



TOGETHER
for a sustainable future

OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.



TOGETHER
for a sustainable future

DISCLAIMER

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries, or its economic system or degree of development. Designations such as “developed”, “industrialized” and “developing” are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of firm names or commercial products does not constitute an endorsement by UNIDO.

FAIR USE POLICY

Any part of this publication may be quoted and referenced for educational and research purposes without additional permission from UNIDO. However, those who make use of quoting and referencing this publication are requested to follow the Fair Use Policy of giving due credit to UNIDO.

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

RESTRICTED

17388

DP/ID/SER.A/1180
3 April 1989
ORIGINAL: ENGLISH

ELECTRONIC INSTRUMENTATION, AUTOMATION
AND PROCESS CONTROL DEVELOPMENT

DP/ALB/84/001

ALBANIA

Technical report: Equipment and software for a microprocessor
development station*

Prepared for the Government of Albania
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of H. Otterstatter,
consultant in equipment and software selection

Backstopping officer: C. Gurkok, Engineering Industries Branch

United Nations Industrial Development Organization
Vienna

*This document has not been edited.

TABLE OF CONTENTS

1. **Current Situation at QSPAЕ**
 2. **Requirements of QSPAЕ**
 - 2.1 **Hardware**
 - 2.2 **Software**
 - 2.3 **Emulators**
 - 2.4 **Documentation, Maintenance, Training Support**
 - 2.5 **Conclusion**
 3. **Selection of a System**
 4. **Design of the Development System**
 5. **Next Steps**
-
- Appendix A Offer for a microprocessor development system
- Appendix B Alternative offer for other PC hardware

1. Current Situation at QSPAЕ

The Centre for Study and Design in Automation and Electronics was established in 1983. One of the main tasks of QSPAЕ is develop systems for automation and process control in a close link with the requirements of the industry and other institutes. QSPAЕ develops the appropriate hardware and software. The hardware will be reproduced by an Albanian factory so that there is a need for a good product documentation. For software development exists a monitor which resides in the operating system (written by QSPAЕ) for the process control system. This monitor allows instructions to be entered in machine code, memory contents and registers to be displayed or modified and breakpoints to be set. It uses the same keyboard and seven segment display as the user for programming the application programs.

This way of software development is very slow and can cause numerous problems. There is only a handwritten documents of the contents of the operating system program.

To accelerate the process of developing new systems, it is highly recommended to use a microprocessor development station.

2. Requirements of QSPAЕ

2.1 Hardware for MPD (Microprocessor Development Station)

Besides the MPD, other helpful tools are required in some other fields. There are e.g. requirements for the hardware of these tools. Since these workstations are all based on standard hardware (IBM/AT/compatible) it is required that nearly all configurations can be substituted by each other. This means that every software package should be able to run on every station. (For some applications, this may cause a loss of performance due to running on a configuration with a lower processor speed, a lower amount of memory or without a coprocessor).

- For this reason, the MPD cannot be a dedicated microprocessor development system
- The MPD must be able to run all software development tools and to connect it to the emulators. Additional hardware which must be able to be connected to MPD is:
 - PAL/EPR0M programmers
 - Matrix printer A3
- The following components are not urgently needed but recommended for replaceability and substitution:
 - numeric coprocessor
 - colour display
 - mouse

- For exchanging data between the stations, four different ways can be used:
 - network (LAN, too expensive)
 - serial communication (needs cables through center)
 - diskettes (only small amounts of data 1,2 MB)
 - data pack (large amounts of data up to 30 MB)

The last two possibilities should be integrated in the actual hardware configuration.

- To backup the data of all stations, three ways are suggested:
 - streamer tape (approx. 60 MB, item consuming, when moving from one station to another)
 - diskettes (only small amounts of data 1,2 MB)
 - data pack (large amounts of data up to 30 MB, expensive)

For small amounts of data to be backed up, the diskette could be used. For large amounts, copy of data to the station with the streamer tape by means of the data pack and then backup data pack to streamer tape. The streamer tape could also be used later in a network configuration for a centralized backup.

- The processor for the MPD should be a very powerful one, to obtain short waiting times in the development cycles. Such a processor is the 80386 processor with 20 MHz. There are two other reasons for using this processor:
 - only this chip will guarantee to be the hardware platform for a change to UNIX - whenever it may be necessary.
 - multi tasking by specialized tools/operating systems can be done in an easy way (virtual 8086 machines).

2.2 Software for MPD

In general, the following software packages are required, in order to use the MPD:

- a program editor with the following features:
 - resizable windows
 - multiple file editing
 - supports all used compilers, assemblers
 - supports keystroke macros
 - supports 43-line mode
- an assembler, a utility tool kit and a high level language for the Z80, 8032 and 8086 processors. The tool kit must be provided with a
 - linker,
 - locator
 - librarian and
 - hex-file formatter (if required for EPROM-programmer)

- control software for the emulators
- control software for the PAL/EPROM programmers

Additional requirements are:

- The assembler/compiler must be able to compile programs written with the "Wordstar" editor.
- The assembler/compiler and the included librarian must be able to make fully ROMable code.
- The 8087 coprocessor must be supported by all development tools for the 8086. (assembler, compiler, librarian and control software for the emulator).
- The high level language is most preferably "C".

For disassembling a large amount of Z80 code, an efficient and intelligent disassembler should be integrated in the software for MPD.

Other useful tools for the development cycle on the MPD are:

- Programming environments for the MPD itself, for making your own tools and utilities:
 - Microsoft-C
 - Turbo-C V2.0
 - Topspeed Modula-2
- "Make" utilities that allow a new system to be created by only recompiling/relinking the changed parts and their depending objects. This utility is usually included in the packages above, but is also useable with cross development tools for other targets.
- Version control system for reporting changes on source files.
- Multitasking environments for the MPD, so that concurrent editing/compiling is possible.

These other tools are not required by QSPAЕ, but should be mentioned here and discussed later.

2.3 In Circuit Emulators

At present the center needs emulators supporting the following processors:

- Z80A, Z80B up to 6 MHz
- 8032 and probably related processors with A/D conversion.
- 8086 with 8087 as coprocessor.

All emulators must meet the following requirements

- run the target system in real time
- simulate non existing target hardware

The control software on the MPD must be able to load and support debugging at assembler level language by using all available debug information provided by the development tools.

2.4 Documentation, Training, Installation, Maintenance, Support

The entire documentation must be written in English language. The following must be included:

- user's manual and installation guide (for SW products)
- maintenance documentation
- use of PROM/PAL programmers
- maintenance and repair of emulators

2.4.3 Maintenance

The equipment should be maintained and repaired by the engineers of the center. Therefore the required documentation, a training and a list of commonly used "spare parts" which are often needed and which are not available in Albania must be included.

2.4.4 Support

The conditions of support during and after warranty time have to be mentioned.

2.5 General Conclusion

According to my opinion, the center will make great steps forward in technology for the process of developing systems (including hardware, software and various control systems) with all the suggested new equipment. But I think that besides the technical equipment the center also needs information and knowledge on application and technical trends. This was the result of several discussions about:

- new catalogues for components from distributors
- multitasking systems
- creating a process control language
- designing a new system for machine control
- organizing SW-projects
- using bus systems
- using connector systems

In many cases, only processing information about these topics will be helpful. There should be a way to bring literature about these topics to the center. Sometimes, a discussion with an expert is also necessary.

3. Selection of the System

In accordance to the center, the following systems were discussed:

- Kontron: KSE4 (Z80/8086), SE 8032 and
- Philips: PMDS Z80/MAR 8086 (too expensive, less functions than other products)
- HP64000: no support of 8086, no support of 8032
- Hitex: teletest Z80, teletest 51, teletest 16

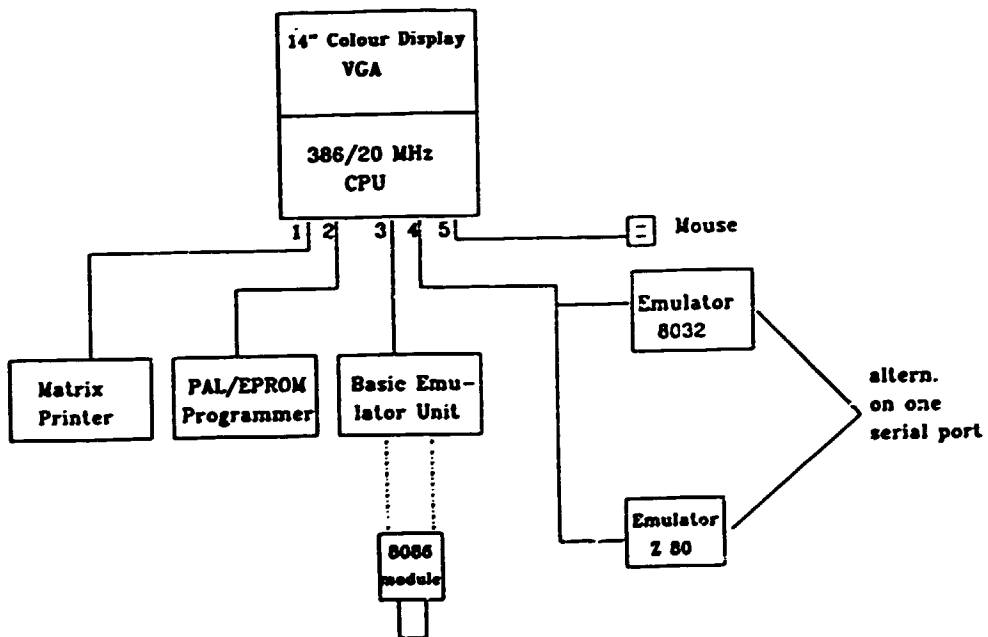
The center decided to work out a full MPD configuration with the products described in the following.

4. Design of the MPD

The selected components are described in detail in the appendices.

4.1 Overview

The following components have been selected for the MPD



- Interface 1: parallel 1 for printer
- Interface 2: serial 1 for PAL/PROM-Programmer
- Interface 3: parallel 2 for emulator 8086
- Interface 4: serial 2 for emulator 8032 or Z80
- Interface 5: serial 3 for logitech mouse

4.2 Components of the Development Station

4.2.1. General Development Equipment

These components are common for all microprocessors. For a detailed description see appendix A.

4.2.1.1 Hardware

- Tandon 386/20 MHz
- additional second/third serial interface (for programmer/mouse)
- matrix printer, 24 pins, 260 char/sec., EPSON LQ850
- Logitech mouse
- graphics adapter VGA and colour monitor 14"
- PROM programmer
- PAL programmer

4.2.1.2 Software

- editor for editing programs (brief)
- PAL programming software
- PROM programming software

4.2.1.3 Spare Parts

- diskettes (100 pcs) 1.2 MB
- printer ribbons (20 pcs)

4.2.1.4 Options for the General Development System

Here, useful but not necessary parts are listed:

- 80387 coprocessor for the TANDON 386/20
- data pac slot for Tandon (In PAC)
- one data pack (30 MB)
- memory expansion on mother board 1 MB

4.2.2 Additional Equipment for Z80 Support

4.2.2.1 Hardware

- Z80 emulator with 64K-RAM map-memory
- power supply for emulator

4.2.2.2 Software

- tool kit with assembler, linker, locator
- high level language PL/Z80

4.2.2.3 Spare Parts

- adapter cable

4.2.3 Additional Equipment for 8032 Support

4.2.3.1 Hardware

- 8031 emulator with 128 K emulation memory
- logic probe
- adapter cable for 8031/8032/8344

4.2.3.2 Software

- Assembler for 8031/8032
- C51-Compiler including linker, locator and librarian

4.2.3.3 Spare Parts

- adapter cable for 8031/8032/8344

4.2.4 Additional Equipment for 8086/8087 Support

4.2.4.1 Hardware

- basic unit for 16 bit Intel processors
- emulation module for 8086/8088
- adapter for 8087 support
- parallel interface to MPD

4.2.4.2 Software

- assembler and utilities
- C86 compiler

4.2.4.3 Spare Parts

- adapter cable for 8086/88

4.3 Training, Maintenance and Support

See Appendix A

5. Next Steps

Enclosed with this report are the following offers:

- one for the microprocessor development station
- one for three other PC-based stations for PCB-layout, desk-top publishing and laboratory control.

As has been mentioned before, most of these products meet the conditions described in the embargo list of the COCOM countries. Therefore we have to get a permission from the COCOM headquarter for delivering these products to Albania. This task is very time consuming and needs a lot of paper work to be done to get the permission.

We will make all efforts to get the permission when we get the order for delivering these products. But right now we are not able guarantee to get the permission for all products. One possible solution may be to reduce (say 80286 instead of 80386) or to exclude some positions from the offer in accordance with the QSPAЕ, so that COCOM conditions can be fulfilled. This depends only on the negotiation with our "Bundesamt fur Wirtschaft" and the COCOM headquarters.

Appendix A

Offer for a Microprocessor Development System

Based on our terms of delivery and sale, and under the condition that we get the export permit, we offer you the following products:

1. Development System

1.1 Hardware

1.1.1 DS 386/20-70

DM 12.276,--

High-performance computer with 80386 processor (20 MHz) and 64-kbyte cache memory; 1,2 MB floppy disk 5 1/4"; 70 MB hard disk (access time < 80 ms); 1 MB RAM (can be upgraded up to 16 MB); expansion slots: 2 X 8 bits, 6 x 16 bits; socket for 80387 coprocessor; Hercules-compatible monochrome-graphics adapter; 14" screen bernstein, rotatable, multi functional keyboard; 1 serial and 1 parallel interface; MS-DOS 3.3; WINDOWS 386; GW-BASIC; Manuals.

As an alternative we offer (if we should not get the export permit)

DS-PCA70P

DM 7.013,--

AT-compatible with 80286 processor (10,7 MHz); 1 MB RAM; 1,2 MB slimline disk drive; 70 MB hard disk (average access time 29 msec); Hercules-compatible monochrome graphics adapter; 14" bernstein screen, rotatable; multifunctional keyboard; 1 serial and 1 parallel interface; operating system DOS 3.3; MS-WINDOWS; GW-BASIC; manuals.
(Manufacturer: Tandon)

1.1.2 Logitech-Mouse, serial, three buttons

DM 390,--

1.1.3
VGA-CO16

DM 1.575,--

additional price for VGA color monitor, including VGA 16-bit card (instead of monochrome monitor)

1.1.4
SER2

DM 150,--

additional price for the second serial interface.

1.1.5
EP-LQ850

DM 1.848,--

Epson-printer, 24 dots, 260 char./sec. high-speed print, 88 char. sec., correspondence print, 6 K text buffer, integrated paper feed tractor, semiautomatic paper feed for single and continuous paper, paper width (LQ850/LQ1050): single paper up to 257/364 mm, continuous paper up to 254/406 mm, serial and parallel interface, printer ribbon, user's manual

1.1.6
PRT-PAR

DM 45,--

printer cable, parallel, for use with EP-LQ850/LQ1050

1.1.7
HIPRO824S

DM 3.590,--

- Universal E²/EPROM and uP programmer PG824 and
- programs from 2716 to 271024
- integrated UV-deletion unit
- via RS232 interface, remote control via HIPRO
- 64 kB internal RAM
- user's manual
- and operating software HIPRO824 for PG824/834/825 programmers on 360 kB IBM-Disk, V24-data line (25 pin) for connection to an IBM PC or compatible system incl. user's manual.

HIPRO supports the following object file formats:

- Intel 8086
- Intel 8080/85
- Intel 8051
- Intel HEX-Format 8 bit
- Intel HEX-Format 16 bit
- Microsoft .EXE-Format
- binary format

1.1.8 PAL-programming device (see brochure) DM 7.490,--

1.2 Software

1.2.1 Editor Brief DM 500,--

1.2.2 PAL programming software
a) programming combinatoric logic DM 3.375,--
b) programming sequential logic DM 4.885,--

2. Support of Z80

2.1 Hardware

2.1.1 TZ80 DM 3.850,--

Real-time emulator for the processors Z80 A and B including 1 kB emulation memory, 4 hardware breakpoints, real-time trace buffer (1 k x 32), interactive software on 360 kB IBM-Disk, runs under PC/MS-DOS (version 2.0 and later) with symbolic debugging of Intel object files or Digital Research .SYM files, file load-save, in-circuit adapter cable (AKZ80), RS232-data line for IBM PC (RS8) (please specify connector type in your order:
9 pin = ..-9, 25 pin = ..-25) and user's manual.

2.1.2 NG5 DM 195,--

5 Volt power supply (2 Ampere) for T85 and TZ80.

2.2 Software

2.2.1 ALLZ80

DM 1.580,--

Makro assembler for Z80, runs under MS-DOS (version 2.0 and later), creates IEEE 695 format and Intel Obj-format via conversion program as well as relocating linker, locater, librarian, for relocatable object code, conversion programs, user's manual.

2.2.2 PLMZ80

DM 1.830,--

PLM-OPT cross compiler, runs under MS-DOS (version 2.0 and later), creates Z80 mnemonics or IEEE 695 format as well as Intel obj-format via conversion program, including Run-Time-Library and user's manual.

2.3 Spare Parts

2.3.1 AKZ80

DM 105,--

In-circuit adapter cable for T280.

3. Support of 8032

3.1. Hardware

3.1.1
TEL31PVD4--..

DM 14.190,--

Real-time emulator for the 8051 family (ROMless types) including power supply and power connector but no processor and adapter cable. 4 hardware break/trigger registers, 64 k hardware breakpoints, real-time trace buffer (2k x 64), real-time counter, 128 kB static emulation memory. Interactive software for PC/MS-DOS (version 2.0) on 360 kB IBM-PC diskette, loading of Intel object files, extended high-level language debugging, performance analysis function and high-speed trace. RS232 data line for IBM-PC (RS16) (please specify connector type with your order: 9 pin = ..-9, 25 pin = ..-25) and user's manual (BH51).

The emulation processor type will be fixed by the corresponding in-circuit adapter cable (PV...) which has to be ordered separately. The emulator may be upgraded to TEL51Dx, TEL515Dx and TEL512Dx.

3.1.2
PR16

DM 480,--

Logic-Probe for 8 external signals, can be connected to the in-circuit emulators TEL16x- and TEL51x/31x.

3.1.3
PV31/44

DM 690,--

In-circuit adapter cable for the emulation of the 8031/32/C31 and 8344 processors (DIL40, without processor), can be connected to TEL31PVDx.

3.2 Software

3.2.1
ASM51

DM 600,--

Intel-compatible macro assembler, linker and library manager, runs under PC/MS-DOS (version 2.0) on IBM 360 kB diskette (additional licenses per version: DM 240,--), user's manual.

3.2.2

C51

DM 1.950,--

C-Compiler 51, V. 2.x, optimizing C-Compiler for the 8051 family, linker, library manager, runs under PC/MS-DOS (version 2.0) on IBM 360 kB diskette, user's manual and security device for the printer port.

Additional licenses per version: DM 780,--

3.3 Spare Parts

3.3.1

PV31/44

DM 690,--

In-circuit adapter cable for the emulation of the 8031/32/C31 and 8344 processors (DIL40, without processor), can be connected to TEL31PVDx.

4. Support of 8086/8087

4.1 Hardware

4.1.1

TEL16DM3-..

DM 17.290,--

Real-time in-circuit emulator (series 3) up to 12,5 MHz with power supply and power connection, serial and parallel interface, with 1 MB emulation memory, 8 hardware break/trigger registers, 2 real-time trace buffers (2 x 2k x 56), real-time counter, memory protection, interactive software for EMX86 and EMX186 under PC/MS-DOS (version 2.0) on 360 kB IBM-PC diskette, loading of Intel object files and Microsoft EXE files, symbolic high-level language debugging for C86, PASCAL86, PL/M86, FORTRAN86 etc. (for Intel and Microsoft), RS232-data line for the connection to the PC (RS16) (please specify connector type with your order: 9 pin = ..-09, 25 pin = ..-25) and user's manual (BH16).

4.1.2
EMX86

DM 5.990,--

Emulation module for 8086/88/C86/C88/V20/V30 processors (min and max mode) for 10 MHz operation including in-circuit adapter cable (AK86).

4.1.3
Z8087/86

DM 3.000,--

Upgrade kit of the EMX86, EM86M emulation module for 8087 emulation. Enables the recording of the 8087 memory accesses in the trace memory, assembling and disassembling of 8087 instructions, display and input of interger and real numbers and emulation of the 8087 in the target hardware and in standalone operation. The upgrade kit consists of a 8087 supplement, 8087 adapter cable (AK87) and standalone cable. Assembly instructions and required software are included. (Please ask for further details).

4.1.4
PARA

DM 950,--

Parallel adapter card for IBM PC and compatible systems, together with 2,5 m cable. With this card, the TEL16x in-circuit emulators may be connected through parallel link to the PC, so command execution and file transfer are faster.

4.2 Software

4.2.1
DOS-ASM86

DM 2.500,--

contains the Intel programs ASM86, LINK86, LOC86, LIB86, CREP86 and OH86, runs under PC/MS-DOS (version 2.0).

4.2.2
DOS-C86

DM 2.500,--

Intel compiler C-86, runs under PC/MS-DOS (version 2.0).

4.3 Spare Parts

4.3.1
AK86 DM 280,--

In-circuit adapter cable for EMX86, EM86M,
EM86MC, EM86MH (DIP40).

5. Spare Parts, Upgrade Parts, Accessories

5.1 High-density diskettes (1,2 MB, 5 1/4"),
100 pieces DM 480,--

5.2 Printer ribbon, 20 pieces DM 240,--

5.3 80387 coprocessor for the Tandon 386
running with 20 MHz DM 1.500,--

5.4 Memory expansion on motherboard (1MB) DM 1.490,--

5.5 Data-Pac-Slot for Tandon (InPAC) DM 1.312,--

5.6 30 MB Dat-Pac for InPAC DM 873,--

6 Documentation

6.1 Schematic drawings of the emulators DM 100,--

6.2 Service Manual TANDON 386 DM 600,--

7 Training

Training for the mentioned topics is held by specialists of our company in the appropriate field. The training is performed on the original hardware and with the original literature which will be delivered to QSPAЕ. We suggest the following times for training.

- Installation of the system and the
connected hardware (printer, programmer,
emulators) one day
- Introduction to the language "C" two days
- Use of the development tools
(editor, toolkits, compilers) two days

- Use of the emulators two days
- Use of PROM/PAL programmers and software one day
- Maintenance and repair of systems and emulators two days

Training will be held in English

Training cost per day
(minimum 5 days for max. 4 persons) DM 1.000,--

8. Spare Parts for Maintenance

8.1 A set of spare parts for the emulators

The list of these spare parts will be prepared during training for maintenance. Estimated costs for this item are DM 1.500,--

9. Support

9.1 Product Support

During warranty time of 12 months for our products (six months for other products), we are able to support you by Telex and/or phone without extra cost. Repair of emulators and other hardware can be done by QSPAЕ based on the information received by the training and the schematic drawings.

This repair is done in the responsibility of the QSPAЕ.

During warranty time, the repair of the hardware will be done by Hitex at Karlsruhe at no extra cost except the costs for shipping and insurance.

9.2 Engineering Support

Beyond the product support we can offer the support of our engineers in the field of consult for special tools. This could be specified in a special contract.

10. Conditions

This offer is limited to 12 weeks. It is possible to select pieces of the offer to make your own bundle, except the training. Training will only be available if all emulators and the MPD will be purchased.

You have to add 5% export charge

Shipping costs to the German border are included in the prices. You have to add these costs from the German border to Albania.

We will give you a price reduction of 5% if the amount of ordered parts exceeds DM 60.000,--.

The delivery time is 4 weeks after receipt of the export permit.

2. Desktop Station

2.1 DS-386/16-40

DM 8.768,--

high-performance computer incl. 80386 processor (16 MHz); hard disk 40 MB (< 30 ms) and MFM HD-controller; 1,2 MB floppy disk drive 5 1/4"; 1 MB RAM (can be upgraded to 16 MB); expansion slots: 2 x 8 bit, 6 x 16 bit; socket for 80387 coprozessor; Hercules compatible monochrome graphics adapter; 14" bernstein screen, rotatable, multifunctional keyboard; 1 serial and 1 parallel interface; MS-DOS 3.3; WINDOWS 386; GW-BASIC; user's manual.
(Manufacturer: Tandon)

2.2 Logitech mouse and serial interface

DM 390,--

2.3 19" monochrome display (see brochure)

DM 5.510,--

2.4 Printer LQ1050 (see brochure)

DM 2.448,--

alternatively

HP Laser Jet II (see brochure)

DM 5.590,--

Accessories

2.5 Printer cable (one piece)

DM 45,--

3. Laboratory Station (LAB)

3.1 DS-386/16-40 (as 2.1)

DM 8.768,--

3.2 Logitech mouse and serial interface

DM 390,--

3.3 VGA-CO16 (as 1.1.3 offer A)

DM 1.575,--

3.4 LQ 850 printer (as 1.1.5 offer A)

DM 1.848,--

3.5 IEEE-488 interface

DM 1.800,--

3.6 Disk-drive 3,5", 720 kB + 1,44 MB

DM 480,--

Accessories

3.7 Printer cable

DM 45,--

Accessories in General

| | | |
|---|----|----------|
| 4.1 Printer ribbon LQ 1050, 20 pcs | DM | 240,-- |
| 4.2 Printer ribbon LQ 850, 20 pcs | DM | 240,-- |
| 4.3 Printer paper A4, 2000 sheets, 10 boxes | DM | 350,-- |
| 4.4 Printer paper A3, 2000 sheets, 10 boxes | DM | 560,-- |
| 4.5 InPac | DM | 1.312,-- |
| 4.6 DataPac | DM | 873,-- |
| 4.7 Memory expansion on 1 MB motherboard | DM | 1.490,-- |

5. Conditions

This offer is limited to 6 weeks. It is possible to select pieces of the offer to make your own bundle.

You have to add 5% export charge

Shipping costs to the German border are included in the prices. You have to add shipping costs from the German border to Albania.

We will give you a price reduction of 5% if the amount of ordered parts exceeds DM 60.000,--.

The delivery time is four weeks after receipt of the export permit.