 to 78rpm
- Application of additional specific frequency equalisation to the non-standard recording characteristics used with CETRA, His Masters Voice, Columbia, Parlophon, DGG, Italia, NAB, NARTB, LGC and other gramophone records
- Verification of technical parameters of the audio image
- Adaptive filtration and adaptive suppression of noise and acoustic effects of mechanical damage to the recording grooves (suppression of cracking and undesired groove vibrations)
- Exporting the original and restored audio images onto a carrier CD-DA (16bit) including CD text or DVD Audio (24bit), optionally in a *.wav file format (16bit or 24bit)

EQUIPMENT

- Audio and measurement equipment of Ortofon, Technics, RME Audio, Steinberg, SONY, MRL, Philips, OM&T

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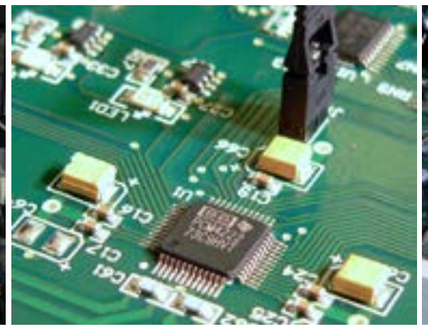
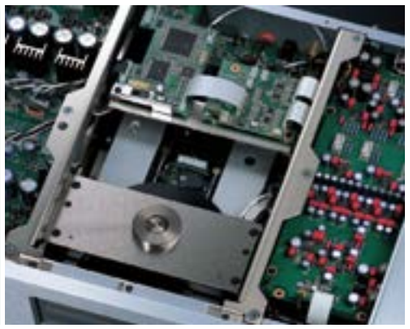
MEASUREMENT AND TESTING OF LOW FREQUENCY AND ELECTROACOUSTIC EQUIPMENT

ELECTRONICS

SERVICES

- Analysis, testing and measurement of technical parameters of low frequency audio equipment where measurements can be carried out in digital and analog domains or combinations thereof; measurements of multichannel audio systems
- Analysis of audio systems including analog or digital interfaces (SPDIF/TosLink, TDIF, ADAT, AES3/AES-EBU, AES11 or others)
- Measurement of technical parameters of low frequency equipment, amplifiers and power amplifiers (up to 30kW) in observance of the recommendations in standards EN 61305 and EN 60268
- Measurement of technical parameters of digital audio components of audio and audiovisual equipment as recommended by standard EN 61606 (audio equipment for professional use, audio parts in consumer electronics, audio parts in personal computers), measurement of technical parameters of A/D and D/A converters as recommended by AES specifications
- Measurement and assessment of speech transmission and processing quality in telecommunication systems using objective measurement methods PESQ, POLQA (ITU-T P.862, P.863)
- Measurement and assessment of high-quality broadband audio signal transmission and processing in consumer and professional audio equipment using the objective measurement method PEAQ (ITU-R BS.1387), perceptual sound quality evaluation and measurement of the audio modulation loudness (ITU-R BS.1770)
- Measurement of technical parameters of analog and digital recording equipment (tape recorders, record players, systems such as CD-DA, DVD-Audio, SACD, MiniDisc, MP3 recorders, HDD recorders etc.) and audio parts of analog and digital television and radio sets

EQUIPMENT

- Measurement equipment of AudioPrecision, Rohde&Schwarz, Dolby Laboratories, PrismSound, RME Audio, Brűel & Kjaer, Earthworks, Neutrik – NTI Audio, Agilent, Tektronix, National Instruments, OPTICOM, AFMG – SDA, MRL, Philips, OM&T

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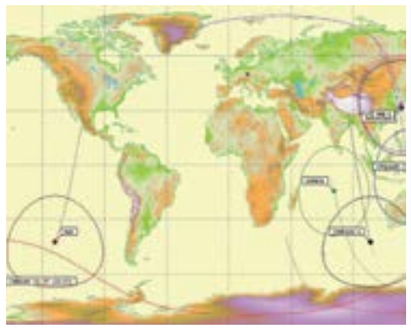
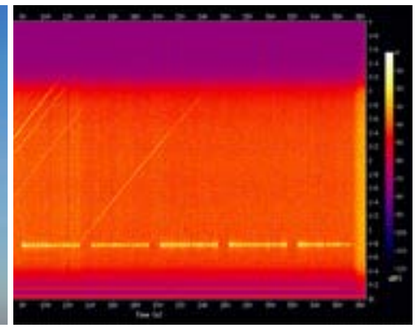
ANALYSIS OF ANTENNA SIGNAL DISTRIBUTION





ELECTRONICS

SERVICES

- Satellite tracking on LEO orbit, verification of orbit parameters based on satellite beacon signal analysis
- Recording of satellite transmissions, passive telemetry receiving and analysis
- Active radio communication with satellites, customisable satellite commanding, health status monitoring, data download and upload

EQUIPMENT

- Parabolic antenna dish of RFHamDesign, diameter 1.9m, helical feed for 2,400MHz band
- Cross Yagi antenna MSQUARE for 435MHz band, antenna gain 14dBdc
- Cross Yagi antenna MSQUARE for 145MHz band, antenna gain 10dBdc
- Transceiver ICOM IC-910H for 145MHZ, 435MHz and 1,200 MHz bands, low-noise amplifiers
- Two axis (azimuth, elevation) antenna positioner AlfaSpid Big Ras with modern MD-01 control unit
- Ground station control PC with Linux Debian, satellite tracker, control interface for transceiver and antenna positioners, scripting language and MySQL support for customisable satellite commanding, local and remote access interface
- Support devices: backup UPS power supply, optical cable to TCP/IP network, TNC for AX.25 system, universal software TNC, TNC for GomSpace Nanocom
- Experimental device: software-defined radio Ettus Research USRP N-200, own experimental platform for 2,400MHz band

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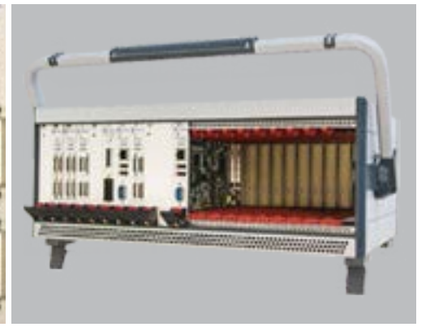
CONTROL SYSTEMS


ELECTRONICS

SERVICES

- Development of control and other electronic systems for transportation industry
- Development of control systems for power generation industry
- Development of applications with power transducers
- Design of single-board control units
- Application of modular control systems for 19" racks
- Development of systems using high-speed communication (such as LVDS 1.3Gb, Ethernet or USB 2/3)
- FPGA design for Altera's programmable circuits, both fully customer-friendly and with the use of, for example, Avalon® Qsys
- Platforms used: Hercules ™ ARM®Safety; ST with Core Cortex M3, M4; TI TMS320F28 335, 377
- Collaboration with third parties in the form of professional consultations, orders, vouchers or joint grant projects

EQUIPMENT

- VF oscilloscope MSOX91304A; bandwidth: 13GHz / 4 CH, sampling frequency: 80GSa / 2 CH, low voltage level measurement 1.30mVrms / 13GHz, compliance tests: USB2/3, Ethernet, DDR
- EMI test receiver R & S ESPI7; bandwidth: 10Hz to 7GHz, resolution: 0.01Hz, integrated tracking generator, I/Q modulator
- 136-channel accurate Keysight 16854A logic analyser; sampling rate: 2.5GHz / 5GHz (full / half channel), internal memory 256 M
- Single-Channel Parametric DC Source Meter Keithley 2401; voltage resolution: 5µV, current rating: 50pA, maximum voltage and current: 20V / 1A
- RLC KEYSIGHT E4980A; accuracy: 0.05%, frequency range: 20Hz to 2MHz
- Double-channel KEYSIGHT 33600A functional generator; bandwidth: 120MHz, sampling rate: 1GSa/s
- ESSEMTEC EXPERT-LINE UP3100 SMD semi-automatic staging unit including BGA
- Software tools: Altium Designer, Matlab, Quartus, Atollic, Code Composer Studio, SolidWorks

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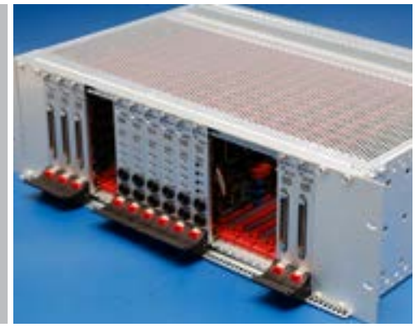
TEST SYSTEMS





ELECTRONICS

SERVICES

- Development of modular test systems for testing of electronic devices
- Selection and assembly of the control computer HW, design of the test system component parts on the selected test platform
- Test plan definition, implementation and optimisation of specific tests according to the DUT specifications
- Modification of the universal RATS interconnection platform with respect to the given number and type of external signals, design of the signal adaptation modules
- Development of special modules to meet the application requirements
- Integration of external measuring instruments into the test system
- Collaboration with third parties in the form of professional consultations, orders, vouchers or joint grant projects

EQUIPMENT

- Complete range of National Instruments development tools (LabVIEW, TestStand, ...)
- Universal modular RATS test platform including:
  — modules for connecting and adapting external data signals (60VDC, 500mADC)
  — configurable backplane for 300 data signals (60VDC, 500mADC), common 3-wire bus for power signals (275VDC / 40A)
  — modules for fault condition simulation (short circuit, disconnection, excessive voltage drops and others) up to 275V / 20A
  — universal 4 × 32 (128) relay matrix modules (60VDC, 500mADC)
  — SW driver libraries for .NET, LabVIEW

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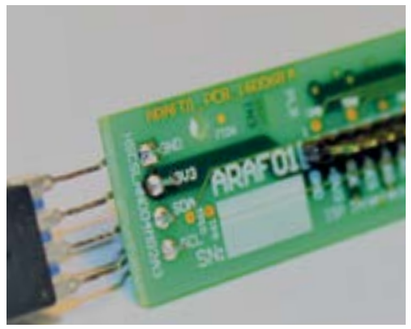
INTELLIGENT SENSORS



ELECTRONICS

SERVICES

- Development of special sensors with integrated intelligence such as liquid, gas and dew-point sensors or pixel radiation detectors
- Development of special-purpose sensors (high pressure, vacuum and remote sensors, rotary sensors for rotating machines)
- Collaboration with third parties in the form of professional consultations, orders, vouchers or joint grant projects

EQUIPMENT

- HF oscilloscope MSOX91304A; bandwidth: 13GHz / 4 CH, sampling frequency: 80GSa / 2 CH, low voltage level measurement: 1.30mVrms / 13GHz, compliance tests: USB2/3, Ethernet, DDR
- EMI test receiver R & S ESPI7; bandwidth: 10Hz to 7GHz, resolution: 0.01Hz, integrated tracking generator, I / Q modulator
- 136-channel accurate Keysight 16854A logic analyser; sampling rate: 2.5GHz / 5GHz (full / half channel), internal memory: 256 M
- Single-Channel Parametric DC Source Meter Keithley 2401; voltage resolution: 5μV, current rating: 50pA, maximum voltage and current: 20V / 1A
- RLC KEYSIGHT E4980A; accuracy: 0.05%, frequency range: 20Hz to 2MHz
- Double-channel KEYSIGHT 33600A functional generator; bandwidth: 120MHz, sampling rate: 1GSa/s
- ESSEMTEC EXPERT-LINE UP3100 SMD semi-automatic staging unit including BGA
- SW: Altium Designer, Matlab, Quartus, Atollic, Code Composer Studio, SolidWorks

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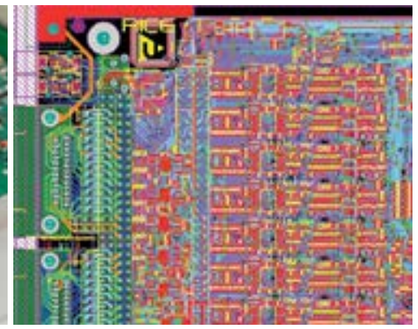
CUSTOM DEVELOPMENT OF ELECTRONIC DEVICES

ELECTRONICS

SERVICES

- Development of special-purpose electronic devices for measurement, control and regulation applications with respect to the requirements of small series production
- Mechanical construction design
- Equipment design finalisation including prototype verification tests, production documentation and data
- Collaboration in the preparation of small series production
- Design of analog circuits for signal processing including pre-processing of sensor signals
- Design of digital circuits based on FPGA or embedded processors
- Development of software and firmware for digital circuits
- Power circuit design
- Front panel design and product prototyping
- Collaboration with third parties in the form of professional consultations, orders, vouchers or joint grant projects

EQUIPMENT

- HF oscilloscope MSOX91304A; bandwidth: 13GHz / 4 CH, sampling frequency: 80GSa / 2 CH, low voltage level measurement: 1.30mVrms / 13GHz, compliance tests: USB2/3, Ethernet, DDR
- EMI test receiver R & S ESPI7; bandwidth: 10Hz to 7GHz, resolution: 0.01Hz, integrated tracking generator, I / Q modulator
- 136-channel accurate Keysight 16854A logic analyser; sampling rate: 2.5GHz / 5GHz (full / half channel), internal memory: 256 M
- Single-Channel Parametric DC Source Meter Keithley 2401; voltage resolution: 5μV, current rating: 50pA, maximum voltage and current: 20V / 1A
- RLC KEYSIGHT E4980A; accuracy: 0.05%, frequency range: 20Hz to 2MHz
- Double-channel KEYSIGHT 33600A functional generator; bandwidth: 120MHz, sampling rate: 1GSa/s
- ESSEMTEC EXPERT-LINE UP3100 SMD semi-automatic staging unit including BGA
- SW: Altium Designer, Matlab, Quartus, Atollic, Code Composer Studio, SolidWorks

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SOFTWARE FOR EMBEDDED APPLICATIONS AND IOT SYSTEMS

ELECTRONICS

SERVICES

- HW and SW designs for embedded applications at different levels from a simple microcontroller to complex PC systems
- Software drivers for embedded systems
- Comprehensive software solutions including customised special-purpose user interface
- Use of database storage facilities and evaluation of data from controlled processes for visualisation
- Deployment of Internet technologies for remote access, monitoring and data collection including execution of specific projects in that area
- Use of buses and protocols for wired and wireless communications with special regard to secure data transfer compliance requirements
- Applications with real-time systems (RTOS)

EQUIPMENT

- Application development tools for assembler, C / C ++, C #, Java - Keil uVision, Atollic TrueStudio, MS Visual Studio, CodeComposer, Eclipse
- Database platforms MySQL, MS SQL, Firebird, PostgreSQL and others
- HW platform development for 8-, 16- and 32-bit microcontrollers based on proprietary core and ARM Cortex-M and Cortex-A
- Test hardware for high-performance devices based on Intel x86 cores and ARM
- Modules for wireless communication based on the Bluetooth, WiFi, Lora, ZigBee, Nordic and others protocols
- Development and debugging tools for microcontrollers: Atmel ICE, GDB debugger, J-Link, ST-Link and others
- PLC-based control systems, module PharLap for Windows RT OS extension

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DEVELOPMENT, TESTING AND DIAGNOSTIC SYSTEMS WITH INDUSTRIAL BUSES

ELECTRONICS

SERVICES

- Development of industrial communication systems
- Development of systems for automotive buses
- Implementation and analysis fieldbus specifications for Ethernet, CAN, FlexRay, LIN, RS485, RS232, MBus and others
- Implementation of high layer protocols for CAN (CANopen, TTCAN), Ethernet (TCP / IP) and other platforms
- Design of distributed control systems based on industrial Ethernet
- Analysis and localisation of problems in industrial communication
- Bus testing and analysis regarding interference resistance and communication reliability
- Design and identification of the best suitable type of industrial communication
- Automotive bus diagnostics
- Testing systems with rest-bus simulation

EQUIPMENT

- Analysis and simulation software from Vector Informatik GmbH company: CANoe
- Four-channel oscilloscope Agilent MSO7104A 1GHz - 4GSa/s with 16-bit logic and bus analysers (FlexRay, CAN, LIN, SPI, IIC, UART / RS232)
- 68-channel logic analyser 16802 68

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DEVELOPMENT OF ELECTRONIC SYSTEMS



ELECTRONICS

SERVICES

- Development of electronic systems for a wide range of applications including sensors, actuators and other special-purpose elements based on up-to-date component parts (DSP / FPGA / ASIC)
- Precise FPGA design with high parameters in the domain of signal processing, ultra-fast time domain processing
- R&D of special-purpose electronic systems
- Analog and digital system simulations
- R&D of radiation resistant electronic systems
- R&D and consultations regarding EMC of electronic systems and components
- Digital and analog algorithm implementation

EQUIPMENT

- HF oscilloscope MSOX91304A; analog bandwidth: 13GHz / 4 CH, sampling rate: 80GSa/s 2 CH, voltage input range 1.30mVrms / 13GHz / 50mV/div,
- Compliance tests: USB2/3, Ethernet, DDR
- EMI test receiver R&S ESPI7; bandwidth: 10Hz to 7GHz, resolution: 0.01 Hz, tracking generator, I/Q modulator
- Picoammeter HP 4140B, input range +/- 0,001pA to 0.2mA
- Logic analyser Agilent 16822A 68 channels, 4GHz time zoom, 64K memory capacity
- 136-channel logic analyser Keysight 16854A; sampling rate: 2.5GHz / 5GHz (full / half channel), 256M memory capacity
- Double-channel function generator KEYSIGHT 33600A; bandwidth: 120MHz, sampling rate: 1GSa/s
- SW: Altium Designer, Matlab, PADS, VHDL-AMS

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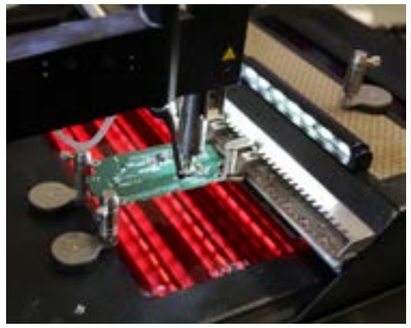
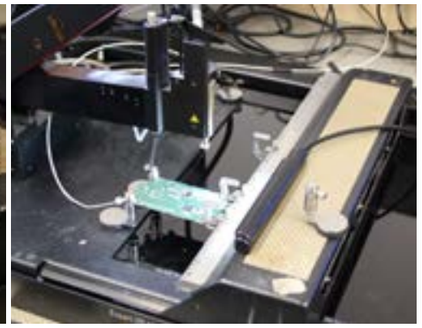
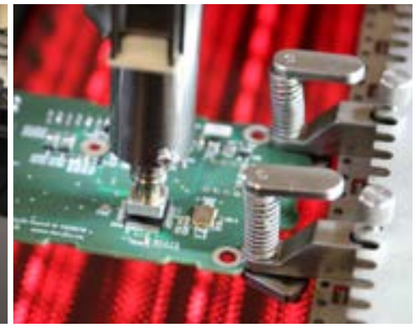
PRECISION MOUNTING OF SMD COMPONENTS

ELECTRONICS

SERVICES

- Piece soldering of all kinds of footprints
- Enhanced soldering method for all kinds of component including state-of-the-art processors (DSP, FPGA, ASIC), passive components, MEMS, drivers and others
- Precise manufacturing of solder masks and solder frames for all kinds of footprints with the accuracy of 0.01mm
- Identification of a suitable temperature profile for soldering and desoldering of electronic components using bottom infrared preheating and temperature probes
- Temperature profile customisation with respect to individual component specifications
- Component placement on the PCB using a camera system
- Replacement of defective components on populated PCBs
- Assembling the prototype boards
- ISO 9000-compliance assurance for both mechanical and electric process parts to attain high process reproducibility and reliability

EQUIPMENT

- MARTIN-SMT soldering station (different nozzles for component handling, high-accuracy positioning system, camera system with interchangeable lenses, BGA, CSP, MLP, hot air soldering, bottom heat infrared element with power control option, small heat ovens for chip revitalisation and reuse – reballing)

MARTIN-SMT	
max. width DPS	390 mm
max. length DPS	500 mm
positioning	75 mm / 75 mm / 23 mm / ±10°
distinction / accuracy positioning	0,01 mm
hot air	50–400 °C (2–35 l/min)
bottom heating - infra	900–4800 Watt

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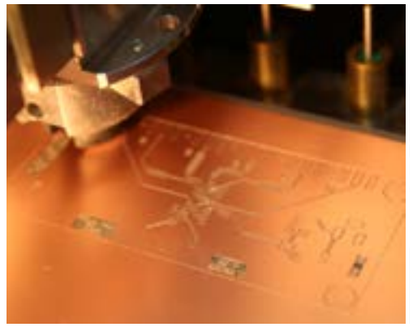
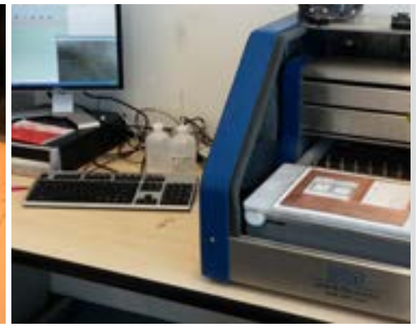
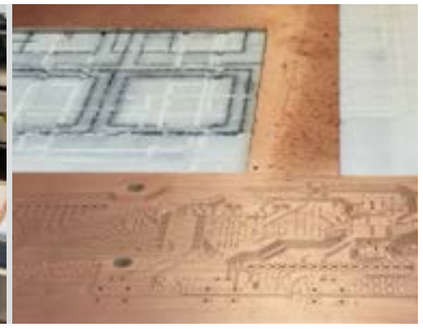
PROTOTYPE PRODUCTION OF PRINTED CIRCUIT BOARDS BY MILLING







ELECTRONICS

SERVICES

- Fast production of single- and double-layer printed circuit boards without conductive vias by milling process (material FR4, application of the method of dividing lines)
- Milling of special substrates (teflon, macor)
- Simple component milling and aluminium plate engraving

EQUIPMENT

- Cutter Protomat S100 including a vacuum table and camera system

Protomat S100	measurement
max. size material	A4+ (225 × 300 mm)
min. conductor / insulating gap width	0,25 / 0,25 mm
max. spindle speed	100 000 rev/min
positioning resolution / accuracy	0,25 micron / ±1 micron
drilling / milling	0,2–3 mm

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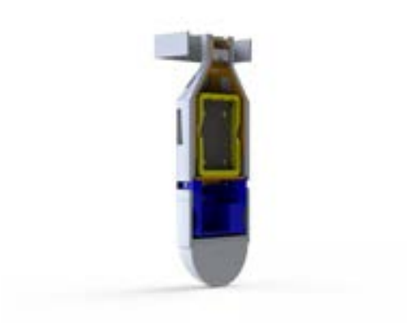
SENSOR UNITS FOR IOT AND SMART CITY APPLICATIONS



ELECTRONICS

SERVICES

- KETcube: a universal platform for the development of IoT applications consisting of a modular HW system (LPWAN communication, battery management, environmental parameter sensors) and special-purpose SW.
- SmartCampus: a testing polygon for SmartCity technology in real campus conditions within UWB (including, among others, smart parking and smart lighting facilities and environmental sensors).
- SmartCity technology including smart parking, intelligent lighting, city sensor systems, communication networks and a cloud storage facility. Design, development, testing, functional, mechanical and climatic tests, upscaling.
- SmartFarming: IoT solutions for efficient farming (e.g. remote monitoring of agricultural soil condition on large areas of farming land)
- Developments in the field of fire sensors (including robust sensor modules mounted on drones for deployment in hard-to-reach or dangerous areas)
- Design and prototyping of IoT devices (LoRaWAN, Sigfox, NB IoT).
- Design and implementation of wireless sensor systems and low-power electronic systems
- Implementation of cooperative and contracted research projects for SmartCity and IoT
- Consulting and expert services concerning Smart City and IoT applications

EQUIPMENT

- Professional HW design tools (Altium Designer)
- Software development tools for embedded devices (compilers and development environments)
- Software for mobile smartphone development projects on Android and iOS platforms
- Testing polygon for Smart City technologies within the university campus (see www.smartcampus.com)
- Prototyping 3D printer PRUSA I3 MK3
- Robodrone Kingfisher for testing sensor systems located on UAV or delivered by UAV
- LoRaWAN testing IoT network covering UWB campus connected to the LORATECH Pilsen network
- Fully scalable Smart Cloud system for IoT applications and other smart solutions

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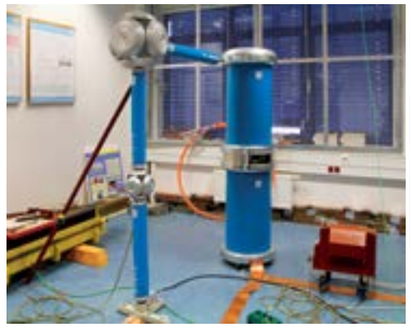
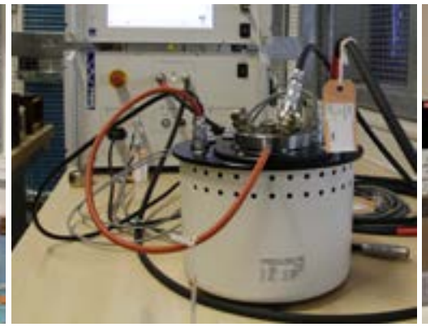
DIAGNOSTIC MEASUREMENT OF ELECTRIC PARAMETERS


ELECTRICAL ENGINEERING

SERVICES

- Diagnostic measurements on technological materials and electrical equipment (machines) consisting of determination of electric parameters such as dissipation factor, permittivity, dielectric strength, partial discharges, insulation resistance, internal and surface resistivity or leakage current
- Diagnostic measurements on technological materials and electrical equipment consisting of determination of the frequency, voltage and temperature characteristics
- Measurements of internal and surface resistivity

EQUIPMENT

- Lemke* probe for partial discharge detection and localisation
- Doble PD SMART: a fully digital measuring system using the global method of partial discharge measurement in accordance with standard IEC 60270
- LDV5 and Haefelly 2820 for measuring tan δ, voltage and temperature characteristics
- Keithley 6517 device for measurement of absorption and resorption currents with automatic recording of the measured values

* suitable for field application

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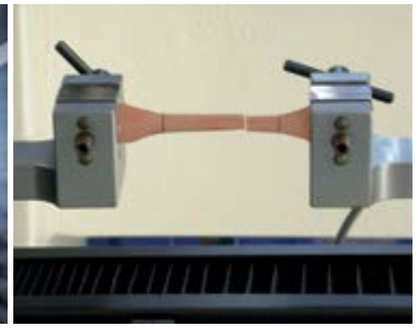
MECHANICAL PROPERTY DIAGNOSTICS





ELECTRICAL ENGINEERING

SERVICES

- Static tests of tensile, bending and compressive strength at ambient and elevated temperatures
- Impact strength tests for metal and plastic materials
- Shore-A and Shore-D tests (ISO 868, ASTM D2240)

EQUIPMENT

- Equipment for testing mechanical properties of technological materials; stress rating up to 100kN and 3kN, temperature characteristics up to 250°C and 10kN
- Equipment for tensile, bending and compressive strength tests and impact (Charpy) stress tests up to 50J

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CALIBRATION OF MEASURING DEVICES



ELECTRICAL ENGINEERING

SERVICES

Stand for basic electric quantity measurements

- Calibration of measuring apparatus
- Measurement of basic electric quantities

Stand for precision frequency measurements

- Precision frequency measurements up to 2GHz
- Precision frequency source up to 1.28 GHz
- Statistical frequency analysis in time and frequency domains

EQUIPMENT

- Calibrator Fluke 5500A
- Multimeter Agilent 3458A
- GPS synchronized frequency standard: NanoSync 2, Fei-Zyfer
- Frequency & time interval analyser: HP5372A, Opt. 040, Opt. 090
- Low phase noise generators: HP8662A and Agilent 33522B

	source	measurement
DC voltage	0 to 1 000 V ±0,006 %	0 to 1 000 V ±0,001 %
DC current	0 to 11 A ±0,06 %	0 to 0,1 A ±0,004 %
AC voltage	1 mV to 1 000 V up to 500 kHz	0 to 1 000 V up to 300 kHz
AC current	0,02 µA to 11 A up to 10 kHz	1 µA to 1 A up to 100 kHz
Resistance	0,1 Ω to 10 MΩ ±0,02 %	0,01 Ω to 10 MΩ ±0,005 %

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MEASUREMENTS OF ELECTRIC AND NONELECTRIC QUANTITIES



ELECTRICAL ENGINEERING

SERVICES

- Measurement of basic and parasitic parameters of electronic components
- Measurement of mutual inductances and capacitances in electronic devices
- Measurement of conductor and cables parameters
- Measurement of electric network parameters (voltage, current, power and apparent power)
- Measurement and analysis of harmonic components in single-phase and three-phase networks
- Recording of fast processes and phenomena
- Analysis of image records
- Measurement of magnetic flux density: 1D and 3D measurements
- pH measurements of substances dissolved in water
- Conductivity measurements of substances dissolved in water (including alimentary solutions)
- Measurement of oxygen concentration in the air using a pipe adapter

EQUIPMENT

- LRC Meter Agilent 4263B: resistance, inductance, capacitance and Q-factor measurements
- High-frequency spectral analyser FS 300 and high-frequency signal generator SM 300
- Three-phase network quality analyser C.A.8332B
- High-speed camera BASLER acA2000
- Teslameter Elimag MP-1 – Lutron GU 3001
- High-voltage source HT 55-I
- Portable pH meter Lovibond SensoDirect PH110: field pH measurements of solutions with pH values ranging from 0 to 14
- Laboratory conductometer inoLab Cond 7310: electrolyte conductivity measurements with conductivity values ranging from 10mS to 10µS
- Portable oximeter Greisinger GNH-3691

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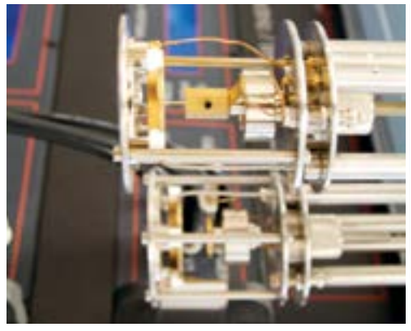
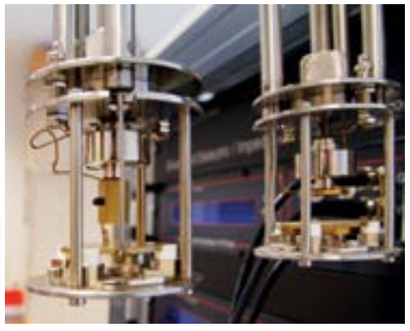
DIELECTRIC SPECTROSCOPY





ELECTRICAL ENGINEERING

SERVICES

- Permittivity measurements
- Loss factor (tan δ) measurements
- Measurements in frequency domain 3μHz to 40MHz at temperatures from -160°C to +400°C
- Novocontrol data analysis software
- The dielectric spectroscopy method can be used for the study of liquid as well as solid materials such as polymers, glass or ceramics.

EQUIPMENT

- Dielectric Analyzer Alpha A Novocontrol Concept 50

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EMC TESTS


L 1090

ELECTRICAL ENGINEERING

The Electrotechnical Laboratory (ETL, accredited laboratory No 1090) performs a variety of compliance and pre-compliance tests of electronic devices. Most of the test methods have been accredited with the Czech Accreditation Institute according to ČSN EN ISO 17025. ETL is a modern well-equipped laboratory with a highly professional and skilled staff.

SERVICES

EMC test laboratory offers compliance and pre-compliance EMC measurements of electronic devices according to the relevant standards. ETL also offers consulting and expert services in the EMC field. ETL's capabilities include measurement of disturbances in the frequency range from 9kHz to 6GHz and immunity tests on a wide range of electrical equipment and devices. Test reports issued by ETL can be used as supporting documentation in the qualification process for CE Declaration of Conformity according to Czech Act 22/97 Coll. and the CE product marking. Some of the accredited tests and measurements can be carried out as field tests.

EQUIPMENT

Publications	Standard
Electrostatic discharge immunity test	ČSN EN 61000-4-2, ed. 2
Radiated, radio-frequency, electromagnetic field immunity test	ČSN EN 61000-4-3, ed. 3 + A1+ Z1 + A2
Electrical fast transient/burst immunity test	ČSN EN 61000-4-4, ed. 3
Surge immunity test	ČSN EN 61000-4-5, ed. 2 + Z1
Immunity to conducted disturbances, induced by radio-frequency fields	ČSN EN 61000-4-6, ed. 4
Power frequency magnetic field immunity test	ČSN EN 61000-4-8, ed. 2
Impulse magnetic field immunity test	ČSN EN 61000-4-9 + Z1
Voltage dips, short interruptions and voltage variations immunity tests	ČSN EN 61000-4-11 ed. 2
Ring wave immunity test	ČSN EN 61000-4-12, ed.2
Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement	ČSN EN 55011 ed. 3 + A1
Electromagnetic compatibility - Requirements for household appliances, electric tools and similar apparatus - Part 1: Emission	ČSN EN 55014-1 ed.3 +A1 + A2
Electromagnetic compatibility of multimedia equipment - Emission requirements	ČSN EN 55032, ed.2
Railway applications – Electromagnetic compatibility Part 3-1: Rolling stock – Train and complete vehicle	ČSN EN 50121-3-1 ed. 3
Railway applications – Electromagnetic compatibility Part 3-2: Rolling stock – Apparatus	ČSN EN 50121-3-2 ed. 3.

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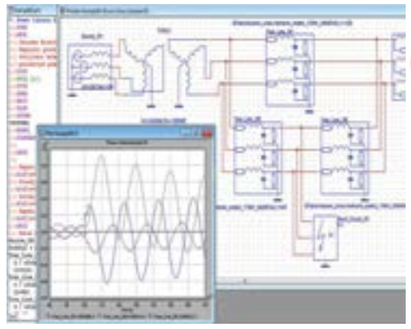
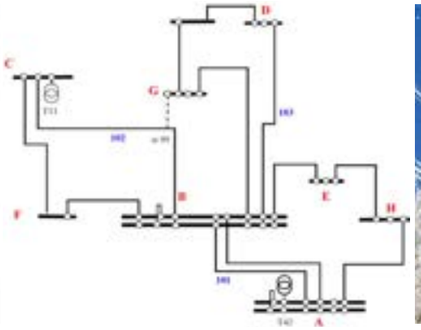
ELECTRIC POWER NETWORK OPERATION AND CONTROL





POWER ENGINEERING

SERVICES

- Modelling of operational and failure conditions of electric transmission and distribution systems at both steady and transient states
- Identification, subsequent evaluation and correction of fault conditions in transmission and distribution power networks, especially by measuring WAMS
- Investigation of the power network parameters such as grid voltage, angular and frequency stability
- Design of low voltage distribution systems, dimensioning of supply networks and distribution equipment regarding short-circuit capacity and mechanical ruggedness
- Design of electric overhead lines with respect to mechanical and weather-related stresses
- Evaluation of power supply indicators regarding quality and operational reliability, assessment of the impact of additional power sources and appliances on the network performance
- Analysis of the power system impact on communication lines and piping systems; calculations of the induced voltage in the newly built gas pipelines and telecommunication networks

EQUIPMENT

- Power quality and energy analyser Chauvin Arnoux C.A 8336
- Software: Mathworks Matlab, Dynast, MODES, SWING

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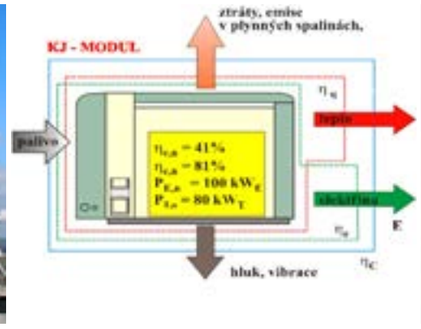
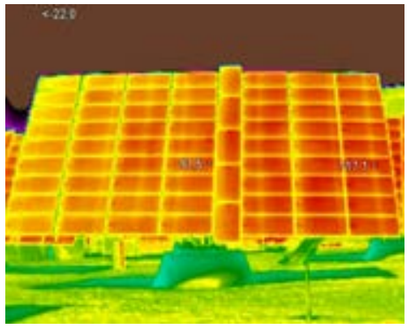
ELECTRIC AND HEAT POWER GENERATION





POWER ENGINEERING

SERVICES

- Engineering and counselling in the field of power generation
- Assessment of the impact of distributed energy sources on the electricity grid stability, the possibility of their deployment and the associated economic benefits
- Modelling and assessment of the impact of additional power sources on the distribution network
- Critical review of the functions of operational data sources, their impact on the power network operation and economy
- Long-term measurements and comparative analyses of photovoltaic systems under real operational conditions in a research photovoltaic mini-park
- Individual and serial testing of European-efficiency photovoltaic inverters using equipment developed for the emulation of photovoltaic panels under 10kW
- Micro-network management, control, connection to and operation within power distribution systems
- Modelling, technical and economic assessment of the operation of combined heat and power generation (CHP) units, their deployment and application within power distribution systems
- Counselling and information services in the field of renewable energy sources

EQUIPMENT

- Laboratory mini-park of renewable power sources comprising various types of photovoltaic system, hot water and heating solar systems, 7kW heat pump and a wind-mill power unit of rated output of 0.5kW

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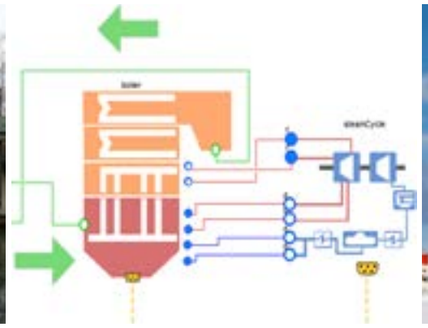
OWN CONSUMPTION OF POWER AND HEAT GENERATION PLANTS, INCREASING THE PRODUCTION EFFICIENCY



POWER ENGINEERING

SERVICES

- Solutions for increasing power generation efficiency and energy saving projects for thermal and nuclear power and heating plants, hydroelectric power plants, pumping systems, pneumatic and other technological systems
- Numerical simulation of selected processes in the field of power production and own consumption combining electrotechnical, thermodynamic, mechanical and hydraulic functions
- Analytic and detailed case studies comparing the key technical and economic indicators for various alternative solutions

EQUIPMENT

- Dassault Systems Dymola
- Mathworks Matlab
- Medium Voltage Drive Pump Save
- Medium Voltage Drive Fan Save

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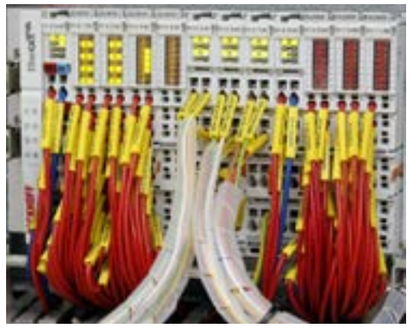
CONTROL SYSTEMS



POWER ENGINEERING

SERVICES

- Control system design and solutions for DCS and HSI (SCADA)
- Design of special-purpose control systems including data processing and evaluation features
- Proprietary tests designed to assess the control system functions (FAT, SAT, PKV, KV)
- Regulation and control algorithms, description of control system functions

EQUIPMENT

- Self-testing stations and equipment for the control system development and testing:
  - Siemens
  - ABB
  - Beckhoff
  - Unitronics
  - Wonderware HMI/SCADA
  - Reliance HMI/SCADA
  - Promotic HMI/SCADA
  - REMCS (RICE Embedded Modular Control System)
  - RATS (RICE Automated Test System)

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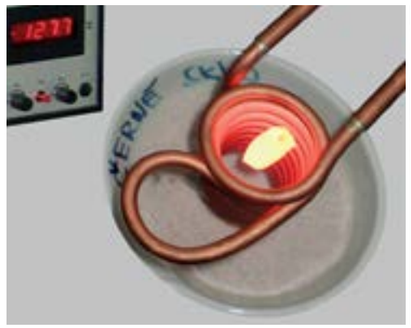
ELECTRIC HEAT TECHNOLOGIES



POWER ENGINEERING

SERVICES

- Counselling, consulting, engineering and research activities in the field of electrotechnology
- Experimental induction heating and melting
  — melting of metal oxides in a cold crucible, technological induction heating of metals, steel induction hardening, metal induction melting
- Solutions for electric heat projects:
  — numerical modelling of induction heating processes (coupled problems, electromagnetic, heating and deformation fields); professional software
  — design of inductors for induction heating and melting
  — design of generators with oscillator circuit and inductors
  — design of electromagnetic shielding for induction devices
  — design of control, measurement and monitoring systems for electric heating processes
- Design of control, measurement and monitoring systems for ventilation equipment (e.g. recuperator units) using own ventilation track with NI components (LabVIEW)
- Remote temperature measurements using IR camera and pyrometer in industrial environments
- Measurement of stray magnetic field in industrial environments and on electric machines
- LCR measurements at frequencies from 10Hz to 2MHz
- 3D-printing (PET, PLA, ABS) equipment used to create 3D product prototypes

EQUIPMENT

- HFG160: a high-frequency induction generator
  — metal oxide melting crucible: frequency range 1.5 to 2MHz, maximum output power 160kW
- PEARTEC FRQ60: a middle-range frequency generator for metal heating and melting
  — equipment for heating, hardening and melting of magnetic and non-magnetic steels
  — frequency range 3 to 40kHz, maximum output power 35kW
- Linn HTG 3000: a high-frequency generator
  — equipment for heating and melting of non-magnetic and electrically conductive metals
  — frequency range 100kHz to 400kHz, power rating 3kW
- Measurement and control systems built of NI units (cRIO + I/O cards) - LabVIEW
- Temperature measurement
  — IR-cam FLIR T335i: measured temperature range -20°C to +1,200°C
  — Marathon MR 1SC pyrometer: measured temperature range 1,000°C to 3,000°C, optics 130:1, spectral sensitivity 1µm
  — Kleiber pyrometer: measured temperature range 300°C to 2,300°C, spectral range 1.58 to 2.5µm, measuring distance 400 to 3,000mm
  — Optris LS pyrometer: measured temperature range -35°C to 900°C, measured surface area 1mm2
- IET/QuadTech 7600 Plus Precision LCR meter: measurements at frequencies from 10Hz to 2MHz
- NARDA ELT 400 probe for electromagnetic field measurements
  — measurements of magnetic induction up to 80mT at EMF frequencies from 1Hz to 400kHz

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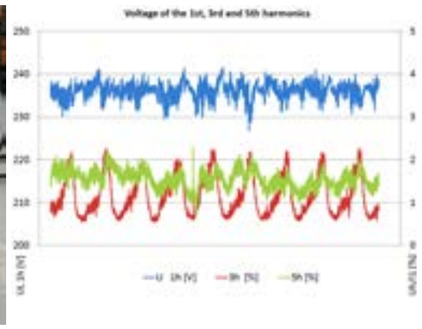
ELECTRIC POWER NETWORK QUALITY MEASUREMENT AND ANALYSIS

POWER ENGINEERING

SERVICES

- Measurements of key electric network parameters (voltage, current, power, power factor, flicker, distortion factor)
- Complex harmonic analyses of single-phase and three-phase electric systems
- Voltage quality assessment according to standard EN 50 160
- Design solutions for network quality disturbance reduction

EQUIPMENT

- Electric power quality and energy analysers Chauvin Arnoux C.A 8332B, C.A 8335
- Electric power quality analyser Dewetron PNA 571
  Analysers simultaneously capture and display values of voltage, current, power & energy (active, reactive, apparent, direction of power flow, power factor), harmonics (ranks of harmonics, percentage relative to the fundamental value, THD and CF), vector diagram of measured variables. Processing and analysis software enables to view data in real time, to generate measurement reports or to make more detailed analysis

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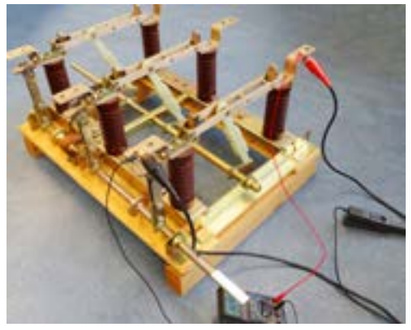
TESTS OF LOW VOLTAGE SWITCHES AND CONTROL DEVICES



POWER ENGINEERING

SERVICES

- Information technology tests according to standard EN 60950-1
- LV switch tests according to standard EN 60947
- Tests of low-voltage circuit breakers, relays and switching equipment
- Tests of HV switches of rated voltage 22 to 420kV
- Consulting services regarding switching capabilities of circuit breakers and disconnectors with rated voltage 22 to 420kV
- Assessment of reliability of switching equipment operated in a network
- Critical reviews of strategic studies on power engineering industry and the use of switching and other equipment in power transmission networks

EQUIPMENT

- Current source Megger, rated current and voltages:
  0 to 500A / 3.5V
  0 to 125A / 14V
  0 to 25A / 70V

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HIGH VOLTAGE TECHNOLOGY



POWER ENGINEERING

SERVICES

- Laboratory tests of high-voltage equipment according to Czech and international standards (EN-ČSN, IEC)
- Insulation system diagnostics for power transformers, HV and VHV equipment, bushings, capacitors and cables
- Measurement of partial discharges in both laboratory and real operating environments
- Measurement of interference signals in the frequency band 9kHz to 30MHz in both laboratory and real operating environments
- Consulting services regarding the choice of insulation system; design of the prophylactic and diagnostic methods for various electrical equipment

EQUIPMENT

- Surge generator ≤ 600kV (4 kJ), ≤ 300kV (15 kJ)
- Two-step transformer cascade: 0 to 620kV, 50Hz, 300kVA; transformers 0 to 200kV, 20kVA
- DC source 300kV, 0.01A
- Impulse generator (± 5kV, 20kHz, 100W)
- Measurement systems for all HV sources
- Equipment for measurement of partial discharges (PDX, PD Smart) according to IEC 60270
- Equipment for measurement of dielectric properties (C / tan δ, Ri)

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PROTECTION SYSTEM TESTS


POWER ENGINEERING

SERVICES

- Selected secondary tests of electric protection devices
- Tests on a wide range of electric protection devices
- Training in the field of protection system application and testing

EQUIPMENT

- Protection Relay Test Set: Omicron CMC numeric relays
  static relays
  electromechanical relays (high load / single phase relays)

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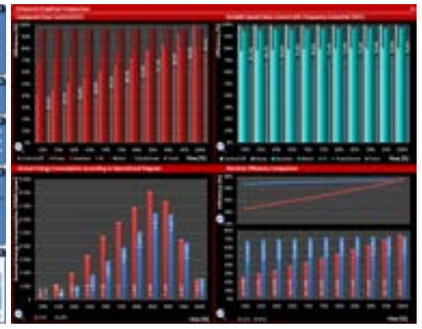
OPTIMISATION OF PUMPING SYSTEM DESIGN AND OPERATION




POWER ENGINEERING

SERVICES

- High-power pumping system control and efficiency optimisation with special regard to thermal and nuclear power plant and pumping station applications
- Detailed case studies of pumping systems including assessment of the key technical and economic indicators for selected alternatives of the system configuration. Provision of services for both new installations and retrofits.
- Sale of non-exclusive licences on the MVD Pump Save software tool for third-party commercial use

EQUIPMENT

- Medium Voltage Drive Pump Save

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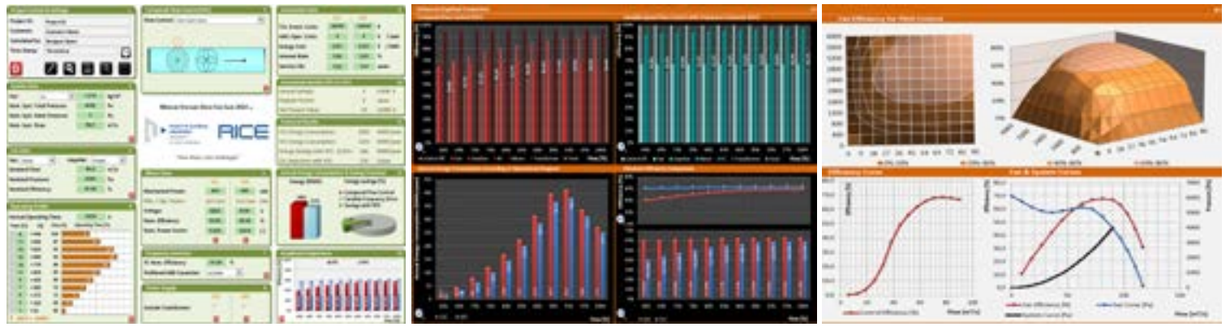
OPTIMIZATION OF PNEUMATIC SYSTEMS



POWER ENGINEERING

SERVICES

- Control devices and operational efficiency optimisation for pneumatic systems with radial and axial ventilators
- Detailed case studies of pneumatic systems including assessment of the key technical and economic indicators for selected alternatives of the system configuration. Provision of services for both new installations and retrofits.
- Sale of non-exclusive licenses on the MVD Fan Save software tool for third-party commercial use

EQUIPMENT

- Medium Voltage Drive Fan Save

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POWER INDUSTRY ECONOMY AND MANAGEMENT

POWER ENGINEERING

SERVICES

- Power industry economy models (power transmission and distribution networks, consumption areas)
- Economic evaluation of power sources and their modes of utilisation
- Power industry management systems
- Consulting in the fields of quality management system implementation and certification, environmental protection and occupational health and safety (QMS, EMS, EMAS, OHS)

EQUIPMENT

- Software tools for process simulations: Matlab, Dynast, ATP, E¬ vlivy (environmental stress effects)
- Dispatching centre for the power generation and distribution process modelling and evaluation: the information and communication environment laboratory for remote processing of the measured data

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CLIMATIC, THERMAL AND VIBRATION TESTS



INTERDISCIPLINARY ACTIVITIES

SERVICES

- Environmental stress tests (temperature, humidity, vibration)
- Material aging tests
- Functional tests of equipment exposed to environmental stresses
- Long-term aging of insulation materials exposed to the action of elevated temperature and/or alternating or pulse voltage
- Accredited tests*

* The Electrotechnical Laboratory (ETL) is accredited with the Czech Accreditation Institute (CIA)

EQUIPMENT

- Thermal shock test chamber (rapid change: –80°C / +220°C)
- Dry and humid heat climatic chamber of 180 litres (–70°C to 180°C, 10 to 98% RH)
- Dry and humid heat climatic chamber of 600 litres (–70°C to 180°C, 10 to 98% RH) with the optional combination of climatic and vibration tests
- Corrosion test chamber (condensation and salt mist tests)
- Exhaust emission test chamber (up to 4 gases: Cl2, SO2, NOx, H2S)
- Vibration bench 10kN, tests in the vertical and horizontal directions
- Muffle furnace for temperatures up to 1,350°C
- Test equipment for combined stress aging of insulators with AC (24kV) or pulse (± 5kV) voltage and temperature up to 300°C

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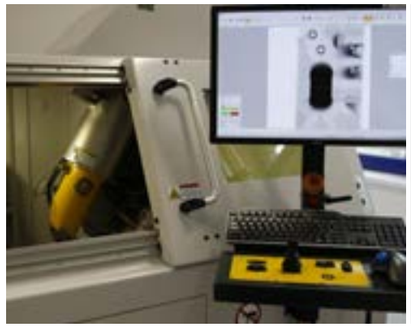
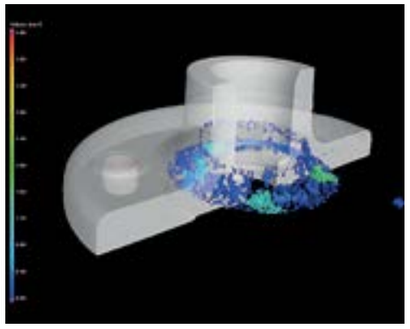
IMAGE ANALYSIS AND MATERIALOGRAPHY





INTERDISCIPLINARY ACTIVITIES

SERVICES

- Precise measurement of dimensions with 5 to 150,000-times magnification
- Non-contact surface roughness measurement with 150 to 150,000-times magnification
- Colour 3D surface reconstruction
- Materialographic cross-section sample preparation technique
- EDS elemental analysis
- 2D X-ray inspection
- 3D X-ray computed tomography

EQUIPMENT

- Laser confocal microscopy: max. magnification 14,400 times, resolution on X and Y axes 120nm, on Z axis 50nm, colour 3D surface reconstruction and surface roughness measurement capabilities
- Olympus LEXT OLS3000
- Electron microscopy: max. magnification 100,000 times, resolution 17nm, elemental analysis (EDS), elemental mapping and line scan features
- AFM microscopy: max. magnification 150,000 times, max. resolution 1nm, max. dimensions of the investigated object 20µm x 20µm x 3µm, contact and non-contact operation modes, 3D surface reconstruction capability
- Industrial X-ray CT scanner: max. detail detectability 1µm, max. sample size 250 x 400mm (d x h), max. sample weight 10kg
- GE phoenix v|tome|x s 240
- Fluorescent microscopy: max. magnification 3,200 times, 3-axis fully motorised table, high-sensitivity microscope camera, image analysis

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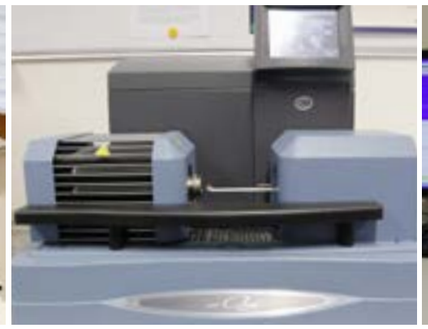
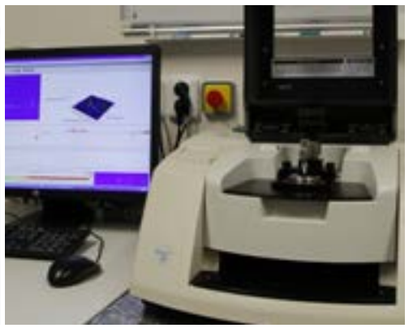
THERMAL ANALYSIS AND FTIR

INTERDISCIPLINARY ACTIVITIES

SERVICES

- Phase transition investigation: measurement of glass transition temperature (Tg), crystallisation temperature (Tc), melting temperature (Tm), measurement of oxidation stability and others
- Measurement of enthalpy of chemical reactions (curing, crosslinking, melting, decomposition and others)
- Analysis of the degree of curing/crosslinking in thermoset and thermoplastic materials
- Reaction kinetics investigation: determination of activation energy, pre-exponential factor and rate constant
- Measurement of the thermal expansion coefficient (CTE)
- Measurement of mechanical properties of materials using dynamic mechanical analysis (DMA)
- Measurement of thermal and weight stability of materials
- Determination of the amount of organic and inorganic fillers
- Density measurements of samples in solid and liquid state
- Analysis of gases evolved during thermal decomposition of the material under test
- Analysis of oxidation and nitration products in insulating liquids
- Qualitative analysis of solid and liquid substances
- Material quality control, contamination analysis

EQUIPMENT

- Differential Scanning Calorimeter (DSC): temperature range -90 to 550°C, modulated DSC mode (MDSC) of operation in combination with UV Light Curing System (Qmnicure series 2000)
- TA Instruments DSC Q2000
- Simultaneous Thermal Analyser (STA): temperature range ambient to 1,500°C, true simultaneous measurements of weight change (TGA) and true differential heat flow (DSC) on the same sample. STA can be combined with an FTIR apparatus to analyse gases evolved during thermal decomposition of the material under test.
- TA Instruments SDT Q600
- Thermomechanical Analyser (TMA): temperature range -150 to +1,000°C, dynamic mode (DTMA) measurements making possible analysis of the reversing and non-reversing dimension change components
- TA Instruments TMA Q400EM
- Dynamic Mechanical Analyser (DMA): temperature range -150 to 600°C, optional clamps: dual/single cantilever, 3-point bend, shear, tension (film, fibre) and compression
- TA Instruments DMA Q800
- Fourier transform infrared spectrometer (FT-IR): spectral range 400 to 4,000cm-1, modes of measurement and analysis: Attenuated Total Reflectance (ATR), transmission mode, Evolved Gas Analysis (TGA-FTIR)
- Thermo Scientific Nicolet 380
- Analytical Balance: weight range 1mg to 52g

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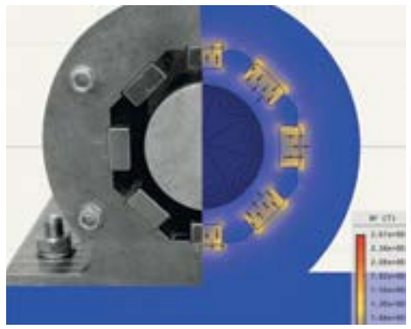
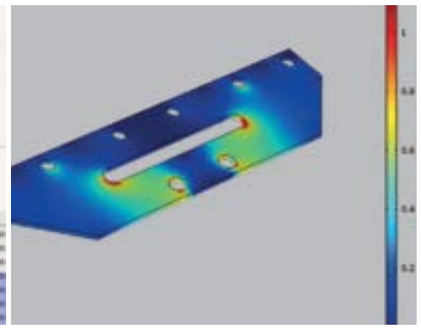
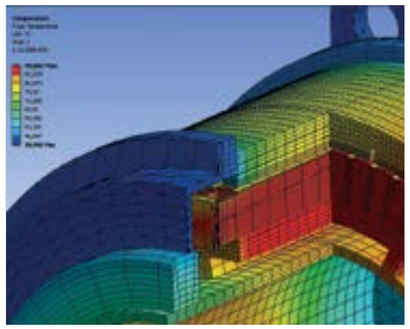
PHYSICAL FIELD MODELLING

INTERDISCIPLINARY ACTIVITIES

SERVICES

- Analysis of stationary and nonstationary electromagnetic fields in linear and nonlinear media including the effects produced by such fields (forces and strains in insulation systems), integral parameter computations
- Solutions for coupled problems – simultaneous actions of several physical fields influencing one another
- Solutions for electromagnetic and metallurgical problems including models with variable geometry and phase changes (cladding, welding, keyhole problems)
- Solution for magnetohydrodynamic problems, e.g. stirring of molten metal by magnetic field
- One- and multi-parametric optimisation methods applied to solving various electrical engineering problems
- Application of integral equations for electromagnetic field analysis

EQUIPMENT

- Agros Suite: a complex environment for modelling multi-physical problems and optimisation tasks
- ANSYS Maxwell: environment for solving physical fields, especially electromagnetic fields
- COMSOL Multiphysics: a tool intended for modelling and simulation of complex multi-physics problems
- CST Studio Suite: design and analysis of high-frequency electromagnetic systems
- MATLAB: environment for scientific and technical computations, modelling, algorithm design and data presentation, parallel computations, signal measurement and processing, design of control and communication systems
- Simulink: environment for dynamic system design and modelling
- LabView: graphic and development environment for the design of measuring and other systems

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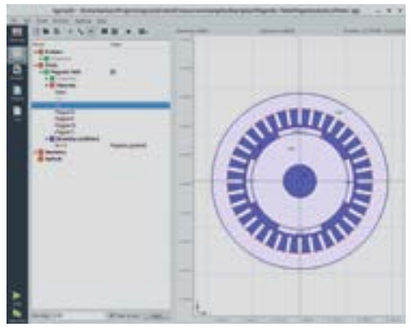
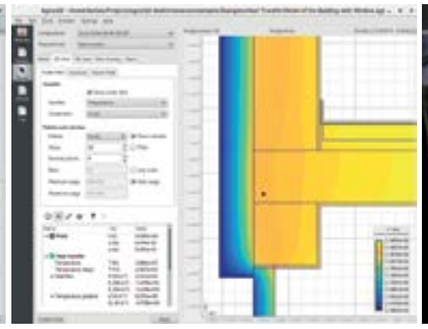
DEVELOPMENT OF SOFTWARE APPLICATIONS


INTERDISCIPLINARY ACTIVITIES

SERVICES

- Development of proprietary SW applications for computer analysis of physical fields and coupled problems
- Parametric studies and optimisation of developed devices
- Development of scalable distributed applications suitable for running on large clusters
- Development of mobile applications using the Android, Java and Qt platforms
- Development of multiplatform applications for operation systems Windows, Linux and Mac OS X on the Qt platform

EQUIPMENT

- Agros Suite platform for solutions of physical fields described by partial differential equations based on advanced higher-order finite element method with automatic adaptivity in both space and time domains
- Environment for software development in C/C++, Java and Python languages
- Computation cluster PowerEdge R730 (8 Intel Xeon E5, in total 128 cores and 2.5 TB RAM, more than 15 GFlops)
- Applications for modelling physical fields: Agros Suite, COMSOL Multiphysics, CST Studio Suite, ANSYS Maxwell
- Universal applications and environments: Matlab, Octave, Wolfram Mathematica, Python, C/C++

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TEMPERATURE FIELD MONITORING



INTERDISCIPLINARY ACTIVITIES

SERVICES

- Surface temperature distribution measurement and analysis
- Contactless measurement of temperature in electric machines and live electric equipment
- Measurement of temperatures of radiator bodies of heating systems and analysis of their functions
- Measurements of the thermal phenomena associated with short circuits and transition resistances
- Measurements on external insulation layers and building facades, thermal insulation quality assessment
- Searching for spots of excessive thermal losses in building structures and insulation materials
- Analysis of temperature fields inside buildings in connection with identification of water condensation risks

EQUIPMENT

- Thermal camera Fluke Ti-55FT for radiometric and contactless measurement of temperature images
- Pyrometer Omega OSXL689 for contactless point temperature measurements
- System Omega MWTC for contact temperature measurements with wireless data transmission
- Measuring card NI DAQ 9213 for multichannel measurements
- Heatmaster HM190: thermocouple cladding set

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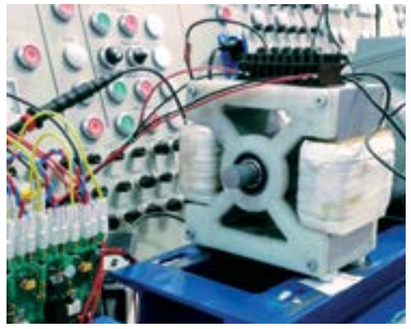
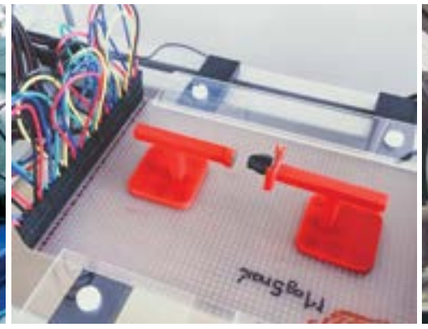
DEVELOPMENT OF LINEAR ELECTROMECHANICAL ACTUATORS


INTERDISCIPLINARY ACTIVITIES

SERVICES

- Development of linear electromechanical actuators
- Mathematical modelling and simulation of the dynamic behaviour of electromechanical actuators
- Electromechanical actuator design optimisation
- Development and implementation of control algorithms for linear electromechanical systems
- Complex testing and functional diagnostics for linear DC and AC actuators (measurement of the feeding circuit parameters, measurement and mapping of the magnetic flux density, temperature rise measurements)
- Measurement of static and dynamic characteristics of actuators

EQUIPMENT

- Load cells for measuring pressure and tensile forces ranging from 0 to 1kN (with the measurement precision ± 1N)
- Experimental stand MARK-10 ES3DE for measuring forces up to 1kN on a path of maximum length 350mm
- Digital deviation meter MARCATOR 1088 W with the measuring range to 25mm and resolution 1μm
- High-speed camera BASLER acA2000-340km with the frame frequency of 340fps, resolution 2MP and linear accelerometers
- RLC meter Agilent HP 4263B for measurements of resistances, inductances and capacitances with accuracy 0.1% in the frequency range of 20Hz to 1MHz
- Teslameter Elimag MP-1 for measurement of magnetic flux density of static and quasi-static magnetic fields in the range of 10mT to 2T with maximum measurement precision ± 0.1mT

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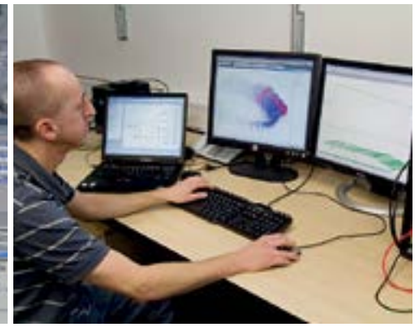
ACOUSTIC MEASUREMENTS





INTERDISCIPLINARY ACTIVITIES

SERVICES

- Noise measurements and frequency analysis in the audible frequency range (FFT analysis, 1/n-octave analysis)
- Free-field sound power measurements using the sound intensity measurement method
- Sound intensity measurements, localisation of sound sources using the sound intensity mapping method
- Electroacoustic transducer parameter measurements
- Measurements of the sound source directional characteristics
- Vibration measurements
- Measurement of the sound absorption properties of acoustic materials
- Room parameter measurements (reverberation time, STI-PA)
- Acoustic modification project design
- Multichannel sound recording of public cultural events

EQUIPMENT

- Anechoic chamber: volume 128.8m3, test room dimensions 5.0 x 4.1 x 6.4m, temperature range 20 to 30°C, cut-off frequency 100Hz, compliance with the requirements of standard CSN EN ISO 3745
- Reverberation chamber: volume 214.9m3, test room dimensions 6.8 x 5.3 x 6.1m, compliance with the requirements of standard CSN EN ISO 354
- Brüel & Kjaer sound analyser, up to 9 channels (software FFT & CPB Analysis, Noise Source Identification, Sound Quality, Datarecorder, Order Analysis)
- Measuring microphones Brüel & Kjaer 4190 for free-field measurements, Brüel & Kjaer 4943 for diffuse-field measurements, Brüel and Kjaer 4955 for low-level noise measurements, uniaxial, triaxial, charge and CCLD accelerometers, sound intensity probe Brüel & Kjaer 3599
- Hand-held sound level meters Brüel & Kjaer 2260, NTi XL2, remote-control turntable for measuring of the sound source directional characteristics, power amplifiers, multichannel signal processors (Sabine), equalizers (Rane), AD/DA converters (RME), sound sources (point, omnidirectional, loudspeaker systems)
- Mobile 24-channel HDR recording system Alesis HD24, two channel hand-held recorders Sony, Marantz, Tascam

As most of the equipment is mobile, it can be used for both laboratory and field measurements

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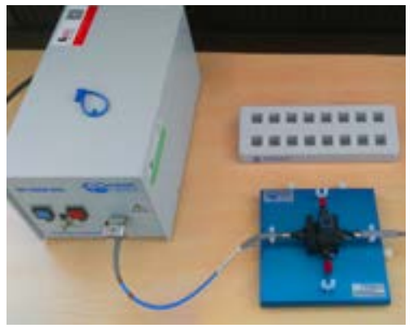
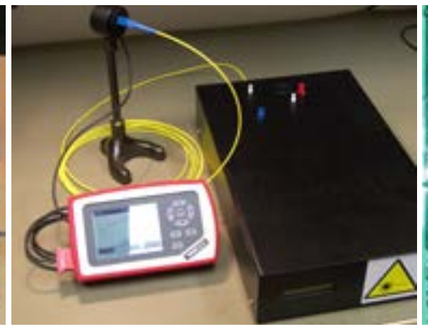
OPTOELECTRONIC AND UV-VIS SPECTROPHOTOMETRIC MEASUREMENTS





INTERDISCIPLINARY ACTIVITIES

SERVICES

- Measurements of the output power of optical sources working within the infrared band (including LEDs and lasers with pigtailed output): wavelength range 800 to 1,700nm, maximum optical power 500mW
- UV-VIS spectrophotometry used for substance identification or characterisation
- Absorption spectra measurements where the substance under test can be dissolved in any solvent
- Measurements of concentration of dyes and other organic substances
- Spectrum measurements on different types of light source
- Measurements of time-dependent reactions and processes (kinetic measurements)
- Measurements at specific wavelengths

EQUIPMENT

- PM100D Thorlabs power and energy meter equipped with the integrating sphere sensor head S144C
- Ocean Optics Spectrometer QE65Pro: a single-beam spectrophotometer, wavelength range 200 to 1,100nm, the radiation sources: tungsten and deuterium lamps for the visible and ultraviolet light spectra, respectively

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