



numspecial

**TOTAL SOLUTION FOR
SPECIAL MACHINES**

NUM [®]
CNC HighEnd Applications

www.num.com

NUM Solutions and Systems

Established Worldwide

Outstanding solutions in machine automation have one thing in common: They are always the product of outstanding performance, exceptional technologies and a high degree of creativity!

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NUM has earned its exceptional reputation in the machinery and tools industry exactly with that. We develop **customized automation solutions** that ensure a high degree of added value both to the machine manufacturer and the user. With our expertise that we have developed over decades, we put our motto “NUM automation solutions provide machine builders with a competitive advantage” into practice. NUM had already developed the first CNC controller in 1961, i.e. 10 years before CNC- or NC control systems found a wide acceptance among users. With the launch in 1964, **NUM was one of the first CNC providers in the world.** Since then, we have maintained our position as a technology leader in this segment and are eager to expand it further. Today’s systems, with their flexibility and our expertise, enable us to automate a large variety of machinery. Our long, successful track record supports this finding in an impressive manner. We will continue to develop the **performance, functionalities and flexibility** of our systems in this direction and make the necessary investments in our products, our research & development, as well as in our staff

As an **international company** headquartered in Switzerland; we have sales, application development and service locations all over the world (see back cover) from which we operate worldwide. Our research and development departments are located in Switzerland, Italy and France. Our main production facility is located in Italy.

It is our clearly defined **vision** that we keep the **development and manufacture** of the core products in the CNC system, including the drives and motors, **under our control.** This enables us to adjust the performance, functionalities and flexibility of our systems to new market requirements very quickly and without delays.

The ready and flexible NUM automation systems combined with our locally available engineering expertise and the machine manufacturer, results in a uniquely flexible and powerful team.

Customized Projects

NUM tailors its support to your projects, ensuring it aligns perfectly with your business and infrastructure needs. Regardless of the specifics, our ultimate goal remains unchanged: collaboratively finding the most efficient solution for your project.



Project facilitation PRODESIGN

Efficient consulting for optimal application solutions

This model is ideal for companies with their own development teams and automation specialists. As an external partner, we provide our expertise and resources in field of CNC automation and take on an advisory role.

Project cooperation CODESIGN

Merging knowledge – potentiating results

Your development team will be combined with our team of specialists. Together we will realize the automation of your machine with clearly defined responsibilities. This form of cooperation has proven to be extremely efficient in many projects.

Total solutions ALLDESIGN

Delegating responsibility – controlling result

We assume the entire project management in the sense of a general contractor and are fully responsible for the successful implementation. Starting with the development of the requirements specification, over the development and commissioning, up to the support and service of the machine, and beyond

NUM Solutions and Systems

Intelligent and Creative

We have developed countless customer- and application-specific solutions for different industries as well as pioneering complete solutions for various industries, thus creating practical solutions for challenging applications and professional requirements.

All of our solutions are based on a wide range of perfectly matched proprietary products such as CNC, drive amplifiers and motors. The partnership with our customers in the evaluation, project and installation phase is further maintained by our training, support and other services even after commissioning. We attach importance to ensuring that our customers are served by our professionals with specific knowledge.



numroto

NUMROTO – successful trendsetter in high-precision tool grinding for many years

numspecial

NUMspecial – creative and practical solutions for your specific applications

numcut

NUMcut – a complete solution for advanced cutting machines

numgear

NUMgear – intelligent total solutions for new machines or as a retrofit in the field of gear machining

numtransfer

NUMtransfer – economical and flexible for all lot sizes for transfer, rotary transfer and multi-spindle machines

numhsc

NUMhsc – excellent quality at the highest speeds on machines with 5 or more axes

numgrind

NUMgrind – grinding and dressing cycles, with intuitive shop floor entry screens and 3D visual validation

nummill

NUMmill – flexible solution with a graphical interface for extensive milling cycles, including full 3D simulation

numwood

NUMwood – long tradition with powerful complete solutions in woodworking

numretrofit

NUMretrofit – rational extension of the service life of your machine by years

NUMspecial – creative and practical solutions

As a world-class CNC system, Flexium controls offer built-in features to cover any demand of the industry from eye surgery needles to rocket boosters, from the tiniest watch mechanism to the biggest ship propulsion gears; from economical standalone machines to the largest supervised machining centers and much more. In line with this pledge of “providing you – our customers – automation solutions to develop your competitive advantage” NUM has packed the Flexium control range with technology to tailor CNCs and drives in order to get the most out of your machines. Lets explore some of these features.

Custom G codes

The Flexium controls offer standard G functions for different types of application. A unique G code with some parameters can execute complex moves either once or after each positioning. Such G codes embedded in the CNC firmware are written in ISO code completed with some additional functions. The respective macro can be exported from the firmware and, despite being complete, can also be modified according to a specific need (particular tooling, special feed rate/spindle speed or whatever). Complete new functions can also be developed. Implementing is as easy as 1–2–3. A lot of applications can be imagined: a particular pocket cycle, starting axis movements with some delay (time or distance), non conventional interpolation, variable feed rate, etc... the sky is the limit.

Some advanced programming functions

As a complement of symbolic or structured programming, the Flexium range offers several less common yet more advanced functions such as BUILD, R.OFF, CUT etc. Together with the custom G codes, these powerful functions significantly enhance the capability to meet specific application requirements.

- **BUILD:** Reads a part program and creates a related table of data. This table makes it easy to perform calculations that can later be used for executing movements. A simple application could be used to execute a trajectory in reverse, but many more possibilities exist.
- **R.OFF/C.OFF:** Calculates an offset trajectory; in addition to BUILD it opens the field of possibilities in tool compensation.
- **CUT:** Used for roughing cycles, this function eliminates areas of the part's grooves that cannot be machined with the selected tool, allowing them to be executed later with a different tool.

- **G76+:** Creates binary files that dynamic operators can use to easily generate a sequence of moves, either synchronous or asynchronous.



The CNC system's integration of a specialized electronic gear-box for axis and spindle synchronization boosts the honing wheel's processing speed by over 2.5 times, significantly enhancing efficiency in machining processes.

Dynamic operators

The 'Dynamic Operators' function is one of NUM controls most powerful features, although the concept is fairly simple. Basically, a dynamic operators' application is a set of read, calculate and write operations executed repeatedly at the same speed of the fastest task. These operations can be described in a simple ISO syntax, or, for the more demanding cases, the C language. The multitude of applications leveraging this feature is extensive, with new opportunities surfacing regularly, underscoring its versatile and widespread utility. Some of the most frequent applications for Dynamic Operators include Coordinate Transformation, Gap Control on cutting machines, Flow Control, Non Linear Interpolation between axes (table defined coordinates), all kinds of compensation, access on E/As in the CNC realtime, etc.

NUMspecial – creative and practical solutions

Comprehensive integrated PLC

The Flexium control units contain an integrated PLC which offers a comprehensive functional range. All five programming languages for application programming defined in the IEC 61131-3 are available:

- **IL** (instruction list) is an assembler like programming language.
- **ST** (structured text) is similar to programming in Pascal or C.
- **LD** (ladder diagram) enables the programmer to virtually combine relay contacts and coils.
- **FBD** (function block diagram) allows to rapidly program both Boolean and analogue expressions.
- **SFC** (sequential function chart) is convenient for programming sequential processes and flows.

An additional graphical editor (not defined in the IEC standard) is also available:

- **CFC** (Continuous Function Chart) is a sort of freehand FBD editor.

The PLC executes quickly because it is compiled into machine code. Debugging functionality is extensive and contains variable monitoring/writing/forcing by setting breakpoints/performing single steps or recording variable values online on the controller in a ring buffer (sampling trace). Libraries for different tasks



By integrating special compensations and a corresponding mechanics, this machine is able to cut parts in the range of ± 0.01 mm by means of a water jet.

are available, streamlining the development process. Due to its extensive functional range, PLC enables a wide range of possibilities for automating machines.



The functionality of this laser cutting machine has been enhanced, leveraging the real-time capabilities of the control system. This enhancement leads to a significant boost in productivity.

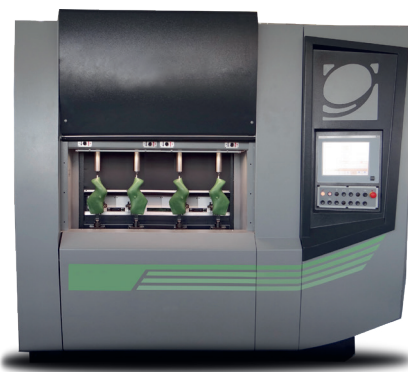
Extended NCK Access (ENA)

Efficient communication between the CNC kernel and PLC in an industrial setting necessitates swift data exchange. Priority is given to transmitting the most rapidly changing data in a fixed, high-speed cycle, ensuring real-time synchronization. To prevent unnecessary communication load, a selective approach is adopted, transmitting only essential data.

To enhance this process, Extended NCK Access (ENA) is employed. ENA facilitates optimized data exchange, offering a means to access crucial information while minimizing communication overhead. ENA is a PLC library permitting to read and write data as well as part program with an easy syntax. The most frequently used functions are:

- Axes information: Positions, offsets, distance to go, over-travel, lag etc.
- Tools data
- NCK parameters

- Drive parameters
- Machine control
- Drive control
- Part Program Memory management: list of program, size, creation, deletion, modification



Shoe modelling is a vital part of shoe production. In order to produce these shoe models efficiently, a special milling machine is necessary. Additional real-time functions and macros were integrated into

the control system. This significantly increases the production output of the machine.

Visualisation

Using Flexium tools, it is possible to easily create graphic pages that will display user information for guiding the machine user. To create a page, just pick a graphic object from our extensive selection, position it with the mouse on your design, define its properties (colors, size, animation, position, rotation, ...) and if necessary the reactions according to an event (get focus, click, ...). In just a few minutes, even users with minimal experience can effortlessly create a polished page. Once the pages are created several possibilities are offered to make the best use of them:

- PLC visualization: The pages are embedded in the main window of the Flexium+ HMI or can be freely positioned with the FlexiumPro.
- Target visualization: The pages created are independent from the Flexium+ HMI.

- Web visualization: the pages can be displayed on any system that is connected to the integrated PLC, using a simple browser.
- CODESYS HMI: Similar to target visualization but the PLC program of the visualization runs on another system than the other PLC programs.

HMI personalization with HTML and FXServer

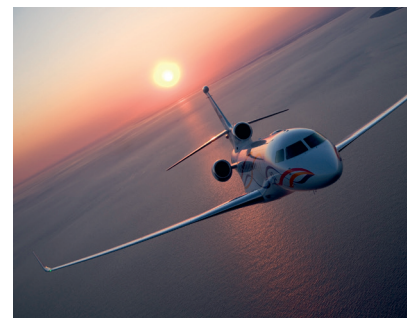
Flexium+ HMI is written in HTML / JavaScript and communicates with the Flexium+ NCK through FXServer in order to read and write data. An advantage of this structure is that the HMI code follows the Internet standards. It is always available and can be edited with a simple text editor or with one of many available HTML editors. No specific development suite has to be provided and managed. Some selected places are foreseen for added code which will remain compatible with all future evolutions of the HMI.

HMI personalization with C#

A major strength of the FlexiumPro HMI is its flexibility. Thanks to a powerful SDK (Software Development Kit), it can be completely adapted, expanded, modified and personalized. Users can easily integrate customer-specific modules into the HMI or compile and adapt the predefined plug-in HMI components according to their own requirements.

The design of the wings of Falcon airplanes needs a special press. It presses the wing in the designed form with up to 200 tons. For this special press with 18 electrical axes, process-relevant real-time

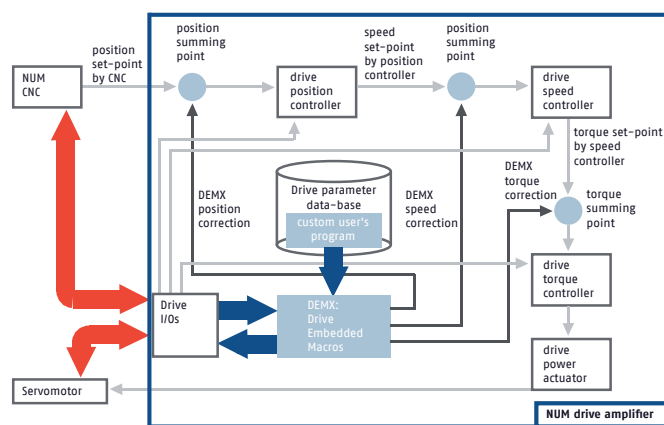
programs and an adapted HMI have been integrated into the control system.



NUMspecial – creative and practical solutions

DEMx (Drive Embedded Macros)

NUM's drive amplifiers have a unique functionality: DEMx (Drive Embedded Macro). It allows the user to create their own realtime macro to interact with all physical and virtual drive resources even manipulating the regulation algorithms. The user can design and implement filters, observers, defines test points, pilot outputs with self-made rules, etc.



Simulation of your Machine in Flexium 3D

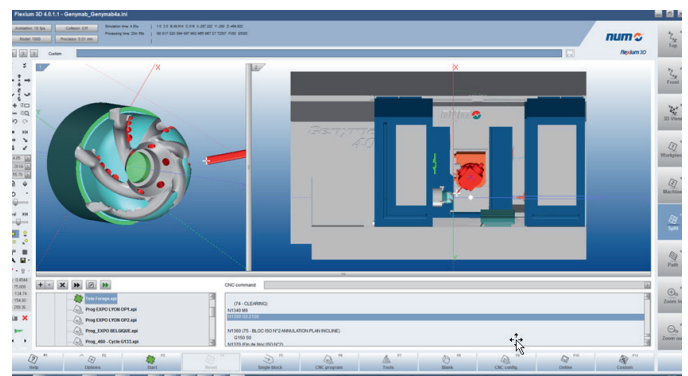
The Flexium control generation offers a 3D simulation tool called Flexium 3D. During the part program simulation the path of the TCP (tool center point) is visualized, the material removal on the work piece is simulated and a collision check is made between machine components, part and tools. The simulation can be executed offline or online. With the Kinematic-Editor, which is part of Flexium 3D, an accurate model of the real existing machine can be made independent of the kinematic type. In the Kinematic-Editor all physical axes are integrated in the parent-child construction tree regarding the kinematic chain of the machine.

Protection of Applications

All of our software contains sensitive information requiring skilled operators and should be protected from unauthorized

users. Software applications should be protected against reading and/or manipulation of source code but also protected against unauthorized execution. To fulfil these needs, Flexium offers different possibilities.

Source code protection of NC programs is accomplished by storing them in encrypted form in macro zone 2, with password protection. Source code of PLC programs can be protected by means of a password set inside Flexium Tools or by means of a security key. The availability of PLC modules and libraries may be provided with associated charges. This can be facilitated through the utilization of a runtime key. To prevent the use of some NC programs, a protection can be integrated into the program itself.



NUM Motors

Perfect for all Applications

Excellent volume/performance ratio and great dynamics, so that our motors can satisfy almost all applications.

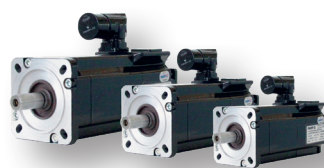
NUM has more than 50 years of experience developing servo and spindle motors. We pioneered the development and production of AC brushless servo motors, as well as synchronous spindle motors with flux weakening.

The comprehensive **servo-motor** series of NUM offer an excellent volume/output ratio, as well as first-class dynamic properties optimized for the machine tool industry. They, with perfect concentric run-out, give great performance even at very low speeds. The so-called "single cable" motors offer the advantage that the complete measuring system cable is eliminated. This simplifies the wiring of the machine significantly and thus saving time and money.

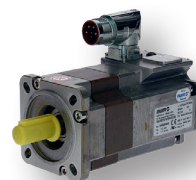
The **asynchronous motors** of the AMS series offer excellent quiet running at low speed, quick and accurate positioning and are ideally suited as a C-axis and for spindle indexing.

The TMX series **torque motors** have an extremely low cogging torque as well as a very high S_1 torque density. They are ideal for applications that require very smooth and precise motion, especially at low speeds. Typical applications are direct drive rotary tables or workhead axes of machine tools.

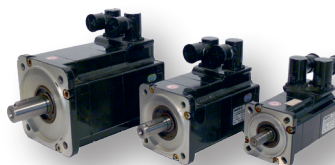
The NUM **LMX linear motors** are specially designed for machine tools. Among other features, they are characterized by a fully enclosed primary, a cooling circuit with large diameters to accommodate fluids with low specific heat capacity, a short pole pitch to increase the force density and reduce temperature, and many other interesting features.



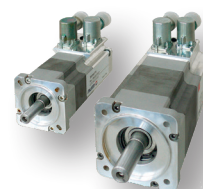
Motors of the series SPX "single cable"



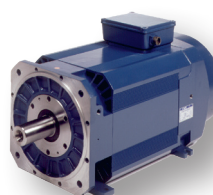
Motors of the series SHX "single cable"



Motors of the BPX series



Motors of the BHX series



Motors of the AMS series



TMX torque motors



LMX linear motors

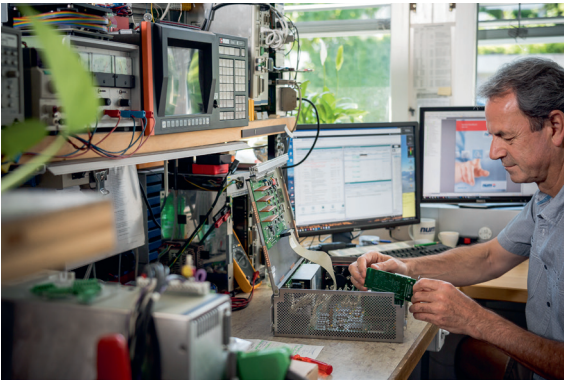
NUM Services

Worldwide at your Service

The decision for NUM is also the decision for a customer service that will support you long after the initial investment as on the first day – even after 20 years and on-site. Our specialists can ensure an extended life for your good (but old) machinery with NUM retrofits.

Worldwide support by experts

For professional analysis and trainings, a perfect infrastructure is available to our experts in all centers of excellence. So that we can assist you quickly and efficiently around the world, we also rely on the advantages of the most modern communication technologies, e.g. for remote maintenance. We can also offer on-site support and consultation services out of our regional branches



Comprehensive training offer

We orient our training to your individual needs – whether its operator training, maintenance, repair and service training, HMI; CNC or PLC programming, or adjustment of servo drives etc.

NUM provides a training offer matched to the customer needs:

- CNC operation
- CNC programming
- PLC programming
- Commissioning and servicing
- Creation of a custom HMI
- Customized customer training

Technically always up to date

Our team of specialists will actively inform you on the latest

hardware- and software developments and provide you with useful technical information.

Repair- and spare parts service

If an error unexpectedly occurs in your CNC system in spite of proper maintenance, you can trust that this will be fixed by dedicated service employees of our global network.



Customer service

For you and your markets, we have a worldwide service organization. The International customer service provides telephone consultation and deployment on site, even for machine installations that are many years old. With a retrofit from NUM, the operating time of an excellent machine can be extended by many years.

Our customer service is available and responsive to help even with cutting edge products and custom developments. We carry local inventory and have your materials and components in stock ready to meet your requirements for quality and delivery times.

Complete CNC Solutions Worldwide



NUM systems and solutions are used worldwide.

Our global network of sales and service locations guarantees professional service from the beginning of a project to its execution and for the complete life cycle of the machine.

NUM has service centers around the world. Visit our website for the current list of locations.

www.num.com



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