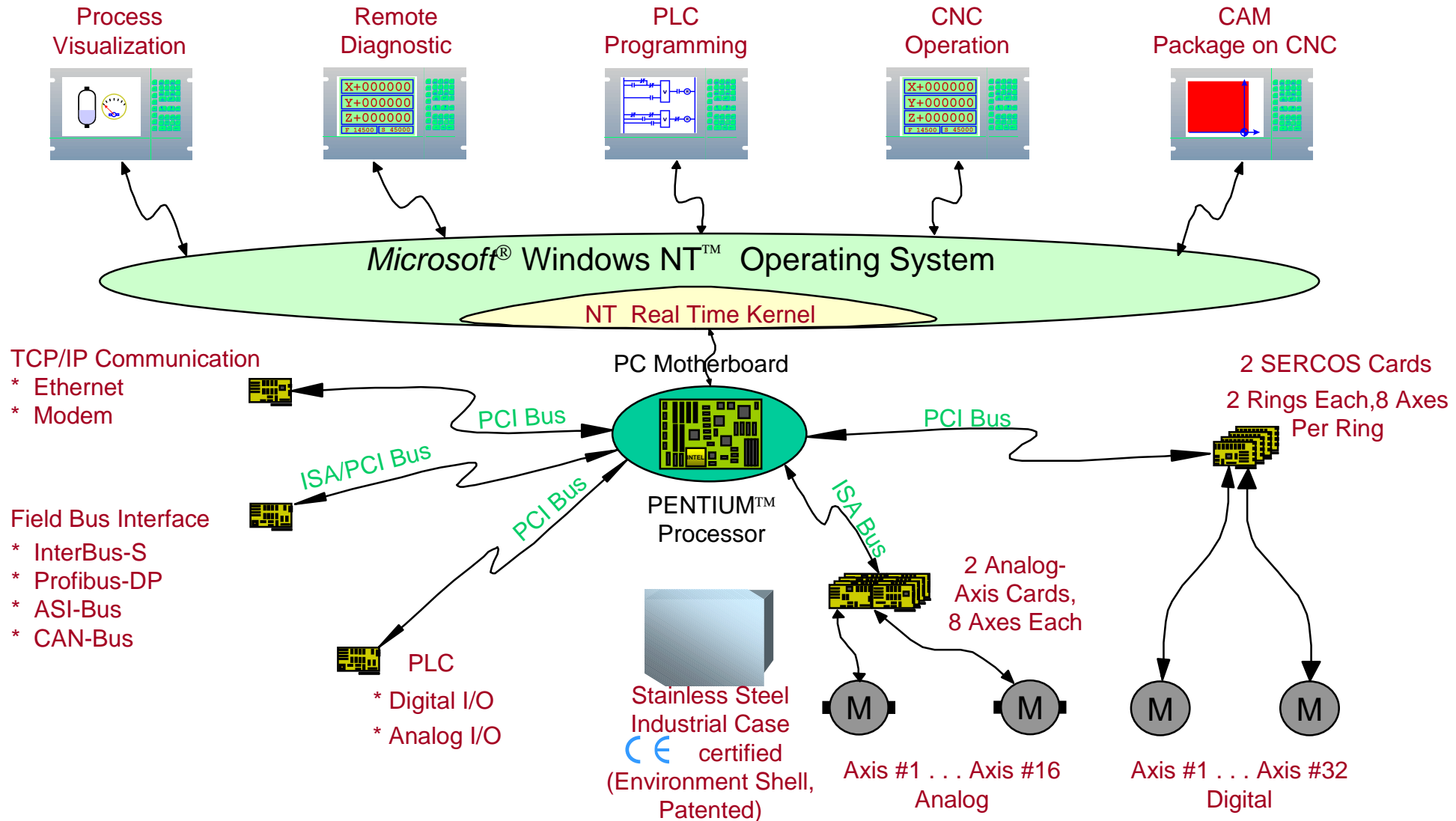
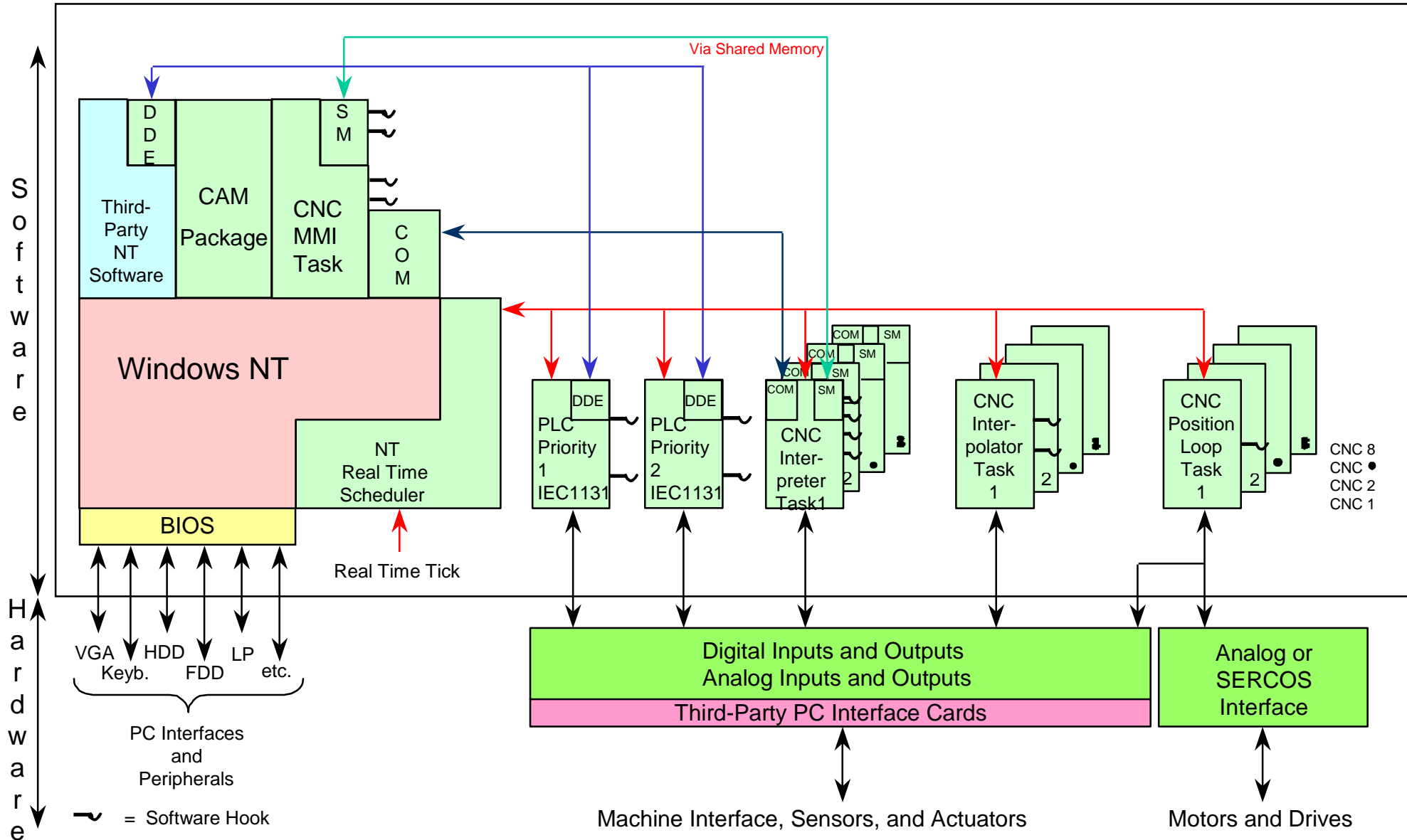


Open PC-Based CNC Systems Using Internationally Recognized Standards



MACHINEMATE® CNC Architecture

All Software Runs on the Main PC Processor (Pentium 233 . . . 700 MHz)



CNC Functions	Software	Hardware
MMI COM	MMI & CAM or Third-Party S/W Compile Cycles Ethernet	PC Motherboard Third-Party PC Boards PCI/ISA
CNC Kernel	CNC Kernel DDE Interface or Applications through Compile Cycles (C++)	Third-Party PC Boards PCI/ISA
PLC	Software PLC (IEC 1131-3) or Other Soft PLC or C++	Discrete I/O InterBus-S, Profibus, CAN Bus, ASI Bus via PCI/ISA Board
Drives	SERCOS Protocol or Analog Drives	SERCOS Board Analog ± 10 V, or Third-Party Drives (PCI/ISA)

**Open Standards
or
Third-Party
Standards**

Proprietary
Components
Provided by
MACHINEMATE, INC.

Application Technologies

- HSC Drilling
- 2½D Milling
- 2½D Machining Center
- 2½D HSC Milling
- Multi-Station CNC Milling
- Two-Axis Turning (Standard and Sub-Micron)
- High Precision Turning
- Diamond Turning (Nanometer)
- Multi-Spindle Turning
- Combined Milling/Turning
- High-Precision Measuring Machines (3D-Probe or 3D Laser Scanner)
- 2D Laser Cutting
- 2D Laser Welding
- 2D Plasma Cutting
- Electrical Die Sinking
- Electrical Wire Cutting
- Glass Cutting
- Glass Grinding
- High Precision Aspherical Glass Grinding
- Gear Hobbing
- Electron Beam Welding
- Five-Axis Milling (Includes Gantry Machines)
- Five-Axis HSC Milling
- Five-Axis Turbine Blade Milling
- Five-Axis Laser Cutting
- Five-Axis Laser Welding
- Five-Axis Surface Treatment
- Five-Axis Grinding
- Five-Axis Wood Milling

MACHINEMATE® CNC Model

PERFORMANCE DATA		MM1	MM3	MM5	MM7
Blocks per Second (ISO)		112	225	450	1800
Typical Position Loop Gain		3	4	7	15
CNC Stations (standard/max)		1/2	1/2	1/4	1/8
Standard Number of Axes		4(A)/8(S)	4(A)/8(S)	4(A)/8(S)	4(A)/8(S)
Maximum Number of Axes		8(A)/8(S)	8(A)/8(S)	16(A)/32(S)	16(A)/32(S)
Dynamic Block Buffer [Blocks]	Base	50	50	50	50
	Max.	1000	1000	1000	1000
NC Program Memory [KB/MB] (on CNC / on hard disk)	Base	128/800	128/800	128/800	128/800
	Max.	872/2100	872/2100	872/2100	872/2100
PLC Memory [KB]	Base	64	64	64	64
	Max.	256	256	256	256
Inputs/Outputs	Base	24/16	24/16	48/32	48/32
	Max.	792/528	792/528	792/528	792/528

Note: A – Analog Axes; S – SERCOS Axes

FACTS = Fast & ACcuraTe & Smooth - Components

Geometry Look-Ahead

Checks for violations of the established tolerance band during direction changes of the contour. Velocity and acceleration will be adjusted such that the tolerance band will not be exceeded.

Dynamic Look-Ahead

Checks during interpolation whether velocity or acceleration are exceeding the respective maximum values for the machine. The path velocity will be adjusted accordingly.

Adaptive ART

A self-adapting algorithm, which enables the feed forward function to achieve zero lag operation even in case of velocity changes on arcs, helix and spline. (ART=Advanced Regulation Technology)

Adaptive Path Filter

Checks for critical frequency ranges during the control process; limits resonances within the control loop in context with the path.

Cubic Spline Interpolator

Located between interpolator and position controller. Is based on cubic spline and introduces smooth acceleration transitions between points of interpolator and position controller.

Ramp Function

Linear ramps (for maximum productivity) are combined with smoothing through exponential behavior. This method yields highest productivity together with smooth acceleration.

Overview MACHINEMATE® Functions (I)

G 000	Rapid Traverse	G 025	Programmable Work Area, Upper Limits
G 001	Linear Interpolation	G 026	Programmable Work Area “Off”
G 002	Circular Interpolation (clockwise)	G 027	Programmable Work Area “On”
G 003	Circular Interpolation (counterclockwise)	G 033	Programmable Thread Cutting, Constant Lead
G 012	Circular Interpolation (clockwise)	G 034	Thread Cutting, Variable Lead
G 013	Circular Interpolation (counterclockwise)	G 035	Prepare Oscillation
G2/G3	Helical Interpolation	G 038	Programmable Mirror Image “On”
G 004	Dwell in Milliseconds	G 039	Programmable Mirror Image “Off”
G 005	Spline Type	G 040	Tool Radius Compensation “Off”
G 006	Spline Interpolation (Refer to Specification, p. 29)	G 041	Tool Radius Compensation Left of Path/Intersection
G 007	Tangent Circle Interpolation	G 042	Tool Radius Compensation Right of Path/Intersection
	Helical Interpolation	G 043	Tool Radius Compensation Left of Path/Perpendicular
	Polygonal Interpolation	G 044	Tool Radius Compensation Right of Path/Perpendicular
	Feedrate Interpolation	G 050	Scaling
G 008	Ramp at Block Transition	G 051	Part Rotation; Programming in Degrees
	Look Ahead “Off”	G 052	Part Rotation; Programming in Radians
G 009	No Ramp at Block Transition	G 053	Zero Offset Cancel
	Look Ahead (23 Blocks)	G 054	Zero Offset 1, Per Axis
G 010	Stop Dynamic Block Pre-Processing	G 055	Zero Offset 2, Per Axis
G 011	Stop Interpolation During Block Pre-Processing	G 056	Zero Offset 3, Per Axis
G 014	Polar Coordinate Programming absolute	G 057	Zero Offset 4, Per Axis
G 015	Polar Coordinate Programming incremental	G 058	Zero Offset 5, Per Axis
G 016	Definition of Pole	G 059	Zero Offset 6, Per Axis
G 017	Plane Selection X, Y	G 063	Feedrate/Spindle Override Deactivated
G 018	Plane Selection Z, X	G 066	Feedrate/Spindle Override Activated
G 019	Plane Selection Y, Z	G 070	Inch Format
G 020	Plane Selection, Programmable	G 071	Metric Format
G 021	Parallel Axes “On”	G 072	Interpolation with In-Position-Tolerance “Off”
G 022	Parallel Axes “Off”		
G 024	Programmable Work Area, Lower Limits		

Overview **MACHINE**MATE® Functions (II)

G 073	Interpolation with In-Position-Tolerance “On”	G 105	Polar Transformation “On“, Polar Axis Letters
G 074	Programmable Referencing	G 106	Cylinder Transformation “On“, Polar/Cylindrical Coordinates
G 075	Curvature	G 107	Cylinder Transformation “On“, Polar/Cyl. Coord. with RRC
G 078	Approach to Contour “On“ (With Rotary Axis Orientation)	G 108	Cylinder Transformation “On“, Polar/Cyl. Coord. with PO & RRC
G 079	Approach to Contour “Off“	G 109	Axis Transf., Programming of Tool Cutting Depth
G 080	Canned Cycle “Off“	G 110	Power Control, Axis Selection/Channel 1
G 081	Canned Cycle “Drilling“	G 111	Power Control, Pre-Selection V1, F1, T1/Channel 1
G 082	Canned Cycle “Facing with Dwell“	G 112	Power Control, Pre-Selection V2, F2, T2/Channel 1
G 083	Canned Cycle “Deep Hole Drilling“	G 113	Power Control, Pre-Selection V3, F3, T3/Channel 1
G 084	Canned Cycle “Tapping with Floating Holder“	G 114	Power Control, Pre-Selection T4/Channel 1
G 085	Canned Cycle “Reaming“	G 115	Power Control, Pre-Selection T5/Channel 1
G 086	Canned Cycle “Boring“	G 116	Power Control, Pre-Selection T6/Pulsing Output
G 087	Canned Cycle “Reaming with Stop for Gaging“	G 117	Power Control, Pre-Selection T7/Pulsing Output
G 088	Canned Cycle “Boring with Spindle Stop“	G 120	Axis Transf.; Change Orient. of Rotary Axis for Linear Intpl.
G 089	Canned Cycle “Boring with Intermediate Stop“	G 121	Axis Transf.; Change Orientation In One Plane
G 090	Absolute Programming	G 125	Electronic Gearbox; Straight Teeth
G 091	Incremental Programming	G 126	Electronic Gearbox; Slant Teeth, Axial
G 092	Programmable Zero Shift	G 127	Electronic Gearbox; Slant Teeth, Tangential
G 093	Constant Circumference Speed “On“ (Grinding Wheel)	G 128	Electronic Gearbox; Slant Teeth, Diagonal
G 094	Feedrate Programming in mm/min	G 130	Axis Transf.; Progr. Mode of Orientation Change
G 095	Feedrate Programming mm/Spindle Revolution	G 131	Axis Transf.; Progr. Mode of Orientation Change
G 096	Constant Cutting Speed “On“	G 132	Axis Transf.; Progr. Mode of Orientation Change
G 097	Constant Cutting Speed “Off“	G 133	Learning Mode Threading without Lag “On“
G 098	Positioning Axis Signal to PLC	G 134	Learning Mode Threading without Lag “Off“
G 100	Polar Transformation “Off“	G 135	Distance Control, Axis Selection
G 101	Polar Transformation “On“, Cartesian Axis Letters	G 140	Axis Transformation; Work piece Coordinates
G 102	Cylinder Transformation “On“, Cart. Coordinate System	G 141	Axis Transformation; Active Coordinates
G 103	Cylinder Transformation “On“, w/Real Time Radius Comp.(RRC)		
G 104	Cylinder Transformation w/Profile Offset (PO) and RRC		

Overview MACHINEMATE® Functions (III)

G 160	Activate ART	G 210	Power Control, Axis Selection/Channel 2
G 161	ART Learning Function for Velocity Parameters “On“	G 211	Power Control, Pre-Selection V1, F1, T1/Channel 2
G 162	ART Learning Function “Off“	G 212	Power Control, Pre-Selection V2, F2, T2/Channel 2
G 163	ART Learning Function for Acceleration Parameters “On“	G 213	Power Control, Pre-Selection V3, F3, T3/Channel 2
G 164	ART Learning Function for Acceleration Changes “On“	G 214	Power Control, Pre-Selection T4/Channel 2
G 165	Path Filter “On“	G 215	Power Control, Pre-Selection T5/Channel 2
G 166	Path Filter “Off“	G 270	Turning Finish Cycle
G 170	Digital Probing Signals; Block Transfer with Hard Stop - (Stops and Backs Up)	G 271	Stock Removal in Turning
G 171	Digital Probing Signals; Block Transfer without Hard Stop - (Measures on Fly)	G 272	Stock Removal in Facing
G 172	Digital Probing Signals; Block Transfer with Soft Stop	G 310	Power Control, Axis Selection/Channel 3
G 175	SERCOS Ident Number Write	G 311	Power Control, Pre-Selection V1, F1, T1/Channel 3
G 176	SERCOS Ident Number Read	G 312	Power Control, Pre-Selection V2, F2, T2/Channel 3
G 180	Axis Transformation “Off“	G 313	Power Control, Pre-Selection V3, F3, T3/Channel 3
G 181	Axis Transf. With Non-Rotated Coordinate System	G 314	Power Control, Pre-Selection T4/Channel 3
G 182	Axis Transf. With Rotated/Translated Coordinate System	G 315	Power Control, Pre-Selection T5/Channel
G 183	Axis Transf.; Definition of Coordinate System		
G 184	Axis Transf.; Programming Tool Dimensions		
G 186	Look Ahead; Corner Acceleration, Tolerance on Arc		
G 188	Activate Positioning Axes		
G 190	Diameter Programming “Off“		
G 191	Diameter Programming “On“ and Display Tangent Point		
G 192	Diameter Programming Display Tangent Point Diameter		
G 193	Diameter Programming Display Tangent Point to Center Line		
G 200	Corner Rounding “Off“		
G 201	Corner Rounding “On“ with Defined Radius		
G 202	Corner Rounding “On“ with Defined Corner Deviation		
G 203	Corner Rounding “On“ with Defined Radius up to Maximum Deviation		

Overview MACHINEMATE® Functions (IV)

M 000	Unconditional stop
M 001	Conditional stop
M 002	End of program
M 003	Spindle clockwise
M 004	Spindle counterclockwise
M 005	Spindle stop
M 006	Tool change (see Note below)
M 019	Spindle orientation
M 020	Oscillation On
M 021	Oscillation Off
M 030	End of program
M 040	Automatic spindle gear selection
M 041	Spindle gear transmission step 1
M 042	Spindle gear transmission step 2
M 043	Spindle gear transmission step 3
M 044	Spindle gear transmission step 4
M 045	Spindle gear transmission step 5
M 046	Spindle gear transmission step 6
M 070	Spline, beginning and end curve 0
M 071	Spline, beginning tangential and end curve 0
M 072	Spline, beginning curve 0 and end tangential
M 073	Spline, beginning and end tangential
M 080	Delete the rest of distance using probe function

Note: The M-code values for the machine-specific functions, for such features as coolant control, are specified in the PLC application. Their values are not defined by the CNC.