TechNUM

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THE TECHNICAL JOURNAL OF CNCS AND DRIVES

Editorial

Now that our products are becoming increasingly open, we wanted to establish a closer dialogue with your engineers and technicians. Concerned with meeting your needs, we looked for an efficient way to give you all the information you need as rapidly as possible.

We finally decided on written material and are happy to introduce this first issue of our technical journal, TechNUM, designed to be the tool your staff needs to communicate with our sales engineers.

The main function of TechNUM is to provide you with all sorts of practical information on new products, new functionalities and new applications as soon as they come on the market. Its publication will therefore be coordinated with the dates of introduction of the products.

Although very complete, TechNUM is very readable. Its layout is designed to make it easy for you to look up information on what interests you. It also includes many examples of implementation. TechNUM is published in French, English and German. Its articles are organised under four main headings (which may not all appear in each issue, depending on the innovations presented), called Products, Solutions, Applications and Practical Information. Other headings may be created if you think they are necessary. The main subject of this first issue is index J of the software, which applies to all the products of the NUM 1000 line.

This topic includes information on the compact panel, remote inputs/outputs, operator intervention during production, programming on PC and the most recent developments in High Speed Machining.

Equip your machines with the new compact, low-cost NUM line associating NUM 1020/1040 CNCs with the modular Num Drive line.

TechNUM

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**** 1 N = new • E = upgrade***

Products

Products:

NUM 1020 - 1040 - 1060

Version or reference :

software index J

Field:

MAN MACHINE INTERFACE

Persons concerned:

Operators

Others:

O.E.M.

New

Référence : ***PR1***

Compact panel

Advantages:

Low cost, compact design, aimed at entry level application and mechanically simple machines. It completes the range of NUM panels : 14" colour CRT, 9" B&W CRT and 10" colour CRT ,operator panel.

Presentation

By combining the CNC with the machine panel, the compact panel has a functional emphasises on m/c operation. The COMPACT PANEL is fitted with either a 9'' B&W or 10'' colour CRT. The basic unit can be used in the following contexts:

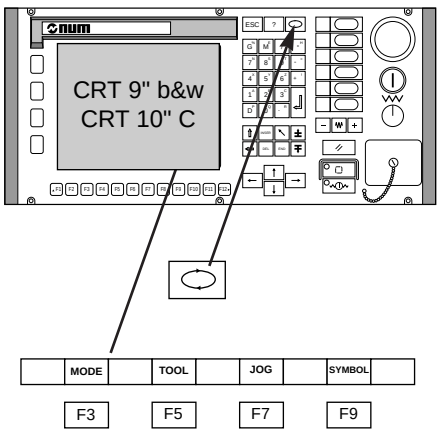
- production
- set up
- PROCAM

A 102 keys PC keyboard can be connected for the following functions:

- commissioning
- part program edit
- advenced maintenance operations

The COMPACT PANEL can work with the whole range of NUM 10x0 CNC's, except the PCNC. The COMPACT PANEL is the only panel available for the 1020. Although the panel can be used with the standard NUM operating screens, it is equally intended for totally customization with MMI tool.

Panel description



The alphanumeric keys can operate simple commands

- in MDI mode
- cursor control (4 keys)
- context changes

The menus can be selected by softkeys and function keys.
Four selection keys located on the left side of the screen can be used with customized screen pages.
The Num screen pages are the same as with other panels, except for the status windows, where additional information is displayed:

- active machine functions
- selected axis

Pressing the CONTEXT key gives access to a special softkey window, specific to the COMPACT PANEL:

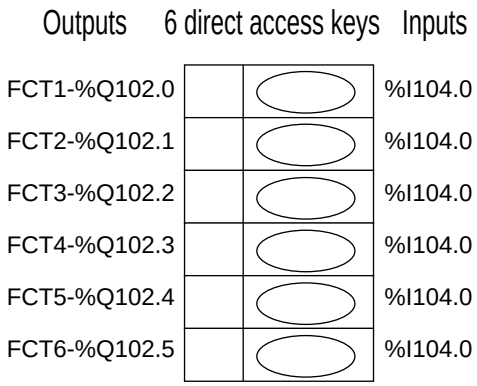
- selecting the MODE softkey (F3) allows access to the NC modes
- selecting the TOOL softkey (F5) allows access to the tool offsets
- selecting the JOG softkey (F7) allows access to an axis selection window
- selecting the SYMBOL sofkey (F9) allows access to the softkeys; I J K L O U V W allowing simple modifications to ISO part programs, without the additional 102 key PC keyboard.

A 102 key PC keyboard (US QWERTY or AZERTY) can be attached to the front connector, for temporary use, or, (for better environmental protection) to a back connector, for permanent use.
Note : the PC keyboard is not supplied by NUM.
An AZERTY keyboard is selected by the command '' Scroll_lock 1 ''
A QWERTY keyboard is selected by the command '' Scroll_lock 0 ''
The X-OFF character is generated by the command ''Control_S''

Machine control via the Compact Panel

Control is split into two parts :

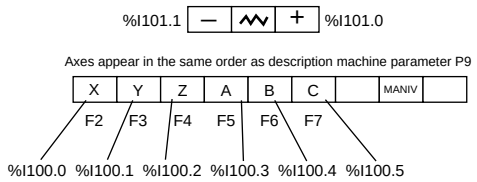
- a software part, linked to the CNC through the standard panel cable: RESET, CYCLE, CYCLHOLD, axis controls, 6 customized machine functions and the feed potentiometer
- a hard wired part: emergency stop push button, power up button, 9 pin serial link connector.



Four selection keys on the left hand side, can be read via the %R0.W PLC memory location. The codes are $DC(upper key), $DD, $DE, $DF.
The exchange area (read by the PLC ladder program) operates the machine functions. The customizable function keys are 100ms pulse commands. Their status is displayed on the status screen window via FCT1 to FCT6. Two keys can be pressed simultaneously, but a third will be ignored.

The CYCLE and CYCLE_HOLD keys are also 100ms pulse commands

- CYCLE %I103.1 %Q100.1 (Led)
- CYCLE_HOLD %I103.0 %Q100.0 (Led)
- Feed potentiometer %I122.W



Axis control in JOG mode :

Additionnal system bits give the following information:
If a NUM extension I/O is detected on the optical fiber bus, any conflicts in the %I1xx, %Q1xx, zones, will set bit %R97F.1 (DEF_CONF) to 1. The presence of a COMPACT PANEL is detectable if %W97F.1 (PUP_ECO) = 1.

Documentation

938938/0 Installation and commissionning manual

Products:

NUM 1040 - 1060

Version or reference:

Commercial 80097-8-9 and software vers. J

Field:

Installation

Persons concerned:

OEM

New

Reference : ***PR2***

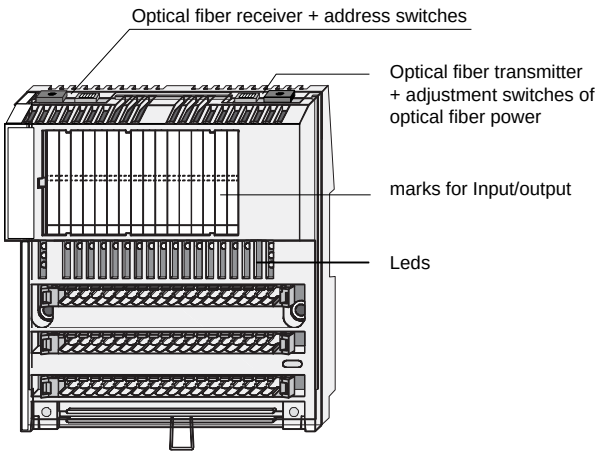
Remote inputs/outputs modules

Advantages:

These modules, are linked to the optical fiber bus, to allow the I/O to be mounted as close as possible to the sensors and actuators, (decreasing both the cost of the wiring and the size of the electrical cabinet,) thus offering a compact and safe solution.

Presentation

Used alone, or together with normal I/O cards, the remote I/O modules can increase the possible configurations of 1040 and 1060 CNC's equipped with an optical fiber ring. The sensors and actuators connected to these modules have good immunity to electromagnetic noise. The commissionning time is reduced to a minimum thanks to clip-on mounting devices



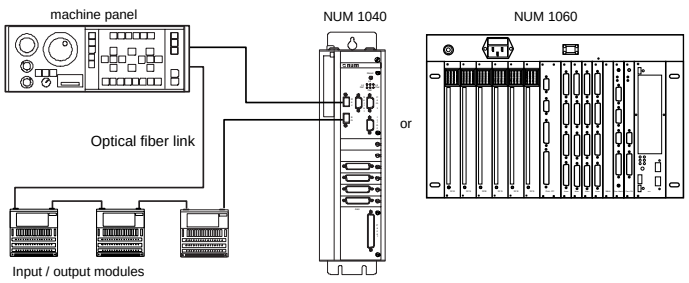
The offer

There are 3 types of module

- 16 INPUTS / 24V DC (ref : 080097)
- 16 INPUTS / 24V DC + 16 OUTPUTS / 24V DC 0,5 A : 2 groups of 8 static outputs (ref : 080098)
- 8 INPUTS / 24V DC + 8 RELAY OUTPUTS 2A : closed contact outputs / 4 insulated and 4 with a common (ref: 080098)

Maximum I/O cofiguration :

- 16 modules for a 1060 SI
- 336 I/O (local or remote) for a 1060 SII
- 256 I/O (local or remote) for a 1040
- maximum distance between modules : 40 m



Maximum optical fiber length: 40 m .
A 18 pins connectors is supplied for a connecting board with screw (1,5 mm2) or a connecting board with spring (2,5 mm2).
additional connectors (1, 2, or 3 rows of 18 pins) can be supplied as busbar connecting board for supply or earth connections.

Practical

Green LEDs indicate the I/O status (red LEDs indicate a fault on static ouputs).
Clip-on mounting with DIN profile locking (or fixed by 2 screws).
The optical fiber transmission strength can be adjusted by dip switches on the module to suit the length of fibre.
A PLC I/O address must be defined for each module. The rack number (4 or 5) and the board number (0 thro F) are selected by switches. The module is read from or written to by the PLC ladder program via %Ircmv or %Qrcmv variables in the usual way (r = rack, c = card).

Documentation

938954/0 Commissionning remote I/O modules
938846 Ladder language manual (and C language)

Backtrack and Automatic Recall

Advantages:

During an operator intervention, following a cycle_hold, this advanced feature will allow the operator to easily retract a tool and to restart the program, (with all attendant safety requirements,) either from some earlier point in the program, or from where the axes were stopped.

Products:
NUM 1020 - 1040 - 1060
Version or reference:
Software ver. J
Field:
Operating mode
Persons concerned:
Operator
Others:
Machine designers
New
Reference: ***PR3***

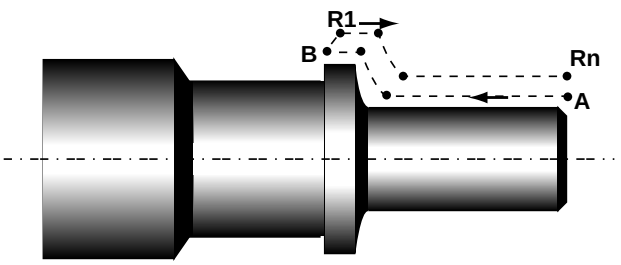
Presentation

In the case of a machining problem, (such as loss of the flame in a flamecutting operation, or a tool breakage during a turning or milling cut,) it is necessary either to go backward along already processed blocks (before reigniting the flame) or to clear away from the part, remove the broken tool and restart the program from where it stopped. In tackling these critical situations with minimum loss of production, NUM has developed two new operator functions : backward move on trajectory (backtrack) and automatic axes recall.

Exploitation

Backtrack

After a cycle_hold, a continuous action on the ''backtrack button'' will provoke a backward move along the programmed trajectory. The backward move can be performed in either continuous, single, or rapid mode. The operation will be different depending on the mode selected.



Continuous Mode:

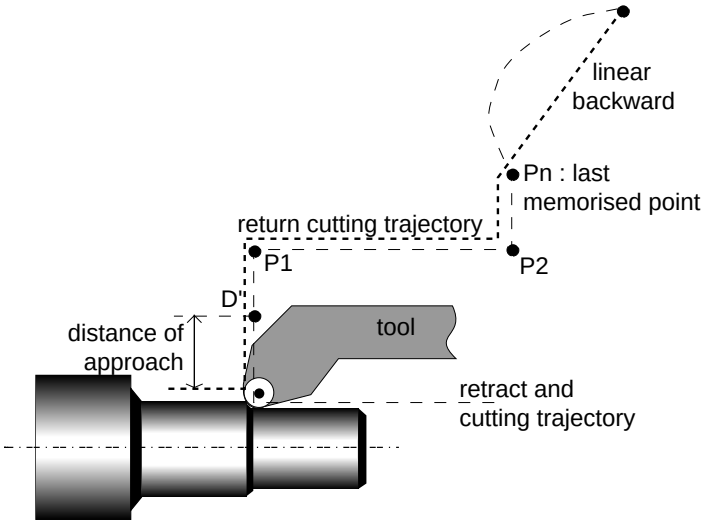
The backward move will continue as long as the operator presses the backtrack button. The speed will be the programmed speed of the block in progress.

Single Mode:

Same as continuous mode, except the backward button must be re-pressed, at the start of each block.

Rapid Mode:

Same as continuous mode, but the moves will be done at rapid speed.
At all times, the operator has the option, if he chooses, to clear the tool from the part, by simply pressing the axis ”recall” button and manually jogging the axes to a safe position.
Once the program path has been left, the backtrack trajectory can be continued, but it will be shifted by the distance jogged. It is possible to return to the program path, by pressing the ”return” button. The method for the return jog motions are the same as for the old ”axis recall”. Once back on track, the forward part program path can be resumed at any time, simply by pressing cycle start.



Automatic axes recall

Following a cycle_hold, all the axis displacements in intervention mode are stored. To return to the initial position automatically, it is sufficient to validate the axis recall and press the ‘’automatic axis recall button’’ whereupon the axes will move back to their former position along the stored trajectory at the speed they were originally jogged.
At a predefined distance from the part (‘’the approach distance’’) the axes will pick up the programmed speed.

Machine builder

Backtrack

The backtrack function is a s/w option (ref 6x546).

a) machine parameter
P114, word N0, defines the number of program blocks which can be stored. (Maximum value = 100, default value = 10)

b) PLC interface
Three bits have been added in the exchange area:
%W39.0 (Backward): backtrack move request. As long as this bit is set to 1, the axes move backward along the program trajectory until the maximum number of blocks is reached.
%W39.1 (Forward): Return move request. As long as this bit set to 1, the axes move forward to the initial cycle_hold position.
%R2.4 (Statetrace): this bit indicates that forward/backward functions are active.
These bits can be displayed on the operator panel through LEDs.

Automatic axis return

This is a standard feature on all systems.

a) machine parameters
P114, word N1, defines the maximum number of stored points. (A point is only stored at changes of direction, so successive jog moves along the

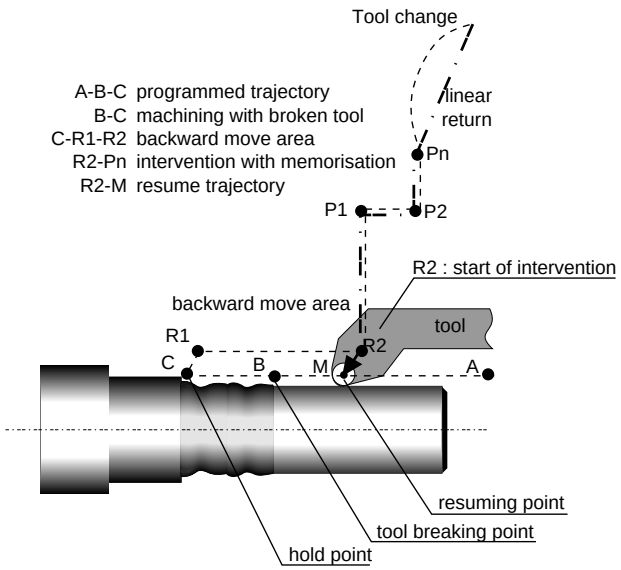
same axis will only result in the final point being saved.) The default is 0 (which invalidates automatic axis return). The maximum value is 10.
P114, word N2, defines the approach distance in internal increments. The default is 0.

b) PLC interface
%W39.2 (Initpos): automatic axis return request.

Practical example

Example of use of the forward/backward functions :

During the cyle, the cutting tool breaks. After a short time, (while perhaps a few blocks have been executed with the broken tool,) the operator presses cycle_hold, stopping all axis motion.
The tool is jogged clear of the part, moved backward along a parallel program trajectory ahead of the break point, then fully retracted. After the tip has been changed, the tool is returned to the program path via the automatic return request, (cancelling the manual jog moves,) and then picks up the normal program execution.



Documentation

These new features are documented in the following manuals:

Operating mode	
Operator manual 1060M	**N∞ 938821/2**
Operator manual 1060T	**N∞ 938822/2**
Comissionning	
Machine parameter manual	**N∞ 938818/6**
PLC Ladder programming	**N∞ 938846/5**

Products:

NUM 1020 - 1040 - 1060

Version or reference:

Software index J

field:

Axes command

Persons concerned:

EOM

Evolution

Reference : ***PR4***

High Speed Machining

Advantages :

Since software version G, some special algorithms have been developed in order to respond to the high speed machining market. These use graphical aids (directly on the CNC panel) to assist with m/c parameter set up.

Presentation

High speed machining requires some hardware and software functions.

1) Evolution of high speed machining functions

Accuracy evolution of servo drives	available before J version	new since J indice
Progressive acceleration	●	
Total anticipation algorithms	●	
Antipitch correction	●	
Speed control on an angle	●	
Trajectory difficulties analysis		●
Speed control on curve		●

2) Evolution of the aids for setting up the servo drives

Setting macros	available before J version	new since J version	Funtion extension with J version
G254: Gains alignment	●		
G255: Ball-bar trace acceleration anticipation setting	●		antipitch and filtering times settings
G25 : Ball-bar trace antipitch + filtering setting	●		
G253: Approach speed setting + maximal gain search	●		
G252: error trace on profile		●	

3) Improvements in the numerical control performance for High Speed Machining

Goals	Performances
Augmentation of prepared block	60
Diminution of the minimum time for block execution	from 3 to 5 ms
Augmentation of the efficient speed for drip feed mode by serial line	30 k bauds efficient
Drip feed mode possibility through the hard disk of the integrated PC or through Ethernet network	80 kBPS between the hard disk Ethernet adapter of the integrated PC

The numerical control requirements for High Speed Machining

Numerical controllers dedicated to High Speed Machining have to respond to the following needs :

- high feed rates, due to high spindle speeds and high cutting feedrates
- Machining with small segments : treatment of small blocks makes for large volumes of data and consequently for special trajectory analysis algorithms.

Machining complex profiles from CAD/CAM generated data is based on tool trajectories made up from many small linear segments. The high speed machining of such trajectories requires a powerful numerical control with fast calculation speed, fast data transmission capabilities (by serial line or network) and a large memory.

Assessing these needs for the numerical control

Generally, the axis feed rate is linked to three different factors by the following relationship :

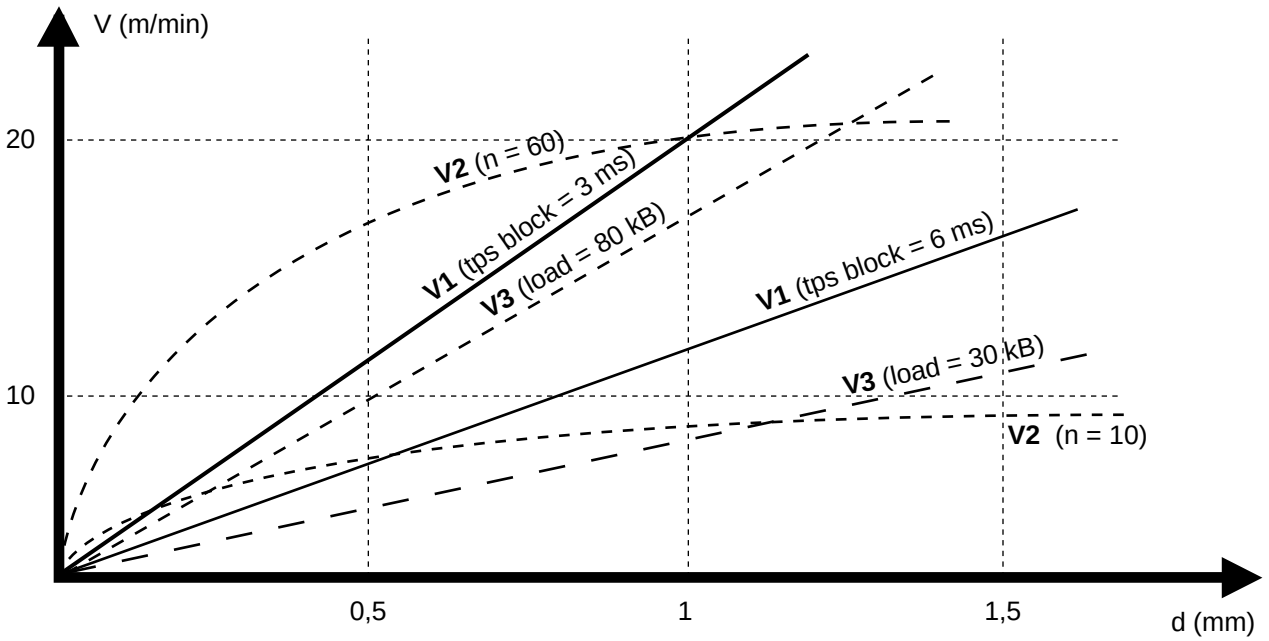
- minimum block execution time : $V1 = d / Tps\ block$
- number of blocks prepared in advance : $V2 = Sqrt(2.n.d.A)$
- transmission speed in drip feed mode : $V3 = 0,1.Rate.d / N$

where:-

d = block size,
Tps block = minimum time for block execution,
n = number of blocks prepared in advance,
A = machine acceleration,
Rate = effective serial line speed, network or hard disk,
N = number of characters per block.

These formulae determine the maximum speed that can be obtain with an averaged block length.
The number of prepared blocks allows the system to anticipate sudden changes in direction so as to correctly control axis motion and prevent any overshoots.

The following curves show that to get a reliable system, the three curves V1, V2 and V3 must be aligned to each other as far as possible :



The NUM commercial offer

Options or products linked to high speed machining

Standard features of the NUM1060 M range :

- progressive acceleration,
- anti-pitch correction,
- cornering speed control.

”High accuracy profiling” option

Commercial reference 6x155 is available on the whole NUM1060 M range. It provides for total anticipation and analysis of trajectory algorithms to give zero following error.

”High speed machining” option

Commercial reference 6x146 available only on NUM1060 Serie I M and NUM PCNC 1060 Serie I M includes the following features :

- the ”High accuracy profiling” function,
- an additional NC processor,
- a CMP (data compression) mode, for use on serial lines, which gives twice the speed of normal drip feed mode (on NC or machine processor serial lines).

NUM PCNC 1060 numerical control

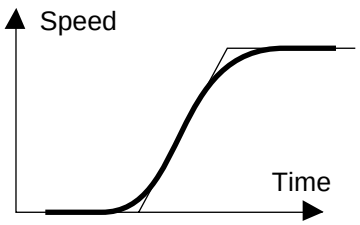
This controller allows the part program to be stored on the integrated PC’s hard disk and facilitates linking the machine to a network through an Ethernet adapter connected to either the parallel or optional PCMCIA port (option reference 6x180). This type of connection can then make use of standard protocols such as TCP/IP or Novell. Program execution is done in drip feed mode directly on the NC bus between the PC memory and the NC memory, at transfer rates of more than 80k bps.

Expected performance from different controller configurations

Products **Performance**	**1060 PCNC SI + UGV**	**1060 PCNC SI**	**1060 SI + UGV**	**1060 SI**	**1060 SII**	**1060 PCNC SII**	**1060 SII**
Tps block for 3 axes	2 ms	3 ms	2 ms	3 ms	4 ms	4 ms	4 ms
Tps block for 5 axes	4 ms	5 ms	4 ms	5 ms	6 ms	6 ms	6 ms
Drip feed mode speed	80 kB	80 kB	30 kB avec mode CMP ou carte ITLS	15 kB	13 kB	70 kB	15 kB
Usable memory size	> 270 Mo 1,4 Mo	> 270 Mo 1,4 Mo	1,4 Mo	1,4 Mo	1,4Mo	> 270 Mo 640 Ko	640Ko

The various basic algorithms

Reminder of available functions before version J software.

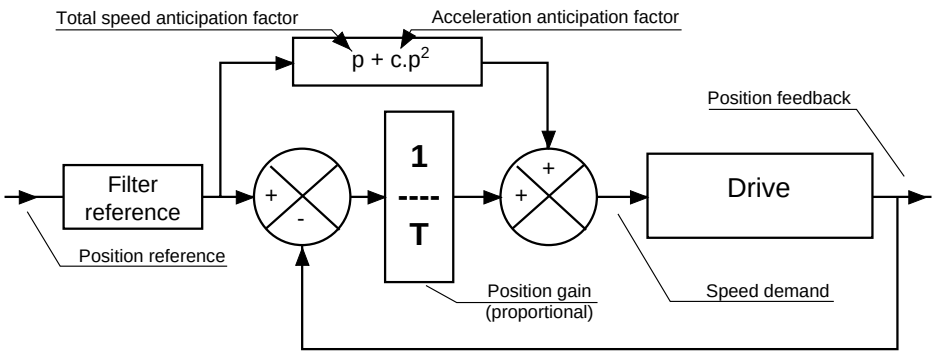


Progressive accelleration

This gives a smoother axis response, in order to get a better surface finish, and will avoid any overshoot when the total anticipation algorithm is active. The "sin²" law corresponds to a pair of half-parabolas resulting from a triangular acceleration profile (linear from 0 to A max. and from A max. to 0).

Total anticipation algorithms

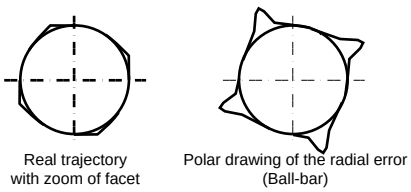
These are designed to improve the trajectory accuracy. The principle is based on harmonizing the position loops of interpolating axes, in order to cancel any servo following error between the axes position references and their feedbacks. The principle depends of three factors:



- total velocity anticipation , which cancels the following error of linear moves at a steady speed,
- acceleration anticipation, which cancels the radial error of circular moves at a constant speed and the following error of linear moves of uniform acceleration,
- filtering the interpolator position reference, to smooth trajectory discontinuities caused by lots of very small moves.

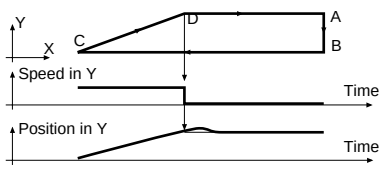
Anti-Pitch compensation (stick-slip on direction reversal)

Pitch error, as displayed on a ball-bar trace, can be explain as a discontinuity of the motor forces due to the the stick-slip friction phenomena which occurs during axis reversals. It is corrected by providing a feedback pulse, of pre-defined amplitude and duration, at the point of reversal.



Angle path analysis

This analysis consist of establishing a velocity threshold, to be observe when passing through an angle, which will limit any overshoot to an pre-defined acceptable limit. The velocity threshold depends on the programmed feedrate and the angle formed by the programmed trajectory.

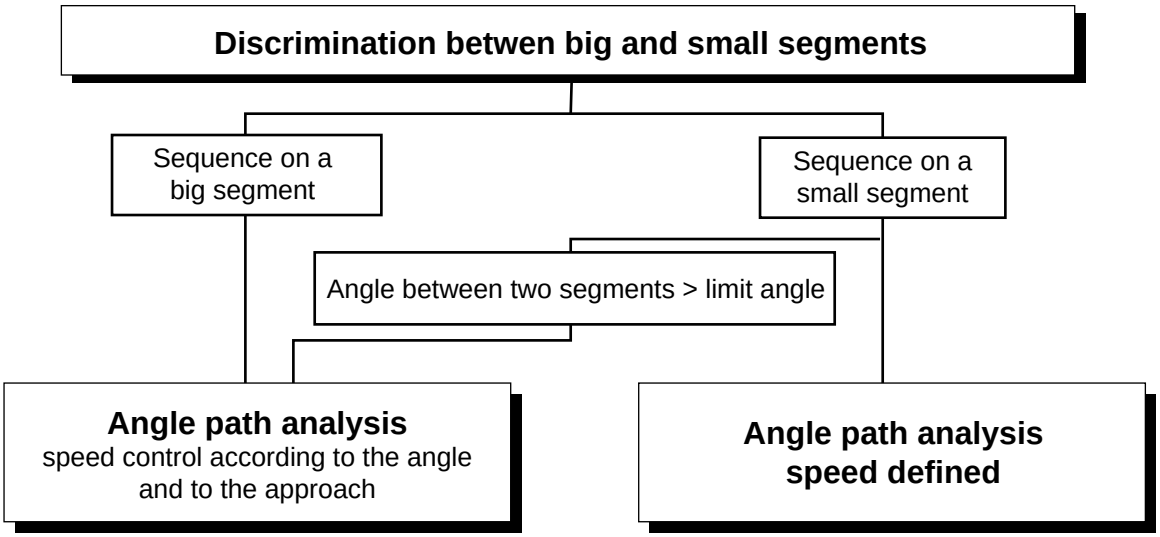


Path analysis problems

The treatment of programs consisting of many small blocks which are required to follow an accurate profile, have obliged us to develop a new algorithm for trajectory analysis in real time.

Curve analysis

This consists of analysing the segment sizes, according to their cordal error and the angle between the segments, in order to define if an angle path analysis or a curve radius calculation needs to be made. The radius of curvature, the servo error allowed, and the maximum permitted acceleration, will determine a velocity which will satisfy the twin constraints of accuracy and acceleration.



Velocity control as a function of curvature

Approximation of the radius of curvature

Automatic calculation of radius of curvature during block preparation: R = D / angle.

Servo accuracy constraint

Velocity limit, as a function of acceptable error, is defined by the following formula:
Em = (V x Tp)4 / (27 x R3) gives a max. speed limit that cannot be exceed
Vlim = (1 / Tp) x (27 x R3 x Em)1/4
where: Tp = the position time constant, R = the radius of curvature,
Em = the maximum acceptable servo error, as defined by m/c parameter P52, which can be changed by external parameter E32002.

Maximal acceleration constraint

The velocity limit, according to the maximum acceleration acceptable on the trajectory, is defined by the following formula :
An = V2 / R, which yields a velocity limit: $Vlim = (Am \times R)^{1/2}$
where: Am = the maximum speed acceptable on the trajectory and R = the radius of curvature.

Curve analysis set up

Three parameters must be set :

- the servo control error authorised on a circle, P52 N0. This parameter is also used in software version J1, on curves programmed with small segments. The external parameter, E32002, is the memory image of P52, which can be changed from the part program. This value is the servo control accuracy constraint determining the speed limit.
- the cordal error, E32004, needs to be around 110% to 120% of that defined for the CAD/CAM package used to generate the part program. This parameter must be initialised before program execution. The value discriminates between small and big segments in order to execute, either the curve analysis or the angle analysis, as the case may be.
- the angle over which the angle path analysis is always executed, E32003, (whatever the segment size). This parameter must be initialised before program execution. Generally a value from 7 to 10 degrees is acceptable.

Changing the High Speed Machining parameters from part programs

Up to software version J, the high speed machining parameter values were restricted to machine parameters. Memory copies of the parameters are now accessible as external parameters. This allows their temporary modification for special trajectories or for less demanding machining situations.

	Machine parameters	**New external parameters**
Filtering time	P55 words N8 to N15	E32005
Angle path speed	P33	E973xx
Servo control error on a circle	P52 word N0	E32002
Amplitude of pitch correction at reversal	P19 words N32 to N63	E982xx
Time constant of pitch at reversal	P19 words N64 to N95	E983xx

This possibility allows the creation of G functions to alter the machine's characteristics, for example:

High Speed Machining function disabled:

E11012=0 E973xx=0

Fast but less accurate High Speed Machining:

E11012=1 E32002 high E973xx high

Accurate High Speed Machining:

E11012=1 E32002 low E973xx low

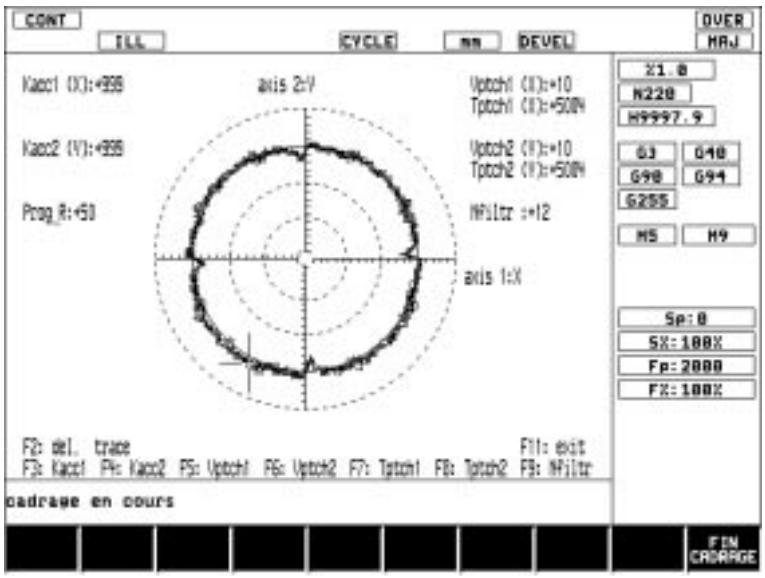
The filtering parameter E32005 and the parameters for setting the anti-pitch are used in the ball-bar macro to facilitate High Speed Machining set up.

Commissioning aids for servo control set up

Without external instrumentation, these commissioning aids reside in the CNC software and allow the verification of axis behaviour by displaying various axis motion traces.

1) Accurate matching of the time constant to the loop gain (KVAR), or vice-versa => G254

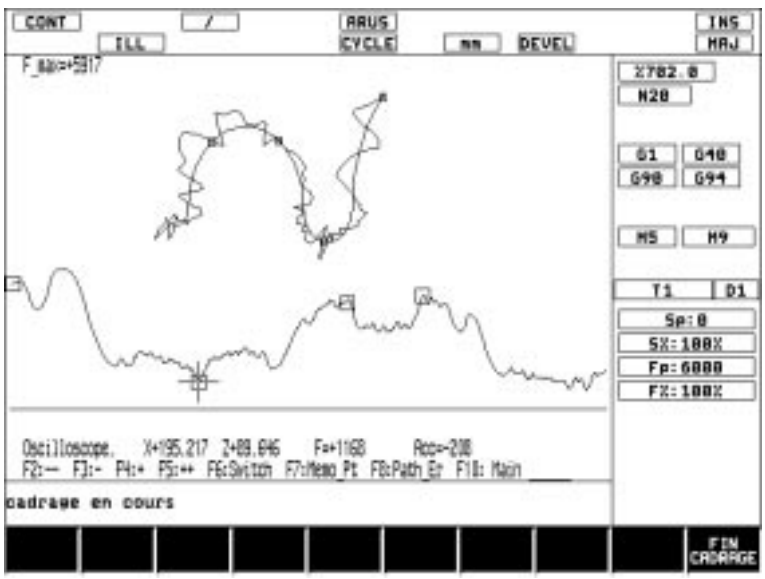
2) Finding the angle approach speed or the maximum possible position loop gain => G253



3) Ball-bar function => G255, this set up aid shows the radial shift. It also allows the following settings to be determined:

- the acceleration anticipation
- the position reference filter constant
- the anti-pitch parameters
- ball-bar traces can be with G02/G03 circles or with circles generated in small segments (Tabcyls) on the principal axes or on another axis pairs.

=> The trace is obtained by running %9997.9



4) A macro to show up errors on a segment of profile:

- zoom in on a trajectory
- measure the average feed rate
- trace the error or speed along the trajectory

G252 X<x1> I<x2> Y<y1> J<y2> [P<oc>] [Q<esp>] [R<ech>] [S<nv>]
Y<y1> J<y2> Z<z1> K<z2>
Z<z1> K<z2> X<x1> I<x2>

X, I, Y, J: profile storage window
<oc>: occurrence of passage through the window (default is 1)
<esp>: RTC ticks between each record (default is 1)
<ech>: error scale magnification (default is 20)
<nv>: number of possible points (1000 is the maximum and also the default)

NB: The trace is obtain by running the graphic scaling function for program %8083 or program %12252.

Part program access to the parameters for High Speed Machining

External parameters	Designation	UT05	Units	Access	Software version
E110 12	Enabling of ”Accurate following profile” function It’s necessary if the option is present and if the filtering value is not equal to zero		0/1	L / E	G
E11013	Enabling of progressive acceleration	P7 N7 bit 05	0/1	L / E	G
E32000	Minimum time for execution of interpolated block	P51 N0	ms	L / E	<G
E32002	Servo control error acceptable on a circle programmed in G02/G03 or in small segments	P52	µm	L / E	<G
E32003	Angle over which the angle path analysis is always executed whatever the block size		degres	L / E	J
E32004	Cordal error allowing the distinction between big and small segments		µm	L / E	J
E32005	Terms of the filter in total speed anticipation	P55 N8 N15	in Nbr HTR CN	L / E	J
E41005	Value of the sampling period	P50 N0	µs	L	<G
E41006	Time constant value of the position loop of the axes group	P56	ms	L	G
E970xx	Maximum axis speed	P30	mm / min deg. / min	L	<G
E971xx and E972xx	Axis acceleration in machining speed and axis acceleration in rapid speed	P32	mm / s^2 deg. / s^2	L	<G
E973xx	Approach speed (authorised speed level during the angle path)	P33	mm / min	L / E	J
E980XX	Value of the servo control coefficient	P21	1/1000ème	L / E	G
E981xx	Time constant value for axis acceleration anticipation	P19 N0 to N31	µs	L / E	G
E982XX	Amplitude of anti-pitch pulse during axis reversal	P19 N32 to N63	µm	L / E	J
E 983XX	Time constant of anti-pitch pulse during axis reversal	P19 N64 to N95	1/100s	L / E	J

The software version corresponds to that for which the external parameter was created.

Documentation

938956 High Speed Machining, (forthcoming in Feb. 96)
Functional description of High Speed Machining functions.
Settings process and tools macro using.

Products:

NUM 1020 - 1040 - 1060

Version or reference:

Software index J

field:

Axes command

Persons concerned:

OEM

Other persons concerned:

Operators

Evolution

Reference : ***PR5***

Manual control, by eye

Advantages :

Improvements in axis control by handwheel JOG mode and in 3/5 AUTO + RTCP mode.

Presentation

Numerical controllers for 5 axis machines equipped with special heads, often need to perform special axis transformations to suit the particular machine's structure. Already available on NUM 760 CNCs, these transformations have seen important evolutions on the NUM 1060 range.

NUM offer

CN function	NUM 1060 < G version	NUM 1060 G version	NUM 1060 J version
Inclined plane	integrated since F version: G24	integrated: G24	integrated: G24
RTCP	dynamic operators macro	integrated: G26	integrated: G26
N/M AUTO	2/3 AUTO and 3/5 AUTO dynamic operators	integrated by the E912xx parameters	integrated by the E912xx parameters
Axes control RTCP + 3/5 AUTO	travel control by software limits	STOP generated by axes travel limits P17	half acceleration of master axes + speed modulation of slave axes
Axes control in handwheel JOG mode	travel limits control		speeds and accelerations control accelerations

Commercial references

CNC function	Commercial references
"inclined plane"	xx914 includes APP_TOOL (disk ref. 229203577B)
RTCP	xx154 includes APP_TOOL
N/M AUTO	xx082 necessity of LADDER language
Handwheel inputs	xx209 maximum of4

APP_TOOL is a PC based commissioning aid allowing the customisation of the desired transformation function (inclined plane, axis coupling or RTCP) according to the cinematic structure of the machine and its associated head.

Axis moves with the handwheel

Speed and acceleration

The cancellation of following error with High Speed Machining could introduce some instability when the axis was controlled from a handwheel. Now, the speed is restricted to the maximum value of the axis eventually driven.

Changes to the handwheel speed management

This algorithm allows a deceleration at constant value and at constant gain. It is used in JOG mode as well as in N/M AUTO mode.

Taking into account several handwheels on the same axis

Possible accumulation of several handwheel increments directed to the same axis. For example: AFMAN1=0(%W1A.B) and AFMAN2=0(%W1B.B) will link two handwheels to the axis with address @0

Taking into account of feed stop signal per axis

Actions on the handwheel (or the jog controls) are ignored as long as the corresponding bit of %W3A.L is set. (N/M AUTO pays no regard to the axes to be eventually driven.)

Possibility of axis commands on diameter

The fourth byte (N3) of machine parameter P4, defines if diameter commands are to be made in incremental JOG and handwheel (including N/M AUTO) for the X or U axes of each group.

Different MULT/DIV for rotary axes

Eight extra words have been created in P13, (from N10 to N17) for different mult/div values, when the handwheel is controlling a rotary axis. For example, N10 and N11 will be the mult/div for handwheel 0, when it is controlling a rotary axis.

Miscellaneous

Only the handwheels declared in P14 are taken into account. The divisors declared in P13 must not be zero, otherwise the corresponding handwheel is not usable. Soft travels are now handled internally (not by the PLC) if the inclined plane function is active.

Movement in N/M AUTO

Definitions

N/M AUTO means that N axes out of a total of M, are controlled in MANUAL mode while the others are controlled by the part program. In practise, 2/3 AUTO and 3/5 AUTO are the most commonly used configurations.
2/3 AUTO allows the command of the tool axis (generally Z) by the handwheel with X and Y under program control.
3/5 AUTO allows manual control of the tool position when it is mounted on a swivelling spindle, such as a ”twist” head or a universal head, in order to optimise the cutting conditions during machining. This function must be integrated into the RTCP function.

The RTCP (Rotating Tool Centre Point) function corrects the position of the main linear axes (those under program control) while the spindle head is orientated by the rotary axes (so called master axes), either from the part

program (5 axis program) or manually (3 axis program with 3/5 AUTO active), in order that the position of the tool centre is maintained relative to the piece part.

Evolutions in RTCP + 3/5 AUTO mode

While RTCP is active, master axis speed changes are limited to half maximum acceleration, in order to avoid possible over-accelerations on driven axes.

Limitation of interpolation speeds

In order to avoid over-accelerations on driven axes, the maximum interpolation speeds can be limited by external parameters, E7n101. These should be included in the 3/5 AUTO activation macro, as in the following example :-

- Enabling the 3/5 AUTO function
  E91207=1 E91208=1 (axes 7 and 8 in manual)
  E70101=70 E71101=70 E72101=70 (70% speed limit)
- Disabling the 3/5 AUTO function
  E91207=0 E91208=0 (axes 7 and 8 in auto)
  E70101=100 E71101=100 E72101=100 (100% of P30)

Pracical information

Part program access to the 5 axis function set up parameters.

External parameters	Designation	<==> UT 05	Unit	Access	Software version
E11017	Enabling status of inclined plane function G24 function		0,1	L	G
E11018	Enabling status of RTCP function G26+ function		0,1	L	G
E7n000	Position reference that could be transformed by G24 or G26 functions		µm	L	F
E7n100	Position reference not transformed by G24 or G26 functions		µm	L	F
E7n101	Modulation of a logical axis interpolation limitation		from 0 to 100%	L / E	J
E912xx	Declaration of a not interpolated axis for the manual command by N/M AUTO function		0,1	L / E	G
E970xx	Maximum axis speed	P30	mm/min deg;/min	L	<G
E971xx and E972xx	Axis acceleration in working speed and axis deceleration in rapid speed	P32	mm/s^2 $deg./s^2$	L	<G

The software version correspond to that for which the external parameter was created.

Documentation

938935: integration tool for inclined plane and axis coupling
938936: integration tool for RTCP function
938872: Supplementary programming manual
(description of functions for coordinates transformation, RTCP, N/M AUTO)

Spindle control

Advantages :

Various functions cover many new situations using spindles, to provide more flexibility with parametised programming and save on machining cycle time.

Products:
NUM 1020 - 1040 - 1060
Version or reference:
Software index J
Field:
Programming
Persons concerned:
Programmer
Other persons:
OEM
Evolution
Reference : ***PR6***

Axis / spindle switching by parametised programming

This function allows the linking of a measurement feedback (axis or spindle) to the drive reference output of another address via the part program. That's the case for example, when the same motor is alternately used as a C axis and a spindle, but using separate encoder feedbacks.

Programming the E942xx external parameter (read/write) :

- E942xx = yy means that the drive reference, xx is to be linked to the yy measurement feedback (axis or spindle).
- xx = physical address of the spindle or axis motor's output reference
- yy = physical address of the measurement feedback

"error 92" is generated if the addresses xx and/or yy are not recognised.

caution : this association is inefficient on DISC axes
the E942xx parameters remain unchanged through an NC RESET

ISO programming of spindle speeds beyond 60 000 RPM

From now on, it is possible to programme the S address from 10 to 600,000 rpm for high speed spindles, especially for High Speed Machining, after defining it in the m/c parameters.
Setting bit 6 of words 1 to 4 in machine parameter P6, will dictate that other declarations of spindle related machine parameters shall be expressed in tens of rpm and declarations of acceleration parameters shall be express in tens of degrees/s2.

The concerned machine parameters are :

- P46 to P49 : spindle speed ranges
- P45: gains expressed in rpm/rev
- P43: spindle indexing speed threashold
- P32: acceleration

Caution : the maximum measurement feedback stays at 32768 increments per sample. For example: if P50 = 5000 and P40 = 4096, the maximum speed is equal to (32768/4096) * 60000/5 = 96000 rpm.

M19 Servo Spindle Indexing In "BACKGROUND"

Using the "after" M code function, M19, axis motion in the same block will be executed before the spindle is indexed.
This is the usual sequence :

- X10 Y20 M19 executes the movement X10 Y20 and then indexes the spindle.

In order to save time, it is now possible to perform the indexing operation during the axis motion.
It is sufficient to couple M19 to %11019 in machine parameter P35.

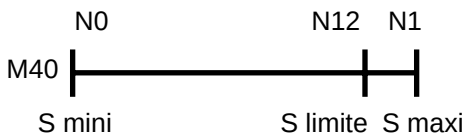
Spindle speed changes without controlling acceleration

For cycle time reasons, the spindle can now be started or stopped instantaneously without acceleration management :

- either by defining a zero value for the spindle acceleration / deceleration machine parameter, (P32, words 48, 50, 52, 54 respectively for spindles 0, 1, 2, 3).
- or by setting the appropriate E9033b parameter to zero, (where b = the spindle number).

Caution: don't forget that a spindle without acceleration control, cannot also be declared as having constant indexing acceleration (see bit 5 of machine parameter P6, words 1 to 4).

Spindle range detection



When a spindle is declared "servo controlled", it is necessary to declare the maximum program speed for a 9 volt output signal, as it is also done for an axis. It is necessary to take this into account in defining the laws governing multiple speed ranges.
Henceforth, in addition to the maximum speed in each range, (as defined by the old P46, P47, P48, P49 parameters), there is also a nominal speed ceiling in each range, via new words, N12 to N17.

The nominal speed ceiling must be less than or equal to the maximum speed in the range.
If it's value is 0, (the default value), the ceiling will be taken as the maximum value in the range.

Caution:
When the programmed S lies between the ceiling S and the maximum S :

- if the speed range is defined in the program, then error 29.
- if the speed range is undefined and automatic range search is authorised, then a range compatible with the demanded speed will be selected.

Setting bit 7 of word 0 in P7, inhibits automatic range searches.
Programming a range whose a maximum speed is 0, will generate error 29.

Spindle speed control

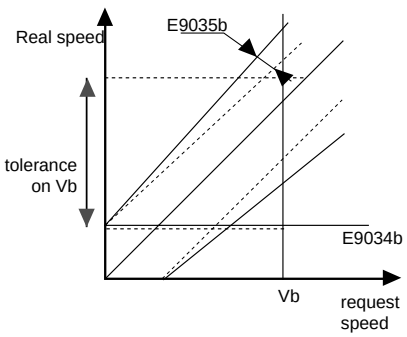
Creation of new flags, in the NC - PLC exchange area :

- Spindle "AT SPEED" : %R12.0 to %R12.3 (spindles 0 to 3)
- Spindle "STATIONARY" : %R12.4 to %R12.7 (spindle 0 to 3)

These flags help the PLC manage a servo spindle during the accel/decelleration phases or when indexing the spindle.
It is necessary to set suitable speed threshold values (via part program parameters). The control can then detect that the spindle is "at speed" by checking if the real speed is within the requested speed's tolerance band, and also detect that the spindle is "stopped" if its speed is less than the minimum threshold declared.

The **E9034b** parameter defines the speed threshold, under which, the spindle is considered stopped.
This parameter is expressed in rpm and is initialised to a default value of 10 during the power up stage. (It is also defines the initial band value for the spindle ”at speed” caculation.)

The **E9035b** parameter is the coefficient used in the ”at speed” threashold calculation. The parameter is expressed in 1/256 and is initialised to a default value of 13 during the power up stage. (This equates to 5%.) The letter b indicates the spindle number, (from 0 to 3).



ISO programming / G104 : smoothing points in space

Advantages:

This feature transforms a trajectory defined by a simple set of points, into a polynomial curved trajectory in space.

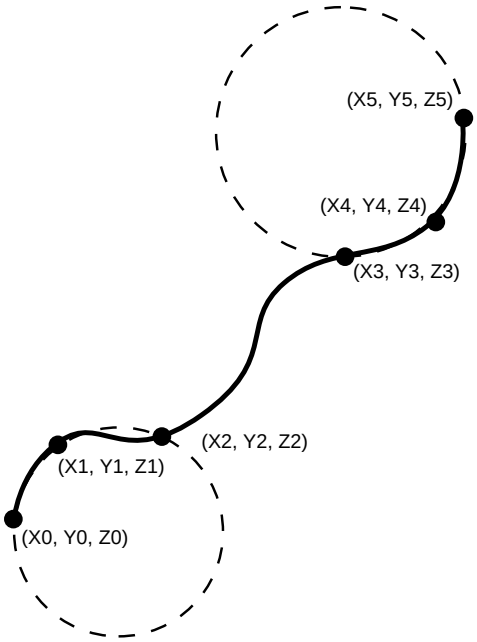
Products:
NUM 1020 - 1040 - 1060
Version or reference:
Software index J
Field:
Axes servoing
Persons concerned:
ISO programmer
New
Reference : ***PR7***

Presentation

The programing of free curves in space meets such difficulties as :
- calculating the polynomial order of the curve
- calculating the tangent values at each end of the spline curve.

These difficulties appear most notably, on machines programmed by teaching methods, such as when copying from a master model. Here, the trajectory smoothing function can give an easy and practical solution, avoiding all the aforementioned mathematical definitions.

Programing Example :




```
%123
......
X0 Y0 Z0
G104 X1 Y1 Z1
X2 Y2 Z2
X3 Y3 Z3
X4 Y4 Z4
G80 X5 Y5 Z5
......
M2
```

The point (X0, Y0, Z0) must be defined before calling theG104 function.
The point (X5, Y5, Z5) must be included in the G80 block.

This function automatically achieves polynomial interpolation between the points defined in space by X,Y,Z. At either extremity, the trajectory is calculated from a tangent passing through the three end points.

The point definition blocks can also contain M codes, or calculations with E or L parameters.

Execution

The G104 function is directly interpreted without preliminary calculations. The number of points is not therfore limited. There is no axis hesitation at the extremities of the curve. G104 can be executed in any CNC mode, (particuliary useful in search mode in order to execute only part of the curve).
These features should make it preferrable to those of the old spline curve function.

Application

Obviously, the points can be defined by a teaching programing. This feature is particulary well suited to applications which use continuous processes, such as electric welding, glue laying, laser cutting, etc.
This function should prove indispensible for a ”general purpose” machine working in space, because it is an universal solution for axis motion programming.

Supply

This option is a macro program written in ISO code, delivered on a floppy disk. This macro must be loaded into the protected area. (option 81706 available on NUM 1060M and NUM 1040GP).

Program display in graphic mode

Advantages:

Now it's possible to display a program defined by a 5 digits number (before the point) and sub-programs called by M functions.

Products:
NUM 1020 - 1040 - 1060
Version or reference:
Software index J
Field:
Programming
Persons concerned:
Programmer
Evolution
Reference : ***PR8***

Programmes defined by a 5 digits number

Sub-programs %10100 to %10199 (called by G functions G100 to G199 respectively) are primarily concerned with this evolution. (See NUM1060 supplementary programming manual - chapter 5). They can now be executed directly.
This evolution allows the graphic trace of some of NUM's internal macros, specifically those macros (G25x) used to help in setting up the High Speed Machining parameters.

Sub-programs called by M function

In MULTIGROUP systems, sub-programs called by an M function must now be defined in P35 with an index. The index must be less than (or equal to) the number of groups.

ISO programming of tool numbers, T

Advantages:

The tool number T can now be defined by an 8 digits number (instead of 5) .

Products:
NUM 1020 - 1040 - 1060
Version or reference:
Software index J
Field:
Programming
Persons concerned:
Programmer
Evolution
Reference : ***PR9***

Presentation

In this way, the tool address can support many applications in which tool numbering needs to be extend. (For example, to indicate additional data asociated with specific tools.) The T address can also support additional data, completely independent of the notion of tooling, because the address value is transmitted directly to the PLC.

Caution : a DNC1000 request for the tool number will still only return the least significant word, which can only cover 5 digits.

Products:

NUM 1020 - 1040 - 1060

Version or reference:

Software index J

Field:

Programming

Persons concerned:

Programmer

Evolution

Reference : ***PR10***

ISO programming / G77

Advantages:

The new " G77 - i " syntax, can access blocks in the calling program(s).

In the following example, the circled number indicates the execution sequence.

	%1 (main program)	❷ ⇨	%10 (Sub-program)
	…	❸ ⇨	…
❶ ⇨	N3 G77 H10	❹ ⇨	N30 G77-1
❺ ⇨	N4 G1 X.Y.	❻ ⇨	N40 …
❽ ⇨	N5 …	❼ ⇨	N50 …

This operation can be executed though several program nesting levels. The " i " value, which can be an immediate value or a variable, defines the difference in nesting level between the current program and the one to be called. This function finds it's use in the creation of special G codes (G100 to G199) and the subprograms they call (%10100 to %10199). For example, to apply different G functions to a single motion block, or simply to analyse the different G functions of a user program, without executing them. (See NUM1060 supplementary programming manual - chapter 5).

Products:

NUM 1020 - 1040 - 1060

Version or reference:

Software index J

Field:

Programming

Persons concerned:

Programmer

Evolution

Reference : ***PR11***

Parametric ISO programming / declaring axes with clamps

Advantages:

An axis can be declared " with " or " without " clamps by programming the parameter E9130x (where x is the physical address of the axis).

This extension to ISO programming capabilities is in response to complex machining situations (such as changing a machining head) which needs some modification to the original machine builder's configuration, without loosing time.

E9130x = 1 ⇨ axis x with clamps

E9130x = 0 ⇨ axis x without clamp

Caution: after an NC RESET the various axes return to the values declared in machine parameter P8.

The list of axes with clamps is transmitted to the PLC in %R24.L

ISO programmation / $

Advantages:

The programming of messages by the "$ message" function is extended to communicate with the integrated PC board, for user applications.

Products:
NUM 1020 - 1040 - 1060
Version or reference:
Software index J and PNC index C3
Field:
Programming
Persons concerned:
Programmer
Evolution
Reference : ***PR12***

Introducing

The "$9 message" syntax can send a message to a user application on the PC board directly from an ISO part program, without stopping the program's progress.
The message is transmitted by the UNSOLICITED DATA process within the DNC1000 internal protocol.

A "$91 message" syntax will suspend the program's progress until an acknowledgement request (segment 226) is returned from the PC application (with or without cyclic re-transmission).

The "$" instruction is used generally as a direct communication function :

- for displaying on the CNC screen : "$0",
- for an exchange with the PLC program : " $1 ",
- for an exchange with a NETWORK station (UNITELWAY-MAPWAY-ETHWAY) : "$2", "$3", "$4",
- for an exchange with a serial line, without protocol : "$5", "$6",

Thus, for the programmer, the intermediate resources connected to the system become transparent.

PLC / control of saved variables

Advantages:

On power up, if the saved variables CHECKSUM is incorrect, the PLC is stopped and the machine is inhibited.

Products:
NUM 1020 - 1040 - 1060
Version or reference:
Software index J
Field:
Automatism
Persons concerned:
Operator (for maintenance)
Evolution
Reference : ***PR13***

This function gives a good level of security for an installation. It detects any data changes due to the hardware failures or to external influences.

During power up, the system re-calculates the CHECKSUM (%M0 ‡ %M77FF) and compares it with that calculated during the previous period. If they are different, the PLC is stopped:

- the fault LED is ON
- on entry into UTILITY 7, the message "ERRONEOUS SAVED VARIABLE CHECKSUM" is displayed. The operator can either acknowledge the message without modification, or RESET all the saved variables.

Products:

NUM 1020 - 1040 - 1060

Version or reference:

Software index J

Field:

Automatism

Persons concerned:

Integrator

Evolution

Reference : ***PR14***

PLC / CNC Exchanges

Advantages:

The PLC can authorise " motion " for each axis independently.

By writing to %W3A.L (each bit reflecting the physical address of an axis,) the PLC can now control the feed stop demands on a per axis basis, whereas before it was per group.
This function is useful for some functions of PLC machine supervision such as "anti-collision".

Effect of setting these bits:

- **In machining mode or JOG:**
  - if the axis is already in motion
    ⇨ stop all axis motion in the group
  - if the axis is not present in this block but is in the next
    ⇨ stop all motion at the end of the block and wait till the bit is reset
  - if the axis is not in this block nor in the next
    ⇨ the program continues normally until the previous situation is encountered

- **When using the N/M AUTO function**

The actions on the jog controls or on the handwheel are ignored while the corresponding bit of the axis directly controlled is set at a 1 in %W3A.L.

caution: it doesn't take into account axes moved indirectly, for example when using the RTCP function.

Products:

NUM 1020 - 1040 - 1060

Version or reference:

Software index J

Field:

Automatism

Persons concerned:

EOM

Evolution

Reference : ***PR15***

Ladder language / general purpose functions Binary <--> BCD

Advantages:

These conversion functions make the treatment of numerical data easier.

The transformations are; BINARY -> BCD with the BIN-BCD function, and the opposite; BCD -> BINARY with the BCD-BIN function, on 8, 16 or 32 bits operands.

Mode selection by DNC1000

Advantages:

The UNI-TE " mode selection " request, can now demand an NC MODE change without repeating the exchange.

Products:
NUM 1020 - 1040 - 1060
Version or reference:
Software index J
Field:
Automatism and industrial informatic on PC board
Persons concerned:
OEM
Evolution
Reference : ***PR16***

The (WORD length) object, associated with the "write object" request (as applied to the 180 segment) can now indicate, in addition to the numerical code of the new MODE (which only requires the 4 least significant bits), a "maintained" mode change request, simply by setting the word's most significant bit.

If the most significant bit is 0, the demand will be refused if it cannot be done immediately (error 26). A refused demand must then be repeated.

This feature can be applied as a "customer function" developed in the PLC, or on a PCNC.

PC TOOL KIT

Summary :

Development aid, for communication applications, either on an external PC or a NUM PCNC.

Products:
NUM 1020 - 1040 - 1060
Version or reference:
Software index J
Field:
Industrial data processing and automation
Persons concerned:
Integrator
Evolution
Reference : ***PR17***

NUM PC Tool Kit Presentation

PC TOOL KIT allows the rapid development of PC based applications that need to communicate with a NUM 10x0 control system. These applications can be easily switched between the following configurations:

- PCNC 1060 SI and SII
  - under OS/2
  - in a WINDOWS session of OS/2 (WIN-OS/2).
  - in a DOS session of OS/2 (DOS-OS/2).
- External PC connected to a NUM system
  - under WINDOWS.
- CNC 10x0
  - in the PLC (for applications written in C language).

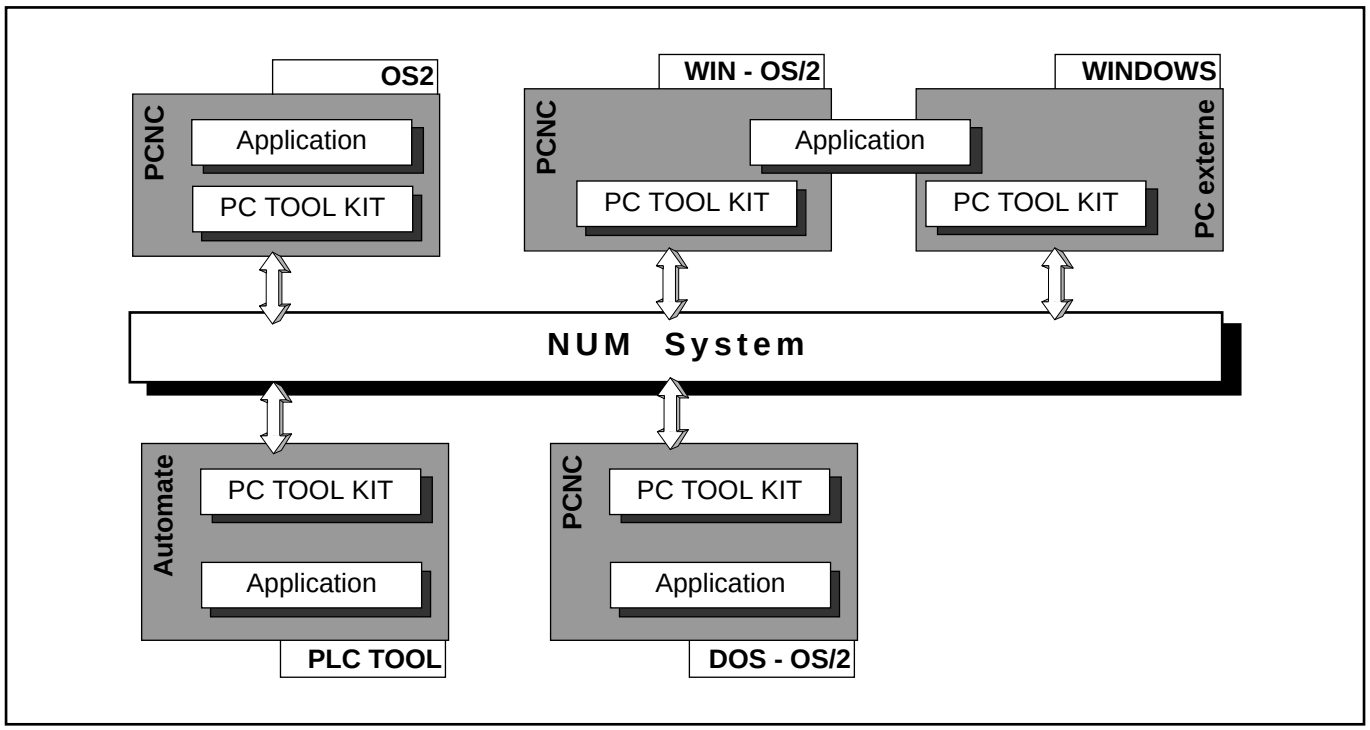
A WINDOWS application can be transported from an externally executing PC solution to a PCNC solution, without recompilation.

The PC TOOL KIT also offers an easy transportation method between WINDOWS and OS/2 via a source recompilation.

It provides access to most NC objects:

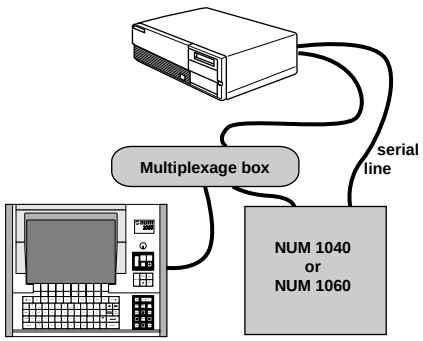
- can transfer all system files (part programs, utilities, PLC).
- tool offsets, axis positions, speeds, NC variables, ...
- PLC variables and the NC/PLC exchange area.

In essence, it makes the exchange mechanisms, (controlling access to these data stuctures,) completely transparent.



Principle.

This overview shows the different development environments that accept TOOL KIT components.



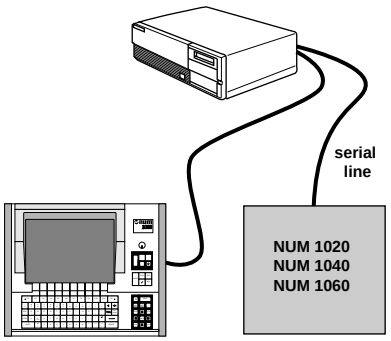
Hardware configurations.

a) NUM 1040/1060, 14 inch colour panel, multiplexer, external PC (without screen).

This configuration can switch, (by a combination of key presses on the NUM panel) between the conventional NUM NC dialogue, and another, as defined by the PC application.

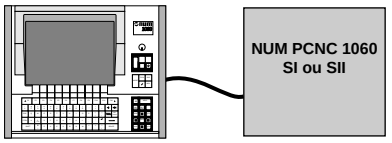
b) NUM 1020/1040/1060, 14 inch colour panel, external PC (without screen).

In this configuration, the PC application takes total charge of the man machine interface.



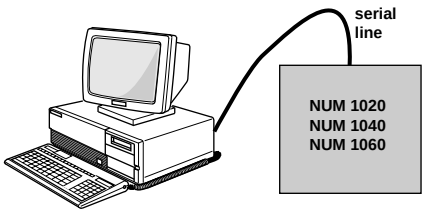
c) PCNC 1060 SI or SII, 14 inch colour panel.

This configuration allows the rapid exchange of data between the PC application and the NC. The conventional NUM NC dialog is accessible as well as that embedded in the PC application.



d) 1020, 1040, 1060, PC external.

This configuration allows all the PC configurations on the market. (Extension boards, high resolution graphic cards, ...)



Remote loading.

This product will soon be available on NUM SA's Paris based server.

Installation.

Start SETUP.EXE from the WINDOWS file manager and choose the directory where you want to install the TOOL KIT.
Some simple examples and some utilities are directly executable from WINDOWS program manager.

Supply.

This product includes:

- dynamic libraries to access the NUM objects (WINDOWS and OS/2).
- static libraries (PCNC under an OS/2 DOS session).
- static libraries for C language in the PLC (MICROTEC compiler).
- access templates for C language and VISUAL BASIC functions.
- hyper-text help document, for use with the functions.
- many varied working examples, provided with source files.
- an illustrative example of the NUM utilities.

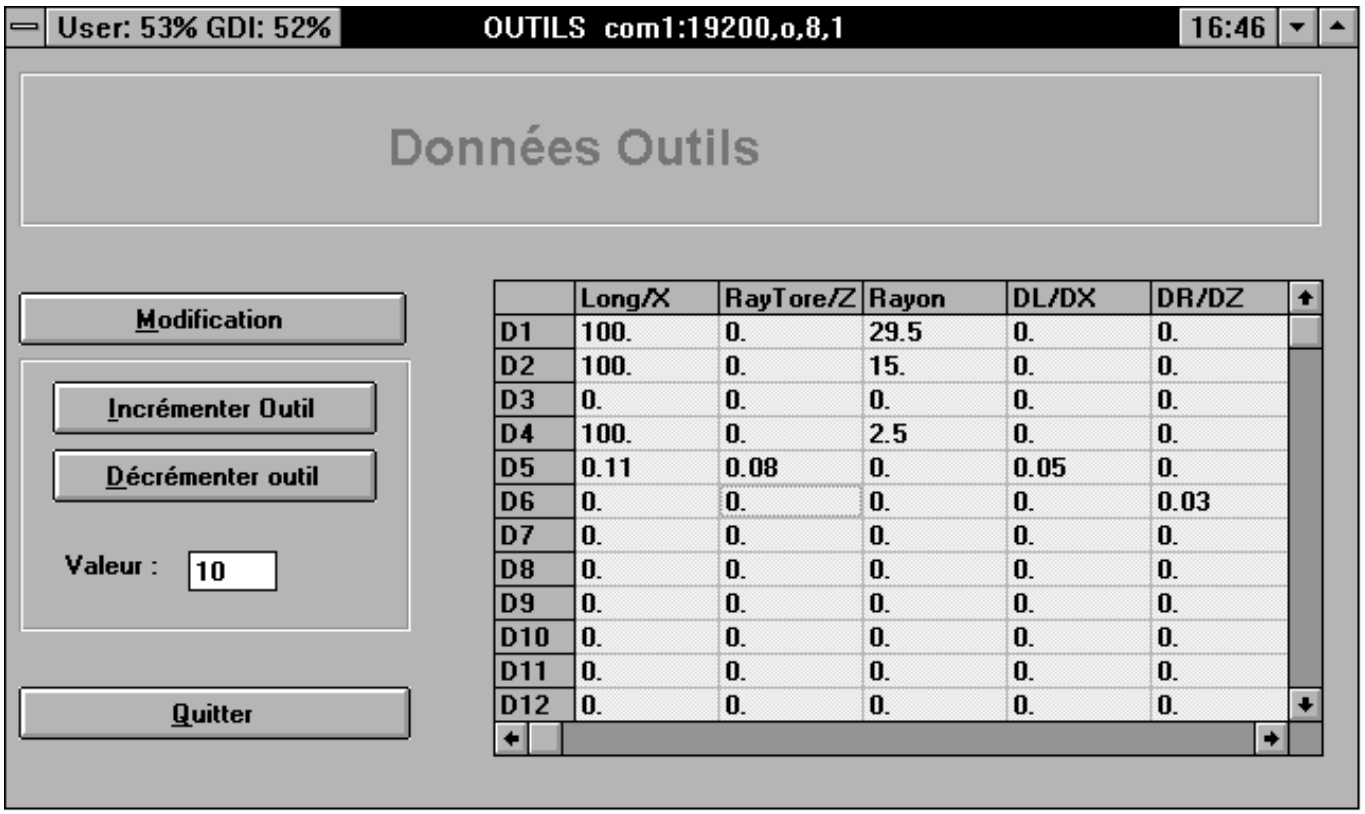
Necessary option.

The use of NUM Tool Kit based applications on an external PC, requires commercial option xx939 on the numerical control.

Documentation.

The product includes a help file, describing the principles and functions in the Tool Kit's libraries.

NUM Tool Kit example



This example demonstrates read/write access to the tool data. In particular, it uses the following functions:

Open_Unite()
: open the communication driver.

Get_Port(port)
: get a free port to work with.

ReadTool(Port, Number, Quantity, pData, Mode).
: read tool data.

WriteTool(Port, Number, Quantity, pData, Mode).
: write tool data.

Free_Port(port)
: free the port when the job is finished.

Close_Unite()
: close the communication driver.

PCNC version 2

Advantages:

PCNC V2, Port PCMCIA, OS/2 WARP, Server function, Modification of LIB_UNIT.DLL. The PCNC is more open and more powerful.

Products:

NUM 1020 - 1040 - 1060

Version or reference:

Software version J and PC version C3

Field:

Industrial data processing and automation

Persons concerned:

Integrator

Evolution

Reference : ***PR18***

PCNC VERSION 2, PORT PCMCIA.

The PCNC version 2 offers new hardware and software possibilities:

- on the front panel, a new 37 pin plug allows the connection of a floppy disk drive.
- 486 DX2 66 processor.
- 270 Mb hard disk.
- an optional PCMCIA port, (type 1 and 2 comptible).
- the operating system is OS/2 WARP.

Modification of LIB_UNIT.DLL.

To stay compatible with PLC_TOOL, the PC Tool Kit's dynamic link library (LIB_UNIT.DLL under OS/2) has been split into two parts:

- LIB_UNIT.DLL, containing only low level functions.
- DNC.DLL, NC object access library.

Old applications must be re-linked to use the new libraries.

Server function

A NUM application called SERVER, has been created to communicate with the PCNC. It allows either the PLC or a part program to send messages directly to a PCNC application.
The PLC can have read/write access to files in a specific PCNC directory.
The PLC can:

- deleate a disk file (Delete_File).
- read the available memory on the hard disk (Read_Mem_Free).
- create a file on the disk (Open_Download_Sequence, Write_Download_ Sequence, Close_Download_ Sequence).
- read a file, or list of filenames, in the specific directory (Open_Upload_ Sequence, Read_Upload_Segment, Close_Upload_ Sequence).
- send a message to a PCNC application (Unsollicited Data).
- minimize the NUM application.
- restoration of NUM application.
- prohibit/authorise access to the OS/2 desktop, as well as to quit the NUM application.
- system shutdown (SHUTDOWN).
- run a specified NUM_CLIENT application.

A part program can:

- send a message to a PCNC application (Unsolicited Data), via functions $9 and $91. These functions are also described earlier under the heading "programming ISO/$".

Option needed

The use of these requests from the PLC implies commercial option number xx112 (DNC1000).

Products:

NUM 1020 - 1040 - 1060

Version or reference:

Software index J

Field:

Industrial data processing and automation.

Persons concerned:

Integrator

New

Reference : ***PR19***

UNI-TE 2.0 protocol upgrade

Advantages:

UNI-TE version 2.0 considerably improves the capabilities of applications made for the PLC, the PC card or externally connected PCs

UNI-TE requests in the original version 1.0

This section lists the objects accessible to systems before s/w version J. Objects are accessible for read (R), for write (W), or read/write (R/W). They are:

Current part program (R/W)
Current NC Mode (R/W)
Servo controlled axes (R)
Spindle speed (R)
Spindle position (R)
H variables (R/W)
HOMED axes (R/W)
E80000, E81000, E82000, E30000, E40000 (R/W)
Decoded M functions (R)
Axis inclination (R/W)
Machine origin (R/W)
Axis travel limits E7x002 and E7x003 (R/W)
Axis correction E950xx (R/W)
Axis position demand E7x000 (R)
Axis position feedback E900xx (R)
DAT1, E6x000 (R/W)
DAT2, E6x001 (R/W)
DAT3, E6x004 (R/W)
Distance to go, in the current block (R)
Active G functions, program or sub program number in execution, block number, error number, active tool corrector (R)
Programmed feed and override (R)
Tooling data (R/W)
PLC variables (R/W)
Available part programming memory (R)
List of part programs (R)
Part program delete (W)
Transfer a part program from NC RAM to PC (R)
Transfer a part program from PC to NC RAM (W)
Transfer a file from the system to PC (R)
Transfer a file from PC to the system (W)
Drip feed mode (W)
Part program block (R/W)
Rename a part program (W)
Delete an NC/PLC file (W)
System Identification (R)
PLC initialisation (W)
PLC stop (W)
PLC start (W)
NC reset (W)
NC cycle hold (W)
NC cycle start (W)

UNI-TE requests in the new version 2.0

This version introduces a new type of request (READ_OBJECT_LIST and WRITE_OBJECT_LIST), allowing object access to:

Address equivalence table (R)
Program variables (R)
Current part program nesting level (R)
Sub program tree (R)
Active G functions (R)
Active M functions (R)
Programmed end point/program ref. (R)
Circle centre (R)
Tool orientation in space (R)
Programmed spindle speed (R)
Programmed acceleration (R)
Angular shift (R)
Multigroup synch. flags (R)
Mirrored axes (R)
External Parameters (R)
Current axis positions /program ref. (R)
Current axis positions /machine ref. (R)
Current coupled axis positions (R)

Current block (R)
List of physical axes (R)
NC type (R/W)
Dialogue with modes (W)
Change a part program name and its comment (W)

Documentation

NUM1060 Installation and commissioning manual 938816/4
NUM1020/1040 Installation and commissioning manual 938938/1

Axis connection module

Advantages:

To make wiring easier, an axis connection module has been developed for use with the new (absolute encoder compatible) axis boards.

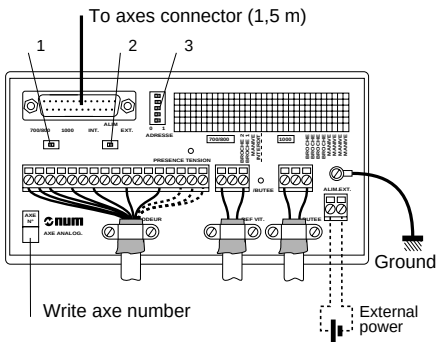
Products:
NUM 1020 - 1040 - 1060
Version or reference:
commercial ref. 80089
Field:
Installation
Persons concerned:
OEM
New
Reference : ***PR20***

This module splits the axis card connection cable, allowing for separate connections to :

- the drive reference
- the encoder feedback
- the home switch

It makes wiring the servo-controls much easier, in as much as a ready made 1,5m cable is also supplied with this module for final connection to the axis card.

A row of five switches (see position 3) makes it very easy to set the axis address.
This offer can also be used with standard incremental encoders as well as absolute SSI encoders.



Documentation :

NUM1060 Installation and commissioning manual 938816/4
NUM1020/1040 Installation and commissioning manual 938938/1

Products:

NUM 1020 - 1040 - 1060

Version or reference:

commercial reference CONN1xxD/G00

Field:

Commercial offer

Evolution

Reference : ***PR21***

Motor connector upgrade

Advantages:

Since January 96 the connectors have been defined separately from the motor reference.

NUM DRIVE offers and orders, for BMH, BMG, IM and AMS motors must now, nearly always, indicate the CONNECTOR REFERENCE.

These new references are : **CONN1xxD/G00**

Caution: The supply of cables equipped with connectors for **BMHQ10Mxx and 5FMxxMyy** are not concerned, in as much as they have already got the new references. ie. an offer with equipped cables will not change.

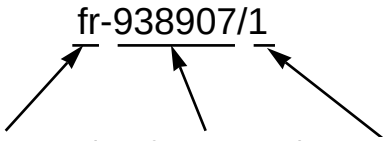
Documentation

938919/1: NUM DRIVE catalogue reference (page 3-6)
938920/0: next release of the DISC catalogue.

Reminder: before, motors ordered with connectors didn't need separate references for the connectors.

Status of our NUM 1000 CNC manuals

How to decode the manual's references



language code, manual's reference number, revision number.

Language (ISO 639): **fr** = French, **en** = English, **de** = German, **it** = Italian, **es** = Spanish, **ne** = Dutch
cf / CN conforms to the CNC software version described
cf / tool conforms to the PC software version described

N.B. : cf / CN and cf / tool are indicate for the french version of the manual.

The following tables show the version of the manuals available in each language and also the corresponding software version, if relevant.

Standard integration *Reference* **: Prat 1**

Designation	Reference	fr	cf / CN	cf / tool	en	de	it	es
Material and parameters								
Installation and commissioning NUM 1060	938816	4			3	3	1	0
UCSII central unit (integrated to 938816/4)	938922	1			1			
64E/48S board integration (integrated to 938816/4)	938915	0			0			
Input / output module	938954	0						
PC module	938928	0			0			
DISC integration manual	938907	1	F2		1	1		
SET TOOL	938924	1	F2	D	0	0		
Installation and commissioning NUM 1020/1040	938938	1	J	D	1	1	1	1
Parameters	938818	5	G		5	5	5	1
Automatism								
Machine processor programming Ladder langage (and C langage)	938846	6	H		5+	5	1	
PLC TOOL	938859	2	G	D	2	0		
Machine processor programming (assembler language UT6type)	938817	4	G		4	2	2	2
APA10	938753	C	G	D	C	C	C	B
Supplementary UT6 Programming manual - Ladder language (760 type)	938905	2	H		2			
PLC UT7	938906	1	G	D	1	0		

Standart integration — *Reference*: Prat 1

Designation	Reference	fr	cf / CN	cf / tool	en	de	it	es
Machine option								
Two spindle synchronisation manual	938854	1	A					
Duplicated and synchronised axes manual	938875	0	E		0			
Integration tool RTCP function	938936	0	G		0			
Integration tool for inclined plan and axes affectation	938935	0	F		0	0		
Products complements								
CNC*PLUS* installation manual	938934	1	G		0	0	1	
DIDACNUM	938926	0			0			
Cylindrical grinding commissioning manual	938929	1	H					

Supplementary integration — *Reference*: Prat 2

Designation	Reference	fr	cf / CN	cf / tool	en	de	it	es
PROCAM - description language	938904	0	B		0			
Dynamic operators manual	938871	0	E		0			
Supplementary programming manual (in ISO : structured, symbolic, G function calls,…)	938872	1	F		1	1	1	

Exteranal communication — *Reference*: Prat 3

Designation	Reference	fr	cf / CN	cf / tool	en	de	it	es
DNC1	938923	0	F		0	0		
UNI-TE -protocol commissioning	938914	0	E		0	0		
UNI-TELWAY	938880	1	E		1			

Operator — *Reference*: Prat 3

Designation	Reference	fr	cf / CN	cf / tool	en	de	it	es	ne
Operator NUM 10X0 M - W	938821	1+	G		1+	1	1	0	
Operator NUM 10X0 T	938822	1+	G		1	1	1	0	1
CNC*plus* user's manual Operator et programmer)	938933	1	G		0	1			

Programmer — *Reference*: Prat 4

Designation	Reference	fr	cf / CN	cf / tool	en	de	it	es	ne
PROFIL function user's manual	938937	0	F		0	0			
Milling and woodworking									
Programming NUM 10X0 M - W (ISO language)	938819	4	J		3	3	3	0	
PROCAM MILL interactive programming manual NUM 10X0 M	938873	0	A		0	0	0	0	
Turning									
Programming NUM 10X0 T (ISO language)	938820	4	J		3	3	3	0	3
PROCAM TURN interactive programming NUM 10X0 T	938874	0	A		0	0			
Grinding									
Cylindrical grinding programming manual NUM 1060G	938830	1	H		0	x	0		
PROCAM GRIND interactive programming manual NUM 1060 G	938831	0	H		0	x	0		
Surface grinding programming manual NUM 10X0 GS	938945	0	H		x				
PROCAM GRIND interactive manual NUM 10X0 GS	938953	0	H		x	x	x		
Gear cutting and grinding									
Gear cutting and grinding manual NUM 1060 H - HG (with integration)	938932	0	F		0	0	0		
Options									
Rigid tapping manual NUM 1060 (including integration)	93881	0	E						
Polygon machining NUM 1060 T	938952	x	B		x				
Probing cycles NUM 10X0 M	938948	0	E		0				
Probing cycles NUM 10X0 T	938947	0	E		0				
NUMAFORM	938678	A	A		A	A	A		

State of NUMDRIVE servo-motors manuals

Definition catalogues *Reference*: **Prat 5**

Designation	Reference	fr	en	de	it	es	ne
NUM DRIVE axes and spindle motors - drives	938919	1	0		0		
DISC motors - current amplifiers	938920	0	0				

Integration Manuals *Reference*: **Prat 6**

Manual = 738 X YYY / Z
With X = language F french, E english, T german, I italian, S swedish

Designation	Reference	F	E	T	I	S
PC SET LINK Instruction manual (UAC and MONODRIVE drives)	738001	B	B	B	B	
UAC DIGITAL SERVODRIVE Commissioning and maintenance manual	738003	C	C	B	C	
AC MONODRIVE	738006	D	D	D	D	D
MDLL - MDLP installation and handling manual (MDLA drives with MDLT100 tool)	738008	B	B		B	
NUM DRIVE - Parameter Monitor DPM (MDLA drives with tool on PC)	738011	A	A		A	

Notices

Windows 95* with PLC TOOL and SET TOOL

PLC TOOL, PLCUT7, and SET TOOL will not run on Windows 95* : a new version must be developed.

PLC TOOL and power management on portable PCs

The power management features of some portable PCs can give rise to serial communication problems. Generally, a power management configuration screen will allow serial data reception without activating the power management features. Failing this, power management should not be started in AUTOEXEC.BAT or CONFIG.SYS.

PLC TOOL and Compaq* PCs

Use of a 1024x768 pixel, 256 colour Qvision* card, (driver CPQHQV08.EXE on 15/03/95 with 206912 bytes) can lock up PLC TOOL's ladder editor : this is corrected with Compaq's 7.60a version of the driver.

** The names PC, Windows, Windows 95, OS/2, Compaq and Qvision are registrated marks of IBM, Microsoft, Compaq and Qvision.*

Numerical control OEM information (since October 95):

This table gives references and summaries of OEM information notes, provided with our product deliveries in the last quarter.

It shows the PERIOD during which the OEM information note will be attached to our deliveries and the reference manual which will eventually include the information contained in the note.

Number	Product	Designation	Summary	Period or manual
61	NUM 720	Modification of CNC - PLC process since H version	The M functions treatment has been change to optimize the cycle times containing many exchanges. This amelioration needs a PLC program modification.	Oct. 95 to Oct. 96
62	NUM 1060	Compact panel	Installation instructions	Dec. 95 to March 96
63	NUM 1020/1040	Compact panel	Installation instructions	Dec. 95 to March 96
Erratum	NUM 1020 /1040/1060	Erratum to OEM informations 62 - 63	Section 2 instruction de programmation Ladder	
64	NUM 1060	60W SAED power supply	Fiber-optic loop setting of this new power supply.	938816/4
66	NUM 1020 /1040/1060	Compact panel / 102 Keys standard PC keyboard	Characteristics needed for 102 keys PC keyboard	Dec. 95 to Feb.96

Training

SCHNEIDER TRAINING INSTITUTE (Paris- Cergy FRANCE)

New courses

- NPCNC - 3 days : Customisation of PCNC1060
- NDISC - 3 days : DISC integration

Courses for 1020 / 1040 CNCs

NOPER and NPROG (end user) courses and NEXPL- NMINT (integrator) courses, described in " TRAINING 1996 electrical distribution - industrial control " catalogue for 1060 Numerical Controls are already adapted for 1020/1040 Numerical Controls.
All courses needed for PLC programming are also concerned : NLAD1 - NLAD2 - NUMC1 - NUMC2.

For more information on all training courses,
please contact our Schneider Training Institute Phone : 33 (1) 30 75 32 00, for France.

Special courses

Do not forget that our technical departments (subsidiaries or application engineers in FRANCE) can propose a short training course, customised to your needs, in order to get practical and fast information or to complete your knowledge on specific functionalities.

For more information, please contact the salesman in your country or in your area .

Supply your machines with the new compact and economical products from NUM. Lock into NUM's 1020/1040 CNCs and the modular NUM DRIVE range.

NUM SA 21, avenue du Maréchal Foch, BP68, 95101 Argenteuil Cedex (France) - Téléphone : 33 (1) 34 23 66 66 - Telex : 609611 - Fax : 33 (1) 34 23 65 49 • AGENCES : Bordeaux, Lille, Limoges, Lyon, Metz, Mulhouse, Nantes, Rouen, St.-Etienne, Toulouse • FILIALES ET BUREAUX DE REPRÉSENTATION: **Allemagne** : NUM GÜTTINGER GmbH, Stuttgart/Ostfildern, Bielefeld, Chemnitz, Mechernich, Ratingen • **Autriche:** NUM GÜTTINGER AG, Linz/Marchtrenk • **Chine:** NUM SA, Beijing Office • **Espagne** : TELENUM SA, Irun • **Etats-Unis** : NUM CORPORATION, Chicago/Naperville • **Grande-Bretagne** : NUM SERVOMAC UK Ltd, Coventry • **Italie** : NUM SpA, Milan, Bologne, Padoue, Turin • **Suède** : NUM NORDEN AB, Västerås • **Suisse** : NUM GÜTTINGER AG, St.-Gall/Teufen, Bienne • **Taiwan** : NUM TAIWAN, Taichung / DISTRIBUTION ET SERVICE APRES-VENTE : **Afrique du Sud** : MACHINE TOOL TECHNOLOGIES, Jeppestown • **Algérie** : Société R.M.O., Alger • **Belgique** : SCHNEIDER MGTE, Bruxelles • **Danemark** : SCHNEIDER MGTE, Ballerup • **Finlande** : NUCOS OY, Helsinki, Tempere • **Inde** : SCHNEIDER ELECTRIC INDIA, New Delhi • **Japon** : GROUPE SCHNEIDER, Tokyo • **Norvège** : ELEKTROPROSESS A.S., Oslo • **Pologne** : SCHNEIDER ELECTRIC POLSKA, Varsovie • **Portugal** : SCHNEIDER AUTOMATISMOS INDUSTRIAIS, Lisbonne • **République Tchèque** : SCHNEIDER ELECTRIC, Písek • **Roumanie** : SCHNEIDER ELECTRIC, Bucarest • **Russie** : SCHNEIDER ELECTRIC, Moscou • **Thaïlande** : N.R. AUTOMATION, Bangkok • **Turquie** : SCHNEIDER ELEKTRIK SANAYI ve TICARET AS, Istanbul