ANNUAL REPORT

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Department of Microelectronics
Faculty of Electrical Engineering
Czech Technical University in Prague
Czech Republic

CONTENTS:

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Edited by Jan Vobecký (December 2000)

FOREWORD

The Department of Microelectronics belongs to The Faculty of Electrical Engineering (FEE) that is one of the five faculties forming the Czech Technical University in Prague (CTU in Prague). The roots of CTU in Prague can be followed as far back as the year 1705, when Christian Josef Willenberg (1655 - 1731) wrote a letter to Emperor Leopold I. in Vienna seeking permission to begin public teaching of engineering sciences. This was granted by a decree of Emperor Josef I (successor to Leopold I.) on 18 January 1707. For these reasons, the priority of CTU to be the first technical school at university level in the world is usually claimed for.

The Department of Microelectronics has been established in January 1977. During the past 23 years more than 1000 students graduated in the branch of Microelectronics and 30 Ph.D and 5 DrSc. degrees have been awarded. Five persons from the Department staff became professors and 14 Associate Professors. The Department offers the B.Sc., M.Sc. and Ph.D. degrees in Electronics.

The Department maintains international co-operation with many universities, research laboratories, and institutes in the Europe, namely in connection with the TEMPUS Joint European Projects, NEXUS and COPERNICUS projects and in the frame of the NATO Science for Peace programme. This year, a TEMPUS project, entitled Education for European Business Economics and Law at Technical Universities (ELEGIS), was finished. Many further activities are maintained by means of the EUROPRACTICE projects.

The Department gives a high priority to collaborative research with industry, e.g. ABB Semiconductors AG, MOTOROLA, ST Microelectronics, Vitatron, CertiCon a.s., Polovodiče a.s., etc. Successful technology transfer projects include advanced irradiation techniques and simulation approaches dedicated to modern power devices.

This brochure is the 11th annual review of our Department. The contents of this report emphasise our effort for continuing the close association of teaching, research and co-operation with external subjects at a national and international level.

Prague — Jan Vobecký
December 2000 — Editor

STAFF OF THE DEPARTMENT

Head of the Department:	M. Husák, M.Sc., Ph.D.
Deputy:	J. Schrőfel, M. Sc., Ph.D., DrSc.

Professors:	M. Husák, M.Sc., Ph.D.
	J. Kodeš, M.Sc., Ph.D., DrSc.
	J. Vobecký, M.Sc., Ph.D., DrSc.
Associate Professors:	Z. Burian, M.Sc., Ph.D.
	J. Foit, M.Sc., Ph.D.
	P. Hazdra, MSc., Ph.D.
	J. Schrőfel, M.Sc., Ph.D., DrSc.
	M. Šemberová, M.Sc., Ph.D.
	V. Třeštíková, M.Sc., Ph.D.
	F. Vaníček, M.Sc., Ph.D.
	J. Voves, M.Sc., Ph.D.
Assistant Professors:	J. Jakovenko, M.Sc.
	L. Jirásek, M.Sc., Ph.D.
	M. Kirschner, M.Sc.
	A. Krejčiřík, M.Sc., Ph.D.
	Z. Rozehnal, M.Sc., Ph.D.
	V. Záhlava, M.Sc., Ph.D.
Research Fellows:	P. Tesař, M.Sc.
	R. Vít, M.Sc.
Ph.D. students:	Z. Brychta, M.Sc.
	L. Čopák, M.Sc.
	J. Burčík, M.Sc.
	V. Janíček, M,Sc.
	P. Jelínek, M.Sc.
	J. Novák, M.Sc.
	B. Palán, M.Sc.
	L. Polívka, M.Sc.
	M. Slunečko, M.Sc.
	O. Starý, M.Sc.
	T. Váňa, M.Sc.
	J. Vít, M.Sc.

SUPPORT STAFF

Administration

R. Burianová
H. Kubátová

Teaching Laboratories:

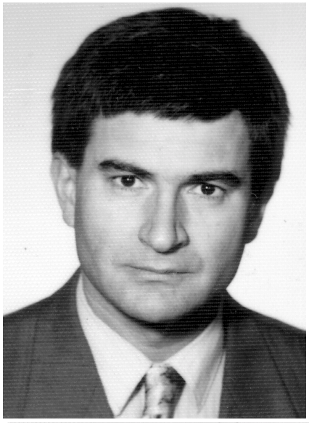
L. Kafka

Technical Service

M. Horník
P. Telinger, Mgr.

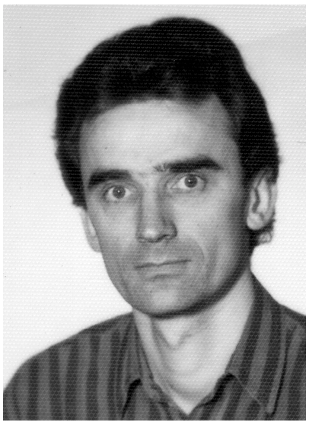
Military Service (duty to compensate) F. Černý

ABOUT THE STAFF



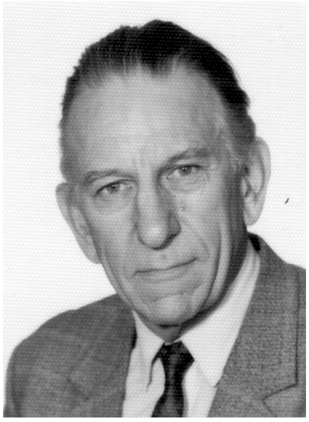
Miroslav Husák was born in 1953. He graduated in Radioengineering. Ph.D degree in 1985 from FEE-CTU. 1978-1984 research fellow in the Department (device modelling). Assistant Professor from 1984, Assoc. Professor from 1997, Full Professor from 2000. He is the author of 3 lecture notes, co-author of 1 exercise note and 45 technical papers. He is working in the field of sensors, sensor systems and microsystems. He is teaching the courses Sensor systems, Power Suppliers in electronics and Sensors in Security systems and Microsystems.

Jiří Kodeš was born in 1932. He received MSc., Ph.D., and D.Sc. degrees in electronics, semiconductor physics and microelectronics from the CTU in Prague in 1956, 1963 and 1990, resp. At present, he is Full Professor at the Department. His area of research includes electronic transport in semiconductors and quantum electronics devices. He is the author or co-author of numerous technical papers in journals and conference proceedings. He has written several textbooks for students.



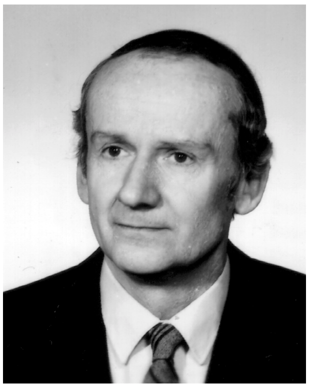
Jan Vobecký was born in 1957. He graduated in Electrotechnology from the FEE-CTU in 1981. PhD. degree in 1988, Assoc. Professor in 1992, DrSc. degree in 1999, Full Professor in 2000. In 1988, 1989/90, and 1993 visiting fellow in the University of Uppsala, and MOTOROLA Toulouse, resp. Author of numerous technical papers, 2 patents, one textbook and 8 printed lectures. He is teaching Electronics, TCAD and Modern power devices. Research in the field of power devices and ICs. Chairmen of the IEEE-EDS in the Czech Republic.

Zdeněk Burian was born in 1944. He graduated from the FEE-CTU in 1966. In 1975 he received PhD. degree. He is the author of 35 technical papers, 10 printed lectures and he owns 7 technical inventions. He is Assoc. Professor and gives lectures on optoelectronics. He is working in the field of integrated optics and planar optical waveguides. He researched the optical waveguides in silica in University of York, U.K.. Member of EOS and Czech Society of Photonics.



Julius Foit was born in 1932. He received MSc., PhD. and Ass. Prof. degrees in Radar Engineering, Colour TV Eng. and Multiphase Signal Processing from the CTU in Prague in 1954, 1961 and 1978, resp.. Dean of the Faculty in the University of Maiduguri, Nigeria in 1987-1989 and B. Tech. Programme Coordinator in the University of Zimbabwe, Harare, in 1990-1993. Currently, he is Associate Professor in the Dept. He is the author of many papers, several monographs and textbooks for students. He is a Fellow of ZIE and President-elect of Rotary Int.

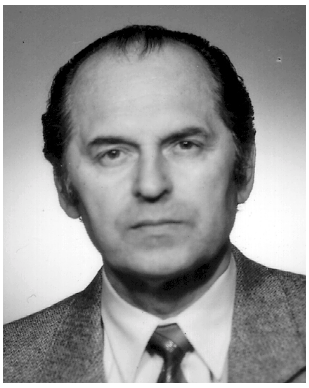
Pavel Hazdra was born in 1960. M.Sc. and Ph.D. in Microelectronics from FEE-CTU. In 1987 and 1996 he became Assistant and Assoc. Professor, resp. In 1988, 1992, and 1993 visiting fellow at the University of Surrey, Hull, and Lund, resp. Research on defects in semiconductors and characterization (DLTS, etc.). Manager of the Electron Device Group. More than 70 scientific and technical papers, 2 patents and printed lectures.



Josef Schrőfel was born in 1933. He graduated from FEE-CTU in Prague in 1956. PhD. degree from STU Bratislava in 1972, D.Sc. degree from CTU in Prague in 1994, and Assoc. Professorship in 1996. In 1974-1990 he was with Tesla Research Inst., Prague, working in research on electronic components, thin-films, solid state surface phenomena and semiconductors. Since 1975 his field is optoelectronics, optical fibres and integrated optics. He is the author of about 120 papers, 17 patents, 2 monographs and 3 books. Member of IEEE and EOS.

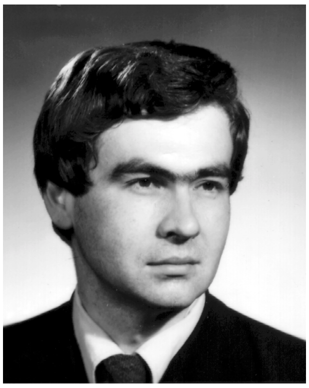
Miroslava Šemberová was born in 1939. She graduated in Radioelectronics from the FEE-CTU in Prague, in 1961. She received PhD. degree in 1973 and Associate Professorship in 1985. She is author of 12 technical papers and 10 printed lectures. She gave lectures in the area of electronic and microelectronic components. She was involved in research program concerning MOS integrated circuits and, at present, she is interested in sensors.

Vladimíra Třeštíková was born in 1943. She graduated in Automation technique from the FEE CTU in Prague, in 1965. She received PhD. degree in 1980 and became Associate Professor in 1985. She is presently teaching Electronic and Microelectronic Devices. She is the author of 5 printed lectures and 12 technical papers. She was involved in research program concerning MOS integrated circuit technology and, at present, she is interested in sensors.



František Vaníček was born in 1936. He graduated in Radioelectronics from the FEE-CTU in Prague, in 1960. PhD. in 1972 and Assoc. Professorship in 1978. From 1972 to 1975 he gave lectures in MTC Kahira, Egypt, and from 1981 to 1983 in HIE Beni Walid, Lybia. He is the author of 15 techn. papers and 10 printed lectures. He is teaching in the area of semiconductor structures and their models. The winter term of 1992 and 1993 he spent in KIHWV Ostende in the frame of TEMPUS programme.

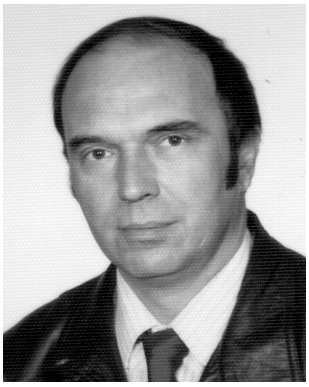
Jan Voves was born in Prague in 1960. MSc. and RNDr. degree in Physical Electronics and Optics from the Charles' University in Prague in 1984. Since 1984, Research Assistant in the Department (characterisation of ion implanted doping profiles in semiconductors). From 1987 and 1996, Assistant and Assoc. Professor, resp. Ph.D in 1993. Research in the device physical modelling (Monte Carlo Method). Author of about 30 technical papers and 3 printed lectures. Member of the IEEE.



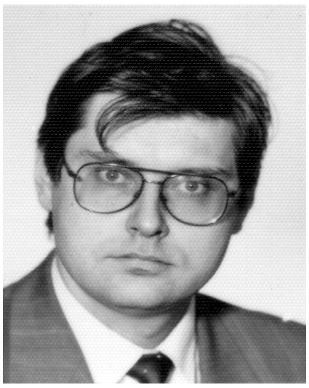
Lubor Jirásek was born in Prague in 1953. He graduated from the FEE CTU in Prague, in 1978. He received PhD. degree in Electronics in 1983. From 1978 to 1983 he was working as a Research Fellow in the area of high-power devices. He is author of 7 technical papers and 3 printed lectures. He is teaching in the area of semiconductor devices and solid-state physics. Presently, he is responsible for the curriculum of the Department.

Jiří Jakovenko was born in Prague in 1972. He graduated in Microelectronics from FEE-CTU in Prague. He started his PhD. study with Microsystems group where he deals with the MEMS design and modeling. In 1998 he spent four months in Hogeschool Gent in the frame of TEMPUS programme. Since 1999 he is an Assistant Professor at the Department. He is teaching Electronics and IC Design.

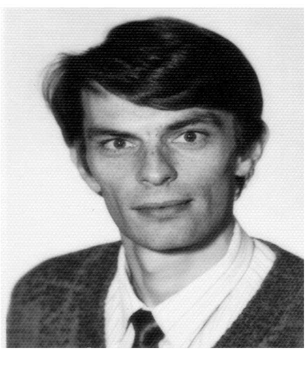
Michal Kirschner was born in Prague in 1960. He graduated from the FEE-CTU in Prague in 1984. He had been with TESLA Research Inst. for Telecommunications till 1991. There he worked in a laboratory for measurement of test structures for characterisation of CMOS ICs. Since 1991 he is an Assistant Professor at the Department. He deals with the IC design.



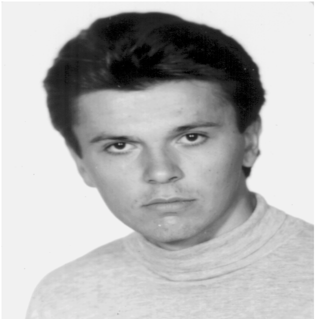
Alexandr Krejčiřík was born in 1947. He graduated in Electrotechnology from the Faculty of Electrical Engineering, CTU in Prague, in 1971. He received PhD. degree in Mathematics and Physics – branch Semiconductors. He is the author of 10 technical papers, 21 printed lectures and 6 textbooks. He is teaching courses on Electronics, Power supplies and Computer Peripherals.



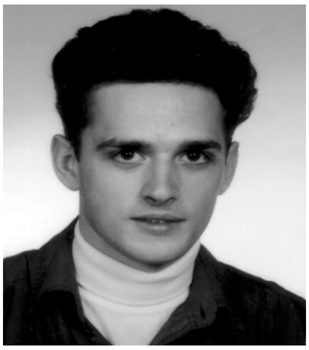
Zdeněk Rozehnal was born in Prague in 1963. He graduated in Microelectronics from the Faculty of Electrical Engineering, CTU in Prague, in 1987. At present, he is working as an Assistant Professor. He is teaching electronics, microprocessors, single-chip microcomputers, PLDs and digital technique. He is the author of 20 technical papers, 3 printed lectures and holder of two certificates of technical invention.



Vít Záhlava was born in Prague in 1965. He graduated in Microelectronics from the FEE-CTU in Prague in 1988. He received Ph.D. degree in 1994. He is teaching the basic course of electronics and pcb design. His current interest is EMC on pcb, design, application and testing of pcb. He is the author of 3 textbooks, several printed lectures for students, and technical papers on power devices.



Petr Tesař was born in Strakonice in 1971. He graduated in Microelectronics from the FEE-CTU in Prague, in 1994. The last two terms of his study he joined KIHWV, Oostende, Belgium, where he dealt with the design of On chip Iddq sensors for CMOS logical circuits (analog design). At present, he is research fellow in the Department. He is a member of Microsystems group.

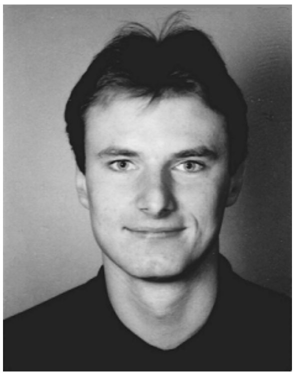


Radek Vít was born in Trutnov in 1971. He graduated in Microelectronics from the FEE CTU in Prague, in 1994. The last two terms of his study he joined the KIHWV, Oostende, Belgium, where he dealt with the design of Built in Sensors (BIC) for CMOS logical circuits (analog design). At present, he is research fellow in the Department. He is a member of Microsystems group.

Zdeněk Brychta was born in Dačice in 1973. He graduated in Microelectronics from the FEE-CTU in Prague in 1999. He is working towards his Ph.D. He is member of the Optoelectronic group. His work is concentrated on the fabrication and diagnostics of optical planar elements.

Jaroslav Burčík was born in Havlíčkův Brod in 1973. He graduated in Microelectronics from the FEE-CTU in Prague, in 1998. He is working towards his Ph.D in the field of optoelectronics and optical networking. He is a member of the Optoelectronic group.

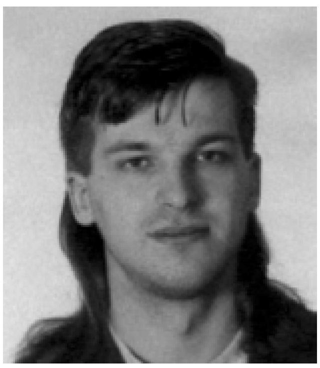
Libor Čopák was born in Jablonec nad Nisou in 1975. He graduated in Microelectronics from the FEE-CTU in Prague in 2000. He is working toward his PhD. He is a member of the Microsystems group. His activity is concentrated on the temperature fiber optic sensors.



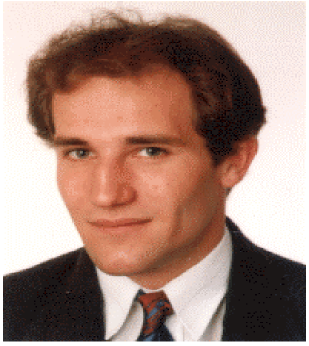
Vladimír Janíček was born in 1974 in Most. He graduated in Microelectronics from the FEE-CTU in Prague. He is a member of Microsystems group. He is currently working towards his PhD. His research is in the field of optimization of charge process. At present, he takes part on a study stay abroad.

Jan Novák was born in Prague in 1973. In 1998, he graduated in Microelectronics from the FEE-CTU in Prague. He is working towards his PhD. in the field of Electromagnetic compatibility of Neural Networks. He is a member of the Microsystems Group.

Bohuslav Palán was born in Pelhřimov, CZ, in 1973. He graduated in Microelectronics from the CTU in 1997. He joined TIMA Lab., Grenoble, France, (analog IC design of ISFET and pressure sensor interfaces - BARMINT ESPRIT III European project). His current research includes analog ASIC design, microsensors and microsystems for biomedical applications. Student member of Audio Engineering Society.



Leoš Polívka was born in 1974 in Semily. He graduated in Microelectronics from FEE-CTU in Prague in 1999. He is working towards his PhD. He is a member of the Optoelectronics group. His work is concentrated on the fabrication and measurement of optical waveguides on semiconductors substrates.



Martin Slunečko was born in 1972 in Pacov. He graduated in 1997 in Electrotechnology from the FEE CTU, Prague. He is working towards his PhD. He is a member of the Optoelectronic group. His work is concentrated to the fabrication and diagnostics of optical planar elements.

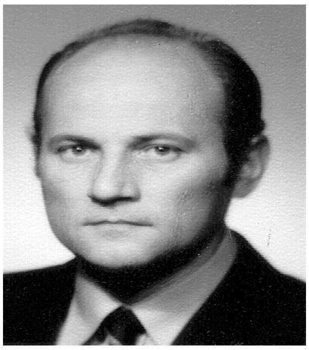
Ondřej Starý was born in Prague. He graduated in Telecommunications from the FEE-CTU in Prague in 1999. Since 2000, he is working towards his Ph.D. in the Department of Microelectronics. He is a member of the Microsystems group.

Josef Vít was born in 1974 in Třebíč. He graduated in Microelectronics from the FEE-CTU in Prague in 1999. He is currently working as a PhD student in the Electron Device Group. His research is in the field of bipolar power devices, lifetime engineering, and TCAD simulation of electron and ion irradiated power semiconductor devices.

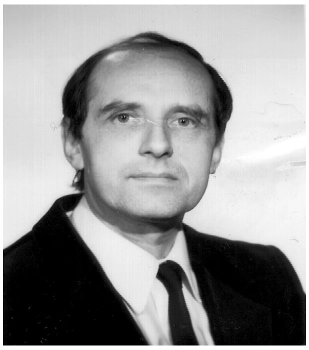
Tomáš Váňa was born in 1975 in Pardubice. He graduated in Microelectronics from the FEE-CTU in Prague in 2000. He is currently working as a PhD student in Microsystems group. His research is in the field of optoelectronics sensors and microsystems.

Renáta Burianová was born in Prague in 1960. She graduated from grammar school in 1979 and Secondary school for librarians in 1981. She joined the Department of Microelectronics in September, 1981. From that time she has been in charge of administrative work of the Department.

Hana Kubátová was born in Český Brod in 1941. She graduated from Secondary Business school in 1958. She joined the Department of Microelectronics in 1977. Since that she has been in charge of organisational and administrative work of the Department, mainly as the Departments secretary.



Lubomír Kafka was born in 1943. He attended the grammar school from 1958 to 1961. From 1961 to 1963 he studied the secondary school on "Mechanic of electronic equipments". In 1965 he joined the CTU in Prague as a technician. At present, he is working as a technician in the Department. He is responsible for teaching laboratories. He is engaged in mechanical and electronic service.

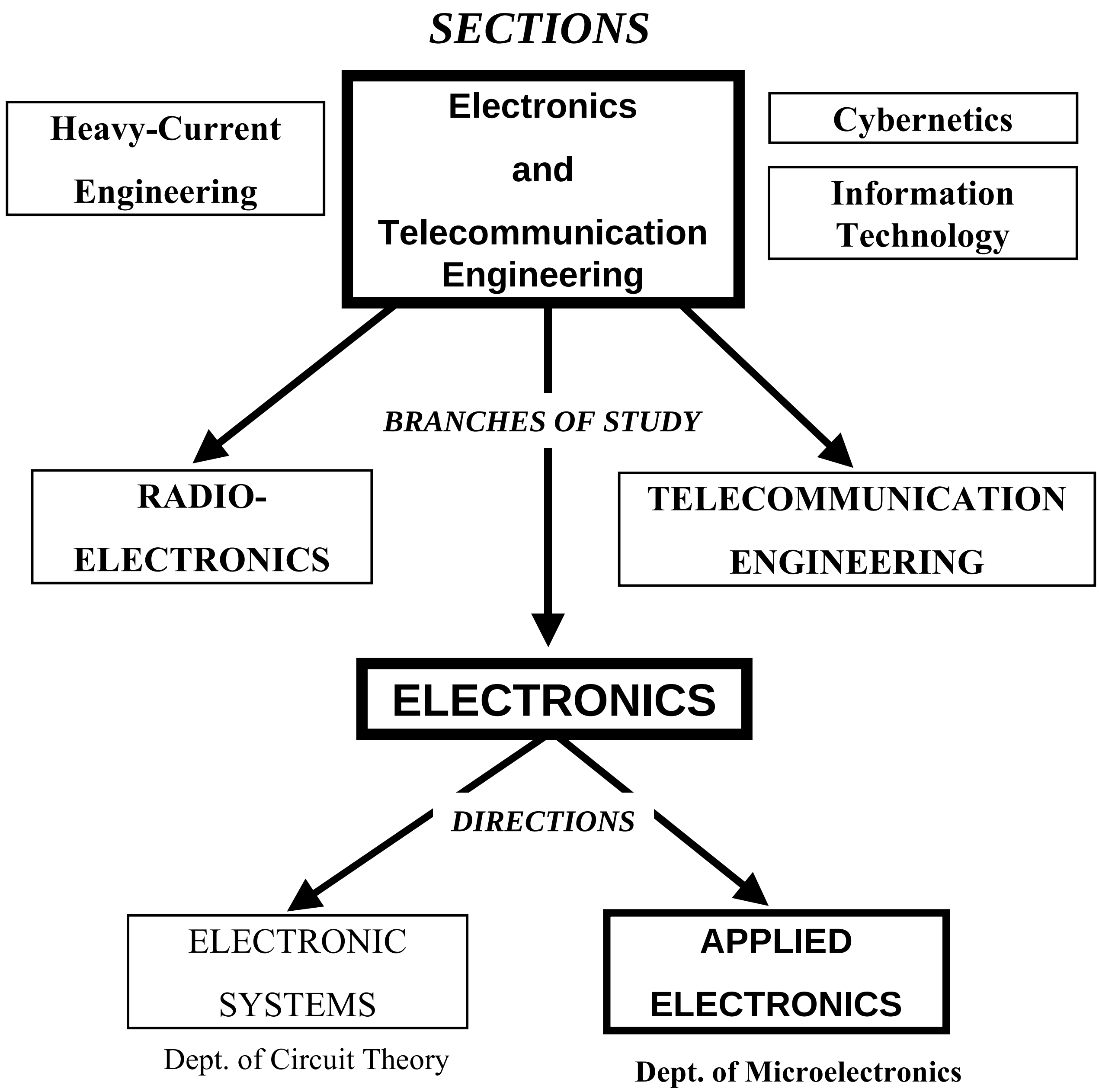


Miroslav Horník was born in Prague in 1946. He graduated in 1966 at a Secondary school specialized in Machinery engineering in Prague. He joined CTU Prague, then the Institute of Physics, Czechoslovak Academy of Science and, nowadays, he is working in the Department as a technician. He provides repair and service of miscellaneous tools and equipments.

Filip Černý was born in 1979. In 1999, he graduated from Dance Conservatory in Prague. He spent one year with Liberec Theatre of F. X. Šalda as a soloist. At present, he is a member of technical service of the Department in the frame of the civil military service.

UNDERGRADUATE TEACHING

Organization of study at the Faculty of Electrical Engineering



BRANCH OF STUDY ELECTRONICS

The objective of the electronic branch of study is to educate electrical engineers who should be competent to solve problems concerning the wide spectrum of the structure of electrical industry and also extending to the field of information and computing technology, ecology, health care, mechanical engineering, robotics, etc..

The study involves the necessary theoretical introduction into subjects that provide general education for an electrical engineer which is followed by specialized courses. As to specialized orientation, the stress is laid on electronic components, semiconductor structures, digital and analog electronic circuits, microelectronics, application specific integrated circuit design, microcomputers, signals and electronic systems, sensors, design of electronic equipment, integrated and coherent optics, radiation sources and detectors, applications of optoelectronics and telecommunication systems.

The study of the applied electronics and electronic systems aims to prepare engineers who should be able to solve problems of the applications of integrated circuits and of the special electronic structures and systems, as well as the electronic instrumentation design. The students should master the digital signal processing methods and the implementation of algorithms in the special processor systems.

The optional subjects in the higher terms provide the students an opportunity of individual choice of their further specialisation emphasising the applications of electronics, electronic systems, optoelectronics and physical electronics.

The topics of lectures, laboratory and seminar exercises have been selected so that a student can master the reported stuff perfectly also in practice. The Department of Microelectronics endeavours to give the students, especially those with excellent results, the possibility of satisfying their professional ambition home, as well as abroad. The graduates are also offered a possibility of further postgraduate (Ph.D) studies. We believe that the graduates of our specialisation will find good jobs in industry of developed countries.

CURRICULUM OF THE BRANCH ELECTRONICS
Obligatory and facultative subjects
(first two years of study):

Course name	Lectures and exercises in hours per week	Term
Obligatory subjects:		
Mathematics I	3 + 4	Winter
Introduction to Algebra	2 + 2	
Introd. to Computers Design and Programming I	3 + 2	
Physical Chemistry	2 + 1	
Introduction to Electrical Engineering	1 + 1	
Technical Documentation	2 + 2	Win/Sum
Economics	2 + 2	
Mathematics II	3 + 3	Summer
Mathematical Logic	2 + 1	
Introd. to Computers Design and Programming II	2 + 2	
Physics I	3 + 3	
Circuit Theory I	3 + 2	
Mathematics III	3 + 2	Winter
Physics II	4 + 3	
Circuit Theory II	3 + 2	
Material Technology for Electronics	2 + 1	
Electronics Microelectronics Dept.	2 + 2	
Electrical Measurements	3 + 3	
Mathematics IV	3 + 3	Summer
Electromagnetic Field Theory I	3 + 3	
Introduction to Computer Systems	2 + 2	
Facultative subjects:		
Basic Course on Power Electronics	3 + 2	Summer
Materials and Technology	3 + 2	

Obligatory and facultative subjects of the branch Electronics

Bachelor Study (beginning from the third year of a study (Microelectronics, Optoelectronics, Applied Electronics)

Course	Lectures and exercises in hours per week	Term
Obligatory subjects:		
Electron Devices Microelectronics Dept.	3 + 3	Winter
Electronic Circuits	4 + 2	
Mathematics V	2 + 2	
Electromagnetic Field and Waves	3 + 3	
Facultative subjects:		
Power Supply for Electronics Microel. Dept.	2 + 2	
CAD for High Frequency Techniques	2 + 2	
Analysis of Electronic Circuits	2 + 2	
Obligatory subjects:		
Basic Course on Digital Techniques	3 + 3	Summer
Linear Circuits and Systems	2 + 2	
Signals and Systems	4 + 2	
Facultative subjects:		
Microcomputers Microelectronics Dept.	2 + 2	
Circuit Tech. of Electronic Systems	2 + 2	
Antennas and Wave Propagation	2 + 2	
Obligatory subjects:		
Telecommunication Systems	3 + 3	Winter
Bachelor Project (only for st. ended as BSc.)	0 + 6	
Facultative subjects:	2 + 2	
Microelectronics Microelectronics Dept.	2 + 2	
Optoelectronics Microelectronics Dept.	2 + 2	
Sensor Systems Microelectronics Dept.	2 + 2	
Introd. to Digital Signal Processing	2 + 2	
Electrical Filters	2 + 2	
Application of Signal Processing for DSP	2 + 2	

MSc. COURSE
CURRICULUM OF THE BRANCH ELECTRONICS

Obligatory and facultative subjects (beginning from the fifth year of a study)

Course name		Lectures and exercises in hours per week	Term
Obligatory subjects:			
Mathematics VI		2 + 2	Winter
Digital signal processing		3 + 2	
Electronics of Semiconductors	Microelectron. Dept.	2 + 2	
Facultative subjects:			
Sensors in Security Systems	Microelectronics Dept.	2 + 2	
Design of Integrated Circuits	Microelectronics Dept.	2 + 2	
Architecture and Using of Programmable Circuits I		2 + 2	
Electronic Systems		2 + 2	
Obligatory subjects:			
Optoelectronics II	Microelectronics Dept.	3 + 2	Summer
Analogue and Digital Systems		3 + 2	
Semestral Project		0 + 4	
Facultative subjects:			
Practices on IC Design	Microelectronics Dept.	1 + 3	
Applications of Power Devices	Microelectronics Dept.	2 + 2	
Radiation Sources and Detectors		2 + 2	
Implementation of DSP		2 + 2	
Architecture and Using of Programmable Circuits II		2 + 2	
Obligatory subjects:			
Diploma Project	Microelectronics Dept.	0 +14	Winter
Practices in Laboratories of Electronics		0 + 4	
Facultative subjects:			
Design of Analogue and Digital Mixed Signal Systems		1 + 3	
Communications in Data Networks		2 + 2	
Satellite Communication and Navigation Systems		2 + 2	

FACULTATIVE SUBJECTS

Facultative subjects offered by the Dept. of Microelectronics for the whole Faculty are as follows:

Course name	Lectures and exercises in hours per week	Term
Microelectronics Department only		
Appliccation of Microelectronic Devices	2 + 2	Summer
Device Interconnection Techniques	3 + 1	S/W
PLD - Architecture and Application	2 + 2	Summer
Computer Interfaces	2 + 2	Summer

Facultative subjects offered by the Department of Microelectronics to Ph.D. Students of the whole Faculty:

Course name
Advanced Semiconductor Power Devices and Ics
Applications of TCAD Tools
Crystaloptics and Nonlinear Optics
Diagnostics and Testing in Microelectronics
IC Design
Integrated Optics
Microsystems
Optical Radiation Detection and Detectors
Programmable Logic Devices
Prospective Electronic Devices
Semiconductor Radiation Sources
Technology of Optoelectronic Structures
VLSI Structures and Technologies

A BRIEF DESCRIPTION OF COURSES GIVEN BY THE DEPARTMENT

Electronics, (Basic course)

Semiconductors, PN junction, diodes, bipolar transistors, unipolar transistors, power amplifiers, small signal amplifiers, switching circuits. Power amplifier classes. Multilayer switching devices. Op-Amps. Optoelectronics: sources and detectors. Thermistor, posistor, Hall sensors. Power triode, klystron, magnetron, TWT. Applications.

Electron Devices, BSc

Diodes, unipolar and bipolar transistors, switching, optoelectronic and passive components, vacuum tubes. Physical mechanisms, principles of device operation, properties, characteristics, parameters and models of devices. Basic circuits, recommended applications, switching operation. Noise parameters. Basic structures of integrated circuits. Computer modeling and experimental verification.

Power Supplies in Electronics, BSc

Rectifiers. Stabilisers - parametric, with continuous control. IC voltage regulators. Fly-back converter. Forward converter. Push-pull converter, double forward converter. Monolithic regulators. EMC. Over current protection. Over voltage, under voltage, output reverse voltage protection. Overload and thermal protection. Batteries, solar battery, accumulator, chargers. References.

Application of Microelectronic Devices, BSc

Parasitic parameters of Op. Amps. Suppression of DC and AC residual errors in Op. Amps. Power amplifiers, stabilizers, switch mode power supplies. Logic circuit families. Interference: signal, supply, external, switching. Timing errors, data refresh, grounding. Integrated signal coders and decoders, telecommunications devices, AD and DA converters. Requirements, tolerances, application directions.

Microcomputers, BSc

Motorola 68HC05 and 68HC11 families. I/O tasks, MCS-48, 8243 expander, programmable peripheral ICs. Development and debugging tools. Design and programming of instruments and systems based on single-chip computers. Individual students' projects.

Computer Interfaces, BSc

Architecture of computers oriented mainly on IBM PC platform (Microprocessors in PC, available chip sets, trends, suppliers). Hardware and software description oriented on different kinds of interfaces. PC interface standards, throughput and data flow. Protocols, basic boards in PC. Floppy Disc, Hard Disc interfaces. Serial interfaces: RS232C, RS422A, RS485. Parallel interfaces: CENTRONICS, IEEE488. Computer networks. Internet, e-mail, conferences, WWW.

Microelectronics, BSc

Basic functional structures of ICs. Passive and active elements. Technological process. Bipolar and unipolar structures. Logic integrated circuits, VLSI circuit systems. Analogue integrated circuits. Design of vertical structure, layout, design rules. System of IC process quality control. IC functional and parametric testing, test structures, yield and reliability.

Optoelectronics I, BSc

Basic principles of optoelectronics. Planar and fiber optical waveguides. Semiconductor lasers and LEDs. Semiconductor light detectors. Structures for distribution and harnessing of optical radiation. Optoelectronic processors. Optical communication systems. Optical amplifiers. Display devices. Optical memories. Optical fiber sensors. Integrated optical and photonic structures.

Sensor Systems, BSc

Sensor - classification, materials, production. General characteristics - static and dynamic parameters, errors, noise, linearisation, calibration. Microelectronic sensors materials, physical principles, design, integration. Temperature sensors, pressure sensors, SAW sensors, optoelectronic sensors, fibre optic sensors. Radiation sensors. Magnetosensors. Chemical sensors, biosensors. Humidity sensors. Flow meters. Level sensors. Sensor signals processing. Smart sensors. Application of sensors.

Physics of Semiconductor Devices, MSc

Semiconductor crystal lattices, band structure of semiconductors, statistical distributions, charge transport, scattering mechanisms, non-equilibrium carrier densities, non-homogeneous semiconductor systems, heterostructures, physics of bipolar and unipolar devices, semiconductor sources and detectors of radiation, laser physics, low dimensional structures.

Design of Integrated Circuits, MSc

Importance of ICs. Economic aspects of IC. Design methodologies: gate arrays, standard cells and functional blocks, full custom design. Design hierarchy: behavioural description, logic and electric design, simulation, layout capture and verification. CAD tools for IC design: HDL, front end tools, simulators, layout editors, structural synthesis, silicon compilers. IC testing.

Sensors in Security Systems, MSc

Security, safety and multi-channel systems. Dynamic analysis and optimisation. Signal interference and system internal noise. Input quantities. Analog and digital signal processing, conversions. Signal representation and sensor signal code. System calibration. Communication in system, interface. Output unit - communication, indication, registration, protection, switch, local and remote control, actuators.

Optoelectronics II, MSc

Optocouplers. Sensors (spectral, amplitude, interferometric, polarimetric). Distributed fiber-optics sensors. Fiber-optics communications, components of the optical fiber link, modulation. Modulation, multiplexing and coupling. System performance. Receiver sensitivity. Coherent optical communications. Optical memories. Optical processors. Laser measuring system. Laser Doppler velocimetry. Spectral analyzers.

Application of Power Devices, MSc

Static and dynamic processes of power structures in forward, blocking and reverse mode of operation. Power diodes, BJTs, thyristors and special thyristor structures, field controlled power devices, HF and HV devices, power ICs, characteristics and features. Packaging and cooling, transient thermal impedance. Principles of application in power circuits, basic trigger and application circuits.

Radiation Sources and Detectors, MSc

Optical radiation Thermal sources, electroluminescent diode. Lasers active medium, optical resonators, gas, liquid, dye, solid-state and injection lasers, laser modes: mode controlled, frequency agility, spectral width, frequency stability, amplifiers, mode locked. Photomultipliers, photoresistors, photodiodes, nonselective detectors. Optical receivers, PIN and APD coupling, optical preamplifiers.

Practice of IC Design I, MSc

Main purpose of this course is to enable students to design their own integrated circuit. Students will work in groups (of 5 to 10 students) on the design project using industrial standard CAD tools (CADENCE, SYNOPSYS). Successful circuits could be fabricated via EUROPRACTICE project. The lectures will be concentrated in the first three weeks of the term and will be devoted to IC design methodologies, CAD tools, description of available libraries and design rules.

Advanced Semiconductor Technologies, MSc

Electrical characteristics of processed materials. Bulk crystal growth. Oxidation. Lithography. Doping. Etching. Chemical vapour deposition. Physical vapour deposition. Ion implantation. Packaging. VLSI Processes. Microsystems. Cleanliness and purity in the process environmental.

Applications of Modern Devices, MSc

Analog devices, optimisation. Interference of different types of signal transmission, optimisation. Rules for optimisation of large arrays, power distribution, interfacing. Mixed-mode devices. Diagnostics in ADC's and DAC's, minimising residual errors. Standards for interface buses, sensors, actuators, ergonomics. Processing of small and large signals, noise, insulation.

Design of Power Supplies, MSc.

This represents extension of the subject “Power Supplies in Electronics”. The main field comprises Integrated circuits for SMPS (principles, design, verification.) Coils, transformers, regulators, synchronous rectifiers, resonance power supplies.
Switcher CAD. Magnetic design Tool. Filter CAD. MicroPower Switcher CAD.

TCAD for Electronics I

Principles of Technology CAD. ATHENA technology simulator. Introduction to the ATLAS device simulator. Drift-diffusion approximation. Poisson and continuity equations. SRH model. Models of Auger, optical generation-recombination and surface recombination, impact ionisation and mobility. Heat flow equation. Boundary conditions. Boltzmann transport equation. Mathematical background of simulation techniques.

Device Interconnection Techniques

Computer design of printed circuit boards (PCB). System OrCAD. Design rules for PCB according to EMC in analog, digital and power applications. Supply and grounding techniques. Technological processes and fabrication of PCB, classes of accuracy. Surface mount technology and devices, circuit layout process and soldering. Technological and design trends. Design of student PCB by use of PC in departments computer room.

Programmable Logic Devices

Programmable logic devices (PLD): history and perspectives, principles of operation, overview of basic architectures and production technologies. Simple PLD (PAL, GAL, PLA), Complex PLD (EPLD and CPLD), Field Programmable Gate Arrays (FPGA) : internal architecture, device types, properties, design principles and development systems. PLD design: design procedure, hardware description languages (ABEL, VHDL), partitioning, design implementation. Design economy, comparison with other ASIC methodologies. Design of SPLD and CPLD using various development systems (Lattice – Synario, Xilinx – Foundation).

TCAD for Electronics II, MSc

Technology CAD. Application of ATHENA technology simulator and ATLAS device simulator. Drift-diffusion and hydrodynamic models. Models of recombination, impact ionisation and mobility. Simulation of optoelectronic and power devices. Heat flow equation. Boundary conditions. Boltzmann transport equation. Monte Carlo Method. Simulation of quantum coupled devices. Simulation techniques. Examples.

Design of CMOS and BiCMOS Circuits, MSc

Trends in CMOS and BiCMOS technologies. Parameters of basic structures. Modeling and simulation. Parasitic structures. Design rules, layout design. CMOS and BiCMOS logic gates. Standard CMOS and BiCMOS ICs families. CMOS and EECMOS memories. PLDs, FPGAs. Analogue CMOS and BiCMOS circuits. Switched-capacitor and switched-current techniques, MOST-C filters. Comparators, operational amplifiers, OTAs.

Applications of TCAD Tools, PhD

Fundamentals of TCAD. Technology, process, device and mixed device-circuit simulators. ATHENA, principles and application. ATLAS, principles and application. Semiconductor equations. Boundary conditions. Numerical methods. Models of recombination, impact ionisation, mobility. Practical exercises according to individual projects on SUN workstations.

Crystaloptics and Non-linear Optics, PhD

Optical medium type classification. Single- and double-axis optical anisotropy. Chiral media. Propagation of planar waves, polarisation, phase and group velocity vectors. Energy balance and reciprocity. Reflection and refraction. Electro-optical and piezoelectric tensors. Theory and design of beam handling devices.

Diagnostics and Testing in Microelectronics, PhD

Physical and electrical methods of measurement of material properties, operational structures and electronic devices. Test structures and test chips. Functional and parameter testing of integrated circuits.

Programmable IC Design, PhD

IC reasons of integration, IC design methodologies and approaches. Application Specific Integrated Circuits (ASIC) and programmable devices. Principles, architecture, technologies and internal structure of Programmable Logical Devices (PLD), Complex Programmable Logical Devices (CPLD) and Field Programmable Gate Arrays (FPGA). Automatic design tools. Design using Hardware Description Languages (HDL): Abel, VHDL. Design methodology, optimization and partitioning.

Integrated Optics, PhD

Theoretical and technological principles of IO. Light propagation in dielectric waveguide structures. Methods of waveguide structures solution. Basic physical effects and interactions used for IO structures. Fabrication of dielectric waveguides and IO structures. Passive and dynamic waveguide devices. Non-linear devices. Semiconductor integrated optoelectronics.

Optical Radiation Detection and Detectors, PhD

Electromagnetic radiation spectrum. Radiometric and photometric units. Detection of optical radiation. Ideal detector, internal and external photo-effect. Optical receivers, design principles, properties. Noise. Detectors based on external or internal photo-effect, on thermal phenomena and others. Solar cells, properties.

Advanced Electron Devices, PhD

Energy band engineering, quantum well, wire, point. 2-D electron gas devices (HEMT, MOD FET) and double-barrier resonance tunneling (RDTB, RHET) as memories, generators, multipliers etc. Heterostructures, microwave and cryotronic devices. Recording media.

Advanced Power Semiconductor Devices and ICs, PhD

Physical and technological principles of advanced power devices. Trends of evolution. Parameters and applications of advanced devices. Bipolar structures. MOS structures. BiMOS structures. PN diodes. Schottky diodes. BJT transistors. DMOS and IGBT transistors. Thyristors, including GTO and MCT. Secondary breakdown theory and design rules. Smart-power devices. High voltage devices, applications.

Semiconductor Radiation Sources, PhD

Stimulated emission in semiconductors, Homogeneous junction and heterojunction. Double heterostructure lasers. Waveguide resonators, DFB structures. Types and properties of lasers. Bistable and memory devices, switches. Non-coherent LEDs. Super-LEDs. Laser injection amplifiers. Applications and measurement of various types.

Technology of Optoelectronic Structures, PhD

Preparation of optoelectronic materials and structures, diagnostic and testing methods. Fabrication of semiconductor waveguides, LEDs, lasers, photodetectors and QW structures. Design and fabrication of planar dielectric waveguide structures for distribution and harnessing of optical radiation. Measuring and testing methods. Properties of various structures, practical examples.

VLSI Structures and Technologies, PhD

Functional structures of integrated circuits, unipolar and BiMOS structures. 3D structures, submicron technologies. Problems associated with dimensional reduction. Memory cells. Test structures. VLSI processes. New technologies. IC design, layout, design rules. Reliability and yield. Limitations in ICs.

Electrical Transport in Semiconductors, PhD

Electrons and holes in semiconductor crystals. Boltzmann transport equation, scattering. High field transport. Quantum transport, resonant tunneling. Single electron transport, Coulomb blockade. Ballistic transport. Transport in magnetic field, quantum Hall effect.

RESEARCH ACTIVITIES

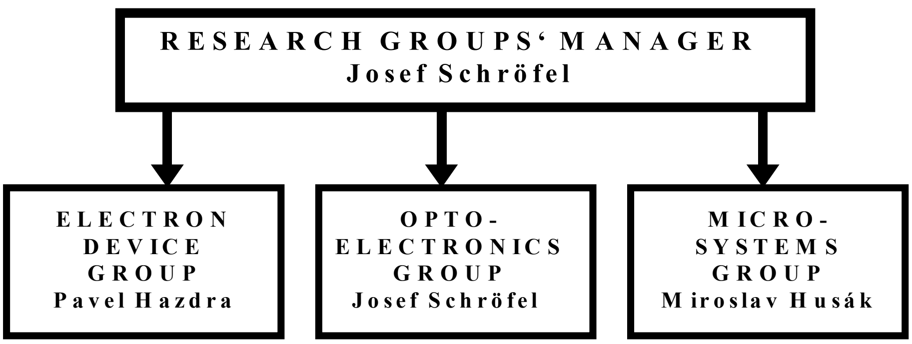
The Department has continued in research activities through grants and contracts rendered. The grants have included those of the Ministry of Education of the Czech Republic, Grant Agency of the Czech Republic, and CTU in Prague.

Already second year, the partial financing of our research activities is running by means of the so-called Research Intentions of Ministry of Education. The goal is to provide long-term institutional support of relevant research areas. In our Department, the following scientific fields are covered:

- Information and Communication Technology,
- Environmental Research,
- Energy Quality and Savings,
- New Measuring Methods of Physical Quantities,
- Reasoning and Control in Production.

In the field of research contracts, co-operation with foreign institutes and companies has continued to play a dominant role. As in previous years, co-operation with MOTOROLA, Transportation Systems Group, and ABB Semiconductors AG has proceeded.

The research activities of the Department are in continuation of our previous work which is focused on Electron Devices, Optoelectronics and Microsystems. These three directions constitute an organisation scheme of the research in our Department as is schematically shown below. This scheme is supplemented by a brief summary of activities of individual research groups and list of their members. This is followed by description of relevant research projects of individual research groups. The list of contracts is given as well.



ELECTRON DEVICE GROUP

Head of the Research Group: P. Hazdra
Members: J. Vobecký, J. Voves, Z. Rozehnal, V. Záhlava, J. Kodeš, J. Vít
Research Activities:

- Quantum Devices and Nanostructures
- Device and Process Simulation
- Lifetime and Defect Engineering
- Ion Irradiation
- Power Devices and Integrated Circuits
- Current Injection Capability of Micro-controller Units
- Programmable Logic Devices

OPTOELECTRONICS GROUP

Head of the research Group: J. Schrőfel
Members: Z. Burian, M. Slunečko, J. Burčík, L. Polívka, Z. Brychta, V. Prajzler
Research Activities:

- Preparing and Testing of Planar Waveguides Based on Various Deposition and Diffusion Techniques
- Analysing, Preparing and Testing of Novel Planar Electro-Optic Structures for Distribution and Harnessing of Optical Radiation
- Research toward the Integrated Optic Circuits for Measuring and Sensor Applications

MICROSYSTEMS GROUP

Head of the Research Group: M. Husák
Members: Z. Burian, J. Jakovenko, L. Jirásek, M. Kirschner, F. Vaníček, B. Palán, P. Tesař, R. Vít, L. Čopák, V. Janíček, O. Starý, T. Váňa, J. Foit, J. Novák

Research Activities:

- Semiconductor Microsystem Structures
- Sensor Signals Processing and Wireless Transmission
- Sensor Control Systems
- Biomedical, Temperature, Pressure Sensors, and Flowmeters

RESEARCH PROJECTS

ELECTRON DEVICE GROUP

RADIATION DEFECT CHARACTERIZATION IN SILICON POWER DEVICES USING CURRENT TRANSIENT TECHNIQUES

P. Hazdra, K. Brand[*]
[*]Dynamitron-Tandem-Laboratorium, Ruhr-Universität Bochum, Germany

Novel techniques of local lifetime control in semiconductor devices and recent development of radiation-hard detectors necessitates new methods capable to identify and trace deep levels located in the deep bulk of the semiconductor. The aim of the project is to develop and verify nondestructive characterization tools capable to detect particular deep levels with high sensitivity and resolution in the depth of several hundreds of micrometers. The approach is based on the measurement of temperature dependence of transient current response stimulated by reverse pulse excitation of the P-i-N diode in the kV range. New characterization tool, High Voltage Current Transient Spectroscopy (HVCTS), was used to identify radiation defects after proton irradiation with energies 3.0, 4.0 and 5.2 MeV and in the dose range up to 10^{11} cm^{-2}. The results were compared with those received by an alternative and recently developed technique of I-V profiling.

LOCAL LIFETIME CONTROL BY LIGHT ION IRRADIATION : IMPACT ON BLOCKING CAPABILITY OF POWER P-I-N DIODE

P. Hazdra, K. Brand[*], **J. Rubeš** and **J. Vobecký**
[*]Dynamitron-Tandem-Laboratorium, Ruhr-Universität Bochum, Germany

The impact of local lifetime control by $^{1}H^{+}$ and $^{4}He^{2+}$ irradiation on blocking characteristics of power P-i-N diodes was studied in the dose range up to $5x10^{12}$ cm^{-2}. Energies and doses for both types of projectiles were chosen in a way to create a comparable damage in three qualitatively different regions close to the anode junction. Blocking capabilities of irradiated diodes were measured, compared and simulated. Results show that there is no difference between hydrogen and helium irradiation, if the damage is located inside the anode area. When the damage peak is placed into the N-base side of the anode junction and the dose of protons exceeds 10^{12} cm^{-2}, blocking capability of the diode drastically decreases while it stays at the same level for analogous irradiation by helium ions.

EFFECT OF DEFECTS PRODUCED BY MeV H AND He IRRADIATION ON CHARACTERISTICS OF POWER SILICON P-I-N DIODES

P. Hazdra, K. Brand[*], **J. Rubeš**, **J. Vobecký**, **J. Vít**
[*]Dynamitron-Tandem-Laboratorium, Ruhr-Universität Bochum, Germany

The influence of defects produced by high-energy H^+ and He^{2+} implantation on characteristics of power P-i-N diode was investigated and compared. The analysis was performed for three qualitatively different locations of defect maximum in the dose range covering practical applications. Results show that both projectiles provide identical dynamic behavior of implanted diodes while their influence on blocking capability varies with dose and damage peak location. This effect is explained by different introduction rate of generation centers and shallow thermal donors when hydrogen is replaced by helium.

OPTIMIZATION OF POST-IRRADIATION ANNEALING IN SILICON POWER DEVICES

P. Hazdra, **J. Vobecký**, **V. Záhlava**, **J. Vít**

The aim of the project is to optimize annealing process following proton, helium and electron irradiation. All these radiation treatments are widely used separately or in combination for lifetime control in contemporary silicon power devices. Appropriate post-irradiation annealing, which is necessary to stabilize resulting defect structure, can substantially improve the device parameters, if it is properly designed according to device application. The influence of isochronal annealing in the temperature range from 100 to 600°C on electrical parameters of P-i-N power diodes irradiated by protons, helium and electrons is currently under study.

CROSSING POINT CURRENT OF ELECTRON, PROTON AND HELIUM IRRADIATED POWER DIODES

J. Vobecký, **P. Hazdra**, **V. Záhlava**

Project support: Polovodiče a.s.

Contemporary power modules comprise parallel connected active and passive semiconductor components in which a homogeneous distribution of current is a serious problem. This is because in surge conditions, there are large values of peak current and voltage together with the increase of die temperature that may lead to thermal destruction. This can be eliminated in a device with positive temperature coefficient of the forward voltage drop (PTC). However, a bipolar device always possesses negative temperature coefficient (NTC) at low currents which can switch to PTC at certain current level called crossing point current I_{Xing}. As it is desirable to design devices with low I_{Xing}, this project was started with aims to investigate the I_{Xing} level in dependence of electron and proton irradiation doses and energies. This study is further extended on helium irradiated diodes. The devices under consideration are the soft recovery ones from Polovodiče a.s.

IMPACT OF LIFETIME CONTROL ON THE REVERSE RECOVERY OF HIGH-POWER P-i-N DIODE

J. Vít, J. Vobecký, P. Hazdra

Increasing switching frequency of power circuits puts continuous demand on increased *dJ/dt* and *dV/dt* capability of silicon P-i-N power diode. At the same time, a decrease of turn-off losses and recovery charge, optimized snap-soft factor and improvements of other relevant parameters are expected in order to approach the ideal diode limit. Fast turn-off process can result in device failure, where dynamic avalanche with subsequent avalanche injection is generally recognized as the starting mechanism. Compared to the rest of bipolar devices, there is one more failure mode in power P-i-N diodes. This is the snap-off which may appear when a steep fall of current takes place under application of a high dc reverse voltage. For given driving conditions, appearance of the above described failure modes primarily depends on the ON-state excess carrier spatial distribution. To extend the safe operation area (SOA) an appropriate shaping of the spatial distribution of these carriers can be realized using particle or combined electron-particle irradiation. The aim of this project is to study the details of the failure modes above in the mode of resistive switching.

QUANTUM SIZE InAs/GaAs LASERS - PREPARATION AND PROPERTIES

E. Hulicius*, **P. Hazdra** , **J. Voves** , J. Oswald*, J. Pangrác*, K. Melichar*,
M. Vančura*, O. Petříček* and T. Šimeček*
*Institute of Physics, Academy of Sciences, Prague, Czech Republic

Semiconductor lasers based on Quantum Dots or very thin InAs Strained Quantum Wells are intensively studied during the last few years. The advantage of a zero-dimensional structure lies in its δ-function density of states, but it is devaluated by the large fluctuations of the size and shape of Quantum Dots. However the higher electroluminescence efficiency and higher working temperature remain. That is why the use of very thin Strained Quantum Wells can be a reasonable compromise for the preparation of highly efficient lasers emitting near 1 μm. Laser structures based on very thin Strained Single and Multiple Quantum Wells with threshold current density less than 0.2 kAcm^{-2} were prepared. The WA characteristics, mode structure, threshold current density and efficiency of these lasers were studied in the temperature range from 13 K to 370 K. Results show that lasers are capable to work at room and elevated temperatures with differential quantum efficiency of up to 70 %. It was shown that it is possible to tune the laser emission energy in the range from 1.1 eV to 1.4 eV by varying the number of strained quantum wells.

DESIGN, SIMULATION AND CHARACTERIZATION OF MBE GROWN SEMICONDUCTOR STRUCTURES

J. Voves, **P. Hazdra**, M. Cukr*, Z. Výborný*,
*Inst. of Physics, Academy of Sciences, Prague, Czech Republic

Quantum electronic devices based on GaAs/GaAlAs heterostructures suitable for electronic applications and education purposes (RTD, HEMT, superlattices) are designed in the framework of this project. The design is based on the device simulation using standard TCAD tools and specific quantum equations solvers, as well. Devices based on heterostructures grown by molecular beam epitaxy are prepared at the Institute of Physics, Czech Academy of Sciences in Prague. This year, different types of High Electron Mobility Transistor were designed and characterized as a pilot structure. Fabricated devices will be used for student education in the subject of Semiconductor Electronics.

SAFE SYSTEM FOR PRODUCTION CONTROL AND AUTOMATIC DATA STORAGE

Z. Rozehnal

The safe system for production control and automatic data storage software was designed for the purpose of ISO 9000 product data acquisition system in small factories. The software was written, tested and applied on MicroPEL programmable logic controllers (PLC). The system was installed to control casting machines in the Benes&Lat factory. Production of up to 30 casting machines is being checked simultaneously, data are evaluated and stored for every cast. Software construction is open and features are available for modification of the software for other applications in a wide range of application needs.

AUTOMATIC SOURCE CODE GENERATION FOR MICROCONTROLLERS

Z. Rozehnal

The programming of keyboard handling and display driving can be performed automatically by using proper software tools. The tools for code design and generation of a control object in the Windows operating system appear in several programming languages (Visual C^{++}, Borland C, Delphi etc.). Similar software tools are not commonly available especially for small microcontroller systems and single-chip microcontrollers though they would be very useful. The system principle of such design tool was studied and some experience with the design of an automatic code generator was gained. The generator and the final source code is tested by means of the 68HC11 microcontroller family assembler (Motorola Freeware PC/Compatible 8-Bit Cross Assemblers) in the environment of a special language called SIMPLE (MicroPEL, Simple - Programming language), which is designed for the MICROPEL programmable logic controllers (industry automation). Testing was performed on the Borland C^{++} version 3.1 language for IBM PC (Borland C++, (1993), Programmers guide) as well. The development time for the handling panels is extremely short for every tested platform, especially for the HC11 microcontroller family assembler. The problem, which remains open, is an insufficient optimization of the final source code. Moreover, it is not sure yet, if the source code generation is completely independent of the language and hardware used in every application, but this is normally being expected.

OPTOELECTRONICS GROUP

OPTICAL WAWEGUIDE STRUCTURES BASED ON ION - EXCHANGE IN GLASS SUBSTRATES

J. Schröfel, J. Špirková -Hradilová [*], J. Čtyroký[**], P. Nekvindová [*], P. Nebolová [*], J. Denk[*], J. Kosíková[***],
[*] Dept. of Inorganic Chemistry, ICT
[**] Inst. of Radio Eng. and Electronics, Academy of Sciences, Czech Republic
[***] Institute of Physics, Academy of Sciences, Czech Republic
Project support: Grant Agency of the Czech Republic No. 102/99/1391

Planar and channel waveguide structures fabricated by ion-exchange in glass could be potentially utilised in large variety of components for distribution and harnessing of optical radiation. The research work deals with study of preparation and properties of single and multimode planar waveguides based on pure thermal or field-assisted exchange of K^+-Na^+, Li^+-Na^+ and Cu^+-Na^+ ions. The research has continued in fabrication of single mode channel waveguides and verification of their application in distributive and sensor structures.

OPTICAL WAVEGUIDE STRUCTURES BASED ON APE IN $LiNbO_3$

J. Špirková -Hradilová *, **J. Schröfel**, J. Čtyroký**, P. Nekvindová[*], **Z. Burian, Z. Brychta, P. Čech,** P. Nebolová[*]
*Dept. of Inorganic Chemistry, ICT
**Inst. of Radio Eng. and Electronics, Academy of Sciences Czech Republic

Project support: Grant Agency of the Czech Republic, No. 102/99/1391

Annealed proton exchange (APE) provides a perspective alternative for fabrication of high quality single mode channel waveguides in lithium niobate. The last experimental works are concerned on explanation of the relations between lithium and hydrogen subsurface distribution and refractive index profile and properties of the waveguides. The research has continued in verification of possible application of prepared waveguides in optical modulators and sensors.

FABRICATION AND PROPERTIES OF ACTIVE PLANAR WAVEGUIDES IN GLASS AND LITHIUM NIOBATE SUBSTRATES

J. Schröfel, J. Spirková -Hradilová *, **Z. Burian**, J. Čtyroký**, **M. Slunečko**, P. Nekvindová*, **Z. Brychta,** P. Nebolová*
*Dept. of Inorganic Chemistry, ICT
** Inst. of Radio Eng. and Electronics, Academy of Sciences, Czech Republic

Project support: Grant Agency of Czech Republic, No. 102/99/1391

Active channel waveguides in lithium niobate and glass substrates are perspective candidates for planar optical amplifiers for optical communications. Our research starts with experimental study of doping of lithium niobate and glass substrate with Er^{3+} ions and will continue in fabrication of waveguides in erbium-doped substrates. The very important task of the research is study of relations between properties of the substrates, technological conditions waveguides fabrication and properties of the fabricated waveguides. Last but not least, the necessary measurements methods, for example for absorption or luminescence properties, are to be developed.

RESEARCH OF OPTICAL WAVEGUIDE GaAs/GaAlAs STRUCTURES

J. Schröfel, Z. Burian, J. Burčík, J. Čtyroký*, M. Brožíček**, **L. Polívka**, P. Čech**
* Inst. of Radio Eng. and Electronics, Academy of Sciences, Czech Republic
** Inst. of Physics, Academy of Sciences, Czech republic
Project support: Grant Agency of the Czech Republic, No.102/99/0414

The aim of the project is to fabricate and investigate waveguide structures for wavelength 1.00 - 1.55 micrometers based on various types of semiconductors. Main method of fabrication of the test structures is metalorganic chemical vapour deposition. At present time, the structures based on GaAs/GaAlAs system have been studied. Very important task of the research is to design suitable methods of measurements. The research will continue by verification of possible applications of prepared waveguides in optical sensors

OPTICAL WAVEGUIDES ON SILICON SUBSTRATE

Z. Burian, I. Hüttel***, J. Schröfel, Z. Brychta,** J. Čtyroký[**], V. Prajzler
[*] Department of Solid-State Engineering, ICT, Prague
[**] Inst. of Radio Eng. and Electronics, Academy of Sciences, Czech Republic
Project support: Grant Agency of the Czech Republic, No.102/00/0895

The aim of the project is to fabricate and investigate carbon and carbon nitride planar waveguides on silicon substrates. Planar waveguides are created by a carbon or carbon nitride layer which is deposited in PECVD apparatus on layer of silicon oxide providing optical shielding of the substrate and is prepared by the oxidation of silicon wafer. The present works are concentrated on determining of suitable conditions of technological process and on measuring of waveguides properties. We have proved that is in principle possible to dope the deposited layers by erbium ions so that resulting structures can be used as the active waveguides as well.

MICROSYSTEMS GROUP

DESIGN OF THERMALLY ACTIVATED MICRO-MIRRORS

M. Huja
Project support: Ministry of Education, No. VS97046 - CEMIS

The objective of this project is to design a matrix of pivoting micro-mirrors with optimum optical area, deflection angle, and power consumption. A matrix of 10 x 20 micro-mirrors was designed in 0.8 μm CMOS double-metal technology. The cantilever is a sandwich made of aluminum and silicon oxide, with a poly-silicon heating resistor. The control unit consists of a 20-bit shift register with serial data input and output. An output CMOS stage drives thermal micro-actuators which incline the individual micro-mirrors. The ANSYS program was used for thermal-mechanical simulation of micro-mirrors. The model enables simulation of the structure and its thermal, electric, piezoelectric, and magnetic fields in 3-D with coupling between the fields.

HYBRID INTEGRATED CIRCUITS - BIOPOTENTIAL DETECTION

P. Tesař
Project support: Ministry of Education, No. VS97046 - CEMIS

This work deals with living cells biopotential detection using hybrid integrated structures. Such structures should improve the parameters of current circuitry used for living cells biopotential detection. The current construction is significantly scaled down, hence parasitic parameters are reduced and measured signal spectrum is widened up to the higher frequencies. There are used probes constructed in the past years. The hybrid part of the construction contains the probes and the input buffer which are both the most critical parts from point of view of signal processing. The rest of the construction has not changed yet. The project is solved in co-operation with the Institute of Radio Engineering and Electronics, CAS Prague.

INTERFACE DESIGN FOR A NEW TYPE OF AN ISFET SENSOR
B. Palán

The design has been done in co-operation with IMEC Leuven in Belgium where the technology of organic polymer based ISFET sensors were developed. With respect to low output currents (in the order of nA with the sensitivity about 30nA/pH) and low-power low-noise interface, this sensor can be used for continuous monitoring.

REALISATION AND EXPERIMENTAL VERIFICATION OF PRODUCTION OF CHEMICAL ISFET SENSORS IN 0.6 μm CMOS TECHNOLOGY
B. Palán

Considerable effort has been exerted towards development of a fully integrated single-chip ISFET micro-system for pH measurements. A few N-type and P-type channel structures were fabricated in standard CMOS technology and tested. One of the N-ISFET structures with oxinitride passivation as ion-selective layer exhibits sensitivity about 25mV/pH.

ON-CHIP REFERENCE ELECTRODE FOR BIO-MEDICAL MEASUREMENTS
B. Palán

The objective is to find a simple, easy to make reference electrode for bio-medical measurements. Production of a tiny reference electrode for an ISFET sensor which is a basic part of a micro-system for ”in vivo” measurements, is still a problem. The functionality of the reference electrode determines the precession of the ISFET. One of the applications is measurement of blood gases during hyperventilation in patients with respiration diseases.

A TEMPERATURE SENSOR FOR NOISY MICRO-WAVE ENVIRONMENT

M. Husák, L. Čopák

Project support: Ministry of Education, No. VS97046 - CEMIS

This project aims to design a fibre optic sensor of temperature. The usage of this sensor is advantageous for its good immunity against electromagnetic interference. The principle of the fibre optic sensor is based on the absorption edge shift with temperature. The work completes the two preceding project phases with modelling, simulation, material choice and technology optimisation.

SEMICONDUCTOR STRUCTURES FOR MICROSYSTEMS – COMPARISON BETWEEN MOST AND BIPOLAR TRANSISTORS

F. Vaníček

Project support: Ministry of Education, No. VS97046 - CEMIS

The technology of the future is probably BICMOS. The technology combines both bipolar and CMOS technologies on the same chip. Most companies offer such process. A good example of such BICMOS technology is the LinBICMOS process of Texas Instruments. It offers conventional NMOS, PMOS and vertical NPN transistors and also poly-poly capacitors for linear applications. Other companies use different technologies. The exact process is of no importance, it is important only to know, that the both bipolar and CMOS technologies are available on the same chip. For a designer, it is important to understand which transistor to use in which position. A comparison is given between a bipolar transistor and a MOST from the designers point of view. DC and AC characteristics, noise and the design difficulties are compared.

DESIGN OF A TWO-WIRE DIGITAL TEMPERATURE SENSOR

J. Nedvěd

Project support: Ministry of Education, No. VS97046 - CEMIS

This work continues the preceding research of temperature sensors for precise measurement (down to 0.1 K) in noisy electromagnetic environment. The number of leads is critical due to requirements on dimensions (less then 0.5 mm). The designed integrated circuit consists of an analog block generating the temperature dependent quantity, a Sigma-Delta converter, and a control logic. Communication with the controller proceeds via a two-wire system used also for the integrated circuit power supply.

DESIGN OF A FIBRE SENSOR WITH LIQUID CORE FOR TRACE CHEMICAL ANALYSIS

Z. Burian, P. Solařík

Project support: Ministry of Education, No. VS97046 - CEMIS

The project treats the development and design of opto-fibre sensor with liquid core for trace chemical analysis. The project is directed to design multi-mode waveguide with liquid core for spectrophotometric measurements. The project is related to the previous work, where the literature was studied and the method of the sensor design was chosen. The sensor was modelled, simulated and the most suitable technology and materials were searched for.

DESIGN OF OPTICAL FIBRE SENSORS FOR THE WASTE WATER AND THE ENVIRONMENT MONITORING

Z. Burian, P. Solařík

Project support: Ministry of Education, No. VS97046 - CEMIS

The project treats the development and design of chemical optofibre sensors with evanescent wave for waste water and environment monitoring. The goal is to design chemical sensors for the purpose of mono-mode fibre waveguides with evanescent wave. The project is related to the previous stage, where the literature was studied and the method of the sensor design was chosen. The sensor was modelled, simulated and the most suitable technology and materials were searched for.

ELECTROMAGNETIC COMPATIBILITY IN MICROSYSTEM DESIGN

J. Foit, J. Novák

Project support: Ministry of Education, No. VS97046 - CEMIS

A rather extensive work was done investigating the mutual influencing of electronic systems, microsystems, devices, and the surrounding environment. The work was aimed at improving the accuracy of existing knowledge on the influence of electromagnetic interference in systems using electronic devices, especially mounted on PCBs. Model arrays of PCB structures were built with accurately defined layouts permitting a high degree of elimination of harmful side effects. A theoretical study was performed to find the exact distribution of electric and magnetic fields around the structures as well as to make possible to measure the electrical properties of the substrate. An addition to simulation program for electric field distribution was prepared to make possible to use it for calculations of magnetic field distribution as well. A discrete-parameter electrical model was devised that simplifies considerably the analysis of real structures by standard simulation programs. A large set of measurements was performed on the model layouts in order to verify the theoretical assumptions. The results have shown an exceptionally good agreement between theory and simulation, suggesting that the theoretical assumptions and model structures were correct and valid. Two main direction of work are planned for the future:

1. to extend the results to analog-signal carrying structures
2. to direct the analysis and simulation into the cases of integrated devices and microsystem structures.

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  Project no. VS 97046
  Project Manager: **M. Husák**

- Integrated Intelligent Microsensors and Microsystems
  Project of the Grant Agency of the Czech Republic.
  Grant no. 102/00/0939
  Project Manager: **M. Husák**

- Microwave Monolithic Integrated Transmitted Power Sensors and Their Industrial and Metrology Applications.
  Grant EU NATO Science for Peace Programme, no. SfP-974172
  Project Manager: T. Lalinský (Slovak Academy of Science, Institute of Electrical Engineering, Bratislava, Dept. of Microelectronics: **M. Husák)**

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  Project of the Ministry of Education, Project no. J04/98:210000012
  Project Manager: Konvičková (Faculty of Mechanical Engineering, CTU)
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  Project Manager: V. Haasz (Faculty of Electrical Engineering CTU in Prague)
  (Dept. Of Microelectronics: **M. Husák**)

- Formation and Monitoring of Environment.
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  (Dept. Of Microelectronics: **M. Husák**)

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  Project Manager: **M. Husák**

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  ST Microclectronics, Munich
  Project Manager: **M. Husák**

- New Technologies for Fabrication of Dielectric Waveguide Lasers and Amplifiers
  Grant Agency of Czech Republic, Grant No. 102/99/1391
  Project manager: **J. Schrőfel**

- MOVPE Prepared Materials and Structures for Electronic and Optoelectronic Devices
  Grant Agency of Czech Republic, Grant No. 102/99/0414
  Project manager: E. Hulicius, Czech Academy of Sciences, Prague
  (Dept. of Microelectronics: **J. Schrőfel**)

- Methodical Centre for Photonic Waveguide Structures,
  Grant Agency of Czech Republic, Grant No. 102/99/M057
  Project manager: J. Čtyroký, Institute of Radio Engineering and Electronics, Academy of Sciences of the Czech Republic
  (Dept. of Microelectronics: **J. Schrőfel**)

- Information Technologies, Research Project of the Ministry of Education of the Czech Republic
  Project no. J04/98:213200014
  Project manager: J. Vejražka (Dept. of Radioelectronics, FEE-CTU)
  (Dept. of Microelectronics: **J. Schrőfel**)

- Laser Systems and their Applications
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  Project manager: J. Vrbová (Faculty of Nuclear Science, CTU in Prague)
  (Dept. of Microelectronics: **J. Schrőfel**)

- New Technologies for Passive and Active Planar Structures Based on Carbon and Carbon Nitride for Integrated Optics,
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  Project Manager: I. Huttel (Institute of Chemical Technology, Prague)
  (Dept. of Microelectronic : **J. Schrőfel**)

- Energy Quality and Energy Savings
  Project of the Ministry of Education, no. J04/98:212300017
  Project manager: J. Tůma (Dept. of Electronergetics, FEE-CTU)
  (Dept. of Microelectronics: **J. Vobecký**)

- Current Injection Capability Investigation of Microcontroller Units
  MOTOROLA Transportation System Group, Munich, East Kilbride
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  Project Manager: **J. Voves**

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R. Josef, "Control of Graphic Display Using the 68HC11 Processor"

M. Klauz, "Connection of Microelectronics Sensors to PC"

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V. Schybal, “Electronics System for Higher Comfort in Using a Personal Car”

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M. Turan, “Calculation of Line Impedance with TEM Wave”

V. Vocel, “Opto-Chemical Sensor”

M. Zadražil, “Sensor matrix for Measurement of Wind Velocity and Direction“

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