

**Czech Society for New Materials and Technologies  
Praha**

**Research and application of microtechnologies  
in the Czech Republic**

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# 1. INTRODUCTION

Since the invention of a microprocessor in 1971, the miniaturisation has progressively developed into real science and many application areas. The main driving force behind the miniaturisation of parts, facilities, systems, and their mass was their better reliability, lower manufacturing costs and prices. The main carriers of this development have been the silicon integrated circuits and the technologies for their packaging. Integrated circuits with their fantastically increasing complexity and density have become, for sure, the main motor of the miniaturisation, but they were the technologies of their packaging, which have allowed for their implementation. In the meantime, the density of integrated circuits, or the capacity of memory chips doubles every 18 months (Moore's law). With the progressing miniaturisation, many useful instruments have become mobile, e.g. the mobile telephones, television sets, computers, music players, etc. These instruments have become also cheaper, more intelligent, and more reliable at the same time. Similarly as with miniaturisation of electro-mechanical systems, a similar potential for the miniaturisation also exists in facilities transferring heat, or managing chemical reactions.

The miniaturisation made possible by the utilisation of microtechnologies is nowadays used in many industries, where the size and mass of products need to be decreased, while their reliability should increase and the use of energies and materials decrease. Applications of microproducts have already resulted, and they will result also in future, in important economic, environmental and other benefits in the industries like, for example, the production and the use of energies, transport, space technologies, chemistry, healthcare, protection of the environment, miniaturisation, information and telecommunications, defence and security, etc. A number of microtechnologies have been already utilised in practice, or they make the subjects of the applied research and development, while the miniaturisation progresses further towards its final size target – to nanometres. The basic research of nanotechnologies has already fully developed and the first applications have been already noted<sup>1</sup>.

The countries, which dominate in the development and utilisation of microtechnologies today, are especially USA, Germany, and Japan. While USA focuses mostly on research and development of parts of micro-electromechanical systems (MEMS), equipment for the information technologies, and bio-medicine and genetic engineering, Germany dominates in sensor technologies for the automotive industry and Japan keeps its traditionally strong position in micro-processing, precise mechanics, in devices for the information technologies, and especially in consumer miniaturisation. Intensive applied research, development and application of microtechnologies take place also in Switzerland, United Kingdom, France, China, Taiwan, and Korea.

The situation existing in the Czech Republic will be described in this publication.

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<sup>1</sup> Prnka, T., Šperlink, K.: "Nanotechnologie" (Nanotechnology), Repronis Ostrava, 2004, ISBN 80-7329-070-7

## 2. CHARACTERISTICS OF THE FIELD

### 2.1 DEFINITION AND TERMINOLOGY

**Microtechnology** presents the convergence of many technologies and disciplines – physics, chemistry, biotechnology, engineering, medicine, materials science, nanotechnologies, microminiaturisation, information technologies, etc. – which are utilised in structures, devices and systems, where their parts are within the size category of micrometers<sup>2</sup>. A microtechnology is also the ability to utilise synthetic means for the treatment of materials, facilities and systems within the size category of micrometers.

The current microtechnology has developed from electronics and from the precise mechanics by progressive miniaturisation. It was found in 1960s that the arrangement of a large number of microscopic transistors on one chip could create microelectronic circuits, which increase performance, functionality and reliability of electronic devices in a dramatic way, while their prices decrease and the lot manufacturing is made possible. The **microelectronics** have been thus born and developed. The result became the information revolution, which have brought to us the products like the Internet, personal computers, laptops and palmtops, mobile telephones, MP3 players, etc.

It has been found much later that it is useful and also possible to miniaturise not only electric devices, but the mechanical ones as well. While microelectronics could be considered the “brain” of advanced systems and products, micromechanical devices are utilised especially in sensors and actuators, which ensure the connection of devices with the outside world. Nowadays, **micromechanical devices** (micro machines) make key components in a large number of products, e.g. automotive air bags, blood pressure monitors, and projecting displays. Prognoses show that these devices will become as important in near future as the current electronic devices.

In 1980s the word **MEMS** – micro-electromechanical systems (or micro systems) occurred in the scientific literature. The word describes new sophisticated mechanical systems within a chip like, for example, electric micro engines, resonators, gearwheels, ratchet mechanisms, etc. The word MEMS is now used for any microscopic device with mechanical and electrical functions, which are placed on a chip and which allows for the lot manufacturing. The word thus does not relate, for example, to by a laser-treated stent or watch parts. The word MST – the microsystem technology, is often used in Europe instead of MEMS. MEMS are now utilised, for example, in automotive sensors or in ink printers. When an optical device is integrated within the system, it is MOEMS (the micro-opto-electromechanical system). This year, sales of MEMS at the level of about 12 billion euros are expected.

Without doubts, integrated circuits (microelectronics) could be considered the biggest success of the microtechnology. However, the microtechnology develops also in the area of **microchemical systems (MECS)** (the analytical systems, micro reactors, micro separators, heat exchangers, heat pumps, gas absorbers, etc.)<sup>3</sup>, in **micro-biotechnologies** (e.g. bio-chips for the DNA analysis), in the construction of probe microscopes, and also in other fields. The microtechnology market should reach the value of 68 billion euros<sup>4</sup> worldwide in 2005.

In the meantime, together with the progressing miniaturisation of components and products, the size categories have been progressively made more precise as well. The sizes of small structure parts within the precise mechanics exist within the range of about 0.1 – 1mm. The scale from about 100nm to 100µm has been assigned to microtechnologies. The area below

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<sup>2</sup> <http://www.microtechnologycrc.com>

<sup>3</sup> D.L. Brenchley: “Application for Micro Chemical and Thermal Systems”, IMRET 5 Conference, 5/2001

<sup>4</sup> NEXUS Market Study 2002

100nm has become the domain of the emerging technology – the nanotechnology. However, the borders between these individual technologies have not been accurately defined.

The **micromachining** is considered one of the most important parts of the microtechnology. We talk here about classical methods of mechanical micromachining (milling, lathe-turning, planing, drilling, grinding, lapping, fine polishing, etc.) and about the non conventional methods like the electrochemical, laser, plasma, and other micro treatments. The word micromachining covers also the processes used in the manufacture of integrated circuits – the surface and bulk micromachining, photolithography, ion-implantation, dry and wet etching, electric-cladding, etc. Treatments and processing of materials are considered the micromachining, when they take place within the size range from about 1 $\mu$ m to about 2mm<sup>5</sup>.

## **2.2 NOMENCLATURE**

As the above-mentioned definition implies, the microtechnology means a very broad field and its nomenclature is thus very extensive as well. For example, the nomenclature of the big international microtechnology fair “MICRONORA”, which takes place in the French City of Besançon every alternative year (the 16th Fair will take place in 2006), has been divided into two groups: a) Microtechnologies (192 items), b) Manufacturing equipment, instruments, products, and services (204 items)<sup>6</sup>. There are a number of other nomenclatures and classifications.

When activities of research and development workplaces and manufacturing plants are assessed, the following special division of the issues is used:

**A – Semiconductors and parts for microelectronics**

**B - Communication microsystems**

**C - MEMS, MOEMS**

**D – Microscale technologies (mechanical micromachining, lithography, and chemical and other technologies)**

**E – Micro sensors**

**F – Manufacturing equipment for microtechnologies and their parts**

**G – Microanalytical equipment, its parts, and analytical methods**

**H – Microsystems for the use in biotechnology and medicine**

**I - Metrology**

**J - Microchemical systems**

**K - Microthermal systems**

**L - Materials for microtechnologies (particles, layers, composites, etc.)**

**M - Optics and optoelectronics**

**N – Other products of microtechnological equipment and the manufacture of devices (instruments, systems) with microtechnological parts or systems (e.g. computers, different instruments and devices, consumer electronics, etc.)**

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<sup>5</sup> M.Oettle: “High performance and precise treatment by miniature instruments”, MM industrial spectrum, 3/2005, p. 60

<sup>6</sup> www.micronora.com

## **2.3 METHODOLOGY OF THE EXECUTED SURVEY**

The word microtechnology has still not become common in the Czech Republic. The proof of that is, for example, the fact that the only scientific journal in this field, published in Czech by the Institute of Physics of the Academy of Sciences of the Czech Republic, has got the traditional title “Fine mechanics and optics” and the fields covered by the journal do not include any that would start with the prefix micro-.

When assessing the focus of individual research and development workplaces and manufacturing companies, there were activities considered, which could potentially serve the development or application of microtechnologies in different manufacturing industries. For example, there was the research of miniaturisation of analytical separation methods noted in the Institute of Analytical Chemistry of the Academy of Science of the Czech Republic, even if the size category of this miniaturisation was not mentioned. Another example is the manufacture of the precious metals’ prefabricates in the company SAFINA because these metals are utilised in microproducts.

There were also the activities of companies manufacturing products, which include microtechnological components or even individual parts or materials belonging to the micrometre area, recorded in accordance with the mentioned definition. There were thus television sets, screens, TV and radio transmitters, computers, component manufacturers, and even manufacturers of automotive parts registered. The main reason behind that decision was the idea that the development of these industries in the Czech Republic can help, in the form of the market pressure, in focussing the domestic research on microtechnologies. This has been proved right by the establishment of development centres in the private sector. Unfortunately, this has happened mostly only thanks to foreign subjects.

## **3. REVIEW OF RESEARCH AND DEVELOPMENT ACTIVITIES**

The executed survey showed that research and development in the area of microtechnology are in the focus of 9 institutes of the Academy of Sciences of the Czech Republic (AVCR or CAS), 10 university workplaces, and 10 research and development workplaces in the private sector. The applied research and development covering own needs are done in at least 20 large companies (with 250 or more employees) and in small and medium-size enterprises (SMEs).

### **3.1 LIST OF RESEARCH AND DEVELOPMENT ACADEMIC WORKPLACES**

#### **3.1.1 Institutes of the Academy of Science of the Czech Republic**

##### **Institute of Scientific Instruments of CAS**

Královopolská 147, 612 64 Brno

<http://www.isibrno.cz>

Abbreviation: **ÚPT AVCR**

##### **Institute of Radio Engineering and Electronics of CAS**

Chaberská 57, 182 51 Praha 8

<http://www.ure.cas.cz>

Abbreviation: **ÚRE AVCR**

**Institute of Physics of CAS**

Na Slovance 2, 182 21 Praha 8

<http://www.fzu.cz>Abbreviation: **FZÚ AVCR****Institute of Analytical Chemistry of CAS**

Veverí 97, 602 00 Brno

<http://www.iach.cz/uiach>Abbreviation: **ÚanalCH AVCR****Institute of Chemical Process Fundamentals of CAS**

Rozvojová 135, 165 02 Praha 6

<http://www.icpf.cas.cz>Abbreviation: **ÚCHP AVCR****J. Heyrovsky Institute of Physical Chemistry of CAS**

Dolejškova 3, 182 23 Praha 8

<http://www.jh-inst.cas.cz>Abbreviation: **ÚMCHJH AVCR****Institute of Plasma Physics of CAS**

Za Slovankou 3, 182 00 Praha 8

<http://www.ipp.cas.cz>Abbreviation: **ÚFP AVCR****Institute of Macromolecular Chemistry of CAS**

Heyrovského nám. 2, 162 06 Praha 6

<http://www.imc.cas.cz>Abbreviation: **ÚMCH AVCR****Institute of Biophysics of CAS**

Královopolská 135, 612 65 Brno

[www.ibp.cz](http://www.ibp.cz)Abbreviation: **BFÚ AVCR****3.1.2 University workplaces****Charles University, Faculty of Mathematics and Physics, School of Physics**

Ke Karlovu 3, 121 16 Praha 2

<http://www.mff.cuni.cz>Abbreviation: **UK-MFF****Charles University, Faculty of Science, Section of Chemistry**

Albertov 6, Praha 2

<http://www.natur.cuni.cz>Abbreviation: **UK-PrF**

**Masaryk University in Brno, Faculty of Science**

Kotlářská 2, 611 37 Brno

<http://www.sci.muni.cz>

Abbreviation: **MU-PrF**

**Czech Technical University, Faculty of Mechanical Engineering**

Technická 4, 166 07 Praha 6

<http://www.fs.cvut.cz>

Abbreviation: **CVUT-FS**

**Czech Technical University, Faculty of Electrical Engineering**

Technická 2, 166 27 Praha 6

<http://www.fel.cvut.cz>

Abbreviation: **CVUT-FEL**

**Czech Technical University, Faculty of Nuclear Sciences and Physical Engineering**

Trojanova 13, 120 00 Praha 2

<http://www.fjfi.cvut.cz>

Abbreviation: **CVUT:FJFI**

**Brno University of Technology, Faculty of Mechanical Engineering**

Technická 2. 616 69 Brno

<http://www.fme.vutbr.cz>

Abbreviation: **VUT-FSI**

**Brno University of Technology, Faculty of Chemistry**

Purkynova 118, 612 00 Brno

<http://www.fch.vutbr.cz>

Abbreviation: **VUT-FCH**

**Brno University of Technology, Faculty of Electrical Engineering and Communication**

Údolní 244/53, 602 00 Brno

<http://www.feec.vutbr.cz>

Abbreviation: **VUT-FEKT**

**Palacky University, Faculty of Science**

Křížkovského 8, 771 47 Olomouc

<http://www.upol.cz>

Abbreviation: **UPOL**

**University of Pardubice, Faculty of Chemical Technology**

Cs.legií 565, 532 10 Pardubice

<http://www.upce.cz>

Abbreviation: **UPCE**

**Institute of Chemical Technology, Faculty of Chemical Technology**

Technická 5, 166 28 Praha 6

<http://www.vscht.cz>

Abbreviation: **VŠCHT-FCHT**

**Institute of Chemical Technology, Faculty of Chemical Engineering**

Technická 5, 166 28 Praha 6

<http://www.vscht.cz>

Abbreviation: **VŠCHT-FCHI**

**Technical University of Liberec, Faculty of Mechatronics**

Hálkova 6, 461 17 Liberec

<http://www.vslib.cz>

Abbreviation: **TUL-FMM**

**Technical University of Liberec, Faculty of Mechanical Engineering**

Hálkova 6, 461 17 Liberec

<http://www.vslib.cz>

Abbreviation: **TUL-FS**

**University of West Bohemia, Faculty of Applied Sciences**

Univerzitní 22, 306 14 Plzeň

<http://www.fav.zcu.cz>

Abbreviation: **ZCU-FAV**

**University of West Bohemia, Faculty of Electrical Engineering**

Univerzitní 26, 306 14 Plzeň

<http://www.fel.zcu.cz>

Abbreviation: **ZCU-FEL**

**Jan Evangelista Purkyně University, Institute of Science**

České mládeže 8, 400 96 Ústí nad Labem

<http://sci.ujep.cz>

Abbreviation: **UJEP**

### **3.2 REVIEW OF ACTIVITIES BY ACADEMIC WORKPLACES, ACCORDING TO THE CODES**

#### **Code A – Semiconductors and parts for microelectronics**

The following institutes of the Academy of Sciences of the Czech Republic and university faculties implement research activities in this field:

ÚŘE AVCR, FZÚ AVCR, UK-MFF, MU-PrF, CVUT-FEL, VUT-FEKT, VŠCHT-FCHT, TUL-FMM, and ZCU-FEL.

The attention in the research of semiconductors focuses mostly on properties and modern ways of preparation of semiconductor layers of the AIIIbV – GaAs and GaSb kind for the utilisation in optical electronics (ÚŘE AVCR) and electronics (FZÚ AVCR) and on semiconductor properties of the AIIbVI – CdTe kind (UK-MFF). FZÚ AVCR focuses also on the research of preparation ways and properties of the amorphous hydrogenated Si (a-Si:H), microcrystalline hydrogenated Si ( $\mu$ -Si:H), and the porous Si for the use in photovoltaics. Another workplace is involved (no details are available) in the semiconductor physics (the study of defects, etc. – CVUT-FEL), in the technology for the preparation of thin semiconductor layers, and in the study of their properties and the research of the multilayer metal-semiconductor-insulators (MU-PrF).

The workplaces focus, in the area of parts for microelectronics, on the design of integrated circuits (VUT-FEKT, TUL-FMM), the development of integrated optics on semiconductors (VŠCHT-FCHT), and, at ZCU-FEL, they develop facilities with single chip computers. The biggest research capacity related to semiconductors is undertaken at FZÚ AVCR.

### **Code B – Communication microsystems**

The research activities within this area have been registered only at CVUT-FEL, where a small group involved in microsystems, in the Department of microelectronics, deals with the processing of sensor signals and with the wireless data transfer.

### **Code C – MEMS, MOEMS**

Despite the fact that micro-electromechanical systems make the subject of extensive research and development in a number of countries (especially in USA, Japan, Germany, France, United Kingdom, etc.), the Czech research basically ignores this field. Only the Faculty of mechatronics at the Technical University in Liberec (TUL-FMM), the Department of electrotechnology, deals with the basic research of selective circuits by the electromechanical conversion of signals.

### **Code D – Microscale technology**

Research activities in this field have been undertaken by the following institutes of the Academy of Sciences of the Czech Republic and by the following university faculties: ÚPT AVCR, FZÚ AVCR, UK-PrF, CVUT-FS, CVUT-FEL, VUT-FSI, VUT-FCH, VŠCHT-FCHT, and ZCU-FAV.

The Czech workplaces undertake research and development of many varied preparation technologies and the technologies for the microscale treatment of materials – especially of layers and multilayers on different surfaces and the micromachining. However, the following list is not complete because we have not received detailed information from some of the workplaces.

#### Preparation of thin inorganic layers:

- Magnetron sputtering (ÚPT AVCR, ZCU-FAV)
- Molecular beam epitaxial method - MBE and by the method MOVPE (FZÚ AVCR)
- Laser depositing (FZÚ AVCR, VŠCHT-FCHT)
- Direct depositing of the focussed ion beam (VUT-FSI)
- Plasma technologies (ZCU-FAV)
- Sol-gel methods (UK-PrF)

#### Preparation of thin layers of organic materials:

- Plasma depositing of polymer layers (VUT-FCH)
- Plasma layer polymerisation (VUT-FCH, MU-PrF)
- Sol-gel methods (VUT-FCH)

#### Lithographic methods:

- Micro lithography for different purposes – the diffractive optical components, holography (ÚPT AVCR)
- Lithography during the preparation of semiconductor structures (FZÚ AVCR)

#### Single crystal growing:

- New monocrystalline preparation methods for semiconductor compounds (CVUT-FEL)

#### Micromachining by:

- Laser and chip micromachining technologies (CVUT-FS)

#### Optical tweezers:

- Development of optical tweezers for the micro scale handling (ÚPT AVCR).

### **Code E – Microsensors**

Research and development of sensors for different purposes is currently quite popular in the Czech Republic. There were 12 institutes of the Academy of Sciences of the Czech Republic and university faculties identified, the workplaces of which are involved in this field. They are as follows:

- ÚPT AVCR, ÚRE AVCR, ÚMCH AVCR, BFÚ AVCR, UK-MFF, MU-PrF, CVUT-FS, CVUT-FEL, VUT-FEKT, VŠCHT-FCHT, VŠCHT-FCHI, TU-FMM, and UJEP.
- Different kinds of chemical sensors are developed in BFÚ AVCR (biochemical sensors), VUT-FEKT, VŠCHT-FCHI (thermocatalytic – pellistor sensors), and UK-PrF (electrochemical sensors).
- Detectors of the ion radiation are developed in ÚPT AVCR, CVUT-FS, and UK-MFF (gas sensors).
- Pyroelectric sensors are researched in ÚRE AVCR (for the gas detection, in cooperation with Tesla Blatná), CVUT-FEL, and ÚMCH AVCR.
- Piezoelectric sensors are developed at MU-PrF (bio-sensors) and TUL-FMM.
- Humidity detectors are developed at UK-MFF
- Pressure sensors are developed at CVUT-FEL
- Optical (bio)sensors are researched in ÚRE AVCR, ÚMCH AVCR, UJEP, VUT-FEKT, CVUT-FEL, and VŠCHT-FCHI.
- The most extensive research and development activities in this field have been registered in ÚRE AVCR and VŠCHT-FCHI.

### **Code F – Manufacturing equipment for microtechnologies and their parts**

Only one institute of the Academy of Sciences of the Czech Republic and VUT – Faculty of electrotechnology and communication technologies are involved in the development of manufacturing equipment for the area of microtechnologies.

- Parts for micro lithographic systems are developed in ÚPT AVCR.
- Probes for the probe microscopes are manufactured at VUT-FEKT.

### **Code G – Microanalytical equipment, its parts, and methods**

Three workplaces in institutes of the Academy of Science of the Czech Republic and 3 workplaces at university faculties undertake the development of microanalytical equipment and microanalytical methods. They are as follows: ÚPT AVCR, FZÚ AVCR, ÚanalCH AVCR, VUT-FSI, VUT-FEKT, and VŠCHT-FCHT.

ÚPT AVCR undertakes the development of:

- Ultra high vacuum microscope SLEEM
- Low voltage transmission microscope
- Optical tweezers and optical scalpel
- Environmental microscope.

- FZÚ AVCR undertakes the development of new laser kinds.
- ÚanalCH AVCR deals with the development of different bio-analytical instruments.
- VUT-FSI develops:
  - Ultra vacuum facility for the direct depositing of ultra thin layers focussed by ion beam
  - In-situ analysis of surfaces and deposited layers
  - Microanalytical equipment for the spectroscopy of secondary ions (SIMS)
  - Spectroscopy of photoelectrons excited by roentgen radiation (XPS)
  - Surface microscopy by the method (STM/AFM) in the ultra vacuum environment.

VUT-FEKT deals with the research of methods for the utilisation of electron beams in material diagnostics.

VŠCHT-FCHT undertakes the development of application methods for the electron microscopy and of microanalytical methods for the assessment of inorganic materials and the solid compounds' surface analysis.

## **Code H - Microsystems used in biotechnology and medicine**

Four workplaces of the Academy of Sciences of the Czech Republic and 7 workplaces of university faculties undertake research and development in this field. They are as follows: ÚPT AVCR, Úanal.CH AVCR, ÚMCH AVCR, BFÚ AVCR, MU-PrF, CVUT-FS, CVUT-FEL, VUT-FCH, VUT-FEKT, ZCU-FEL, and UJEP. The undertaken research could be called the mixed one.

ÚPT AVCR focuses on the development of an optical scalpel, the construction of instruments for the micro neurosurgery, and the development of instruments for the cardiovascular diagnostics.

Úanal.CH AVCR researches different separation methods like those used, for example, in a single cell analysis.

ÚMCH AVCR undertakes:

- Research of polymer systems for the gene therapy
- Research of polymer systems for the targeted delivery of drugs
- Development of hydro-gels for the managed releases of drugs
- Research in the field of micro- and nano-biotechnology for the preparation of biological interfaces – the preparation of nanostructured molecular sets by the consequent depositing of biological and synthetic macromolecules on synthetic polymer bases and the study of set creation and their properties by the methods of multiple reflective infrared spectroscopy (FTIR, MIRS), surface plasmons resonance (SPR) and AFM in water environment. Specific sets consisting of proteins, polysaccharides and polypeptides are used as biological affinity layers in optical bio-sensors and separation media as the surface layers, which are tolerated by blood and healthcare means and as the surface layers for the cell growth on support polymer structures in the tissue engineering.

The laboratory of bio-macromolecules and their parts in BFÚ AVCR focuses on:

- Research of electrodes: Preparation of fixed electrodes and their modification - Metallic, graphite/carbonaceous and semiconductor materials, mercury film electrodes, amalgam alloys, electrodes modified in a chemical way or by nanoparticles and bio-polymers
- Physical-chemical properties of prepared electrodes. They are studied by electrochemical and optical methods and with the analysis of the surface morphology

- Creation of condensed films and the study of dynamics in two-dimensional condensed films (self-assembled layers) in parts of nucleic acids (bases, nucleosomes and nucleotides) on mercury, mercury-film, amalgam, and solid metallic electrodes
- Sensitive voltammetric detection of nucleic acids and synthetic oligo-nucleotides on chemically modified surfaces
- Study of the morphology and conforming changes in nucleic acids, oligo-nucleotides and proteins on solid electrodes chemically modified by electrochemical (voltammetry, electrochemical impedance spectroscopy) and optical methods
- Development of bio-sensors (especially of the electrochemical ones) detecting the hybridisation of DNA on modified surfaces.

The Department of biochemistry at MU-PrF is involved in:

- Research done in the field of metabolism regulation in microorganisms, animals and plants and in the field of bio-analytical chemistry
- Bio-sensors: Development of electrochemical and piezoelectric bio-sensors, the applications of enzymatic electrodes and immunologic sensors in the environment and in the clinical area, the study of affinity interactions in real time with the help of bio-sensors
- Bio-molecule separation methods by the utilisation of modern separation methods – the high performance liquid chromatography (HPLC) and the capillary electrophoresis (CE) in the qualitative and quantitative analyses of biologically active low-molecular and high-molecular compounds (medicinal herbs, clinical diagnostics, enzymes, etc.).

CVUT-FS, the Institute of Mechanics – the Independent laboratory for the human biomechanics, undertakes research and development in the field of bio-medical engineering as follows:

- Bio-mechanics of the muscle-skeleton system and its replacements
- Bio-mechanics of the cardiovascular system and its replacements
- Research of tissues and organ structures
- Bio-material engineering.
- The attention in this field is paid to the utilisation of new materials for the construction of implants, e.g. bio-ceramics, in the case of total knee joint replacements, or the C-C composites, in the case of inter-vertebrae spacers, and the utilisation of new surface layers for the improvement of implant properties.

CVUT-FEL develops a bio-mimetic nanoactuator – the artificial muscle.

Research in the field of microbiological systems and technologies is undertaken at VUT-FEKT.

ZCU-FEL researches and develops electric devices for the medical use.

At UJEP, they undertake the study of the managed immobilisation of bio-molecules, the self-assembly and the development of bio-sensors.

## **Code I – Metrology**

Metrology issues in the area of microtechnologies are researched by the three following workplaces in institutes of the Academy of Sciences of the Czech Republic and the four following workplaces at university faculties: ÚPT AVCR, ÚRE AVCR, FZÚ AVCR, CVUT-FS, VUT-FSI, TUL-FMM, and ZCU-FEL.

ÚPT AVCR conducts the development of laser length standards and optical frequency etalons.

ÚRE AVCR deals with the time and frequency measuring.

FZÚ AVCR develops different optical measuring methods.

CVUT-FS deals with the engineering metrology and the diagnostics of machined surfaces.

VUT-FSI is involved in the classical and holographic interferometry.

TUL-FMM, the Department of measuring, conducts: The measuring of electric and non-electric values, the development of analogue and digital measuring instruments, automated measuring systems and it uses the following optical measuring methods - laser anemometry, visualisation, interferometry, and computer image processing.

ZCU-FEL organises the development of special measuring technology in the direct and low-frequency areas and the development of software for measuring systems.

### **Code J – Microchemical systems**

Research in the field of microchemical systems was registered only in the Jaroslav Heyrovský Institute of Physical Chemistry of the Academy of Sciences of the Czech Republic and at the Jan Evangelista Purkyně University in Ústí nad Labem. However, we might consider chemical and biochemical micro sensors and some micro systems, suitable for the use in biotechnologies and in medicine (see the Codes E and H), the microchemical systems as well.

ÚFCHJH AVCR conducts research of the synthesis of microporous catalytic systems.

UJEP organises, inter alia, the development of a new technology related to electrochemical microchips.

### **Code K – Micro thermal systems**

No research has been registered in this field.

### **Code L – Materials for microtechnologies**

Research of different material properties and the development of new materials have belonged among the interests of a large majority of the identified workplaces. This review includes the workplaces, which conduct the material research, the results of which could be potentially or directly utilised within microtechnologies, in fabrications of parts, facilities, and systems.

Out of the nine assessed institutes of the Academy of Sciences of the Czech Republic, materials for microtechnologies are not researched only in ÚAnalCH AVCR and BFÚ AVCR. Out of 19 assessed university faculties, materials for microtechnologies are not researched only at CVUT-FJFI and VŠCHT-FCHI. The research takes place in the areas of metals, ceramics and glass, semiconductors, inorganic materials, carbon, polymers, biological, and other special material kinds. There are materials researched and developed in the form of layers, films, particles, and also bulk materials. Individual workplaces conduct research of different intensity and within different scopes. The level of the material research depends very much on the infrastructure (the instrument equipment, experimental and semi-production equipment). The level of the research infrastructure differs in individual workplaces very much because purchases of often costly equipment are not coordinated. Especially at universities, there are only small teams involved in the individual material fields. The situation, according to the individual material kinds, is as follows (Note: Neither the material research division, nor the listing is complete):

Research of metals: FZÚ AVCR, UK-MFF, MU-PrF, CVUT-FS, and VUT-FSI,

Research of ceramics and glass: ÚRE AVCR, FZÚ AVCR, ÚFCHJH AVCR (zeolites), ÚFP AVCR, ÚMCH AVCR, UPCE, MU-PrF, CVUT-FS, VUT-FSI, UPOL, VŠCHT-FCHT, TUL-FMM, and TUL-FS,

Research of semiconductors and silicon: ÚRE AVCR, FZÚ AVCR, UK-MFF, MU-PrF, CVUT-FEL, VŠCHT-FCHT, TUL-FMM, ZCU-FEL, and ÚCHP AVCR,

Research of inorganic materials: ÚRE AVCR, ÚFCHJH AVCR, UPCE, and VUT-FCHT,  
Research of carbon (diamond): FZÚ AVCR, UK-MFF, MU-PrF, and CVUT-FEL,  
Research of polymers: ÚCHP AVCR, ÚMCH AVCR, UK-MFF, MU-PrF, CVUT-FS, VUT-FCH, VŠCHT-FCHT, and TUL-FMM,  
Research of biologically active materials: ÚMCH AVCR, BFÚ AVCR, MU-PrF, CVUT-FS, CVUT-FEL, VUT-FCH, and UJEP,  
Research and deposition of layers: FZÚ AVCR, ÚCHP AVCR, ÚFP AVCR, ÚMCH AVCR, UK-MFF, UK-PrF, MU-PrF, CVUT-FS, VUT-FSI, VUT-FCH, TUL-FS, ZCU-FAV, and UJEP.

Special materials:

Liquid crystals: FZÚ AVCR and UK-MFF,

Ferroelectrics: FZÚ AVCR,

Dielectrics: FZÚ AVCR and CVUT-FEL,

Magnetic materials: FZÚ AVCR, UK-MFF, UK-PrF, and VŠCHT-FCHT,

Superconductors: FZÚ AVCR, MU-PrF, and VŠCHT-FCHT,

Photonic materials: ÚMCH AVCR,

Materials for batteries: VUT-FEKT,

Supercondensers: VUT-FEKT,

Thermoelectric materials: VŠCHT-FCHT and UPCE.

## **Code M – Optics and optoelectronics**

There are 3 workplaces in institutes of the Academy of Sciences of the Czech Republic and 8 workplaces at university faculties involved in the research of optics and optoelectronics. They are as follows: ÚRE AVCR, FZÚ AVCR, ÚMCH AVCR, UK-PrF, CVUT-FS, CVUT-FEL, CVUT-FJFI, VUT-FSI, UPCE, VŠCHT-FCHT, and TUL-FMM.

ÚRE AVCR: Research in the section of photonics is focussed on photonic materials, structures and facilities for the optical communications, and on sensors. The main research directions are as follows: Controlled wave photonics, material research of fibre optics, diffractive optical research, and the research of optical sensors. The section consists of the three following departments: The Department of wave photonics, the Department of optical sensors, and the Department of the optical fibres technology.

FZÚ AVCR: Within the section of optics, activities are undertaken by the Department of multilayer structures, the Department of applied optics and optics (the joint workplace with the Palacký University in Olomouc). The Department of multilayer structures conducts research of the deposition of thin layers in low-pressure systems under the atmospheric pressure, laser deposition and the study of thin layers for optics, engineering, and medicine, ellipsometric measurements of solid compounds' properties, etc. The Department of applied optics deals with the roentgen crystalline optics for the synchrotron radiation, the study of thin layer system properties with optical methods, the design and manufacture of optical parts and sets for the visible, UV, and IR areas of radiation, and with the development of optical measuring methods.

ÚMCH AVCR: The Department of the chemistry of solid materials, placed at the University in Pardubice – the Joint laboratory of solid compounds of ÚMCH AV CR and the University Pardubice, the Group of non crystalline materials, researches the ways of preparation of highly pure glass consisting of elements (S, Se, Te, I, Br) + (P, As, Sb, Ge, Bi, and transitional elements), or their combinations. It studies their optical properties, crystallisation and physical aging. There are passive elements developed for the IR area and sensors,

protective and antireflection layers, and memory media both for the reversible and irreversible storage of information.

UK-PrF: There is the research of non linear optical materials with the hydrogen bond conducted.

CVUT-FS: Research and development of optical instruments and systems.

CVUT-FEL: The Group of optoelectronics in the Department of microelectronics conducts the following research activities: Preparation and measuring of properties of planar waveguides, the preparation of which is based on the utilisation of different deposition and diffusional techniques, the analysis, preparation and measuring of properties of new planar electro-optical structures for the distribution and controls of optical radiation, the research of solutions of integrated optical circuits for the communication, measuring, and sensor applications.

CVUT-FJFI: There are the research and development of laser systems conducted, including their applications.

VUT-FSI: The research activities in the Institute of Physical Engineering, the Department of optics and precise mechanics, are focussed on optical tomography, optical diffraction, and the optical image processing.

UPCE: The Department of general and inorganic chemistry conducts research focussed on the study of chalcogenide, chalcogenide-haloid and haloid glass and amorphous layers. They study the possibility of their application in the creation of sub micron diffraction elements for the visible and infrared areas. There is also research of non silicate oxide glass organised as well as the preparation of new kinds of borophosphate, phosphate, boron, and tellurium glasses, the establishment of their basic physical parameters, the study of properties and optical properties of these glasses, and the study of their structures by spectroscopic methods. The objective is also the finding of relations between the consistency, structure and properties of the described glasses.

VŠCHT-FCHT: There are the preparation and studies of properties of planar optical waveguides organised.

TUL-FMM: The Department of measuring develops optical measuring methods - laser anemometry, visualisation, interferometry, computer image processing, and the research in the area of photonics.

## **Code N – Manufacture of devices and parts**

Academic workplaces do not participate in manufacturing. In none of the academic workplaces they have had conditions so far for the establishment of a spin-off kind enterprise.

### **3.3 RESEARCH AND DEVELOPMENT WORKPLACES IN THE PRIVATE SECTOR**

#### **S3 – Silicon & Software Systems Česká republika, s.r.o.**

Šafránkova 1, 155 00 Praha 5

[www.s3group.com](http://www.s3group.com)

This is a subsidiary of Silicon & Software Systems Ltd., Ireland, focussed on the development of chips for communication systems and digital technology. The enterprise was founded in 2000 and there are about 100 workers employed in it.

Codes: A, B

**SCG Czech Design Center, s.r.o.**

Boženy Nemcové 1720, 756 61 Rožnov pod Radhoštěm  
<http://www.tese.cz/scg>

The development centre CDC is a part of the multinational company ON Semiconductor. It was founded in 1994 as a development workplace of the Motorola Company. It participates in the area of design of integrated circuits and deals with the design of analogue integrated circuits utilising bipolar, BiCMOS, VHV, and CMOS technologies, the development of testing of integrated circuits and their properties, the development of libraries for the design of integrated circuits, and the characterisation of technological processes and their simulations.

The second important part of the CDC activities is made of the internal development of software, mainly the software supporting the manufacture of semiconductors – the automation of manufacturing processes, management of technological facilities, database applications, and intranet solutions. It participates also in the development of e-business solutions and in the support of manufacturing plants in the region of Central Europe - the implementation and operations of standard management systems and production planning.

Codes: A, B

**Flextronics Design, s.r.o.**

Areál Slatina, Turanka 115, 627 32 Brno  
<http://www.flextronics.com/Contacts/GlobalLocations/Brno.asp>

When Flextronics finished its activities in the Czech Republic in 2003, a development centre with 45 workers remained in Brno. They develop complex integrated circuits.

Code: A

**Freescale Polovodice Česká republika, s.r.o.**

1. máje 1009, 756 61 Rožnov pod Radhoštěm  
[www.freescale.com](http://www.freescale.com)

It is a systemic application laboratory of Freescale Semiconductor Inc., USA, which is fully owned by Motorola Inc. The laboratory was founded in 1999 and it employs 40 workers. There is the development and prototype manufacturing of sample technological solutions, involving semiconductor parts, organised especially for the automotive industry and consumer electronics.

Code: A

**AMI Semiconductor Czech, s.r.o.**

Vídenská 125, 619 00 Brno  
<http://www.amis.com>

The development centre of the American company AMI Semiconductor was founded in 1996 and it currently employs about 50 workers, who are involved in the development of custom-made integrated circuits (ASIC), mostly for the mixing of digital and analogue signals.

Code: A

**STMicrominiaturisation**

Pobřežní 3, 186 00 Praha 8

<http://www.st.com>

STMicrominiaturisation NV is one of the leading world development and manufacturing companies active in the area of semiconductors and microelectronics. It has operated its development centre (ID Design Factory) in Praha since 2003. The number of employees increases fast and should reach 250 workers in 2005. Development activities are focussed on high performance linear circuits and products for the automotive industry.

Code: A

**MicroTek, s.r.o.**

Pod vodovodem 3, 158 00 Praha 5

[www.microtek.cz](http://www.microtek.cz)

This enterprise organises research, development, and manufacture of custom-made hybrid integrated circuits and microwave parts designed on ceramic and plastic bases of photolithographs and microgalvanics. The company was founded in 1993 by the privatisation of the former division of microwave parts belonging to the state owned company Tesla VÚST. Number of employees: About 20.

Codes: A, D

**ASICentrum, s.r.o.**

Novodvorská 994, 142 21 Praha 4

[www.asicentrum.cz](http://www.asicentrum.cz)

The enterprise is involved in the development and implementation of custom-made integrated circuits (CMOS, RFID, etc.). It was founded in 1992 and there are about 40 workers employed in it. Some shares of the company have been owned, since 2001, by EM Microelectronic, Switzerland, which belongs to the Swatch Group.

Code: A

**SVM microwaves, s.r.o.**

U Mrázovky 5, 150 00 Praha 5

[www.svm.cz](http://www.svm.cz)

The company makes the research-development base for the support of enterprises active in the field of data transfers and the transfer of radio and TV signals. It was founded in 1994. The company focuses mostly on the development and manufacture of highly advanced and unique electronic devices like, for example, the microwave radio-relay connections, microwave television signal distribution systems, multipoint systems for the distribution of the Internet, etc.

Code: B

**e4t miniaturisation for transportation, s.r.o.**

Novodvorská 994, 14221 Praha 4

[www.e4t.cz](http://www.e4t.cz)

The company, founded in 2001, organises research and development in the area of telematics in cars, data support for the testing portals, the management, simulation, and mechatronics. It is involved also in the analyses of new systems and services for the automotive industry. This

company is a joint venture of Czech Süddeutschland, s.r.o. and ŠKODA AUTO, a.s. from Mladá Boleslav. It employs about 40 people.

Codes: B, E

## 4. MANUFACTURING COMPANIES

This part of the report characterises companies involved mostly in the manufacture of materials and components for microtechnologies, the manufacture of microtechnological equipment and instruments, which include microtechnological parts or microsystems. In some cases, these enterprises conduct also their own research and development. The consumers of products by the mentioned companies are mainly domestic and foreign car and aircraft makers and consumer electronics, computer, and communication technology manufacturers.

The companies have been divided into two following groups: The large companies with 250 or more employees and SME (small and medium-size enterprises) with fewer than 250 employees. Activities of each company are characterised with the code, according to Part 2.2. Companies in each part are alphabetically ordered.

### 4.1 LARGE ENTERPRISES

|                                     |  |
|-------------------------------------|--|
| Name                                | AEG components, s.r.o.   |
| Address                             | Prumyslová 1110, 506 01 Jicín  |
| URL                                 | <a href="http://www.awg-components.cz">www.awg-components.cz</a>               |
| Number of workers, Year of founding | 300, founded in 1998   |
| Activity                            | Manufacture of consumer motor capacitors and condensers for fluorescent lights |
| Status                              | 100% subsidiary of AEG KuW, GmbH, Germany                                      |
| Code                                | A  |

|                                     |   |
|-------------------------------------|---|
| Name                                | ALPS Electric Czech, s.r.o.   |
| Address                             | Drevarská 17, 680 01 Boskovice  |
| URL                                 | <a href="http://www.alps.cz">www.alps.cz</a>  |
| Number of workers, Year of founding | 400, founded in 1995  |
| Activity                            | Mass manufacture of keyboards, RF modulators, TV tuners, and satellite converters (LNB) |
| Status                              | 100 % subsidiary of ALPS ELECTRIC Co, Japan   |
| Code                                | N   |

|                                     |  |
|-------------------------------------|--|
| Name                                | ASUS Czech, s.r.o.                             |
| Address                             | Rudná u Prahy, 252 19 K Vypichu 979            |
| URL                                 | <a href="http://www.asus.com">www.asus.com</a> |
| Number of workers, Year of founding | 200-249, founded in 2002                       |

|          |   |
|----------|---|
| Activity | Manufacture of electronic equipment                       |
| Status   | 100% subsidiary of Asus Holland Holding B.V., Netherlands |
| Code     | N   |

|                                     |  |
|-------------------------------------|--|
| Name                                | ASUSTek COMPUTER                                     |
| Address                             | Ostrava-Hrabová                                      |
| URL                                 | <a href="http://www.asus.com">www.asus.com</a>       |
| Number of workers, Year of founding | About 1000, founded in 2004                          |
| Activity                            | Manufacture of computers, the repair centre          |
| Status                              | Subsidiary of Asus Holland Holding B.V., Netherlands |
| Code                                | N  |

|                                     |  |
|-------------------------------------|--|
| Name                                | AVX Czech Republic, s.r.o.   |
| Address                             | Dvorákova 328, 563 01 Lanškroun  |
| URL                                 | <a href="http://www.avxcorp.com">www.avxcorp.com</a>                   |
| Number of workers, Year of founding | 3600, founded in 1992  |
| Activity                            | Manufacture of tantalum chip condensers and layered ceramic condensers |
| Status                              | 100% subsidiary of AVX Limited, United Kingdom                         |
| Code                                | A  |

|                                     |   |
|-------------------------------------|---|
| Name                                | BRISK Tábor, a.s.   |
| Address                             | Vožická 2068, 390 02 Tábor  |
| URL                                 | <a href="http://www.brisk.cz">www.brisk.cz</a>  |
| Number of workers, Year of founding | 850, founded in 1992/1935   |
| Activity                            | Manufacture of spark and glow plugs, the manufacture of sensors (contactless inductive revolution counters, level gauges), and technical ceramics |
| Status                              | Czech company   |
| Code                                | E, L  |

|                                     |  |
|-------------------------------------|--|
| Name                                | Celestica Kladno, s.r.o.   |
| Address                             | Billundská 3111, 272 01 Kladno                                     |
| URL                                 | <a href="http://www.celestica.com">www.celestica.com</a>           |
| Number of workers, Year of founding | More than 500, founded in 1998/2001                                |
| Activity                            | PCB assembly   |
| Status                              | 100% subsidiary of Celestica European Holdings S.ar.l., Luxembourg |
| Code                                | N  |

|         |  |
|---------|--|
| Name    | Celestica Rájecko, s.r.o.                                |
| Address | Ulice Osvození 363, 679 02 Rájecko                       |
| URL     | <a href="http://www.celestica.com">www.celestica.com</a> |

|                                     |  |
|-------------------------------------|--|
| Number of workers, Year of founding | 1800, founded in 1999  |
| Activity                            | PCB assembly, systems and memories                                 |
| Status                              | 100% subsidiary of Celestica European Holdings S.ar.l., Luxembourg |
| Code                                | N  |

|                                     |  |
|-------------------------------------|--|
| Name                                | Connaught Miniaturisation /CZ/, spol. s r.o.               |
| Address                             | Jirice u Humpolce  |
| URL                                 | <a href="http://www.cel-europe.com">www.cel-europe.com</a> |
| Number of workers, Year of founding | 300, founded in 2004                                       |
| Activity                            | Manufacture of sensors                                     |
| Status                              | 100% subsidiary of Connaught Miniaturisation, Ireland      |
| Code                                | E  |

|                                     |   |
|-------------------------------------|---|
| Name                                | EPIQ CZ, s.r.o.   |
| Address                             | Americká 124, 330 11 Tremošná u Plzne                     |
| URL                                 | <a href="http://www.epiq.com">www.epiq.com</a>            |
| Number of workers, Year of founding | 550, founded in 1991                                      |
| Activity                            | Assembly and manufacture of PCBs (printed circuit boards) |
| Status                              | 100% subsidiary of EPIQ NV, Belgium                       |
| Code                                | N   |

|                                     |  |
|-------------------------------------|--|
| Name                                | ELTES CZ, s.r.o.   |
| Address                             | Nádražní 206, 561 64 Jablonné nad Orlicí   |
| URL                                 | <a href="http://www.eltes-cz.cz">www.eltes-cz.cz</a>   |
| Number of workers, Year of founding | 400, founded in 1999/1994/1929   |
| Activity                            | Manufacture of passive electric components (wire and regulatory resistors, potentiometers, etc.) |
| Status                              | Czech company  |
| Code                                | A  |

|                                     |   |
|-------------------------------------|---|
| Name                                | EPCOS,s.r.o.,   |
| Address                             | Feritová 1, 787 15 Šumperk  |
| URL                                 | <a href="http://www.epcos.com">www.epcos.com</a>  |
| Number of workers, Year of founding | 615, founded in 1999  |
| Activity                            | Manufacture of passive electronic parts made of ferrites                                      |
| Status                              | Subsidiary of the EPCOS Holding (the joint venture of Siemens and Matsushita founded in 1989) |
| Code                                | A, L  |

|                                     |   |
|-------------------------------------|---|
| Name                                | FIC CZ, s.r.o.  |
| Address                             | K Vypichu 1138, 252 19 Rudná  |
| URL                                 | <a href="http://www.fic.cz">www.fic.cz</a>  |
| Number of workers, Year of founding | 370, founded in 1991  |
| Activity                            | Manufacture of motherboards (PCB-printed circuit boards), graphic cards, and the assembly of PC systems |
| Status                              | 100% subsidiary of FIC FIRST International Holding B.V., Netherlands                                    |
| Code,                               | N   |

|                                     |  |
|-------------------------------------|--|
| Name                                | Foxconn CZ, s.r.o.   |
| Address                             | U Zámecku 26, 532 01 Pardubice   |
| URL                                 | <a href="http://www.foxconn.cz">www.foxconn.cz</a>   |
| Number of workers, Year of founding | 2100, founded in 2000  |
| Activity                            | Manufacture of electronic products, computers, and motherboards  |
| Status                              | 100% subsidiary of Foxconn Holdings B.V., Netherlands (Foxconn is the trade mark of the Taiwanese company Han Hai Precision Industry, Co. Ltd., which is the 100% owner of Foxconn Holdings) |
| Code                                | N  |

|                                     |   |
|-------------------------------------|---|
| Name                                | Cherry, spol. s r.o.  |
| Address                             | Osvobozená 780, 431 51 Klášterec nad Ohří   |
| URL                                 | <a href="http://www.cherry.cz">www.cherry.cz</a>  |
| Number of workers, Year of founding | 550, founded in 1993  |
| Activity                            | Manufacture of sensors (speed sensors, acceleration meters, spark sensors) and switches |
| Status                              | 100% subsidiary of Cherry GmbH, Germany   |
| Code,                               | E   |

|                                     |  |
|-------------------------------------|--|
| Name                                | Infineon Technologies, s.r.o.  |
| Address                             | Volanovská 518, 541 01 Trutnov   |
| URL                                 | <a href="http://www.infineon.cz">www.infineon.cz</a>   |
| Number of workers, Year of founding | 750, founded in 2000   |
| Activity                            | Manufacture of optical-fibre wave guides and connectors, optoelectronic exchangers and discrete optoelectronic parts (laser and receiver diodes) |
| Status                              | 100% subsidiary of Infineon Technologies BV., Netherlands  |
| Code                                | M  |

|           |  |
|-----------|--|
| Name      | L.G. Philips Displays Czech Republic, s.r.o.                           |
| Address   | Tovární 605, 753 01 Hranice  |
| URL       | <a href="http://www.philips-displays.com">www.philips-displays.com</a> |
| Number of | About 1500, founded in 2001  |

|                           |   |
|---------------------------|---|
| workers, Year of founding |   |
| Activity                  | Manufacture of electronic parts for the manufacture of screens and activities of a development centre |
| Status                    | 100% subsidiary of L.G. Philips Displays Investment B.V. Philips, Netherlands                         |
| Code                      | N   |

|                                     |  |
|-------------------------------------|--|
| Name                                | Panasonic Mobile & Automotive Systems Czech, s.r.o.  |
| Address                             | Pardubice, Staré Cívce, U Panasonicu 266, Post Code 53006  |
| URL                                 | <a href="http://www.panasonic.cz">www.panasonic.cz</a>   |
| Number of workers, Year of founding | 550, founded in 2001   |
| Activity                            | Manufacture of mobile phones and car radio sets  |
| Status                              | Panasonic Mobile Communications Co. Ltd. (30%), Japan, Matsushita Electric Industrial Co. Ltd. (70%) |
| Code                                | N  |

|                                     |  |
|-------------------------------------|--|
| Name                                | METRA Blansko, a.s.  |
| Address                             | Porící 24, 678 49 Blansko  |
| URL                                 | <a href="http://www.metra.cz">www.metra.cz</a>                             |
| Number of workers, Year of founding | 1480, founded in 1911/1990   |
| Activity                            | Manufacture of electric and electronic measuring instruments and equipment |
| Status                              | Czech company  |
| Code                                | I, N   |

|                                     |  |
|-------------------------------------|--|
| Name                                | ON SEMICONDUCTOR CZECH REPUBLIC, a.s. (ONCR)   |
| Address                             | 1. máje 2230, 756 61 Rožnov pod Radhoštěm  |
| URL                                 | <a href="http://www.onsemi.cz">www.onsemi.cz</a>   |
| Number of workers, Year of founding | 1400, in 1999 (ON Semiconductor took over the manufacture of semiconductor parts from Motorola), in 2003 (the fusion of ON Semiconductor, Terosil, and Tesla Sezam into ONCR)  |
| Activity                            | Manufacture of monocrystalline silicon, manufacture of polished silicon wafers for microelectronics, manufacture of silicon wafers with an epitaxial layer, and the design and manufacture of semiconductor parts. Research and development of silicon wafers, analogue semiconductor parts and semiconductor detectors. |
| Status                              | 100% subsidiary of the globally active concern ON Semiconductor. One of the eight manufacturing plants of the concern.   |
| Code                                | A, E, L  |

|           |  |
|-----------|--|
| Name      | OPTREX Czech, a.s.                               |
| Address   | Bucharova 194, 543 02 Vrchlabí                   |
| URL       | <a href="http://www.optrex.cz">www.optrex.cz</a> |
| Number of | 700, founded in 1996                             |

|                           |  |
|---------------------------|--|
| workers, Year of founding |  |
| Activity                  | Manufacture of LCD displays                    |
| Status                    | 100% subsidiary of OPTREX EUROPE GmbH, Germany |
| Code                      | A  |

|                                     |  |
|-------------------------------------|--|
| Name                                | Panasonic AVC Networks, s.r.o.   |
| Address                             | U Panasoniku 1, 320 84 Plzeň-mesto   |
| URL                                 | <a href="http://www.matsushita.cz">www.matsushita.cz</a>   |
| Number of workers, Year of founding | 1850, founded in 1996  |
| Activity                            | Manufacture of colour television sets, activities of the research-development centre in the field of modern television parts, software, and design |
| Status                              | 100% subsidiary of PANASONIC EUROPE LTD., United Kingdom   |
| Code                                | N, A   |

|                                     |  |
|-------------------------------------|--|
| Name                                | Polovodice, a.s.   |
| Address                             | Novodvorská 138a, 142 21 Praha 4   |
| URL                                 | <a href="http://www.polovodice.cz">www.polovodice.cz</a>   |
| Number of workers, Year of founding | 250, founded in 1963/1994  |
| Activity                            | Development and manufacture of semiconductor parts, Si monocrystals and wafers, electronic applications, and roentgen monochromators |
| Status                              | Czech company  |
| Code                                | A, L, N  |

|                                     |  |
|-------------------------------------|--|
| Name                                | SAFINA, a.s.   |
| Address                             | Vídenská 104, 252 42 Jesenice, Vestec  |
| URL                                 | <a href="http://www.safina.cz">www.safina.cz</a>   |
| Number of workers, Year of founding | 320, founded in 1950/1992  |
| Activity                            | Manufacture of prefabricates and chemicals containing precious metals, reprocessing of precious metals: materials of Ag and its alloys, silver anodes, connections for electrotechnology, Ag and Pt targets, products of palladium, platinum, platinum alloys, rhodium, gold, etc. |
| Status                              | Czech company  |
| Code                                | L  |

|                                     |  |
|-------------------------------------|--|
| Name                                | Saint-Gobain-Advanced Ceramics, s.r.o.                             |
| Address                             | Preperská 1302, 511 01 Turnov                                      |
| URL                                 | <a href="http://www.sgac-turnov.cz">www.sgac-turnov.cz</a>         |
| Number of workers, Year of founding | 320, founded in 1999   |
| Activity                            | Research, development, and the manufacture of special ceramics for |

|        |   |
|--------|---|
|        | cutting tools, electro-ceramics and high-tech products                            |
| Status | 100% subsidiary of the Saint Gobain Ceramiques Avancees Desmarquest Group, France |
| Code   | L   |

|                                     |   |
|-------------------------------------|---|
| Name                                | Siemens VDO Czech Republic, s.r.o.  |
| Address                             | Prumyslová 1851, 250 01 Brandýs nad Labem   |
| URL                                 | <a href="http://www.siemensvdo.com">www.siemensvdo.com</a>  |
| Number of workers, Year of founding | 650, founded in 1994  |
| Activity                            | Development and manufacture of car accessories (combined dashboard instruments – engine revolution counters and speedometers) |
| Status                              | 100% subsidiary of the concern Siemens VDO Automotive AG, Germany   |
| Code                                | N, E  |

|                                     |   |
|-------------------------------------|---|
| Name                                | STROM telecom, s.r.o.   |
| Address                             | Michelská 60, 140 00 Praha 4  |
| URL                                 | <a href="http://www.strom.cz">www.strom.cz</a>  |
| Number of workers, Year of founding | 750, founded in 1993  |
| Activity                            | Manufacture of telecommunication equipment, information systems, and technologies for operators |
| Status                              | Subsidiary of the opened joint stock company of the KNC, Russia (67%), MATRIX 99, a.s. CZ (33%) |
| Code                                | B   |

|                                     |  |
|-------------------------------------|--|
| Name                                | Tatung Czech, s.r.o.                                       |
| Address                             | U Nové hospody 4, Škvřany, 301 00 Plzeň                    |
| URL                                 | <a href="http://www.tatung.com">www.tatung.com</a>         |
| Number of workers, Year of founding | About 450, founded in 2004                                 |
| Activity                            | Manufacture of television sets with LCD and plasma screens |
| Status                              | 100% subsidiary of Tatung, Taiwan                          |
| Code                                | N  |

|                                     |  |
|-------------------------------------|--|
| Name                                | TCT, a.s., Vidce                               |
| Address                             | 756 53 Vidce 96                                |
| URL                                 | <a href="http://www.tctas.cz">www.tctas.cz</a> |
| Number of workers, Year of founding | 1300, founded in 1993/1948                     |
| Activity                            | Manufacture of television screens              |
| Status                              | Member of the ECIMEX Group, Czech Republic     |
| Code                                | N  |

|                                     |   |
|-------------------------------------|---|
| Name                                | TEMOS Tools, a.s.   |
| Address                             | Modlanská 1, 415 01 Teplice   |
| URL                                 | <a href="http://www.somet.cz">www.somet.cz</a>  |
| Number of workers, Year of founding | 250, founded in 1939/1949/1995  |
| Activity                            | Development and manufacture of mechanical and electromechanical measuring devices, gauges, and the provision for calibration services |
| Status                              | Czech company, the owner of the trade mark SOMET  |
| Code                                | I   |

|                                     |   |
|-------------------------------------|---|
| Name                                | Tesla, a.s.   |
| Address                             | Podebradská 56/186, 180 66 Praha 9 – Hloubetín  |
| URL                                 | <a href="http://www.tesla.cz">www.tesla.cz</a>  |
| Number of workers, Year of founding | 750, founded in 1921  |
| Activity                            | Manufacture of radio and television transmitters, electronic measuring equipment, radio-relay equipment, and micromachining |
| Status                              | Czech company   |
| Code                                | N, D  |

|                                     |   |
|-------------------------------------|---|
| Name                                | Tesla Blatná, a.s.  |
| Address                             | Palackého 644, 388 15 Blatná  |
| URL                                 | <a href="http://www.tesla-blatna.cz">www.tesla-blatna.cz</a>  |
| Number of workers, Year of founding | 360, founded in 1958  |
| Activity                            | Manufacture of electronic parts and equipment (resistors, choking coils, photoresistors, opto-couplers with photoresistors) and microwave modules<br>Technology: Photolithography, vacuum deposition, vacuum sputtering |
| Status                              | Czech company   |
| Code                                | A, D, M   |

|                                     |   |
|-------------------------------------|---|
| Name                                | TSE, spol. s r.o.   |
| Address                             | Mánesova 74/390, 371 01 České Budejovice  |
| URL                                 | <a href="http://www.tse.cz">www.tse.cz</a>  |
| Number of workers, Year of founding | 314, founded in 1991  |
| Activity                            | Development, design and manufacture of electronic parts and equipment for telecommunication facilities, instruments for the anaesthesiology |
| Status                              | Czech company   |
| Code                                | B, H, N,  |

|                                     |  |
|-------------------------------------|--|
| Name                                | TTC Holding<br>TTC Telekomunikace, s.r.o.<br>TTC Marconi, s.r.o.<br>And also other companies     |
| Address                             | Trebohostická 5, 100 00 Praha 10   |
| URL                                 | <a href="http://www.ttc.cz">www.ttc.cz</a>   |
| Number of workers, Year of founding | 400, founded in 1953/1992  |
| Activity                            | Manufacture of microelectronic parts for the transmission of telephones, data, and radio signals |
| Status                              | Holding TTC Marconi, s.r.o. is a joint-venture by TTC Telekomunikace and Marconi, plc. (UK)      |
| Code                                | B  |

|                                     |  |
|-------------------------------------|--|
| Name                                | Tyco Miniaturisation Czech, s.r.o.   |
| Address                             | K AMP 1293, 664 34 Kurim   |
| URL                                 | <a href="http://www.amp.com">www.amp.com</a> ; <a href="http://www.tyco.com">www.tyco.com</a>  |
| Number of workers, Year of founding | 1500, founded in 1993  |
| Activity                            | Manufacture of electronic parts (especially of connectors for electronics and optoelectronics) |
| Status                              | 100% subsidiary of Tyco Group S.a.r.l., Luxembourg   |
| Code                                | A  |

|                                     |   |
|-------------------------------------|---|
| Name                                | Vishay Electronic, spol s r.o.  |
| Address                             | Mlýnská 1095, 334 01 Preštice   |
| URL                                 | <a href="http://www.vishay.com">www.vishay.com</a>  |
| Number of workers, Year of founding | 1500 (including operations in Blatná, Prachatice, Volary and Dolní Rychnov near Sokolov), founded in 1991 |
| Activity                            | Manufacture of parts for electronics (resistors, condensers, etc.)  |
| Status                              | 100% owner – Vishay Europe GmbH., Germany   |
| Code                                | A   |

#### 4.2 SMALL AND MEDIUM-SIZE ENTERPRISES

|                                     |   |
|-------------------------------------|---|
| Name                                | 2N telekomunikace, a.s.                                     |
| Address                             | Modranská 621/72, 143 01 Praha 4                            |
| URL                                 | <a href="http://www.2n.cz">www.2n.cz</a>                    |
| Number of workers, Year of founding | About 100, founded in 1991                                  |
| Activity                            | Manufacture of telecommunication equipment (GSM, PBX, etc.) |
| Status                              | Czech company   |
| Code                                | B,  |

|                                     |  |
|-------------------------------------|--|
| Name                                | AEV, spol. s r.o.  |
| Address                             | Jožky Silného 2783, 767 01 Kromeríž  |
| URL                                 | <a href="http://www.aev.cz">www.aev.cz</a>   |
| Number of workers, Year of founding | 220, founded in 1991   |
| Activity                            | Development and manufacture of electronic instruments for cars, aircraft, and the light technology |
| Status                              | Czech company  |
| Code                                | N  |

|                                     |   |
|-------------------------------------|---|
| Name                                | Aseko, spol. s r.o.   |
| Address                             | Vídenská 340, 252 42 Vestec u Prahy   |
| URL                                 | <a href="http://www.aseko.cz">www.aseko.cz</a>  |
| Number of workers, Year of founding | 20, founded in 1990   |
| Activity                            | Development and manufacture of gas sensors (detection systems for CO and other gases) |
| Status                              | Czech company   |
| Code                                | E   |

|                                     |   |
|-------------------------------------|---|
| Name                                | AVIKO Praha, s.r.o.   |
| Address                             | Na Hutmance 2, 158 00 Praha 5   |
| URL                                 | <a href="http://www.volny.cz/vns.aviko">www.volny.cz/vns.aviko</a>  |
| Number of workers, Year of founding | 50, founded in 1990   |
| Activity                            | Design and manufacture of special equipment (metal detectors, optical measuring of part sizes, manipulators, measuring of small differential pressures, etc.) |
| Status                              | Czech company, a subsidiary of HVM Plasma, s.r.o., CZ   |
| Code                                | F, I, M   |

|                                     |   |
|-------------------------------------|---|
| Name                                | Awos, s.r.o.  |
| Address                             | Výzkumná 79, 533 51 Pardubice VII   |
| URL                                 | <a href="http://www.awos.cz">www.awos.cz</a>  |
| Number of workers, Year of founding | 50, founded in 1991   |
| Activity                            | Development and manufacture of electronic parts and systems and the manufacture of PCBs |
| Status                              | Czech company   |
| Code                                | N   |

|                                     |   |
|-------------------------------------|---|
| Name                                | Barco, spol. s r.o.   |
| Address                             | Okružní 741, 686 05 Uherské Hradiště-Maratice   |
| URL                                 | <a href="http://www.barco.cz">www.barco.cz</a>  |
| Number of workers, Year of founding | 12, founded in 1993   |
| Activity                            | Development and manufacture of bar code sensors, terminals, label printers, and wireless networks |
| Status                              | Czech company   |
| Code                                | E, N  |

|                                     |  |
|-------------------------------------|--|
| Name                                | Barco Manufacturing, s.r.o.                      |
| Address                             | Billundská 2756, 272 01 Kladno                   |
| URL                                 | <a href="http://www.barco.com">www.barco.com</a> |
| Number of workers, Year of founding | 100, founded in 2000                             |
| Activity                            | Manufacture of displays                          |
| Status                              | 100% subsidiary of Barco NV, Belgium             |
| Code                                | A  |

|                                     |   |
|-------------------------------------|---|
| Name                                | BD Sensors, s.r.o.  |
| Address                             | Hradištská 817, 68708 Buchlovice  |
| URL                                 | <a href="http://www.bdsensors.cz">www.bdsensors.cz</a>                              |
| Number of workers, Year of founding | 50-99, founded in 1993  |
| Activity                            | Manufacture and supplies of pressure sensors, level sensors, and of the accessories |
| Status                              | Czech company   |
| Code                                | G, N  |

|                                     |  |
|-------------------------------------|--|
| Name                                | Befra-Electronic, s.r.o.                           |
| Address                             | K Prádlu 858, 735 35 Horní Suchá                   |
| URL                                 | <a href="http://www.befra.cz">www.befra.cz</a>     |
| Number of workers, Year of founding | 150, founded in 1992                               |
| Activity                            | Manufacture of PCBs                                |
| Status                              | 100% subsidiary of Bebro electronics GmbH, Germany |
| Code                                | N  |

|                                     |   |
|-------------------------------------|---|
| Name                                | BVT Technologies, a.s.  |
| Address                             | Hudcova 78, 612 00 Brno   |
| URL                                 | <a href="http://www.bvt.cz">www.bvt.cz</a>                            |
| Number of workers, Year of founding | 5, founded in 1990  |
| Activity                            | Development and manufacture of substrates for electrochemical sensors |

|        |  |
|--------|--|
|        | and bio-sensors, and manufacture of micropumps |
| Status | Czech company                                  |
| Code   | E, H, J  |

|                                     |   |
|-------------------------------------|---|
| Name                                | Carl Zeiss, spol. s r.o.  |
| Address                             | Radlická 14, 150 00 Praha 5   |
| URL                                 | <a href="http://www.zeiss.cz/">http://www.zeiss.cz/</a>   |
| Number of workers, Year of founding | 47, founded in 1993   |
| Activity                            | Marketing and services in the area of microscopy, medical technology, optical-electronic systems, semiconductor technology, industrial measuring technology, and optics |
| Status                              | 100% subsidiary of Carl Zeiss B.V., Germany   |
| Code                                | G, H, M   |

|                                     |  |
|-------------------------------------|--|
| Name                                | C-com, s.r.o.  |
| Address                             | U Moruší 888, 530 06 Pardubice VI - Svítkov  |
| URL                                 | <a href="http://www.c-com.cz">www.c-com.cz</a>   |
| Number of workers, Year of founding | 50-99, founded in 1994   |
| Activity                            | Manufacture of RF and passive microwave parts and subsystems (duplexers, filters, dividers, pre amplifiers, etc.) and the manufacture of ceramic materials and parts |
| Status                              | Member of the Andrew Corp. Group, USA  |
| Code                                | N, B, L  |

|                                     |   |
|-------------------------------------|---|
| Name                                | CRYTUR, s.r.o.  |
| Address                             | Palackého 175, 541 01 Turnov  |
| URL                                 | <a href="http://www.crytur.cz">www.crytur.cz</a>  |
| Number of workers, Year of founding | 25-49, founded in 1943/1998   |
| Activity                            | Scintillation materials and detectors, laser rods and components (mirrors), precise optics and mechanics, and sapphirine profiles |
| Status                              | Czech company   |
| Code                                | L, M  |

|                                     |  |
|-------------------------------------|--|
| Name                                | CUBE CZ, s.r.o.  |
| Address                             | Ferdinandov 612, 463 62 Hejnice                                  |
| URL                                 | <a href="http://www.cube.cz">www.cube.cz</a>                     |
| Number of workers, Year of founding | 40, founded in 1998  |
| Activity                            | Manufacture of single and multilayer boards for printed circuits |
| Status                              | Czech company  |
| Code                                | N, A   |

|                                     |  |
|-------------------------------------|--|
| Name                                | CZ-elektronika, s.r.o.   |
| Address                             | Náchodská ul., 549 01 Nové Mesto nad Metují  |
| URL                                 | <a href="http://www.cz-elektronika.cz">www.cz-elektronika.cz</a>                                 |
| Number of workers, Year of founding | 40, founded in 1996  |
| Activity                            | Manufacture of PCBs, assembly of electronic products, and photovoltaic applications (since 2002) |
| Status                              | Czech company  |
| Code                                | N  |

|                                     |   |
|-------------------------------------|---|
| Name                                | Ce Me Bo, s.r.o.  |
| Address                             | Porící 1602/24, 678 01 Blansko  |
| URL                                 | <a href="http://www.cemebo.cz">www.cemebo.cz</a>  |
| Number of workers, Year of founding | 50, founded in 1994   |
| Activity                            | Manufacture of PCBs   |
| Status                              | Czech company   |
| Code                                | N   |
| Name                                | Delong Group<br>Delong instruments, a.s.<br>Delong industrial, a.s.   |
| Address                             | Bulharská 48, 612 00 Brno<br>Purkynova 99, 612 00 Brno  |
| URL                                 | <a href="http://www.lv-em.com">www.lv-em.com</a><br><a href="http://www.dicomps.com">www.dicomps.com</a> ;<br><a href="http://www.diindustrial.com">www.diindustrial.com</a> ;      |
| Number of workers, Year of founding | 60, founded in 1992<br>200, founded in 1994   |
| Activity                            | Research, development, and manufacture of scientific equipment and special electronics (electron microscopes, roentgen analysers, neutron radiation systems, surgical gamma-probes) |
| Status                              | Czech company   |
| Code                                | G, H, N   |

|                                     |   |
|-------------------------------------|---|
| Name                                | ELCERAM, s.r.o.   |
| Address                             | Okružní 1144, 500 03 Hradec Králové                                     |
| URL                                 | <a href="http://www.elceram.cz">www.elceram.cz</a>                      |
| Number of workers, Year of founding | 150, founded in 1994  |
| Activity                            | Manufacture of white and printed ceramic substrates (corundum ceramics) |
| Status                              | The owner is the Czech company ESGK, s.r.o.                             |
| Code                                | L   |

|                                     |   |
|-------------------------------------|---|
| Name                                | ELIS Plzen, a.s.  |
| Address                             | Lucní 15, 304 26 Plzen  |
| URL                                 | <a href="http://www.elis.cz">www.elis.cz</a>  |
| Number of workers, Year of founding | 45, founded in 1990/1997  |
| Activity                            | Development and manufacture of ultrasound water meters, ultrasound and inductive flow-meters and heat meters in water and steam |
| Status                              | Czech company   |
| Code                                | N   |

|                                     |  |
|-------------------------------------|--|
| Name                                | Elmarco, s.r.o.  |
| Address                             | V Horkách 76, Liberec 9, 460 07  |
| URL                                 | <a href="http://www.elmarco.cz">www.elmarco.cz</a>   |
| Number of workers, Year of founding | 80, founded in 2000  |
| Activity                            | Manufacture of systems for the dosing of chemicals in the process of surface treatments of silicon wafers and the development and manufacture of equipment for the manufacturing of polymer nanofibre non woven textiles |
| Status                              | Czech company  |
| Code                                | F  |

|                                     |   |
|-------------------------------------|---|
| Name                                | ELMET, spol. s r.o.   |
| Address                             | Nádražní 889, 535 01 Prelouc                                    |
| URL                                 | <a href="http://www.elmet.cz">www.elmet.cz</a>                  |
| Number of workers, Year of founding | 55, founded in 1991   |
| Activity                            | Manufacture of PCBs and the manufacture of electronic equipment |
| Status                              | Czech company   |
| Code                                | N   |

|                                     |  |
|-------------------------------------|--|
| Name                                | ELTON hodinářská, a.s.   |
| Address                             | Náchodská 2105, 549 01 Nové Mesto nad Metují                   |
| URL                                 | <a href="http://www.elton.cz">www.elton.cz</a>                 |
| Number of workers, Year of founding | 30, 1998/1949  |
| Activity                            | Manufacture of watches of the brand PRIM, the fine engineering |
| Status                              | Czech company  |
| Code                                | N  |

|                                     |  |
|-------------------------------------|--|
| Name                                | ESY, s.r.o.                                |
| Address                             | Americká 856/78, 460 10 Liberec 3          |
| URL                                 | <a href="http://www.esy.cz">www.esy.cz</a> |
| Number of workers, Year of founding | 30, founded in 1995                        |

|          |  |
|----------|--|
| founding |  |
| Activity | Development and manufacture of custom-made electrotechnology (control technology for thermal processes, measuring technology, and information displays), and the manufacture of custom-made software |
| Status   | Czech company  |
| Code     | N  |

|                                     |  |
|-------------------------------------|--|
| Name                                | FEI Czech Republic, s.r.o.                                 |
| Address                             | Podnikatelská 2956/6, 612 00 Brno                          |
| URL                                 | <a href="http://www.feicompany.com">www.feicompany.com</a> |
| Number of workers, Year of founding | 166, founded in 1992                                       |
| Activity                            | Development and manufacture of electron microscopes        |
| Status                              | Subsidiary of FEI Electron Optics International B.V.       |
| Code                                | G, H   |

|                                     |  |
|-------------------------------------|--|
| Name                                | GeneAge Technologies, a.s.   |
| Address                             | Pod kaštany 3/5, 160 00 Praha 6  |
| URL                                 | <a href="http://www.geneagetech.com">www.geneagetech.com</a>   |
| Number of workers, Year of founding | <10, founded in 1999   |
| Activity                            | Development of the DNA chip technology, the custom-made manufacture of recombinant proteins, and products for the molecular genetics |
| Status                              | Czech company  |
| Code                                | H  |

|                                     |  |
|-------------------------------------|--|
| Name                                | GEN-TREND, s.r.o.  |
| Address                             | Dolní 2, 370 04 České Budejovice   |
| URL                                 | <a href="http://www.gentrend.cz">www.gentrend.cz</a>   |
| Number of workers, Year of founding | < 5, founded in 1996   |
| Activity                            | Development and manufacture of diagnostic sets used for the detection and quantification of pathogenic micro organisms by the reverse hybridisation on the micro-array chips |
| Status                              | Czech company  |
| Code                                | H  |

|                                     |   |
|-------------------------------------|---|
| Name                                | Goldcard, s.r.o.  |
| Address                             | Vetrná 401, 686 05 Uherské Hradiště   |
| URL                                 | <a href="http://www.goldcard.cz">www.goldcard.cz</a>  |
| Number of workers, Year of founding | 20-24, founded in 1991  |
| Activity                            | Development and manufacture of identification systems and components (terminals, readers, etc.) |

|        |               |
|--------|---------------|
| Status | Czech company |
| Code   | N             |

|                                     |   |
|-------------------------------------|---|
| Name                                | Harlingen, s.r.o.   |
| Address                             | Dvorákova 328, 563 01 Lanškroun   |
| URL                                 | <a href="http://www.harlingen.cz">www.harlingen.cz</a>  |
| Number of workers, Year of founding | 20-24, founded in 2004  |
| Activity                            | Manufacture of parts for microelectronics:<br>Precise thin layer resistors<br>Thermal nickel sensors<br>Linear converters<br>Cermet resistance three- grid valves<br>and others |
| Status                              | Czech company (which has taken over a part of the former production facilities of Tesla Lanškroun)  |
| Code                                | A   |

|                                     |   |
|-------------------------------------|---|
| Name                                | HC miniaturisation, s.r.o.  |
| Address                             | Kalendova 688, 500 04 Hradec Králové  |
| URL                                 | <a href="http://www.hcminiaturisation.cz">www.hcminiaturisation.cz</a>  |
| Number of workers, Year of founding | 65, founded in 1993   |
| Activity                            | Fitting of printed circuits with a mixed and surface assemblies,<br>development and manufacture of crystalline oscillation generators,<br>development and manufacture of hybrid integrated circuits, and<br>sales of SMD parts in sets, or individually |
| Status                              | Czech company   |
| Code                                | A   |

|                                     |  |
|-------------------------------------|--|
| Name                                | Hokami CZ, s.r.o.                                |
| Address                             | Ampérova 464, 460 08 Liberec 8                   |
| URL                                 | <a href="http://www.hokami.cz">www.hokami.cz</a> |
| Number of workers, Year of founding | 60, founded in 1997                              |
| Activity                            | Manufacture of PCBs                              |
| Status                              | Czech company                                    |
| Code                                | N  |

|                                     |   |
|-------------------------------------|---|
| Name                                | HVM Plasma, s.r.o.  |
| Address                             | Na Hutmance 347/2, 158 00 Praha 5-Jinonice                          |
| URL                                 | <a href="http://www.hvm.cz">www.hvm.cz</a>                          |
| Number of workers, Year of founding | 60, founded in 1992   |
| Activity                            | Manufacture and services: Technology for the coating by the PVD and |

|        |   |
|--------|---|
|        | PACVD methods made on order (hard layers, tribological coatings – DLC, and decorative coatings).<br>Research and development: Development of coating technologies, development of particle sources (magnetrons, arched and ion sources), modelling, analyses of thin layers, and plasma diagnostics |
| Status | Czech company   |
| Code   | L, F  |

|                                     |   |
|-------------------------------------|---|
| Name                                | IMA, s.r.o.   |
| Address                             | Pod Vodovodem 2, 158 01 Praha 5   |
| URL                                 | <a href="http://www.ima.cz">www.ima.cz</a>  |
| Number of workers, Year of founding | 45, founded in 1992   |
| Activity                            | Development and application of integrated identification systems, GSM technology, and car electronics |
| Status                              | Czech company   |
| Code                                | N, B  |

|                                     |   |
|-------------------------------------|---|
| Name                                | Incline Global Technology Services (Czech), s.r.o.                          |
| Address                             | Jakubská 647/2, Praha 1, 11000  |
| URL                                 | <a href="http://www.incline-qts.com">www.incline-qts.com</a>                |
| Number of workers, Year of founding | 10-19, founded in 2005  |
| Activity                            | Repairs of LCD panels in notebooks, LCD television sets, and plasma screens |
| Status                              | 100% subsidiary of Incline Global Technology Service, Inc., United Kingdom  |
| Code                                | N   |

|                                     |   |
|-------------------------------------|---|
| Name                                | Krystaly Hradec Králové, a.s.   |
| Address                             | Okružní 1144, 500 03 Hradec Králové   |
| URL                                 | <a href="http://www.krystalv.cz">www.krystalv.cz</a>  |
| Number of workers, Year of founding | 130, founded in 1996  |
| Activity                            | Manufacture of piezoelectric crystalline units, crystalline filters, and crystalline oscillation generators |
| Status                              | Czech company   |
| Code                                | L   |

|                                     |   |
|-------------------------------------|---|
| Name                                | Laird technologies  |
| Address                             | Prumyslová 497, Liberec, 46211                                  |
| URL                                 | <a href="http://www.edb.cz">www.edb.cz</a>                      |
| Number of workers, Year of founding | 200, founded in 2003  |
| Activity                            | Manufacture of shield materials, conductors of Be copper, power |

|        |   |
|--------|---|
|        | conducting textiles and elastomers, microwave absorbers, etc. |
| Status | 99% subsidiary of Laird C.I. Holdings Limited, Caiman Islands |
| Code   | L, A, 3   |

|                                     |   |
|-------------------------------------|---|
| Name                                | LAMBDA Praha, s.r.o.  |
| Address                             | Musílkova 12/488, 150 00 Praha 5  |
| URL                                 | <a href="http://www.lambda.cz">www.lambda.cz</a>                                  |
| Number of workers, Year of founding | 15, founded in 1919/1993  |
| Activity                            | Manufacture of biological microscopes and optical components (micro lenses, etc.) |
| Status                              | Czech company   |
| Code                                | H   |

|                                     |   |
|-------------------------------------|---|
| Name                                | Letecké přístroje, s.r.o.   |
| Address                             | Pod Hájkem 406/1, 180 00 Praha 8  |
| URL                                 | <a href="http://www.lp-praha.cz">www.lp-praha.cz</a>  |
| Number of workers, Year of founding | 40, founded in 1993   |
| Activity                            | Development and manufacture of sensors and indicators (revolution counters), magnetic compasses, electromagnetic valves, actuators, electromechanical and electronic aircraft equipment |
| Status                              | Czech company   |
| Code                                | E, N  |

|                                     |   |
|-------------------------------------|---|
| Name                                | LISS, a.s.  |
| Address                             | Zuberská 2603, 256 61 Rožnov pod Radhoštěm  |
| URL                                 | <a href="http://www.liss.cz">www.liss.cz</a>  |
| Number of workers, Year of founding | 50, founded in 1991   |
| Activity                            | Coating centre equipped with the equipment by Platit Co., Switzerland, galvanic plating (vibroplating), metallisation of non-conducting materials |
| Status                              | Czech company   |
| Code                                | D   |

|                                     |  |
|-------------------------------------|--|
| Name                                | M.A.G. Galvanochemie, a.s.   |
| Address                             | Dvorská 9, 466 01 Jablonec nad Nisou   |
| URL                                 | <a href="http://www.magchem.cz">www.magchem.cz</a>   |
| Number of workers, Year of founding | 53, founded in 1999/1993   |
| Activity                            | Manufacture of chemical compounds for the surface treatment and preparations for the manufacture of printed circuits |
| Status                              | Czech company  |
| Code                                | L  |

|                                     |   |
|-------------------------------------|---|
| Name                                | MEGA, a.s.  |
| Address                             | Drahobejlova 1452/54, 190 00 Praha 9<br>Pod Vinicí 83, 471 27 Stráž pod Ralskem   |
| URL                                 | <a href="http://www.mega.cz">www.mega.cz</a>  |
| Number of workers, Year of founding | 50-99, founded in 1992  |
| Activity                            | Development and manufacture of heterogeneous ion-exchanging membranes RALEX for the electrolysis, electrophoresis, electro-deionization, etc., products for biotechnologies (bio-catalysers, e.g. immobilised enzymes and cells in polyvinyl-alcoholic carriers), and the development of membranes for fuel cells |
| Status                              | Czech company   |
| Code                                | J, H  |

|                                     |  |
|-------------------------------------|--|
| Name                                | Mesing, spol. s r.o.   |
| Address                             | Mariánské nám. 1, 617 00 Brno  |
| URL                                 | <a href="http://www.mesing.cz">www.mesing.cz</a>   |
| Number of workers, Year of founding | 21, founded in 1990  |
| Activity                            | Products in the area of the precise mechanics – length measuring devices, indication length sensors, and automatic measuring devices and systems |
| Status                              | Czech company  |
| Code                                | I  |

|                                     |   |
|-------------------------------------|---|
| Name                                | MESIT PCB, spol. s r.o.   |
| Address                             | Sokolovská 573, 686 01 Uherské Hradiště                               |
| URL                                 | <a href="http://www.pcb.mesit.cz">www.pcb.mesit.cz</a>                |
| Number of workers, Year of founding | 55, founded in 1998   |
| Activity                            | Manufacture of multilayer metallised boards for printed circuits      |
| Status                              | Czech company, a part of the MESIT Holding, a.s. Group (12 companies) |
| Code                                | N   |

|                                     |  |
|-------------------------------------|--|
| Name                                | MEV, s.r.o.                                |
| Address                             | Podebradská 51, 198 00 Praha 9             |
| URL                                 | <a href="http://www.mev.cz">www.mev.cz</a> |
| Number of workers, Year of founding | 55, founded in 1993                        |
| Activity                            | Manufacture of PCBs                        |
| Status                              | Czech company                              |
| Code                                | N  |

|                                     |   |
|-------------------------------------|---|
| Name                                | Microelektronika, spol. s r.o.  |
| Address                             | Kpt. Poplera 55/III., 566 01 Vysoké Mýto  |
| URL                                 | <a href="http://www.microelektronika.cz">www.microelektronika.cz</a>  |
| Number of workers, Year of founding | 93, founded in 1991   |
| Activity                            | Automated systems for the checking-in of passengers in the public transport systems, including automats for the sale of tickets (stationary and mobile), electronic markers, chip card readers, time and zone indicators, equipment for the sale of tickets and the supporting control and evaluation equipment for the data processing in PCs. Special control electronics for buses and trucks and the manufacture for spare consumption, e.g. regulators, control equipment, timers, and special automated electronics |
| Status                              | Czech company   |
| Code                                | N   |

|                                     |  |
|-------------------------------------|--|
| Name                                | Micro – sensor, spol. s r.o.   |
| Address                             | Na Libuši 891, 391 65 Bechyne  |
| URL                                 | <a href="http://www.micro-sensor.cz">www.micro-sensor.cz</a>   |
| Number of workers, Year of founding | 55, founded in 1991  |
| Activity                            | Development and manufacture of sensors for the measuring of distance and strength, the development in the field of precise mechanics and electronics |
| Status                              | A member of the Micro-Epsilon Messtechnik Group, Ortenburg/Passau since 1992, Germany  |
| Code                                | E, I   |

|                                     |  |
|-------------------------------------|--|
| Name                                | Micro Tek, s.r.o.  |
| Address                             | Pod Vodovodem 2, Praha 5, 158 00   |
| URL                                 | <a href="http://www.microtek.cz">www.microtek.cz</a>   |
| Number of workers, Year of founding | 6-9, founded in 1992   |
| Activity                            | Design, development and consequent manufacture of custom-made hybrid integrated circuits for the general use and microwave parts and sub systems created by thick layer and thin layer technologies on ceramic and plastic bases |
| Status                              | Czech company  |
| Code                                | A, N   |

|                                     |  |
|-------------------------------------|--|
| Name                                | MICROTEL, s.r.o.                                     |
| Address                             | Jana Palacha 1573, Roztoky 252 63                    |
| URL                                 | <a href="http://www.microtel.cz">www.microtel.cz</a> |
| Number of workers, Year of founding | 1-5, founded in 1993                                 |

|          |   |
|----------|---|
| Activity | Development and manufacture of electronic equipment, especially in the area of telecommunications |
| Status   | Czech company   |
| Code     | B, N  |

|                                     |  |
|-------------------------------------|--|
| Name                                | MITE Hradec Králové, s.r.o.  |
| Address                             | Veverkova 1343, 500 02 Hradec Králové  |
| URL                                 | <a href="http://www.mite.cz">www.mite.cz</a>   |
| Number of workers, Year of founding | 20, founded in 1993/1988   |
| Activity                            | Development and manufacture of microcomputer systems for the industrial applications made on order, equipment for the measuring of micro-gravitation (utilised in 1996 on the space ship Atlantis) |
| Status                              | Czech company  |
| Code                                | N  |

|                                     |   |
|-------------------------------------|---|
| Name                                | Mitsubishi Electric Automotive Czech, s.r.o.  |
| Address                             | Politických veznu 1564, 274 01 Slaný  |
| URL                                 | <a href="http://www.mitsubishielectric.cz">www.mitsubishielectric.cz</a> , <a href="http://www.meac.cz/">www.meac.cz/</a> |
| Number of workers, Year of founding | 108, founded in 2000  |
| Activity                            | Manufacture of electronic units controlling the running of engines, alternators, and starters                             |
| Status                              | Subsidiary of Mitsubishi Electric Corporation, Japan  |
| Code                                | N   |

|                                     |  |
|-------------------------------------|--|
| Name                                | Monokrystaly, s.r.o.   |
| Address                             | Turnov – Vesecko 487, 511 01 Turnov  |
| URL                                 | <a href="http://www.monokrystaly.cz">www.monokrystaly.cz</a>   |
| Number of workers, Year of founding | 1-5, founded in 1968   |
| Activity                            | Manufacture of ion selective electrodes for the analyses in different fields (medicine, agriculture, food industry, etc.) and pH microelectrodes |
| Status                              | Czech company  |
| Code                                | G, H   |

|                                     |  |
|-------------------------------------|--|
| Name                                | MTEL Communications s.r.o.   |
| Address                             | Krapkova 4, Olomouc, 77200   |
| URL                                 | <a href="http://www.mtelcomms.cz">www.mtelcomms.cz</a>   |
| Number of workers, Year of founding | 10-19, founded in 1995   |
| Activity                            | Design of optical telecommunication and data networks, the complex organisation of all activities related not only to the design of optical routes, but also to the entire assortment of the weak current distribution |
| Status                              | Czech company  |

|      |      |
|------|------|
| Code | M, N |
|------|------|

|                                     |  |
|-------------------------------------|--|
| Name                                | OPTAGLIO, s.r.o.   |
| Address                             | Husinec-Rež 199, 25068 Rež   |
| URL                                 | <a href="http://www.optaglio.cz">www.optaglio.cz</a>   |
| Number of workers, Year of founding | 45, originally founded in 1994   |
| Activity                            | Research and development of applications of the electron lithography and the utilisation of lasers, the manufacture of holographic labels, foils, etc. |
| Status                              | Optaglio Limited (75%), United Kingdom, Optaglio Holdings Limited (25%)  |
| Code                                | D, N   |

|                                     |  |
|-------------------------------------|--|
| Name                                | OPTOKON Co. Ltd.   |
| Address                             | Cervený Kříž 250, 586 02 Jihlava   |
| URL                                 | <a href="http://www.optokon.cz">www.optokon.cz</a> ; <a href="http://www.optokon.com">www.optokon.com</a>  |
| Number of workers, Year of founding | 100, founded in 1991   |
| Activity                            | Research, development, and manufacture of optoelectronic parts and equipment, especially for fibre optics and electronics.<br>Activities of the accredited calibration laboratory related to the optical measuring equipment |
| Status                              | The company is a primary optical division of Methode Miniaturisation, Inc., USA, which owns 75% shares   |
| Code                                | M  |

|                                     |  |
|-------------------------------------|--|
| Name                                | PCB Benešov, a.s.  |
| Address                             | Jana Nohy 1352, 256 01 Benešov                             |
| URL                                 | <a href="http://www.pcb-benesov.cz">www.pcb-benesov.cz</a> |
| Number of workers, Year of founding | 77, founded in 1992  |
| Activity                            | Manufacture of boards with multiple printed circuits       |
| Status                              | Czech company  |
| Code                                | N  |

|                                     |  |
|-------------------------------------|--|
| Name                                | PIVOT, a.s.  |
| Address                             | Prumyslová 3020/3, 787 01 Šumperk  |
| URL                                 | <a href="http://www.pivot.cz">www.pivot.cz</a>                               |
| Number of workers, Year of founding | 25-49, founded in 2002   |
| Activity                            | Development of new coating technologies and manufacture of coating equipment |
| Status                              | Joint enterprise of PLATIT AG, Switzerland, and SHM, s.r.o. from Nový Malín  |

|      |   |
|------|---|
| Code | F |
|------|---|

|                                     |  |
|-------------------------------------|--|
| Name                                | Pragoboard, s.r.o.                                       |
| Address                             | Technologický park Bechovice, 190 11 Praha 9             |
| URL                                 | <a href="http://www.pragoboard.cz">www.pragoboard.cz</a> |
| Number of workers, Year of founding | founded in 1997  |
| Activity                            | Manufacture of PCBs and micromachining                   |
| Status                              | Czech company  |
| Code                                | N, D   |

|                                     |  |
|-------------------------------------|--|
| Name                                | RealTime Technologies, s.r.o.                              |
| Address                             | Veská 35, 533 04 Sezemice (Pardubice)                      |
| URL                                 | <a href="http://www.realtimetec.cz">www.realtimetec.cz</a> |
| Number of workers, Year of founding | 9, founded in 2003   |
| Activity                            | Repairs of PCBs, construction of PCB prototypes            |
| Status                              | 100% subsidiary of Realtime Technologies, Dublin, Ireland  |
| Code                                | N  |

|                                     |  |
|-------------------------------------|--|
| Name                                | Reflex, s.r.o.   |
| Address                             | Novodvorská 994, 142 00 Praha 4  |
| URL                                 | <a href="http://www.reflex-co.cz">www.reflex-co.cz</a>   |
| Number of workers, Year of founding | 14, founded in 1996  |
| Activity                            | Research and development of precise roentgen optics and scientific video cameras, the manufacture of micro mirrors, roentgen video cameras for the roentgen diffractometry and fluorescent roentgen analyses |
| Status                              | 100% subsidiary of Bede, plc., United Kingdom  |
| Code                                | G, M, N  |

|                                     |  |
|-------------------------------------|--|
| Name                                | SHM, s.r.o.  |
| Address                             | Prumyslová 3020/3, Šumperk, 78701  |
| URL                                 | <a href="http://www.shm-cz.cz">www.shm-cz.cz</a>   |
| Number of workers, Year of founding | 25-49, founded in 1993   |
| Activity                            | Research, development and design of wear-resistant layers by the PVD technology, nanolayers MARWIN |
| Status                              | Czech company  |
| Code                                | L  |

|         |  |
|---------|--|
| Name    | SPEEL Praha, s.r.o.                            |
| Address | Beranových 130, 199 05 Praha 9                 |
| URL     | <a href="http://www.speel.cz">www.speel.cz</a> |

|                                     |  |
|-------------------------------------|--|
| Number of workers, Year of founding | 44, founded in 1998  |
| Activity                            | Development and manufacture of fixed memory banks for aircraft recorders and monitoring systems, and electronic speedometers |
| Status                              | Czech company  |
| Code                                | N  |

|                                     |  |
|-------------------------------------|--|
| Name                                | STARMANS Miniaturisation, s.r.o.   |
| Address                             | V zahradách 24/836, 180 00 Praha 8 – Liben   |
| URL                                 | <a href="http://www.starmans.cz">www.starmans.cz</a>   |
| Number of workers, Year of founding | 35, founded in 1993  |
| Activity                            | Research, development and manufacture of industrial ultrasound systems (probes, thickness meters, defectoscopes) and roentgen scanning systems |
| Status                              | Czech company  |
| Code                                | G, I, N  |

|                                     |   |
|-------------------------------------|---|
| Name                                | STROBOS, s.r.o.   |
| Address                             | Křižíkova 68, 61200 Brno-Královo Pole   |
| URL                                 |   |
| Number of workers, Year of founding | <10, founded in 1999  |
| Activity                            | Manufacture of instruments, equipment and special machines for different industries |
| Status                              | Czech company   |
| Code                                | N   |

|                                     |  |
|-------------------------------------|--|
| Name                                | SVM Microwaves, s.r.o.   |
| Address                             | U Mrázovky 5, 150 00 Praha 5   |
| URL                                 | <a href="http://www.svm.cz">www.svm.cz</a>   |
| Number of workers, Year of founding | 6-9, founded in 1994   |
| Activity                            | Development and manufacture of highly advanced and unique electronic equipment like, for example, microwave radio-relay connections, microwave television distribution systems, multi-point systems for the distribution of the Internet, etc. |
| Status                              | Czech company  |
| Code                                | B, G, N  |

|                                     |  |
|-------------------------------------|--|
| Name                                | TECO, a.s..  |
| Address                             | Havlíckova 260, 280 02 Kolín                       |
| URL                                 | <a href="http://www.tecomat.cz">www.tecomat.cz</a> |
| Number of workers, Year of founding | 85, founded in 1919/1994                           |

|          |  |
|----------|--|
| founding |  |
| Activity | Development and manufacture of programmed control automats and programmed management systems |
| Status   | Czech company  |
| Code     | N  |

|                                     |   |
|-------------------------------------|---|
| Name                                | TESCAN, s.r.o.  |
| Address                             | Libušina třída 21, 623 00 Brno  |
| URL                                 | <a href="http://www.tescan.cz">www.tescan.cz</a>  |
| Number of workers, Year of founding | 30, founded in 1991   |
| Activity                            | Development and manufacture of scanning electron microscopes and equipment for the image processing |
| Status                              | Czech company   |
| Code                                | G, H  |

|                                     |  |
|-------------------------------------|--|
| Name                                | Tesla Tech, s.r.o.                                     |
| Address                             | Kláštevní 1, 259 01 Votice                             |
| URL                                 | <a href="http://www.teslatech.cz">www.teslatech.cz</a> |
| Number of workers, Year of founding | 200, founded in 1998                                   |
| Activity                            | Manufacture of PCBs                                    |
| Status                              | Czech company, subsidiary of Strom telecom, s.r.o.     |
| Code                                | N  |

|                                     |  |
|-------------------------------------|--|
| Name                                | TESLA V.T. MICROEL, s.r.o.   |
| Address                             | Nademlejská 600, 198 00 Praha 9  |
| URL                                 | <a href="http://www.tesla-microel.cz">www.tesla-microel.cz</a>   |
| Number of workers, Year of founding | 25, founded in 1993  |
| Activity                            | Development and manufacture of magnetrons for the radiolocation technology, transit-time tubes for television transmitters, and the linear accelerator 4 MEV |
| Status                              | Czech company  |
| Code                                | N, 0   |

|                                     |  |
|-------------------------------------|--|
| Name                                | Unicontrols, a.s..   |
| Address                             | Krenická 2257, 10000 Praha 10-Strašnice (část)   |
| URL                                 | <a href="http://www.unicontrols.cz">www.unicontrols.cz</a>   |
| Number of workers, Year of founding | 136, founded in 1991   |
| Activity                            | Manufacture of electric engines, generators and transformers, telephone and telex equipment and exchanges, radio and television receivers, including the equipment for the recording and image and sound playback, and other similar equipment |

|        |               |
|--------|---------------|
| Status | Czech company |
| Code   | B, G          |

|                                     |   |
|-------------------------------------|---|
| Name                                | UNIS Brno, s.r.o.   |
| Address                             | Jundrovská 33, 624 00 Brno  |
| URL                                 | <a href="http://www.unis.cz">www.unis.cz</a>  |
| Number of workers, Year of founding | 190, founded in 1990  |
| Activity                            | Complex solutions of industrial automation, integrated systems, robotics, and car electronics |
| Status                              | Czech company   |
| Code                                | N   |

|                                     |  |
|-------------------------------------|--|
| Name                                | UVB Technik, s.r.o.  |
| Address                             | Ostravská 79A, 748 01 Hlucín   |
| URL                                 | <a href="http://www.uvbtechnik.cz">www.uvbtechnik.cz</a>   |
| Number of workers, Year of founding | 14, founded in 1991/1993   |
| Activity                            | Development and manufacture of the equipment for precise measuring of metal strip thickness ( $\pm 1\mu\text{m}$ ) |
| Status                              | Czech company  |
| Code                                | I  |

|                                     |   |
|-------------------------------------|---|
| Name                                | VAKUUM Praha, spol. s r.o.  |
| Address                             | V Holešovickách 747/2, 180 00 Praha 8-Liben   |
| URL                                 | <a href="http://www.vakuum.cz">www.vakuum.cz</a>  |
| Number of workers, Year of founding | 35, founded in 1993   |
| Activity                            | Development and manufacture of vacuum and ultra vacuum components, ultra vacuum systems for research and development, vacuum systems for particle accelerators, machine parts, and precise mechanical parts |
| Status                              | Czech company   |
| Code                                | G   |

|                                     |  |
|-------------------------------------|--|
| Name                                | Wendell Miniaturisation, a.s                       |
| Address                             | Tovární 368, 563 01 Lanškroun                      |
| URL                                 | <a href="http://www.wendell.cz">www.wendell.cz</a> |
| Number of workers, Year of founding | 60, founded in 2002                                |
| Activity                            | Mass manufacture of PCBs                           |
| Status                              | Czech company                                      |
| Code                                | N  |

### 4.3 REVIEW OF ACTIVITY OF LARGE COMPANIES, ACCORDING TO THE CODES

Large companies have been classified, within differing scopes, in the code groups A, B, D, E, I, L, M, and N. Seventeen large companies were classified in the group N – Other products belonging among the microtechnological equipment and the manufacture of equipment (instruments and systems) containing microtechnological parts or systems (e.g. computers, different instruments and equipment, consumer electronics, etc.). Ten companies were classified within the group A – Semiconductors and parts for microelectronics, 6 companies were classified within the group E – Micro sensors, 5 companies within the group L – Materials for microtechnologies, and two companies were classified within the groups D – Microtechnology, I – Metrology, and M – Optics and optoelectronics. One company was classified within the group B – Communication microsystems.

Group A comprises: **AEG Components** (condensers), **AVX** (condensers), **ELTES** (resistors and potentiometers), **EPCOS** (manufacture of passive electronic parts made of ferrits), **ON Semiconductor** (Si wafers, semiconductor parts), **Oprex** (LCD displays), **Polovodice** (semiconductor parts), **Tesla Blatná** (resistors, photoresistors, opto-couplers, and other electronic parts), **Tesla Jihlava** (custom-made connectors), **TYCO** (connectors for electronics and optoelectronics), and **Vishay** (resistors and condensers).

Group B comprises: **TTC Holding** (microelectronic parts for telecommunications).

Group D comprises: **Tesla, a.s.** (micromachining) and **Tesla Blatná** (photolithography, vacuum depositing).

Group E comprises: **BRISK Tábor** (revolution counters, level gauges), **Connaught** (acceleration sensors, etc.), **CHERRY** (acceleration sensors, etc.), **ON Semiconductor** (semiconductor detectors of radiation), **Tesla Jihlava** (NO<sub>x</sub> sensors, accelerators), and **Siemens VDO** (revolution counters).

Group I comprises: **Metra Blansko** (metrology) and **TEMOS Tools** (the manufacture of measuring equipment and calibration services).

Group L comprises: **BRISK Tábor** (technical ceramics), **EPCOS** (manufacture of passive electronic parts made of ferrits), **ON Semiconductor** (monocrystalline Si), **Polovodice** (Si monocrystals and boards), **Safina** (prefabricates and chemicals containing precious metals), and **Saint Gobain** (special ceramics).

Group M comprises: **Infineon** (optoelectronic converters, light conducting cables, laser and receiving diodes, etc.) and **Tesla Blatná** (photodetectors).

Group N comprises: **ALPS** (manufacture of keyboards, RF modulators, TV tuners, and satellite converters), **ASU** (manufacture and repairs of computers), **Celestica Kladno** (assembly of mobile telephones, assembly and manufacture of PCBs), **Celestica Rájecko** (assembly and manufacture of PCBs, manufacture of memories), **EPIQ** (manufacture of PCBs), **FIC** (manufacture of PCBs, graphic cards, and computers), **FOXCONN** (manufacture of computers and PCBs), **LG Philips** (manufacture of TV screens and parts), **Matsushita Com.** (assembly of mobile telephones and manufacture of car radio sets), **METRA Blansko** (manufacture of electric measuring instruments and equipment), **Panasonic AVC**

(manufacture of television sets), **Tatung** (manufacture of television sets), **TCT** (manufacture of TV screens), **Tesla, a.s.** (RF and TV transmitters, electronic measuring equipment), **Tesla Jihlava** (electromechanical parts for the automotive industry, keyboards, etc.), and **Siemens VDO** (manufacture of car accessories).

#### **4.4 REVIEW OF ACTIVITIES OF SMALL AND MEDIUM-SIZE ENTERPRISES, ACCORDING TO THE CODES**

Small and medium-size enterprises have been classified in all code groups, with the exception of the codes C – MEMS, MOEMS, and K – Microthermal systems. The largest number of small and medium-size enterprises has been classified, similarly like in the case of large enterprises, in the group N – Other products of the microtechnological equipment, or the manufacture of equipment containing microtechnological parts or systems (38 companies). Ten companies were classified within the groups H – Microsystems for the utilisation in biotechnology and medicine, and L – Materials. Seven companies were classified within the groups A – Semiconductors and parts for microelectronics, and G – Microanalytical equipment etc.

Group A comprises: **Barco Man.** (manufacture of displays), **CUBE** (manufacture of single layer and multilayer boards with printed circuits), **Harlingen** (resistors, thermal sensors, converters, trimers, etc.), **HC Electronic** (development and manufacture of crystalline oscillation generators, development and manufacture of hybrid integrated circuits), **Laird** (manufacture of microwave absorbers and shield materials), and **Micro Tek, s.r.o.** (manufacture of custom-made hybrid integrated circuits).

Group B comprises: **2N** (manufacture of telecommunication equipment), **C-com** (manufacture of RF and passive microwave parts and sub systems (duplexers, filters, dividers, pre amplifiers, etc.)), **IMA** (GSM technology), **Microtel** (manufacture of the equipment for the control of telecommunication traffic and for the measuring of the traffic load), **SVM Microwaves** (development and manufacture of microwave radio-relay connections), and **Unicontrols** (systems for the dispatching controls and management systems for railway vehicles).

Group D comprises: **LISS** (the coating centre equipped with the equipment by Platit, galvanic-plating (Vibroplating), metallisation of non conducting materials), **Optaglio** (research and development of applications of the electron lithography and the utilisation of lasers), and **Pragoboard** (micromachining).

Group E comprises: **ASEKO** (development and manufacture of gas (CO) sensors - detection systems, etc), **Barco** (bar code sensors), **BVT Technologies** (electrochemical sensors and biosensors), **Letecké přístroje** (manufacture of sensors and indicators – revolution counters, etc.), and **Micro-sensor** (development and manufacture of sensors for the measuring of distances and strength).

Group F comprises: **AVIKO** (manufacture of manipulators), **ELMARCO** (manufacture of systems for the dosing of chemicals in the process of surface treatment of silicon boards, development and manufacture of the equipment for the manufacture of polymer nanofibre not woven textiles), **HVM Plasma** (the technology of coating by the PVD and PACVD methods made on order), and **PIVOT** (development of new coating technologies and the manufacture of coating equipment).

Group G comprises: **BD Sensors** (manufacture of pressure sensors), **Delong** (development and manufacture of electron microscopes and roentgen analysers), **Carl Zeiss** (marketing and service of the brand optics, microscopy, medical technology, etc.), **FEI** (manufacture of electron microscopes), **Monokrystal** (manufacture of ion selective electrodes for the analyses in different fields (medicine, agriculture, food industry, pH microelectrodes), **Reflex** (development and manufacture of roentgen video cameras for the roentgen diffractometry and fluorescent roentgen analyses), **SVM Microwaves** (development and manufacture of microwave radio-relay connections), **STARMANS** (development and manufacture of roentgen scanning systems), **TESCAN** (development and manufacture of scanning electron microscopes and the equipment for the image processing), **VAKUUM** (development and manufacture of vacuum and ultra vacuum components, the ultra vacuum systems for research and development, vacuum systems for the particle accelerators), and **Unicontrols** (systems for telemetering and data transfers).

Group H comprises: **BVT** (development and manufacture of biosensors), **Carl Zeiss** (surgical microscopes, optical biometry, optical tomography, etc.), **Delong** (development and manufacture of surgical gamma probes), **FEI** (manufacture of electron microscopes), **GeneAge** (DNA chip development technology, custom-made manufacture of recombinated proteins, products for the molecular genetics), **GEN-TREND** (development and manufacture of diagnostic sets for the detection and quantification of pathogenic micro organisms by the reverse hybridization on the micro-array chips), **LAMBDA** (manufacture of biological microscopes), **MEGA** (development and manufacture of heterogeneous ion-exchanging membranes RALEX for the electrolysis, electrophoresis, electro-deionization, etc., products for biotechnologies (bio-catalysers, e.g. immobilised enzymes and cells in polyvinyl-alcoholic carriers)), **Monokrystal** (manufacture of ion selective electrodes for the analyses in different fields (medicine, agriculture, food industry), pH microelectrodes), **TESCAN** (development and manufacture of raster electron microscopes and the equipment for the image processing), and **TSE** (manufacture of instruments for anaesthesiology).

Group I comprises: **AVIKO** (measuring of small differential pressures), **Mesing** (products in the area of precise mechanics – length meters, indication length sensors, automated measuring devices and systems), **Micro-sensor** (sensors for the measuring of length and strength), **STARMANS** (development and manufacture of roentgen scanning systems), and **UVB Technik** (development and manufacture of the equipment for the precise measuring of metal strip thickness ( $\pm 1\mu\text{m}$ )).

Group J comprises: **BVT Technologies** (manufacture of electrochemical sensors) and **MEGA** (development and manufacture of membranes for fuel cells).

Group L comprises: **C-com** (ceramic materials and parts), **Crytur** (scintillation materials and detectors, sapphirine profiles), **ELCERAM** (manufacture of the corundum ceramics), **HVM Plasma** (hard layers – LCD), **Krystal** (manufacture of piezoelectric crystalline units, crystalline filters and crystalline oscillation generators), **Laird** (manufacture of conductors of Be copper, power conducting textiles and elastomers), **MAG** (manufacture of chemical compounds for the surface treatment), and **SHM** (hard nanolayers).

Group M comprises: **AVIKO** (equipment for the optical measuring), **Carl Zeiss** (eye optics, binoculars, the equipment for night vision), **Crytur** (laser rods and components - mirrors, precise optics and mechanics), **MTEL Communications** (PMD measuring, chromatic CD, polarisation mode dispersion of a single mode optical routes), **Optokon**

(research, development and manufacture of optoelectronic parts and equipment, especially for the fibre optics and electronics), and **Reflex** (manufacture of the precise roentgen optics and micro mirrors).

Group N comprises: **AEV** (development and manufacture of electronic equipment for cars, aeroplanes, and light technology), **Awos** (development and manufacture of electronic parts and systems, manufacture of PCBs), **Barco** (manufacture of terminals and label printers), **BD Sensors** (manometers, level gauges, etc.), **C-com** (manufacture of RF and passive microwave parts and sub systems (duplexers, filters, dividers, pre amplifiers, etc.)), **Befra** (manufacture of PCBs), **CUBE** (manufacture of PCBs), **CZ-elektronika** (manufacture of PCBs, assembly of electronic products), **CEMEBO** (manufacture of PCBs), **Delong** (research, development and manufacture of scientific equipment and special electronics), **ELIS** (development and manufacture of ultrasound water meters, ultrasound and induction flow meters, and the heat measuring devices in water and steam), **ELMET** (manufacture of PCBs and electronic equipment), **ELTON** (manufacture of watches of the brand PRIM, precise engineering), **ESY** (development and manufacture of custom-made electrotechnology – control technology for thermal processes, measuring technology, and information displays), **Goldcard** (development and manufacture of identification systems and components - terminals, readers, etc.), **Hokami** (manufacture of PCBs), **IMA** (development and applications of integrated identification systems, GSM technology, car electronics), **Incline** (repairs of LCD panels in notebooks, LCD television sets and plasma screens), **Letecké přístroje** (manufacture of magnetic compasses, electromagnetic valves, actuators, and electromechanical and electronic aircraft equipment), **PCB Benešov** (manufacture of PCBs), **MESIT** (manufacture of PCBs), **MEV** (manufacture of PCBs), **Microelektronika** (automated systems for the check-ins of passengers in the public transport, including automats issuing tickets (stationary and mobile ones), electronic markers, readers of chip cards, time and zone displays, equipment for the issuance of tickets and the support control and assessment equipment for the data processing with PCs), **Micro Tek** (microwave parts and sub systems for the utilisation, inter alia, in telecommunications), **MICROTEL** (development of telephone PK and MK exchanges), **MTEL Communications** (microtubes and microcables), **MITE** (development and manufacture of microcomputing systems for the custom-made industrial applications), **Mitsubishi El.** (manufacture of electronic units controlling the engine runs, alternators, and starters), **Optaglio** (manufacture of holographic labels and films), **Pragoboard** (manufacture of PCBs), **RealTime** (repairs and design of PCB prototypes), **Reflex** (manufacture of scientific video cameras), **SPEEL** (development and manufacture of fixed memories for aircraft recorders and aircraft monitoring systems, and electronic speedometers), **STARMANS** (research, development and manufacture of industrial ultrasound systems (probes, thickness meters, defectoscopes)), **STROBOS** (manufacture of mechanical parts for machines), **SVM Microwaves** (converters), **TECO** (development and manufacture of programmed control automats and programmed control systems), **TESLA Tech** (manufacture of PCBs), **TESLA VT** (development and manufacture of magnetrons for the radiolocation technology, transit-time tubes for television transmitters, linear accelerators 4 MEV), **UNIS** (complex solutions of the industrial automation, integrated systems, robotics, and car electronics), and **Wendell** (mass manufacture of PCBs).

## 5. SUMMARY EVALUATION OF RESEARCH AND MANUFACTURING ACTIVITIES IN THE AREA OF MICROTECHNOLOGIES

### 5.1 RESEARCH AND DEVELOPMENT

The review of activities by research workplaces, in the Sub Chapter 3.2., clearly shows that there are a number of research projects running, the results of which could be utilised in practice, if they were application-oriented. However, we must stress that a large majority of these research works can be utilised in microtechnologies only potentially and they are not conducted for this purpose. The exceptions are the workplaces at the Faculty of mechatronics TUL and the workplaces of the Department of precise mechanics and optics in the Institute of instrument and control technology in the Faculty of engineering at CVUT, which resolves also practice-oriented projects.

The running basic and target-oriented basic research, which could be applied in microtechnologies, could be divided into the following areas:

- Microelectronics - Research of semiconductors (the production technologies and the semiconductor properties), the development in the design of integrated circuits, and the research of different materials,
- Optics and optoelectronics – Research of optical materials, lasers, optical instruments, and the preparation and properties of optical waveguides, optical sensors, etc.,
- Microsystems usable in biotechnology and medicine – Research of bio-compatible materials, bio-sensors, microanalytical methods, microchips, different instruments, etc.,
- Micro sensors – utilised in different fields (from the automotive industry and the environment to medicine).

However, in the majority of cases, there are no offers by research workplaces. Even demands related to research work results are still missing because most Czech companies, which utilise microtechnologies, are owned by foreign owners, who have brought modern technologies from abroad and their understanding and knowledge of high qualities and capacities of Czech research workplaces are still unsatisfactory.

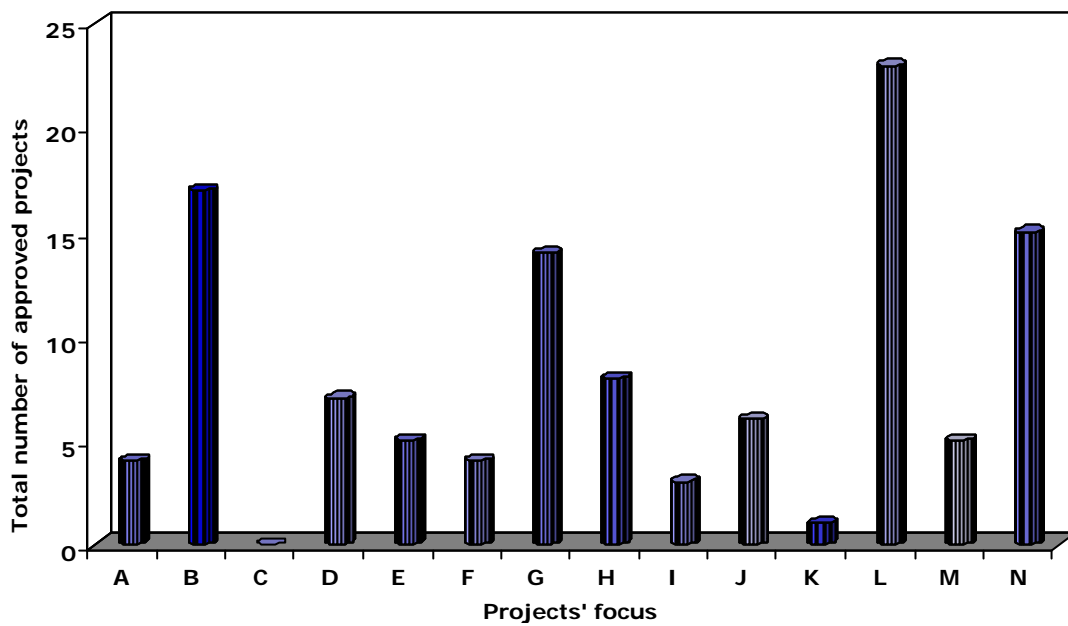
The number of projects implemented in research areas in the period 2002-2005, according to the classification described in the Sub Chapter 2.2. is presented in Fig. 1. The level of public funds assigned to individual research areas is clearly shown in Fig. 2. The projects were looked for in the CEP database<sup>7</sup>, according to science fields – “Sensors, measuring, and regulation”, “Utilisation of computers, robotics, and their applications”, “Electronics and optoelectronics, and electrotechnology”, by insertion of the key word “micro”, and also the key word “fine/precise mechanics”.

The Czech state has provided 67% of the funding - CZK 447.2 million – for 116 projects, the total budget of which reached CZK 669.4 million. Most research projects have been focussed on the area L – Materials for microtechnologies (particles, layers, composites, etc.) and most funds from the state budget (provided for by the Grant Agency of the Czech Republic, the Grant Agency of the Academy of Sciences of the Czech Republic, the Ministry of Industry and Trade of the Czech Republic, and the Ministry of Education, Youth and Sports of the Czech Republic) went to the area F – Manufacturing equipment for microtechnologies and their parts.

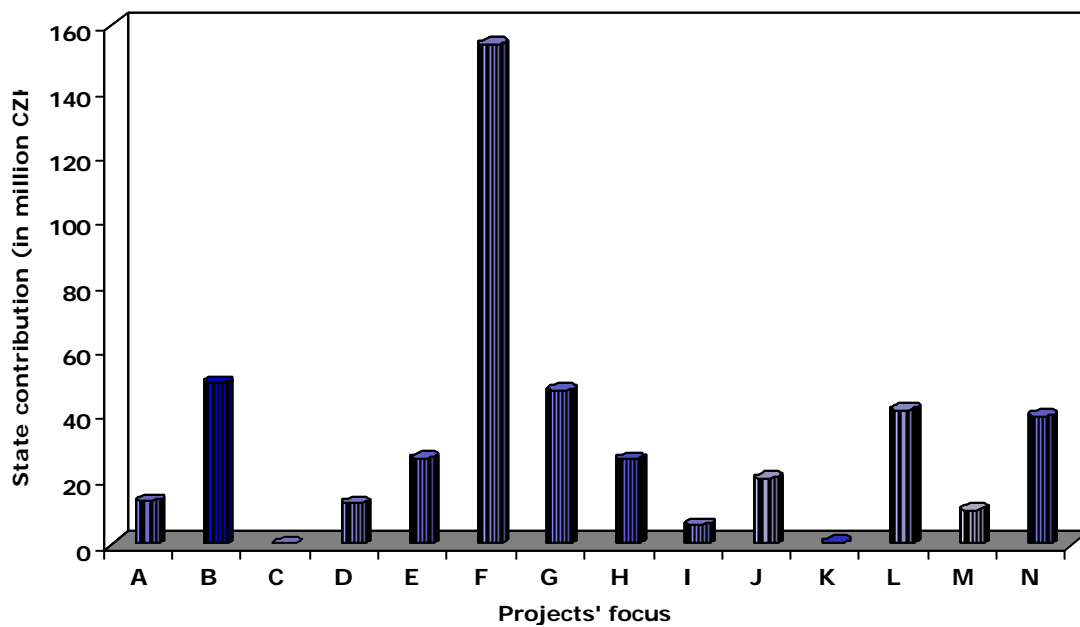
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<sup>7</sup> [Central registry of research and development projects - CEP](#), prepared by Inova Pro, s.r.o. in July 2005

The focuses of individual research and development workplaces are presented, well arranged, in the **Annex No. 1**.



**Fig. 1: Division of the national projects, according to the classification described in 2.2.**



**Fig. 2: Division of the financial contributions, according to the projects' focus (see the classification in 2.2.)**

## 5.2 MANUFACTURING COMPANIES

There are companies characterised in the report, which are involved mostly in the manufacture of materials and components for microtechnologies, the manufacture of microtechnological equipment, or the equipment, which contains microtechnological parts or microsystems. In some cases, these companies organise also their own research and development. The end users of products of the mentioned companies are mostly domestic and foreign car and aircraft makers, manufacturers of consumer electronics, computers, and communication technology. There were also companies evaluated (especially large companies with foreign participation), which utilise microtechnologies and microtechnological products, when completing their own products like, for example, computers, mobile telephones, television sets, etc. We have evaluated also companies focusing on the manufacture and assembly of printed circuit boards (PCBs).

The review of company focuses (especially of large companies and SMEs) is presented in **Annexes No. 2 and No. 3.**

## 6. CONCLUSIONS

The completed analysis and evaluation present the following conclusions:

- Research activities in the area of microtechnologies have been extensive and include a relatively high number of workplaces, which could be characterised by different work quality and capacity,
- Mostly target-oriented basic research prevails, which, with some exceptions, focuses on the utilisation of results in practice,
- There are offers by research workplaces missing and there is only limited demand by manufacturing companies,
- Research teams in institutes of the Academy of Sciences of the Czech Republic, which are involved in individual research projects, are larger than those at universities,
- The private sector has got only smaller development workplaces, which are involved in research and development in the area of microtechnologies, and they focus mostly on microelectronics. They are also mostly owned by foreign subjects,
- Electronic industry and the manufacture of cars make the main driving force in the development of microtechnologies in the Czech Republic,
- Both large companies and SME play important roles in the development of microtechnologies in the Czech Republic.

## Annex No. 1

| <b>Index of R&amp;D workplaces and the field of applications</b>                   |   | A - Semiconductor and parts for microelectronics                          | B - Communications microsystems | C - MEMS, MOEMS | D - Micro-scale technologies (mechanical micromachining, lithography, and chemical and other technologies) | E - Micro sensors | F - Manufacturing equipment for microtechnologies and their parts | G - Microanalytical equipment, its parts, and analytical methods | H - Microsystems for the use in biotechnology and medicine | I - Metrology | J - Microchemical systems | K - Microthermal systems | L - Materials for microtechnologies (particles, layers, composites, etc.) | M - Optics and optoelectronics | N - Other products of microtechnological equipment and the manufacture of devices (instruments, systems) with microtechnological parts or systems (e.g. computers, different instruments and devices, consumer electronics, etc.) |
|--|---|---|---------------------------------|-----------------|--|-------------------|---|--|--|---------------|---------------------------|--------------------------|---|--------------------------------|---|
| List of R&D workplaces of AS CR  | Institute of Scientific Instruments of AS CR            |   |                                 |                 | ●  | ●                 | ●   | ●  | ●  | ●             |                           |                          | ●   | ●                              |   |
|  | Institute of Radio Engineering and Electronics of AS CR | ●   |                                 |                 |  | ●                 |   |  |  | ●             |                           |                          | ●   | ●                              |   |
|  | Institute of Physics of AS CR                           | ●   |                                 |                 | ●  | ●                 |   | ●  |  | ●             |                           |                          | ●   | ●                              |   |
|  | Institute of Analytical Chemistry of AS CR              |   |                                 |                 |  |                   |   | ●  | ●  |               |                           |                          |   |                                |   |
|  | Institute of Chemical Process Fundamentals of AS CR     |   |                                 |                 |  |                   |   |  |  |               |                           |                          | ●   |                                |   |
|  | J. Heyrovsky Institute of Physical Chemistry of AS CR   |   |                                 |                 |  |                   |   |  |  |               | ●                         |                          | ●   |                                |   |
|  | Institute of Plasma Physics of AS CR                    |   |                                 |                 |  |                   |   |  |  |               |                           |                          | ●   |                                |   |
|  | Institute of Macromolecular Chemistry of AS CR          |   |                                 |                 |  | ●                 |   |  | ●  |               |                           |                          | ●   | ●                              |   |
|  | Institute of Biophysics of AS CR                        | ●   |                                 |                 | ●  | ●                 | ●   | ●  | ●  | ●             | ●                         |                          | ●   | ●                              |   |
|  | Workplaces of Universities                              | Charles University, Faculty of Mathematics and Physics, School of Physics | ●                               |                 |  |                   |   |  |  |               |                           |                          |   | ●                              |   |
| Charles University, Faculty of Science, Section of Chemistry                       |   | ●   |                                 |                 | ●  |                   |   |  |  |               |                           |                          | ●   | ●                              |   |
| Masaryk University in Brno, Faculty of Science                                     |   | ●   |                                 |                 | ●  |                   |   |  | ●  |               |                           |                          | ●   |                                |   |
| Czech Technical University, Faculty of Mechanical Engineering                      |   |   |                                 |                 | ●  | ●                 |   |  | ●  | ●             |                           |                          | ●   | ●                              |   |
| Czech Technical University, Faculty of Electrical Engineering                      |   | ●   | ●                               |                 | ●  | ●                 |   |  | ●  |               |                           |                          | ●   | ●                              |   |
| Czech Technical University, Faculty of Nuclear Sciences and Physical Engineering   |   |   |                                 |                 |  |                   |   |  |  |               |                           |                          |   | ●                              |   |
| Brno University of Technology, Faculty of Mechanical Engineering                   |   |   |                                 |                 | ●  |                   |   | ●  |  | ●             |                           |                          | ●   | ●                              |   |
| Brno University of Technology, Faculty of Chemistry                                |   |   |                                 |                 | ●  |                   |   |  | ●  |               |                           |                          | ●   |                                |   |
| Brno University of Technology, Faculty of Electrical Engineering and Communication |   | ●   |                                 |                 |  | ●                 | ●   | ●  | ●  |               |                           |                          | ●   |                                |   |
| Palacky University, Faculty of Science   |   |   |                                 |                 |  |                   |   |  |  |               |                           |                          | ●   |                                |   |
| University of Pardubice, Faculty of Chemical Technology                            |   |   |                                 |                 |  |                   |   |  |  |               |                           |                          | ●   | ●                              |   |

|  |   |  |   |   |   |  |   |   |   |   |  |   |   |  |
|--|---|--|---|---|---|--|---|---|---|---|--|---|---|--|
| Institute of Chemical Technology,<br>Faculty of Chemical Technology                                      | • |  |   | • | • |  | • |   |   |   |  | • | • |  |
| Institute of Chemical Technology,<br>Faculty of Chemical Engineering                                     |   |  |   |   | • |  |   |   |   |   |  |   |   |  |
| Technical University of Liberec,<br>Faculty of Mechatronics and<br>interdisciplinary engineering studies | • |  | • |   | • |  |   |   | • |   |  | • | • |  |
| Technical University of Liberec,<br>Faculty of Mechanical Engineering                                    |   |  |   |   |   |  |   |   |   |   |  | • |   |  |
| University of West Bohemia, Faculty of<br>Applied Sciences   |   |  |   | • |   |  |   |   |   |   |  | • |   |  |
| University of West Bohemia, Faculty of<br>Electrical Engineering   | • |  |   |   |   |  |   | • | • |   |  | • |   |  |
| Jan Evangelista Purkyně University,<br>Institute of Science  |   |  |   |   | • |  |   | • |   | • |  | • |   |  |

**Annexes No. 2 and 3.**

| <b>Index of large companies<br/>(over 250 employees),<br/>products and applications</b> |  |                                 |                 |   |                   |   |  |  |               |                           |                          |   |                                |   |
|---|--|---------------------------------|-----------------|---|-------------------|---|--|--|---------------|---------------------------|--------------------------|---|--------------------------------|---|
|   | A - Semiconductor and parts for microelectronics | B - Communications microsystems | C - MEMS, MOEMS | D - Micro-scale technologies<br>(mechanical micromachining, lithography, and chemical and other technologies) | E - Micro sensors | F - Manufacturing equipment for microtechnologies and their parts | G - Microanalytical equipment, its parts, and analytical methods | H - Microsystems for the use in biotechnology and medicine | I - Metrology | J - Microchemical systems | K - Microthermal systems | L - Materials for microtechnologies (particles, layers, composites, etc.) | M - Optics and optoelectronics | N - Other products of microtechnological equipment and the manufacture of devices (instruments, systems) with microtechnological parts or systems (e.g. computers, different instruments and devices, consumer electronics, etc.) |
| AEG components, s.r.o.  | ●  |                                 |                 |   |                   |   |  |  |               |                           |                          |   |                                |   |
| ALPS Electric Czech, s.r.o.   |  |                                 |                 |   |                   |   |  |  |               |                           |                          |   |                                | ●   |
| ASUS Czech s.r.o.   |  |                                 |                 |   |                   |   |  |  |               |                           |                          |   |                                | ●   |
| ASUsTek COMPUTER  |  |                                 |                 |   |                   |   |  |  |               |                           |                          |   |                                | ●   |
| AVX Czech Republic, s.r.o.  | ●  |                                 |                 |   |                   |   |  |  |               |                           |                          |   |                                |   |
| BRISK Tábor, a.s.   |  |                                 |                 |   | ●                 |   |  |  |               |                           |                          | ●   |                                |   |
| Celestica Kladno, s.r.o.  |  |                                 |                 |   |                   |   |  |  |               |                           |                          |   |                                | ●   |
| Celestica Ráječko s.r.o.  |  |                                 |                 |   |                   |   |  |  |               |                           |                          |   |                                | ●   |
| Connaught Electronics /CZ/, spol. s.r.o.  |  |                                 |                 |   | ●                 |   |  |  |               |                           |                          |   |                                |   |
| EPIQ, spol. s.r.o.  |  |                                 |                 |   |                   |   |  |  |               |                           |                          |   |                                | ●   |
| ELTES CZ, s.r.o.  | ●  |                                 |                 |   |                   |   |  |  |               |                           |                          |   |                                |   |
| EPCOS, s.r.o.   | ●  |                                 |                 |   |                   |   |  |  |               |                           |                          | ●   |                                |   |
| FIC CZ, s.r.o.  |  |                                 |                 |   |                   |   |  |  |               |                           |                          |   |                                | ●   |
| Foxconn CZ, s.r.o.  |  |                                 |                 |   |                   |   |  |  |               |                           |                          |   |                                | ●   |
| Cherry, spol. s.r.o.  |  |                                 |                 |   | ●                 |   |  |  |               |                           |                          |   |                                |   |
| Infineon Technologies, s.r.o.   |  |                                 |                 |   |                   |   |  |  |               |                           |                          |   | ●                              |   |
| L.G.Philips Displays Czech Republic, s.r.o.   |  |                                 |                 |   |                   |   |  |  |               |                           |                          |   |                                | ●   |
| Panasonic Mobile & Automotive Systems Czech, s.r.o.                                     |  |                                 |                 |   |                   |   |  |  |               |                           |                          |   |                                | ●   |
| METRA Blansko, a.s.   |  |                                 |                 |   |                   |   |  |  | ●             |                           |                          |   |                                | ●   |
| ON SEMICONDUCTOR CZECH REPUBLIC, a.s.   | ●  |                                 |                 |   | ●                 |   |  |  |               |                           |                          | ●   |                                | ●   |
| OPTREX Czech, a.s.  | ●  |                                 |                 |   |                   |   |  |  |               |                           |                          |   |                                |   |
| Panasonic AVC Networks, s.r.o.  | ●  |                                 |                 |   |                   |   |  |  |               |                           |                          |   |                                | ●   |
| Polovodice, a.s.  | ●  |                                 |                 |   |                   |   |  |  |               |                           |                          | ●   |                                | ●   |
| SAFINA, a.s.  |  |                                 |                 |   |                   |   |  |  |               |                           |                          | ●   |                                | ●   |
| Saint-Gobain-Advanced Ceramics, s.r.o.  |  |                                 |                 |   |                   |   |  |  |               |                           |                          | ●   |                                | ●   |
| STROM telecom, s.r.o.   |  | ●                               |                 |   |                   |   |  |  |               |                           |                          |   |                                |   |
| Tatung Czech, s.r.o.  |  |                                 |                 |   |                   |   |  |  |               |                           |                          |   |                                | ●   |
| TCT, a.s.   |  |                                 |                 |   |                   |   |  |  |               |                           |                          |   |                                | ●   |
| TEMOS Tools, a.s.   |  |                                 |                 |   |                   |   |  |  | ●             |                           |                          |   |                                |   |
| Tesla, a.s.   |  |                                 |                 | ●   |                   |   |  |  |               |                           |                          |   |                                | ●   |
| Tesla Blatná, a.s.  | ●  |                                 |                 | ●   |                   |   |  |  |               |                           |                          |   | ●                              | ●   |
| Tesla Jihlava, a.s.   | ●  |                                 |                 |   | ●                 |   |  |  |               |                           |                          |   |                                | ●   |
| TSE, spol. s.r.o.   |  | ●                               |                 |   |                   |   |  | ●  |               |                           |                          |   |                                | ●   |
| TTC Holding   |  | ●                               |                 |   |                   |   |  |  |               |                           |                          |   |                                | ●   |
| Tyco Electronics Czech, s.r.o.  | ●  |                                 |                 |   |                   |   |  |  |               |                           |                          |   |                                |   |
| VDO Česká republika, s.r.o.   |  |                                 |                 |   | ●                 |   |  |  |               |                           |                          |   |                                | ●   |
| Vishay Electronic, spol. s.r.o.   | ●  |                                 |                 |   |                   |   |  |  |               |                           |                          |   |                                |   |

**Index of small and medium enterprises (under 250 employees), products and applications**

|  | A - Semiconductor and parts for microelectronics | B - Communications microsystems | C - MEMS, MOEMS | D - Micro-scale technologies (mechanical micromachining, lithography, and chemical and other technologies) | E - Micro sensors | F - Manufacturing equipment for microtechnologies and their parts | G - Microanalytical equipment, its parts, and analytical methods | H - Microsystems for the use in biotechnology and medicine | I - Metrology | J - Microchemical systems | K - Microthermal systems | L - Materials for microtechnologies (particles, layers, composites, etc.) | M - Optics and optoelectronics | N - Other products of microtechnological equipment and the manufacture of devices (instruments, systems) with microtechnological parts or systems (e.g. computers, different instruments and devices, consumer electronics, etc.) |
|--|--|---------------------------------|-----------------|--|-------------------|---|--|--|---------------|---------------------------|--------------------------|---|--------------------------------|---|
| 2N telekomunikace,a.s.                             |  | ●                               |                 |  |                   |   |  |  |               |                           |                          |   |                                |   |
| AEV, spol. s r.o                                   |  |                                 |                 |  |                   |   |  |  |               |                           |                          |   |                                | ●   |
| Aseko, spol. s r.o.                                |  |                                 |                 |  | ●                 |   |  |  |               |                           |                          |   |                                |   |
| Audio Vaic,s.r.o.                                  | ●  |                                 |                 |  |                   |   |  |  |               |                           |                          |   |                                |   |
| AVIKO Praha s.r.o.                                 |  |                                 |                 |  |                   | ●   |  |  | ●             |                           |                          |   | ●                              |   |
| Awos, s.r.o.                                       |  |                                 |                 |  |                   |   |  |  |               |                           |                          |   |                                | ●   |
| Barco, spol.s.r.o.                                 |  |                                 |                 |  | ●                 |   |  |  |               |                           |                          |   |                                | ●   |
| Barco Manufacturing, s.r.o.                        | ●  |                                 |                 |  |                   |   |  |  |               |                           |                          |   |                                |   |
| BD Sensors, s.r.o.                                 |  |                                 |                 |  |                   |   | ●  |  |               |                           |                          |   |                                | ●   |
| Befra-Electronic, s.r.o.                           |  |                                 |                 |  |                   |   |  |  |               |                           |                          |   |                                | ●   |
| BVT Technologies, a.s.                             |  |                                 |                 |  | ●                 |   |  | ●  |               | ●                         |                          |   |                                |   |
| Carl Zeiss spol.s.r.o.                             |  |                                 |                 |  |                   |   | ●  | ●  |               |                           |                          |   | ●                              |   |
| C-com, s.r.o.                                      |  | ●                               |                 |  |                   |   |  |  |               |                           |                          | ●   |                                | ●   |
| CRYTUR, s.r.o.                                     |  |                                 |                 |  |                   |   |  |  |               |                           |                          | ●   | ●                              |   |
| CUBE CZ, s.r.o.                                    | ●  |                                 |                 |  |                   |   |  |  |               |                           |                          |   |                                | ●   |
| CZ-elektronika, s.r.o.                             |  |                                 |                 |  |                   |   |  |  |               |                           |                          |   |                                | ●   |
| Ce Me Bo, s.r.o.                                   |  |                                 |                 |  |                   |   |  |  |               |                           |                          |   |                                | ●   |
| Delong Group                                       |  |                                 |                 |  |                   |   | ●  | ●  |               |                           |                          |   |                                | ●   |
| ELCERAM, s.r.o.                                    |  |                                 |                 |  |                   |   |  |  |               |                           |                          | ●   |                                |   |
| ELIS Plzen, a.s.                                   |  |                                 |                 |  |                   |   |  |  |               |                           |                          |   |                                | ●   |
| Elmarco, s.r.o.                                    |  |                                 |                 |  |                   | ●   |  |  |               |                           |                          |   |                                |   |
| ELMET, spol. s.r.o.                                |  |                                 |                 |  |                   |   |  |  |               |                           |                          |   |                                | ●   |
| ELTON hodinářská, a.s.                             |  |                                 |                 |  |                   |   |  |  |               |                           |                          |   |                                | ●   |
| ESY, s.r.o.  |  |                                 |                 |  |                   |   |  |  |               |                           |                          |   |                                | ●   |
| FEI Czech Republic, s.r.o.                         |  |                                 |                 |  |                   |   | ●  | ●  |               |                           |                          |   |                                |   |
| GeneAge Technologies, a.s.                         |  |                                 |                 |  |                   |   |  | ●  |               |                           |                          |   |                                |   |
| GEN-TREND, s.r.o.                                  |  |                                 |                 |  |                   |   |  | ●  |               |                           |                          |   |                                |   |
| Goldcard, s.r.o.                                   |  |                                 |                 |  |                   |   |  |  |               |                           |                          |   |                                | ●   |
| Harlingen, s.r.o.                                  | ●  |                                 |                 |  |                   |   |  |  |               |                           |                          |   |                                |   |
| HC electronics, s.r.o.                             | ●  |                                 |                 |  |                   |   |  |  |               |                           |                          |   |                                |   |
| Hokami CZ, s.r.o.                                  |  |                                 |                 |  |                   |   |  |  |               |                           |                          |   |                                | ●   |
| HVM Plasma, s.r.o.                                 |  |                                 |                 |  |                   | ●   |  |  |               |                           |                          | ●   |                                |   |
| IMA, s.r.o.  |  | ●                               |                 |  |                   |   |  |  |               |                           |                          |   |                                | ●   |
| Incline Global Technology Services (Czech), s.r.o. |  |                                 |                 |  |                   |   |  |  |               |                           |                          |   |                                | ●   |
| Krystaly Hradec Králové, a.s.                      |  |                                 |                 |  |                   |   |  |  |               |                           |                          | ●   |                                |   |
| Laird technologies                                 | ●  |                                 |                 |  |                   |   |  |  |               |                           |                          | ●   |                                |   |
| LAMBDA Praha, s.r.o.                               |  |                                 |                 |  |                   |   |  | ●  |               |                           |                          |   |                                |   |

