

NORD-500

- a new dimension in computing power



The power of a main-frame and the simplicity of a minemachine

With the introduction of NORD-500, an entirely new class of computers has been created. In this computer system, the latest hardware technology available is combined with an architectural structure previously used only on very large and expensive computers. The bit-slicer modules of our own design are implemented with fast SCHOTTKY TTL logic circuits. The result is a high-speed processing unit with a full 32-bit addressing scheme – a unique combination of compactness and performance at low cost.

THE REGISTER BLOCK

The NORD-500 processor provides full 32-bit registers, – four for program-addressing, four for integer and index arithmetic, four floating point registers for single- or double-precision and two status and trap enabling registers. A stack-register can be used by any process-task using stack-oriented recursive program libraries. In addition several registers can be maintained by system-programs only.

HARDWARE ARITHMETICS AND SHIFT MATRIX

Floating point arithmetic as well as integer multiply and divide are implemented by shift matrix to achieve highest possible speed.

LOGICAL ADDRESS SPACE

The full 32-bit byte-addressing scheme allows direct addressing of very large program areas. Due to the complete separation of instructions- and data-ways throughout the system, any user program can access 4.3 GIGABYTES of instructions, and 4.3 GIGABYTES of data. The separation of instructions and data implies that the system uses two 128-bit gateways to main memory with 16-way interleaving, fetching 16 bytes for each memory-

cycle of 600 nano-seconds. The total bandwidth of the memory is thus 256-bit per cycle from separate memory banks.

PHYSICAL MEMORY

The physical memory that can be connected may range from 128 KB up to the maximum of 32 MEGABYTES. The physical memory is built of 16K MOS RAM chips which are organized on 32/64 KB memory cards, with ERROR CHECKING AND CORRECTION as standard.

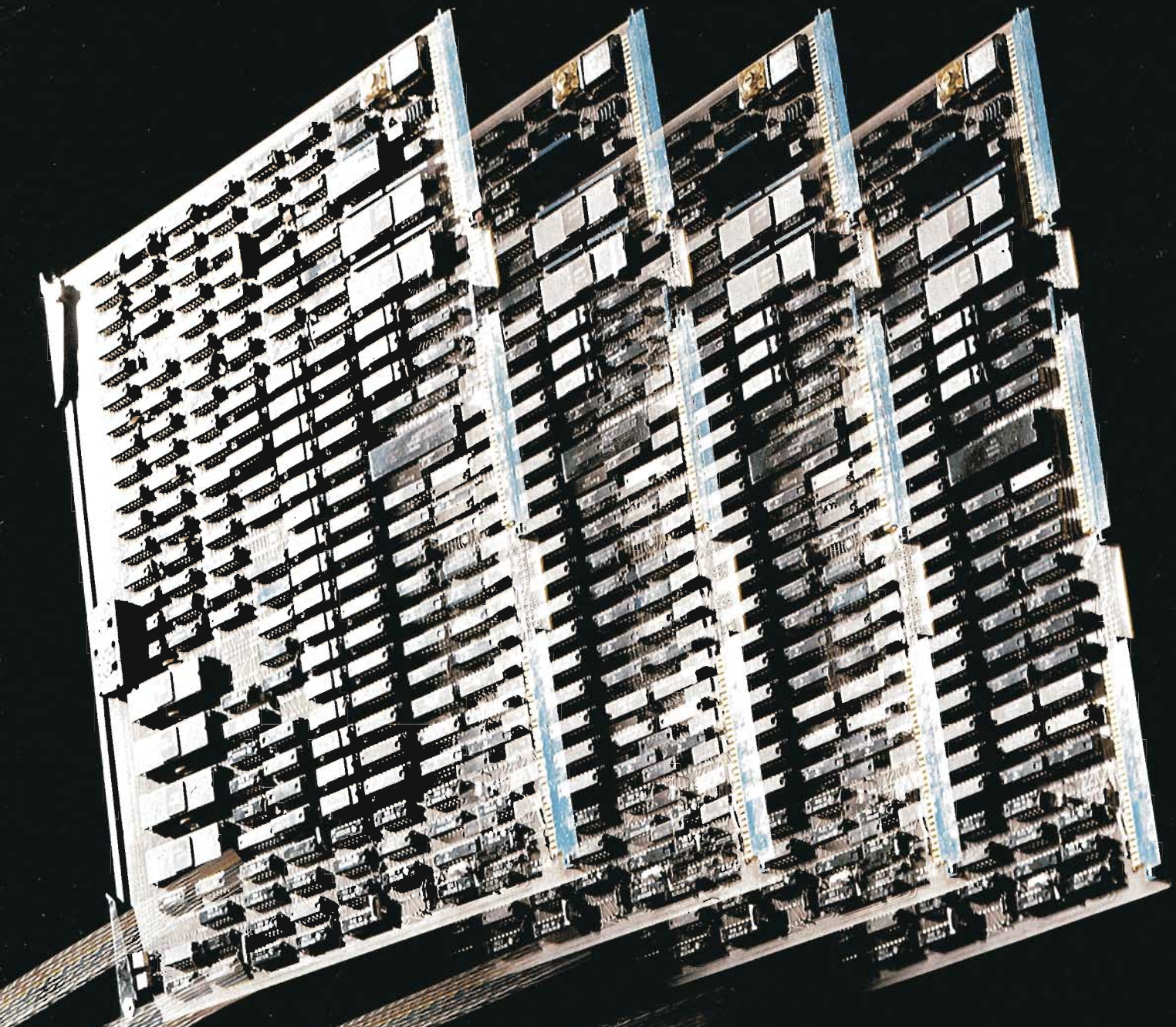
VIRTUAL MEMORY MANAGEMENT

A virtual memory management system performs dynamic allocation of 2 KB program and data-pages. A flexible disk-segment structure facilitates the sharing of program-segments and the use of data-files as an integral part of the program.

An ADDRESS TRANSLATION CACHE keeps track of the last 128 used page numbers of data-pages and 128 page numbers of instruction-pages for fast calculation of the main memory address. The virtual memory area of a task can be structured on 32 instructions and 32 data segment-files, each varying from 2 KB to 134 MB in size. The extremely large address space allows the programmer to implement program-systems without using time-consuming overlay techniques or to worry about memory-limitations often imposed upon him on traditional operating systems

THE CACHE-MEMORY SYSTEM

To increase throughput, a large cache-memory is used to keep the most recent instructions and data ready for the processor. By dividing the instruction and data



areas into separate cache-buffers, all address-conflicts are resolved and a high hit-rate is achieved. The hit-rate is further enhanced by forward-fetching of a 16-byte cache-frame when reading from main-memory. The cache content is both forward and backward accessible to speed-up loop-oriented programs. The DATA-CACHE is of the write-through type with a separate write-buffer for 2, 4 and 8 bytes to take

advantage of available memory-cycles. The INSTRUCTION-CACHE always pipelines 4 bytes onto the information bus to increase instruction decoding. Each of the two CACHE-MEMORIES can range from 32 KB upto 64 KB, with increments of 16 KB for each buffer. The cache-access time is 110 nano-seconds per 4 bytes. To avoid unnecessary erasing of the cache in the multiprogramming environment, the cache-memory can be partitioned into 1, 2 or 4 parts. When switching from one user to another, the contents of the cache-partition will be retained.

Partitioning of the cache may also be used to reserve one part for a particular task, or can be used as a common subroutine library for all the tasks in the system. For very special applications a cache-partition can act as a static memory to support extremely time-critical tasks.

INSTRUCTION AND DATA PREFETCH PROCESSOR

The execution of one instruction and the decoding of the next are carried out in parallel. A special micro-processor acts as a prefetching processor, decoding the operation-code and operand-specifiers, and performs all address calculations, while the previous instruction is executed in the arithmetic and logic unit of the processor.

NORD-500 - more power for your money

The question of cost is nearly always important when a computer system is being selected. Too often the best solution has to be sacrificed for short-term financial reasons.

Compared to traditional systems, NORD-500 offers a vastly improved cost-to-performance ratio. The built-in adaptability of the NORD-500 system helps you protect your investment.

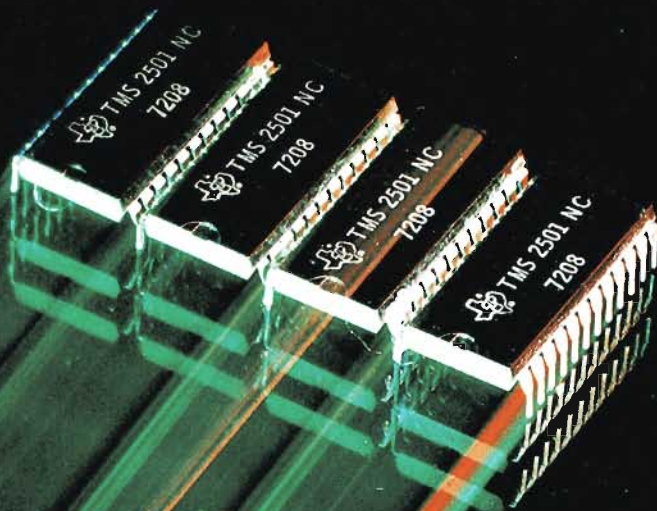
NORD-500 INSTRUCTION REPERTOIRE

The NORD-500 instruction set is specially designed for efficient implementation and execution of high level languages. The instruction-format is of variable byte-length, and the most frequently used instructions are implemented with minimal space requirements. The standard processor's instruction set includes binary arithmetic on 8, 16 and 32 bit data, integrated floating point arithmetic on 32 and 64 bit, packed decimal and string operations on all data-types as bit, byte, halfword, fullword, single and double precision, conditional and unconditional jumps, subroutine calls and entry-points, and many special instructions to suit modern high level language processors. Special sequences of code that are often used are microcoded to achieve maximum throughput, among these are context-switching of multiprocessing tasks, data transfer of large buffers and subroutine entry-points with several memory-allocation schemes as stack-handling and buddy-algorithm. An optional writable control store is available for user-implemented instructions.

HIGH SYSTEM THROUGHPUT

The NORD-500 processing unit is designed to perform heavy time-consuming computational tasks in a demanding time-sharing environment. To avoid unnecessary interrupts, a NORD-100 computer is used as an intelligent system supervisor processing unit. This system supervisor takes care of all external interrupts from connected devices, and runs the multiuser, multilingual SINTRAN III/VS operating system.

A system program, the NORD-500 MONITOR is an integral part of the SINTRAN III/VS that performs all service functions necessary to support this high performance computer. The monitor will share the processing capacity among equal priority tasks.



The NORD-500 system also has an unusual growth potential. The physical memory can easily be expanded up to 32 MB, and higher processing capacity can be obtained by increasing the cache-buffers memory up to 128 KB. One NORD-100 CPU may handle several NORD-500 processing units, with shared memory. Disk storage capacity can be expanded to more than 2300 MB on line.

NORD-500 ADAPTABILITY

NORD-500 is a complete and fully integrated computer system, consisting of a NORD-100 and a NORD-500 CPU. The I/O system, together with the peripherals and the multiport system, may be configured to suit specific applications. The NORD-500 design also gives you a system that can carry out simultaneous execution of Batch, Time-Sharing and Real-Time tasks in the NORD-100, and heavy CPU-bound jobs in the NORD-500. An existing NORD-100 or NORD-10/S system may be upgraded to a full NORD-500 system. This enables a NORD-100 or NORD-10/S user to increase computing power at very-low cost.

RELIABILITY

The NORD processors are designed for high uptime, with automatic error checking and correcting of memory chips. The most reliable technology and components available are employed, and extensive self-testing is built into the hardware.

The operating system software is the well proven SINTRAN III/VS. This system is running on all NORD computers, and is extensively field tested.

All language processors run in the NORD-100, and the object code is thoroughly checked and optimized in software simulators prior to execution tests in the NORD-500 CPU.

NORD-500 - the modern alternative to mainframes

OFF-LOADING MAINFRAMES

In many applications the requirements for high throughput for a job may be more important than the mere execution speed of the computer.

Being able to receive the result of a large calculation at a predicted time for the solution of complex problems, is much more inspiring than standing idle at the operator's desk waiting for output from a large computer.

Being able to run very large jobs, without having to reserve exclusively a large expensive mainframe, running programs late nights or weekends, is very important for many users. Often a simulation must iterate millions of times before interesting results emerge.

The NORD-500 COMPUTER SYSTEM is particularly designed to solve these problems.

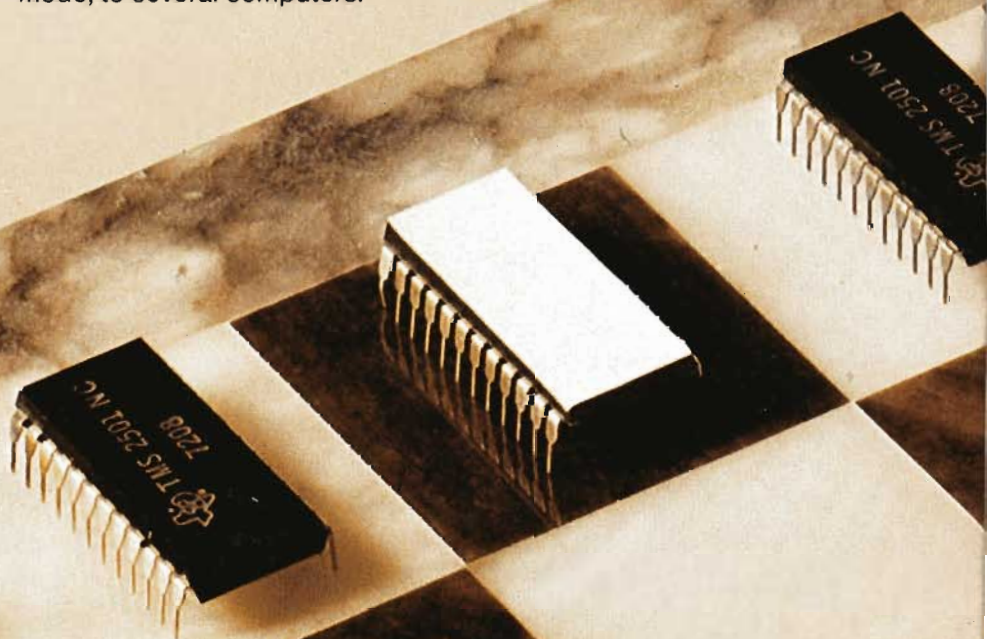
Very often a large computational task requires resources that are very difficult to satisfy in batch-oriented operating systems, often leading to the situation where such tasks tie up a relatively large amount of resources for a very long duration of time.

Moving such demanding tasks to local systems can release valuable resources to the profit of many other user groups.

The choice is not confined either to the use of a local system or a large mainframe, as all NORD computers may utilize data-communication facilities to submit remote-jobs, in interactive or batch-mode, to several computers.

EASY TO USE

The NORD-500 is just as easy to operate as the modern user-oriented minicomputers, and features the same simple installation procedure. The NORD-500 is as powerful as very expensive mainframes, making it impossible to beat in the price/performance-contest.

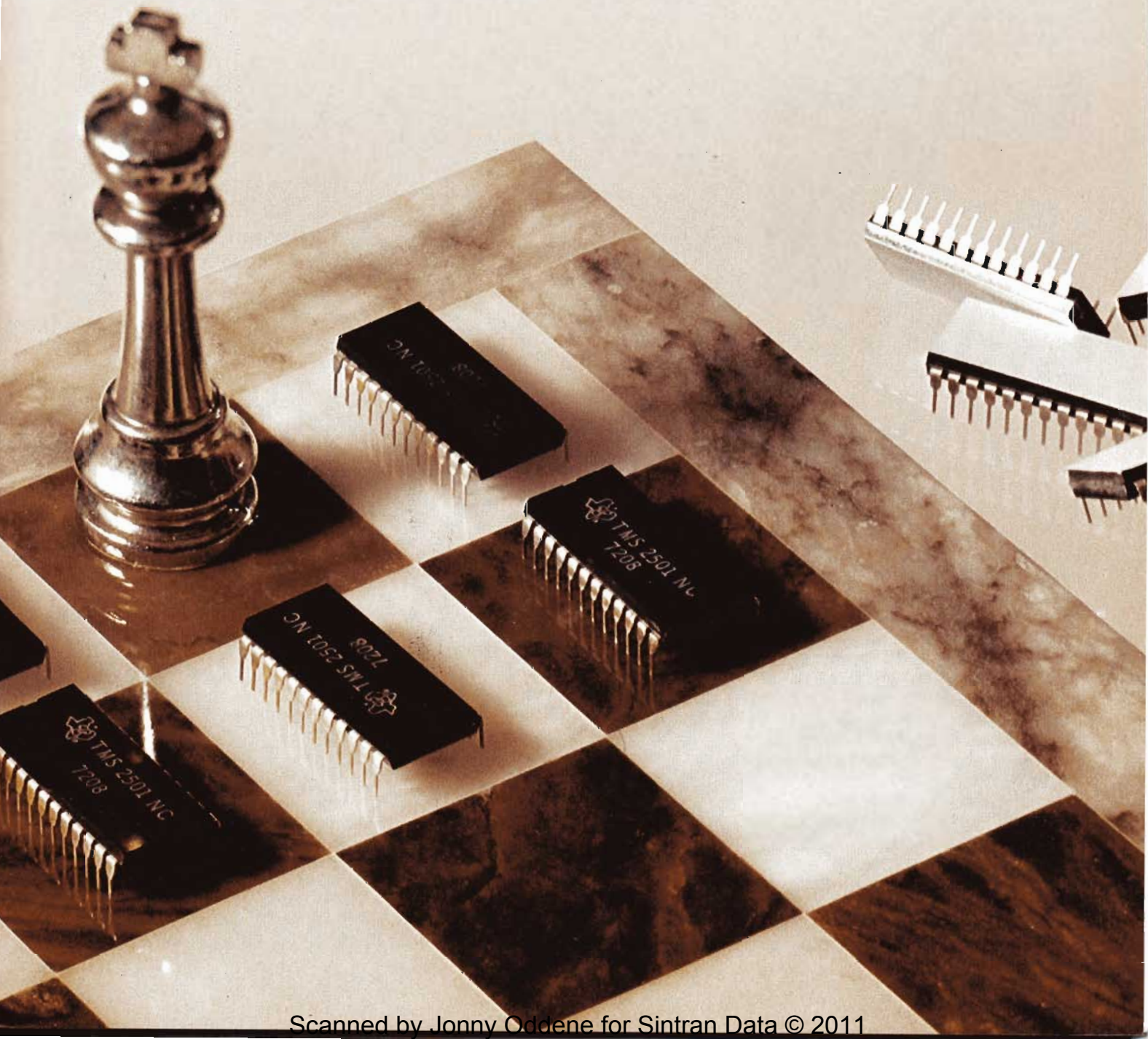


Simple, easy-to-learn commands entered from interactive terminals give the user direct control of the computer. Results can be evaluated immediately, errors can be corrected and jobs can quickly be resubmitted for another execution. A more productive user environment will emerge. The same commands or data can be stored on disk-files and submitted for execution in batch-mode if desired.

MULTIPROGRAMMING

The NORD-500 computer system offers two levels of multiprogramming. The first level is the NORD-100 with the advanced SINTRAN III/VS operating system for program-development tasks such as editing data and source-programs, compiling and building executable programs, listing programs or data on a line-printer, and execution of smaller, non-critical programs.

The second level is the execution of larger, heavy computational tasks, where the NORD-500 MONITOR will share the NORD-500 processing unit among active users, load programs, initiate data-transfers from disk to memory and provide the necessary debugging facilities. The NORD-500 MONITOR can be used by many interactive terminals and batch-users simultaneously.



NORD-500 software

SINTRAN III/VS OPERATING SYSTEM

The sophistication of the novel NORD-500 dual computer system is matched by the unique software concept, the NORD-500 MONITOR as an integrated part of the SINTRAN III/VS operating system, running on the advanced NORD-100 system supervisor. It combines the flexibility and power of a general purpose minicomputer with the high processing capacity of a mainframe dedicated to heavy computational tasks. This solution implies that all management functions are handled by SINTRAN III/VS, leaving the NORD-500 CPU free for optimized processing of demanding jobs without any operating system overhead.

Based on the virtual memory concept, the SINTRAN III/VS operating system features an efficient time-slicing mechanism, output spooling and integrated file system, facilitating extremely fast task processing. It also handles all data transfer operations initiated from the NORD-500 MONITOR. SINTRAN III/VS accommodates up to 64 directly connected terminals, providing an efficient tool for interactive program development and data entry operations. Concurrent processing of real-time, local and remote batch-jobs can be performed in parallel with interactive multilingual terminal sessions, however, critical functions such as process control are guaranteed proper attention and response from the system by means of a versatile priority system. The file management system offers the user the convenience of treating all mass storage devices and peripherals in a uniform, device-independent way, yet contains extensive safeguards against unauthorized access and unintentional destruction of data and programs. The NORD-500 MONITOR allocates system resources to concurrently executing tasks, and initiates all service functions required. In accordance with priorities, the monitor's time-

slicing mechanism shares CPU-time between the different programs, initiates data transfers etc.

The NORD-500 MONITOR is accessible for users of interactive terminals, a simple command repertoire offers a number of convenient features for debugging, as breakpoint-setting, inspection of memory contents by using name of variables, and exhibiting data during execution.

NORD-500 LOADER

The NORD-500 LOADER permits a user to create LOAD-files – executable programs – on disk files, in a format that provides fast transfer and loading.

NORD-500 FORTRAN

The NORD-500 FORTRAN COMPILER generates a very compact code that utilizes the efficient instruction set of the NORD-500. An explicit objective has been to create a language that is compatible with most mainframe versions. As a state-of-the-art compiler following ANS-77 conventions, NORD-500 FORTRAN incorporates a number of features reflecting the current trends in the language's development, as the IMPLICIT, CHARACTER, OPEN/CLOSE and PARAMETER statements. The IF-THEN-ELSE and DO-FOR/WHILE statements have been included to improve program structure. All facilities of the operating system can be used from a FORTRAN program by means of monitor calls. An advanced FORTRAN debug package is available to speed up program development, allowing the programmer to display the values of arrays and variables, set breakpoints at specified lines and display variables during program execution.

UTILITIES

Quick Editor, QED, is the general purpose editor program available for users of NORD computers. QED allows you to alter and modify programs and data files by means of simple yet powerful commands, it is possible to change characters within a line without having to retype the entire line. In addition to edit-commands, QED features instructions for transfer of files to and from mass storage devices and input/output media.

System libraries

NORD SCIENTIFIC SUBROUTINE PACKAGE – SSP

A collection of FORTRAN subroutines, the NORD SSP contains most of the mathematical tools needed to solve problems encountered in science and engineering. It provides the user with procedures for matrix manipulation, statistics and "general" mathematics, and can be called from any FORTRAN program by the CALL statement.

VERSAPLOT I AND II

The VERSAPLOT packages provided by VERSATEC are a collection of FORTRAN programs designed for easy graphical representation of data on electrostatic printers/plotters, and to simulate drum plotting.

PLOT-10

For use on storage tube graphic display units, this is a set of routines provided by TEXTRONICS for graphical computer applications.

The efficient instruction set of the NORD-500 facilitates other high level language processors like SIMULA, PASCAL and COBOL. These languages will be available in the near future.

The NORD-500 system in action

The unique features of the NORD-500 makes this computer system remarkably versatile. Here are just a few examples of possible applications.

PROCESS CONTROL

The fast NORD-100 interrupt system and the real-time features of the SINTRAN III/VS operating system, combined with the NORD-500's

computing power, makes the NORD-500 system particularly suited for process control applications that include heavy computing.



NUMERICAL ANALYSIS

The large logical address space and the memory management system of the NORD-500 can save a lot of time and effort as you don't have to break down data and program to fit within physical limitations. Development time is reduced and you achieve results faster.



SIMULATION

The NORD-500 offers you remarkable performance for the price. That makes the NORD-500 system an excellent choice for simulation of complex technical systems, where high performance and a dedicated system is needed.

SCIENTIFIC COMPUTATION

The high performance and the online features make the NORD-500 system well suited for scientific applications, when fast and easy interaction between scientist and computer is important.

Norsk Data

THE COMPANY

NORSK DATA is a privately owned Norwegian computer company, established in 1967. Compared with other industries, NORSK DATA is a young company – however, we are more experienced than most mini-computer manufactures. From the start NORSK DATA has enjoyed a rapid development that has established the company as a significant force in the world market for data processing systems. However, growth has not been pursued for its own sake. Achieving a 45% annual increase in turnover since 1973, the company has showed a profit every year since its foundation.

Markets outside Norway will become increasingly important to NORSK DATA. Our export record to date demonstrates that the company has the necessary expertise to succeed in international competition. In particular, the level of repeat business from existing customers demonstrates the calibre of our products and services. To provide a solid base in the export markets, subsidiaries are established in several countries.

OUR PRODUCTS

New ideas are the lifeblood of the computer industry, and therefore, we work hard to ensure that NORSK DATA is at the forefront in the exploitation of new techniques. On several occasions we have created computer systems and software that have proved to be well ahead of the general development of medium sized computer systems. The NORD computer itself, that is, the central processor unit, memory and all interface equipment for peripherals, is developed and produced by NORSK DATA. In addition, NORSK DATA produces the general system software; operating system, compilers and data base systems. It is this combination of hardware and software which determines the value of the system to the user, backed up by a complete support facility.

OUR POLICY

The data processing industry is well-known for fast technological development. The policy of NORSK DATA has been continuously to make use of the latest technology to develop products which give the best possible overall solution to your data processing requirements. This policy has led the company to devote considerable efforts to the development of general system software, which makes the NORD computer systems simple and easy to operate, and also extends their application areas.



NORWAY

Oslo:
Norsk Data A.S
Jerikoveien 20
Postboks 4, Lindeberg gård
Oslo 10
Tel.: (02) 39 16 01
Tlx.: 18661 nd n

Bergen:
Lægdesvingen 41-43
5030 Landås
Tel.: (05) 29 64 50

Stavanger:
Oalsgaten 11
4300 Sandnes
Tel.: (045) 66 662.

Tromsø:
Industribygget Tomasjord
Postboks 5173
9021 Tromsdalen
Tel.: (083) 30 790

SWEDEN

Stockholm:
ND Norsk Data AB
Kanalvägen 3, Box 2031
194 02 Upplands Väsby.
Tel.: (0760) 86 050.
Telex: 13528 nordata s

Gothenburg:
Klangfärgsgatan 11, Box 9052
421 09 Västra Frölunda
Tel.: (031) 29 93 50

DENMARK

Copenhagen:
Norsk Data ApS
Øverødvej 5, 2840 Holte.
Tel.: (02) 42 50 55.

GERMANY:

Wiesbaden:
Norsk Data Deutschland GmbH
Abraham-Lincoln-Str. 30
6200 Wiesbaden
Tel.: (06121) 764-1
Tlx.: 4186370 noda d

FRANCE

Ferney-Voltaire:
Norsk Data France
«Le Brévent»
Avenue du Jura
01210 Ferney-Voltaire
Tel.: (050) 40 85 76
Tlx.: 385653 nordata fernv

Paris:
120 Bureaux de la Colline
92213 Saint Cloud Cedex
Tel.: (01) 602 33 66
Tlx.: 201108 nd paris

ENGLAND

London:
Richard Norton (NORD) Ltd.
NORD House
17 Balfe Street, King's Cross
London N1 9EB
Tel.: (01) 278 55 01
Tlx.: 299537 norton g

USA

Boston:
Norsk Data N.A., Inc.
65, William Street
Wellesley
MASS. 02181
Tel.: (0617) 237 7945
Tlx.: 23-0921740 norsk well