GENERAL NUMERIC 11MA

General Numeric's 11MA Milling CNC features:

- **5 axes simultaneous**
- **Large part program (max 12,600 ft.)**
- **Polar coordinate program**
- **Rotation**
- **Scaling**
- **3D Cutter offset**
- **Graphic display**
- **In process/post process gauging capability**
- **Powerful custom macro**
- **DNC capability**

The 11MA is an advanced and highly sophisticated CNC for milling applications designed mainly for relatively large machines which produce complex workpieces. Inductosyn feedback is available for large size machines, without which acceptable accuracy would be difficult to obtain. A maximum 12,600 ft. tape (1.5 mega byte) part program memory is available to store complex part programs, custom macro programs, etc. The 11MA is a CNC which offers sufficient capability to meet today's demanding requirements in the area of large scale Factory Automation Systems (FAS). However, its programming and operation features are structured to be user friendly.

MOST ADVANCED TECHNOLOGIES

The 11MA employs a variety of advanced technologies. They include 8000 gate custom VLSIs, high-speed, 16/32 bit microprocessors, 4 mega bit/chip bubble memories and high-density EPROMs and static RAMs. These features provide outstanding reliability and allow for compact design. In addition, optical fiber connections between the main processor unit and the remote units such as the Manual Data Input MDI/CRT unit and the machine interface unit (Data In {DI}/DataOut {DO}) allow high-speed transmission of data with high-noise immunity. The 11MA is the first CNC in the world employing state-of-the-art optical fiber technology.

HIGH PERFORMANCE, HIGH PRODUCTIVITY

The 11MA is a high-performance CNC capable of controlling axes at a maximum traverse rate of 2400 IPM with a resolution of 0.0001 in. Thanks to a unique acceleration/deceleration control technique (optional), increased servo loop gain is possible, reducing contouring errors resulting from low servo loop gain. A resolution of 0.00001 in. is available as a basic feature for precision machining. Optionally, a fourth and fifth axis can be added for full milling and drilling machining center capabilities. In addition, four more axes can be added for auxiliary axes positioning, such as pallet changer, indexing heads, rotary tables and tool magazine.

FRIENDLY PROGRAMMING

The programming of the control can be accomplished by "direct" entry. That is, the values from a blueprint can be directly input to the part program. The following elements may be directly input:

- arc radius data
- start angle for multiple-lead theading (optional)
- inch per thread data (optional)
- machine position data
- absolute/incremental data
- feedrate data
- chamfer and corner radius insertion (optional)
- work surface speed data (optional)
- spindle speed data (optional)

FRIENDLY OPERATION

The 11MA has a CRT display with software defined keys as standard. The control utilizes these keys to assist the operator in the following ways:

- Full-time status displays
- Software defined keys with guidance messages
- Program directory display with 16 character ID
- CRT display with intensity control to highlight operation status
- Full-time diagnostics with clear messages
- Dynamic display of ladder diagram
- Program edition for characters, words, blocks and multi-blocks

FOREGROUND AND BACKGROUND OPERATION

The 11MA offers the capability of "background editing" as a basic feature. This function allows the programmer/operator to load, edit and check programs with the aid of a graphic display (optional). Therefore, programs may be prepared for the next job without waiting for the completion of the current machining operation. This feature enhances machine productivity as well as operator/programmer efficiency.

FLEXIBLE PROGRAMS

The 11MA offers a unique programming capability called "custom macro". This feature permits parametric programming, arithmetic functions, logical calculations, conditional jump functions, message display capabilities, etc. By using these capabilities, the control can be customized to meet the requirements of user-defined applications. The following are just a few of the examples of how the "custom macro" feature may be used.

- Family programs
- Customized canned cycles
- In-process/post-process gauging routines
- Multi-function M codes
- Feedrate program by workpiece surface finish
- Automatic retraction and recover cycle at tool breakage

APPLICATION FLEXIBILITY

The 11MA offers a wide range of applications from a simple two axis machine to a FMS cell. The powerful built-in Programmable Controller (PC), with wide communication channels, along with the NC control software, offers access to all necessary data for constructing a FMS. The combination of a high-level language (PASCAL) and conventional ladder type program provides for an optimum PC system. Along with a large memory (80K) and the large number of I/O (848 inputs/560 outputs), the system is more than adequate for construction of complex cells. The wide communication channels will accommodate the following items:

- Control of program loading/unloading through serial port
- Terminal emulation by MDI/CRT
- Reporting NC and machine status
- Supervising machining by a host computer
- NC command format conversion

TECHNICAL SPECIFICATIONS

BM BASIC MACHINE INTERFACE: System with BM interface (the only interface with which all functions of SYSTEM 11 can be used). PC is also required.

6 . . . . . System with which interface is compatible with the current SYSTEM 6.

1. BASIC FUNCTIONS

Specifications	With PC		Without PC	Note
	BM	6	6	
Controlled axes : 2 axes / 3 axes	★	★	★	
Name of axes : Optional from X, Y, Z, U, V, W, A, B, C	★	★	★	
Simultaneously controllable axes : 2 axes	★	★	★	
Tape code : EIA RS244A, ISO 840 Automatic recognition	★	★	★	
Decimal point programming	★	★	★	Pocket calculator type available
Max. command value : 8 digits	★	★	★	
Rapid traverse override : F0, F1, 50, 100%	★	★	★	
Feed rate command : mm / min or inch / min	★	★	★	
Feed rate override : 0-254% per every 1%	★	✓	✓	Up to 200% in 6 (Per 10%)
Tangential speed constant control	★	★	★	
Automatic acceleration/deceleration : Rapid traverse ; linear, cutting feed ; exponential	★	★	★	Acceleration/deceleration after interpolation
Positioning (G00)	★	★	★	Linear interpolation type available
Linear interpolation (G01)	★	★	★	
Multi-quadrant circular interpolation (G02, G03)	★	★	★	
Circular interpolation by radius programming	★	★	★	
Combined use of absolute/incremental command : possible in the same block	★	★	★	
Coordinate system setting (G92)	★	★	★	
Local coordinate system setting (G52)	★	★	★	
Work coordinate system selection : 6 pairs (G54-G59)	★	★	★	
Machine coordinate system selection (G53)	★	★	★	
Buffer register	★	★	★	
Dwell (G04)	★	★	★	
Auxiliary functions: M 8-digit (Binary output)	★	✓	✓	BCD 3-digit for misc. functions of 6

★ = Available ✓ = Restricted □ = Not Available

2. OPTIONAL FUNCTIONS CONTINUED

Specifications	With PC		Without PC	Note
	BM	6	6	
External work number search : 31 points	★	★	★	
External data input/output	★	✓	✓	
Input/output interface : RS232C x1, RS422 x 1, RS232C or current loop 20mA x 1	★	★	★	
Custom macro	★	✓	✓	DI/DO = 16/16
Interruption type custom macro	★	★	★	
Automatic corner override (G62)	★	★	★	
Scaling (G50, G51)	★	★	★	
Programmable mirror image (G50.1, G50.2)	★	★	★	
Coordinate system rotation (G68, G69)	★	★	★	
Polar coordinates input (G15, G16)	★	★	★	
Chamfering, corner R : Optional angle	★	★	★	
Handle interruption	★	★	★	
Play back	★	□	□	
Tool life management	★	★	★	
Menu switch	★	★	★	
Manual numerical command under JOG mode	★	★	★	
Graphic display function	★	★	★	
14" color CRT (No graphic functions)	★	★	★	
Run hour display	★	★	★	
External I/O port control	★	□	□	
2nd feedrate override	★	□	□	
Actual spindle speed output	★	□	□	
High speed skip signal input	★	★	★	
High speed tool measuring signal input	★	★	★	
Additional common variables: 200/300 total	★	★	★	
Program encoding and password	★	★	★	
Auto-Manual simultaneous control	★	□	□	
Expanded part program edit	★	★	★	
Axis status output	★	✓	□	✓ Axis selection status only
External position display	★	★	★	
Bubble cassette & adaptor	★	★	★	
LSI cassette & adaptor	★	★	★	
Portable tape reader	★	★	★	
Printer Punch Reader	★	★	★	
Programmable controller	★	★	□	PC-MODEL I
PC window	★	□	□	
Inclination compensation	★	★	★	
Program restart	★	★	★	
Block Restart	★	★	□	
Sequence number comparison and stop	★	★	★	
Optional block skip addition 2-9	★	★	★	

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2. OPTIONAL FUNCTIONS

Specifications	With PC		Without PC	Note
	BM	6	6	
Tape reader without reels	★	★	★	
Tape reader with reels	★	★	★	
Resolver/Inductosyn interface	★	★	★	
Multi-tap transformer 200-550VAC + 10, -15%	★	★	★	
Controllable axes expansion : Max. 5 axes plus spindle control (additional axes) Axes name optional from X, Y, Z, U, V, W, A, B, C	★	★	★	
Simultaneous controllable axes expansion :Max. up to all controlable axes	★	★	★	
Helical cutting : Also for additional axes	★	★	★	
Skip functions (G31)	★	★	★	
Multi-step skip functions (3 additional steps) (G31.1 - G31.3)	★	□	□	
Canned cycles (G73, 74, 76, 80'89)	★	★	★	
Tool offset : G45-G48	★	★	★	
Imaginary axis interpolation : SIN interpolation (G07)	★	★	★	
Single direction positioning (G60	★	★	★	
Cutter radius compensation B : (G38-G42)	★	★	★	Select either
Cutter radius compensation C : (G38-G42)	★	★	★	
3 dimensional cutter radius compensation : (G40, G41)				
Tool offset amount memory B : ± 6 digits, geometry/wear memory, 32 pairs, Common to all tool offets	★	★	★	Select either
Tool offset amount memory C : ± 6 digits, geometry/wear memory, tool length/radius memory, 32 pairs	★	★	★	
Additional cutter radius offsets : 100/200 pairs	★	★	★	
Tool length measurement	★	★	★	
Automatic tool length measurement (G37.1 - G37.3)	★	□	□	
Addition in registered programs : 200/400	★	★	★	Necessary to add tape storage length
2nd, 3rd, 4th reference point return : Automatic (G30)	★	★	★	
Tape storage length : Bubble memory 3840/2560/1280/640/320m	★	★	★	Max. memory length may be limited according to selection offset memory.
Cutting feed automatic acc/dec : Linear before interpolation	★	★	★	
External deceleration	★	✓	✓	X, Y, Z axes only for 6
Manual pulse generator : Max. 3	★	★	★	
Manual arbitrary angle feed	★	✓	✓	PER 5" in 6
Spindle speed binary/analog output	★	★	★	
Thread cutting, cont. thread cutting, synchronous feed (G33, G94/G95)	★	★	★	Position coder required
F1-digit feed	★	★	★	6MB equivalent
Constant surface speed control (G96, G97)	★	★	★	
Tool functions : T-4-digit BCD output	□	★	★	
2nd miscellaneous functions : 8 digits (binary) select address from A, B, C so that it does not duplicate with control axes address	★	✓	✓	✓ : BCD 3-digit
Inch/metric conversion (G20, G21)	★	★	★	
Programmable data input (G10)	★	★	★	
Stored stroke check 2 (G22, G23)	★	★	★	
Stroke check before move	★	★	★	
Stored pitch error compensation	★	★	★	
Straightness compensation	★	★	★	

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Specifications

1.BASIC FUNCTIONS CONTINUED

Specifications	With PC		Without PC	Note
	BM	6	6	
Spindle functions : S 8-digit (Binary output)	★	✓	✓	(with PC). Others BCD 2 digit
Tool functions : T 8-digit (Binary output)	★	✓	✓	2-digit BCD
Tool length compensation : (G43, G44, G49)	★	★	★	
Tool offset amount memory A : 6 digits, 32 pairs common to all tool offsets	★	★	★	
Part program storage, editing	★	★	★	
Background editing functions : Editing during automatic operation	★	★	★	
Tape storage length : Bubble memory 80m	★	★	★	
Registerable programs : 100	★	★	★	Program name display possible
Reference point return A : Manual, Automatic (G27-G29)	★	★	★	
Self diagnosis functions	★	★	★	
Backlash compensation : Max 9999 pulses	★	★	★	
Single block	★	★	★	
Optional block skip	★	★	★	
Manual absolute on/off	★	★	★	
External mirror image : For all axes	★	★	✓	✓ : X,Y axes only
Dry run	★	★	★	
Interlock	★	★	★	
Machine lock	★	★	★	
Every axis machine lock	★	★	✓	✓ : Z axis only
Auxillary functions lock	★	★	★	
Feed hold	★	★	★	
Manual jogging	★	★	★	
Manual incremental feed : x1, x10, x100, x1000, x10000, x100000	★	★	★	
Overtravel	★	★	★	
Stored stroke check 1	★	★	★	
Emergency stop	★	★	★	
Servo off signal input	★	★	★	
Follow up : Emergency stop signal input	★	★	★	
Sequence number : 5 digits	★	★	★	
Sequence number search	★	★	★	
Program number : 4 digits	★	★	★	
Program number search	★	★	★	
Exact stop (G09, G61/G64)	★	★	★	
NC status output	★	★	□	
External power on/off	★	★	★	
Connectable servo motors : AC/DC SERVO MOTOR	★	★	★	
Connectable servo units : AC/DC drive	★	★	★	
Connectable position detectors : Pulse coder/Optical scale	★	★	★	
Connectable spindle motor : AC/DC SPINDLE MOTOR	★	★	★	
Connectable spindle servo units : AC/DC drive	★	★	★	
Power : 200VAC +10%, -15%, 1 phase, 50/60Hz ± 1Hz or 220VAC +10%, -15%, 1 phase, 60Hz ± 1Hz	★	★	★	

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Specifications

2. NEW OPTIONAL FUNCTIONS

Specifications	With PC		Without PC	Note
	BM	6	6	
Cylindrical interpolation	★	★	★	Contour on cylinder surface
Polar coordinate interpolation	★	★	★	Contour by linear axis & rotary axis
Helical interpolation B	★	★	★	2 axes circular and 2 axes linear
Circular thread cutting B	★	★	★	X, Z, & C axes
Exponential interpolation	★	★	★	
Multiple work zero (48 total)	★	★	★	Expansion for G54 ~ 59
Additional tool offset memory (999 total)	★	★	★	
Additional common variable for custom macro (total 600)	★	★	★	
Additional tool group for tool life management (total 512)	★	□	□	
Tool offset selection by T word	★	★	★	
Axes permutation	★	□	□	
Parameter alteration thru part program	★	★	★	
Parts counter display	★	★	★	
Expanded custom macro	★	★	★	
Auto feed adjustment by radius of arc	★	★	★	
Feed stop	★	★	★	
Spindle positioning	★	□	□	
Absolute encoder feedback	★	★	★	
Fine command multiple rate set-up	★	★	★	
Key signal generation by PMC	★	□	□	

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