What is **AxesBrain™** ?

It 'a software package that turns your PC into a control system for mechatronics.

The main functions are:
1) motion control
2) work activities, handling pieces, cutting, etc. ..
3) work pieces through the interpretation of commands G-Code (ISO-CNC)
4) connect to programming languages to develop interfaces specific to the human machine interface (HMI)

Its architecture is an integration with the image processing software package designed by **VisAlgo™**

What are its origins?

Derives from the CNC and automation developed at Olivetti

robotics Olivetti
years 1974-85
MultiTask-Language

Olivetti systems
years 1984-89
FMS-Transfer-Cells

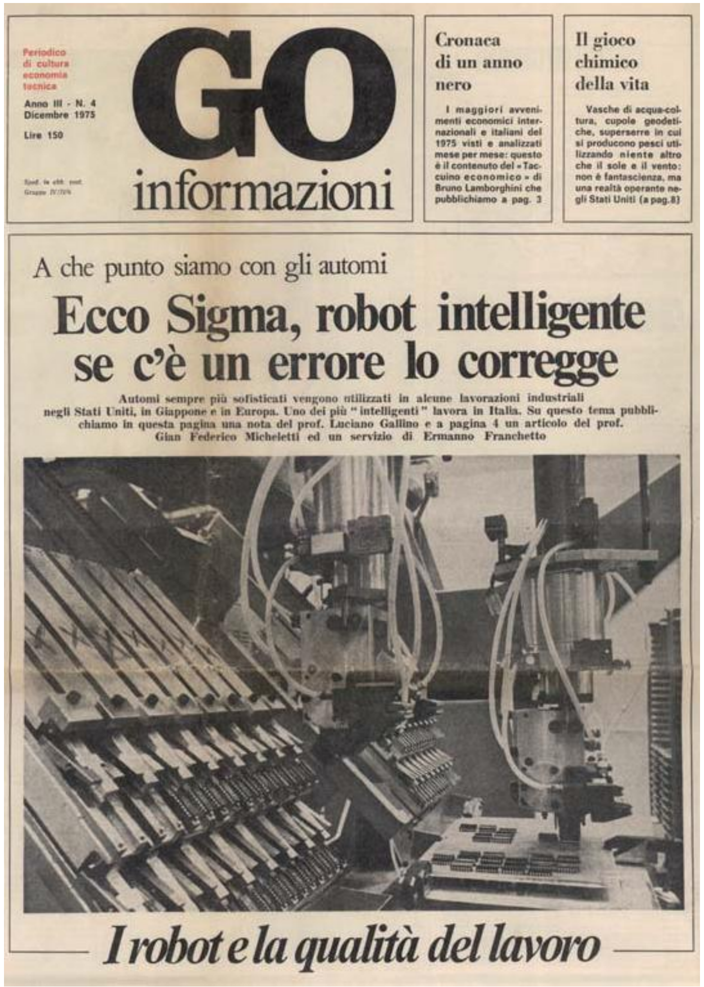
CNC Olivetti
years 1960-80
Algorithms GTL (CNC-milling lathe)

AxesBrain™
VisAlgo™

Olivetti research
years 1984-87
vision system

Olivetti PC
years 1981-89
RealTime system

1974 the beginning….



Periodico
di cultura
economia
tecnica

Anno III - N. 4
Dicembre 1975

Lire 150

Sped. in abb. post.
Gruppo IV/70%

GO informazioni

Cronaca di un anno nero

I maggiori avvenimenti economici internazionali e italiani del 1975 visti e analizzati mese per mese: questo è il contenuto del «Taccuino economico» di Bruno Lamborghini che pubblichiamo a pag. 3

Il gioco chimico della vita

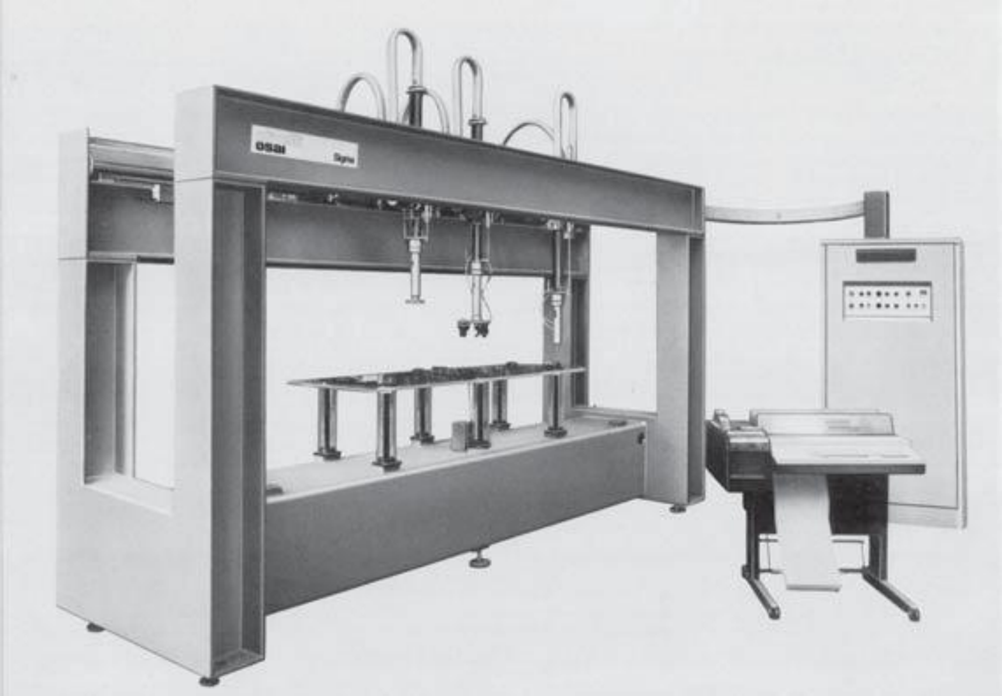
Vasche di acqua-coltura, cupole geodetiche, superserre in cui si producono pesci utilizzando niente altro che il sole e il vento: non è fantascienza, ma una realtà operante negli Stati Uniti (a pag.8)

A che punto siamo con gli automi

Ecco Sigma, robot intelligente se c'è un errore lo corregge

Automi sempre più sofisticati vengono utilizzati in alcune lavorazioni industriali negli Stati Uniti, in Giappone e in Europa. Uno dei più "intelligenti" lavora in Italia. Su questo tema pubblichiamo in questa pagina una nota del prof. Luciano Gallino e a pagina 4 un articolo del prof. Gian Federico Micheletti ed un servizio di Ermanno Franchetto

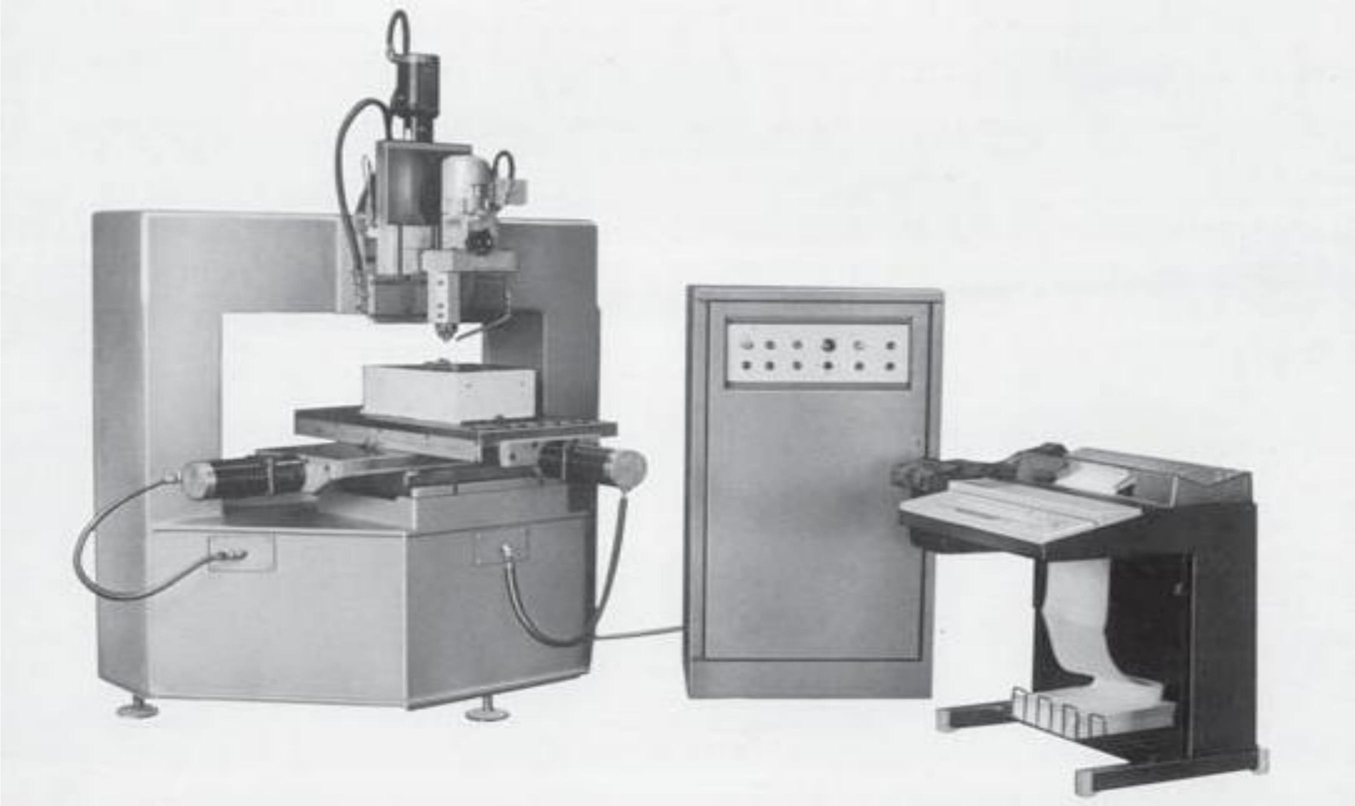
I robot e la qualità del lavoro



1974 Olivetti robotics

Multi Arms = Multi Tasks

The first micromill….



1975 ISO G-Code for micromill maschine

Where we are

We are of IVREA

near TURIN 50 Km, near Milan 100 Km, near Genoa 200 Km

famous for the OLIVETTI and Carnival :

Resources and field devices

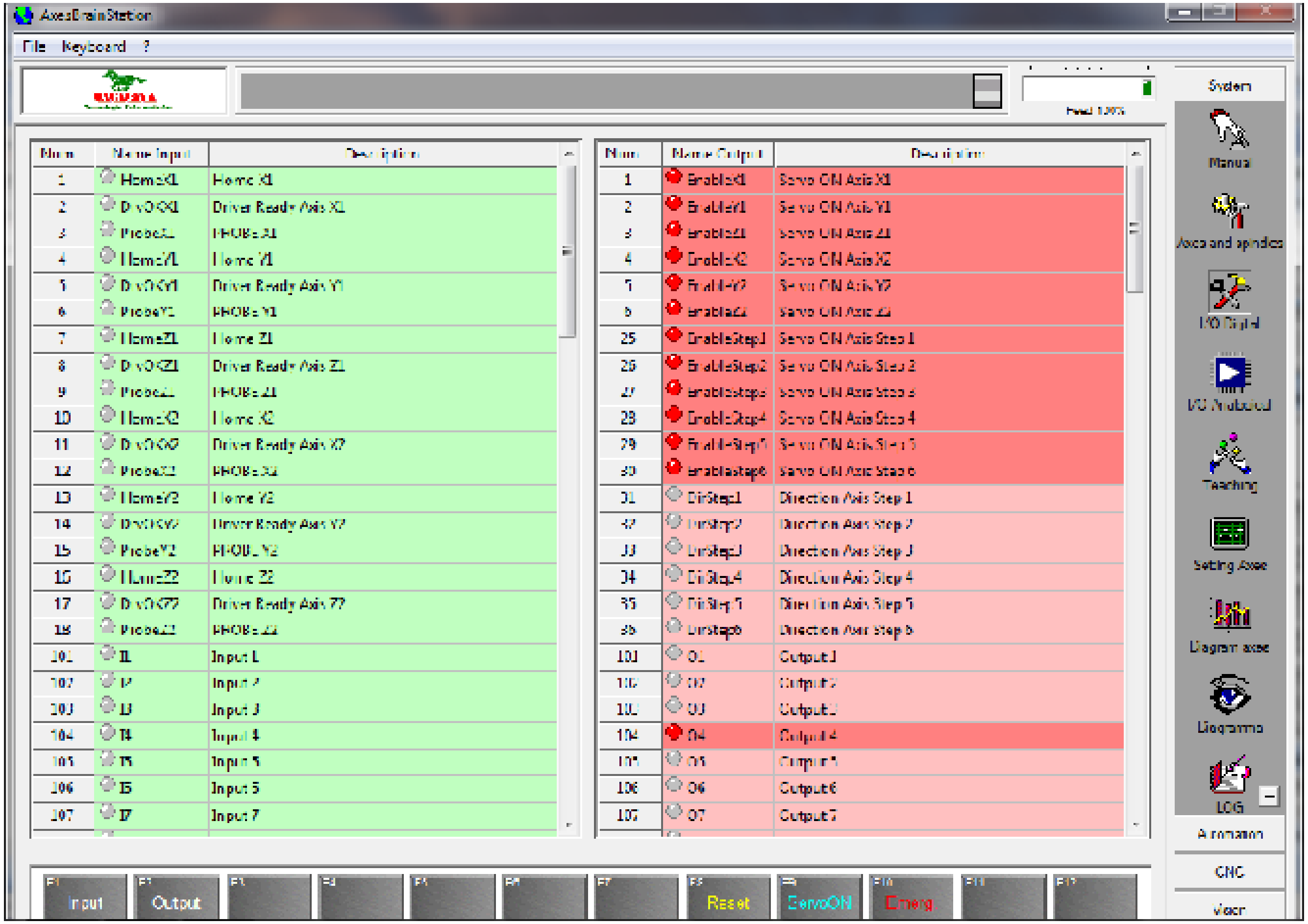
Digital input and output, physical and virtual

Analog input and output

Physical and virtual axes

Spindles

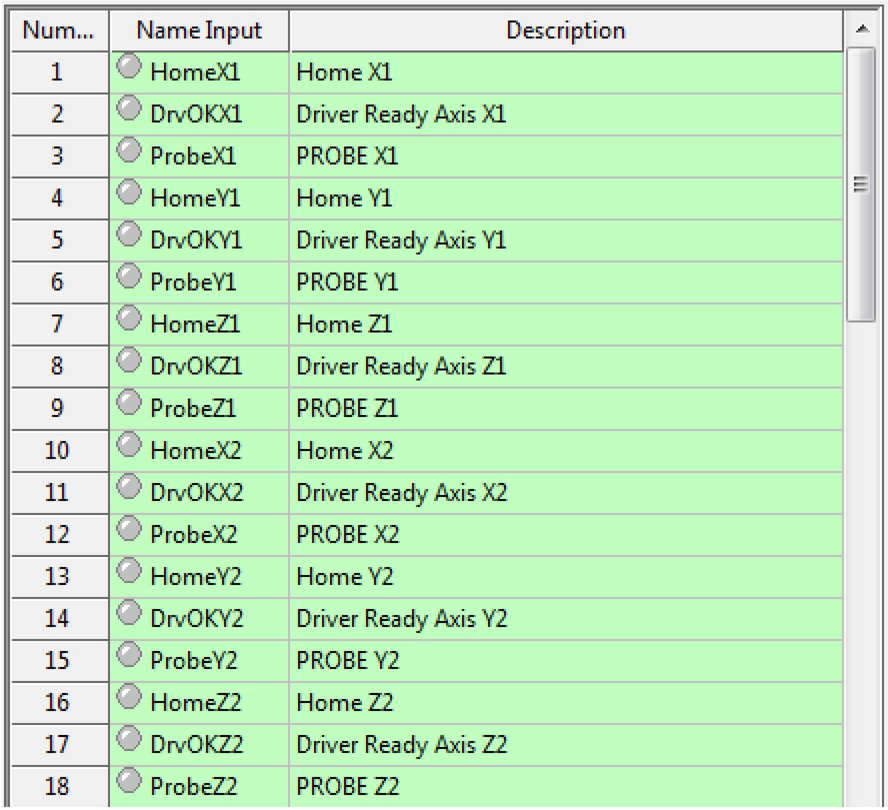
Digital input and output, physical and virtual



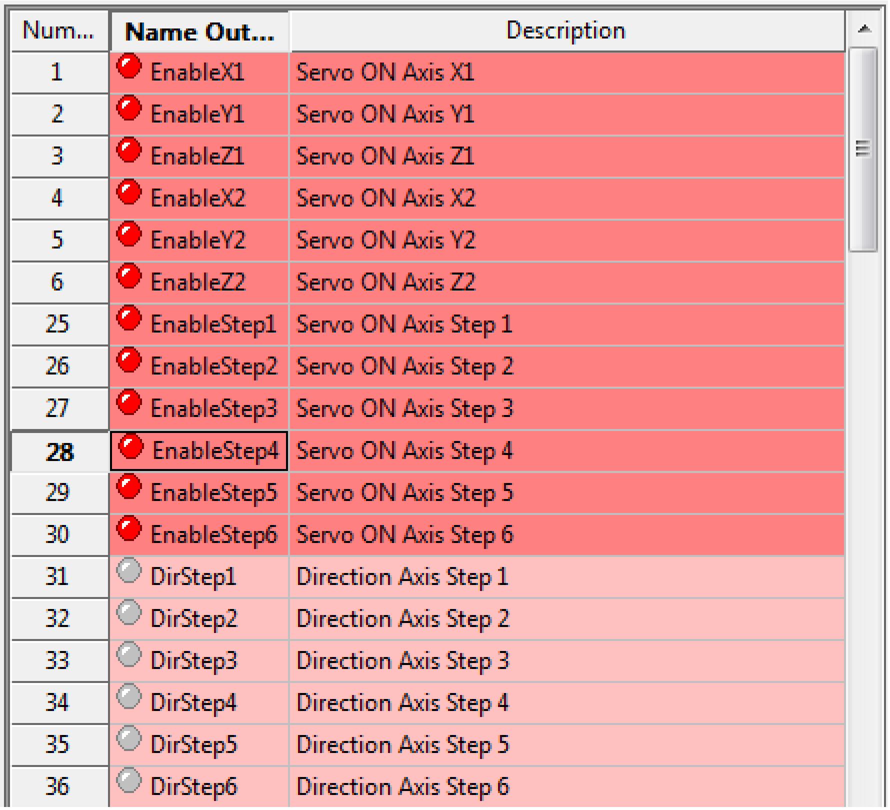
Num	Name Input	Description
1	○ HomeX1	Home X1
2	○ DrvOKX1	Driver Ready Axis X1
3	○ ProbeX1	PROBE X1
4	○ HomeY1	Home Y1
5	○ DrvOKY1	Driver Ready Axis Y1
6	○ ProbeY1	PROBE Y1
7	○ HomeZ1	Home Z1
8	○ DrvOKZ1	Driver Ready Axis Z1
9	○ ProbeZ1	PROBE Z1
10	○ HomeX2	Home X2
11	○ DrvOKX2	Driver Ready Axis X2
12	○ ProbeX2	PROBE X2
13	○ HomeY2	Home Y2
14	○ DrvOKY2	Driver Ready Axis Y2
15	○ ProbeY2	PROBE Y2
16	○ HomeZ2	Home Z2
17	○ DrvOKZ2	Driver Ready Axis Z2
18	○ ProbeZ2	PROBE Z2
101	○ I1	Input 1
102	○ I2	Input 2
103	○ I3	Input 3
104	○ I4	Input 4
105	○ I5	Input 5
106	○ I6	Input 6
107	○ I7	Input 7

Num	Name Output	Description
1	● EnableX1	Servo ON Axis X1
2	● EnableY1	Servo ON Axis Y1
3	● EnableZ1	Servo ON Axis Z1
4	● EnableX2	Servo ON Axis X2
5	● EnableY2	Servo ON Axis Y2
6	● EnableZ2	Servo ON Axis Z2
25	● EnableStep1	Servo ON Axis Step 1
26	● EnableStep2	Servo ON Axis Step 2
27	● EnableStep3	Servo ON Axis Step 3
28	● EnableStep4	Servo ON Axis Step 4
29	● EnableStep5	Servo ON Axis Step 5
30	● EnableStep6	Servo ON Axis Step 6
31	○ DirStep1	Direction Axis Step 1
32	○ DirStep2	Direction Axis Step 2
33	○ DirStep3	Direction Axis Step 3
34	○ DirStep4	Direction Axis Step 4
35	○ DirStep5	Direction Axis Step 5
36	○ DirStep6	Direction Axis Step 6
101	○ O1	Output1
102	○ O2	Output2
103	○ O3	Output3
104	● O4	Output 4
105	○ O5	Output5
106	○ O6	Output6
107	○ O7	Output7

Digital I/O for axes control

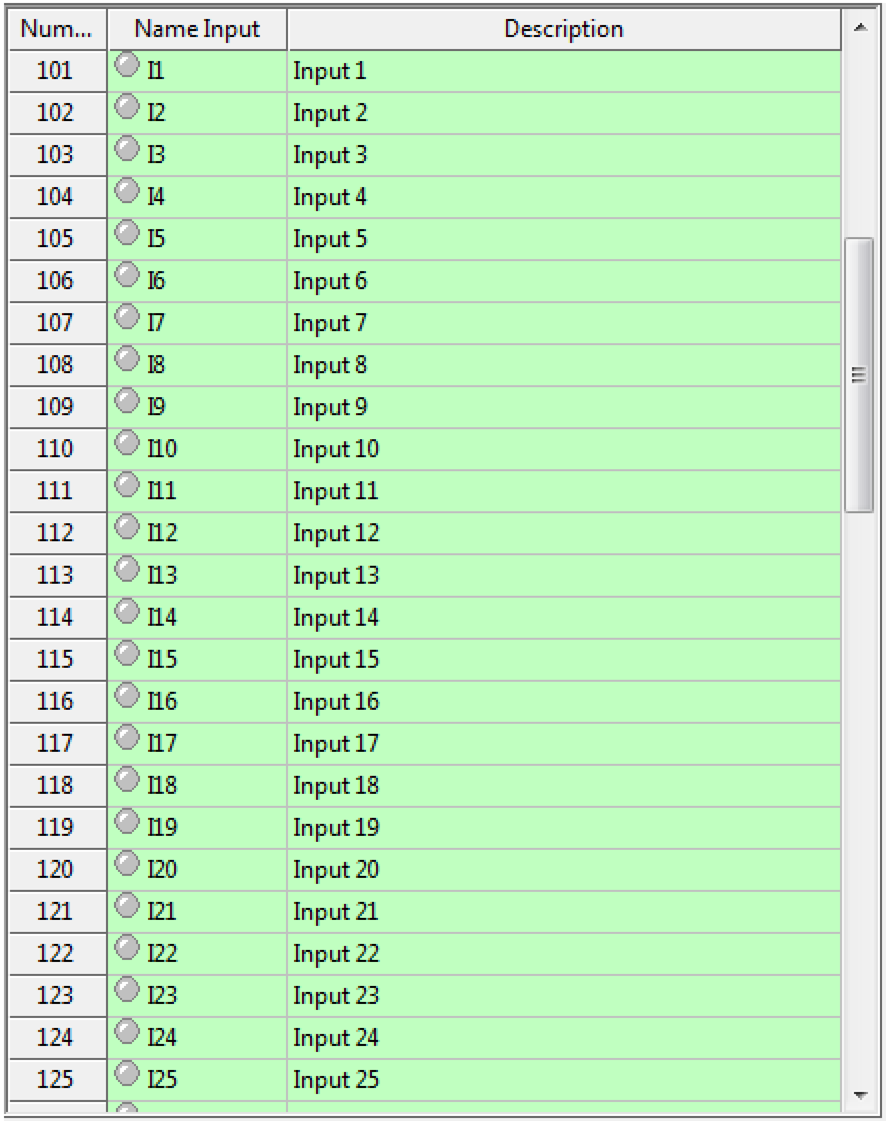


Num...	Name Input	Description
1	○ HomeX1	Home X1
2	○ DrvOKX1	Driver Ready Axis X1
3	○ ProbeX1	PROBE X1
4	○ HomeY1	Home Y1
5	○ DrvOKY1	Driver Ready Axis Y1
6	○ ProbeY1	PROBE Y1
7	○ HomeZ1	Home Z1
8	○ DrvOKZ1	Driver Ready Axis Z1
9	○ ProbeZ1	PROBE Z1
10	○ HomeX2	Home X2
11	○ DrvOKX2	Driver Ready Axis X2
12	○ ProbeX2	PROBE X2
13	○ HomeY2	Home Y2
14	○ DrvOKY2	Driver Ready Axis Y2
15	○ ProbeY2	PROBE Y2
16	○ HomeZ2	Home Z2
17	○ DrvOKZ2	Driver Ready Axis Z2
18	○ ProbeZ2	PROBE Z2

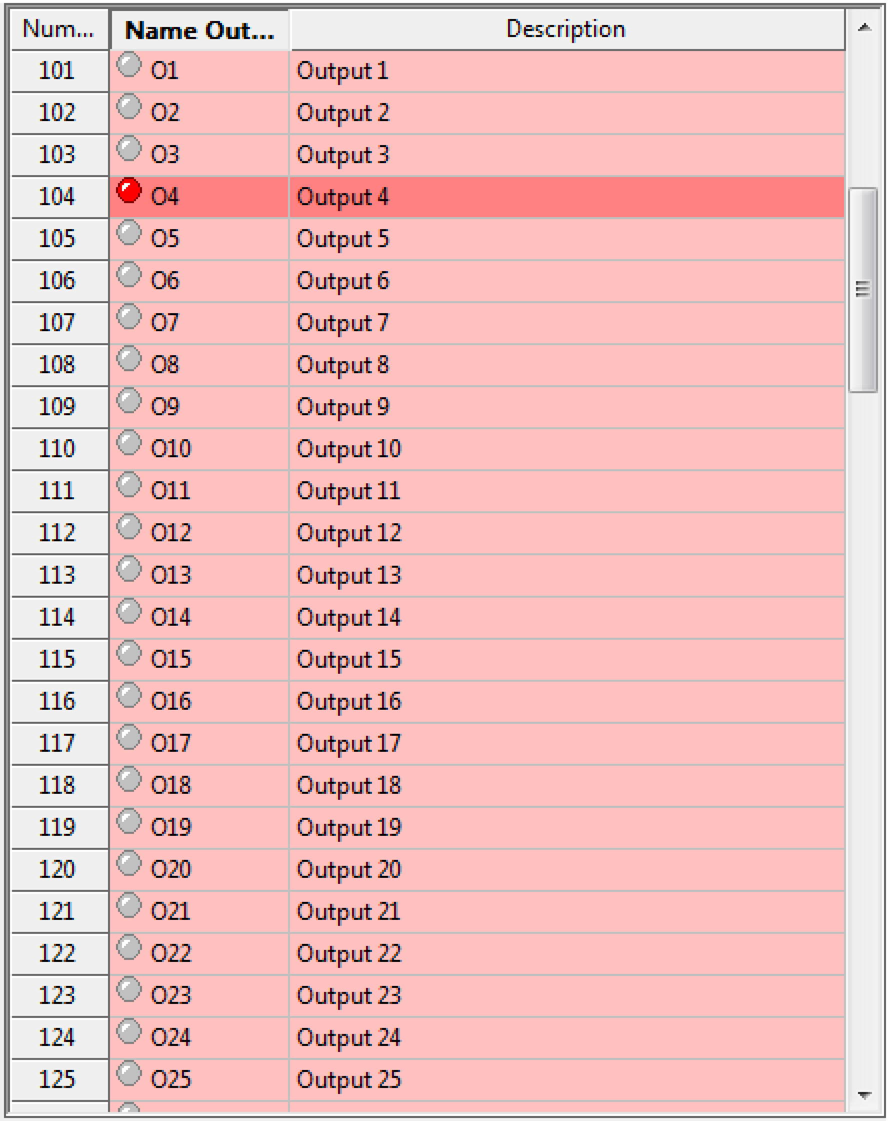


Num...	**Name Out...**	Description
1	● EnableX1	Servo ON Axis X1
2	● EnableY1	Servo ON Axis Y1
3	● EnableZ1	Servo ON Axis Z1
4	● EnableX2	Servo ON Axis X2
5	● EnableY2	Servo ON Axis Y2
6	● EnableZ2	Servo ON Axis Z2
25	● EnableStep1	Servo ON Axis Step 1
26	● EnableStep2	Servo ON Axis Step 2
27	● EnableStep3	Servo ON Axis Step 3
28	● EnableStep4	Servo ON Axis Step 4
29	● EnableStep5	Servo ON Axis Step 5
30	● EnableStep6	Servo ON Axis Step 6
31	○ DirStep1	Direction Axis Step 1
32	○ DirStep2	Direction Axis Step 2
33	○ DirStep3	Direction Axis Step 3
34	○ DirStep4	Direction Axis Step 4
35	○ DirStep5	Direction Axis Step 5
36	○ DirStep6	Direction Axis Step 6

Digital I/O

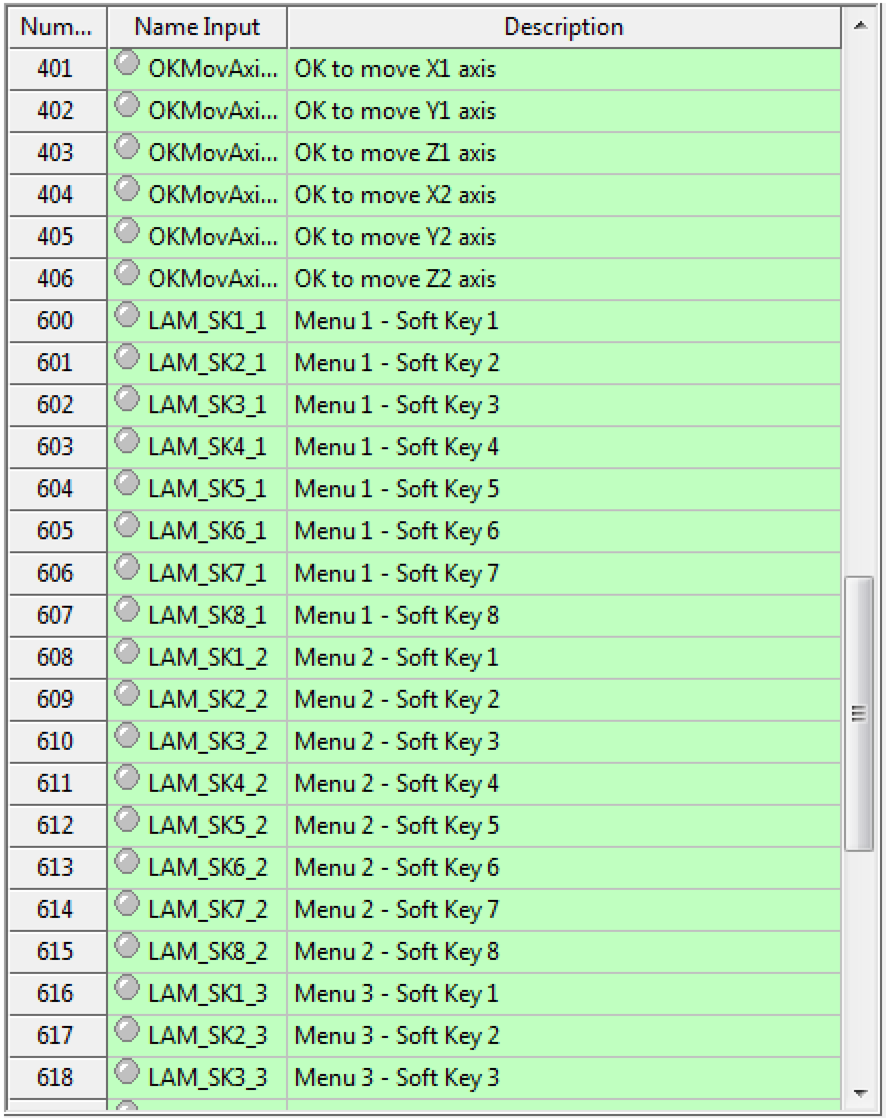


Num...	Name Input	Description
101	○ I1	Input 1
102	○ I2	Input 2
103	○ I3	Input 3
104	○ I4	Input 4
105	○ I5	Input 5
106	○ I6	Input 6
107	○ I7	Input 7
108	○ I8	Input 8
109	○ I9	Input 9
110	○ I10	Input 10
111	○ I11	Input 11
112	○ I12	Input 12
113	○ I13	Input 13
114	○ I14	Input 14
115	○ I15	Input 15
116	○ I16	Input 16
117	○ I17	Input 17
118	○ I18	Input 18
119	○ I19	Input 19
120	○ I20	Input 20
121	○ I21	Input 21
122	○ I22	Input 22
123	○ I23	Input 23
124	○ I24	Input 24
125	○ I25	Input 25

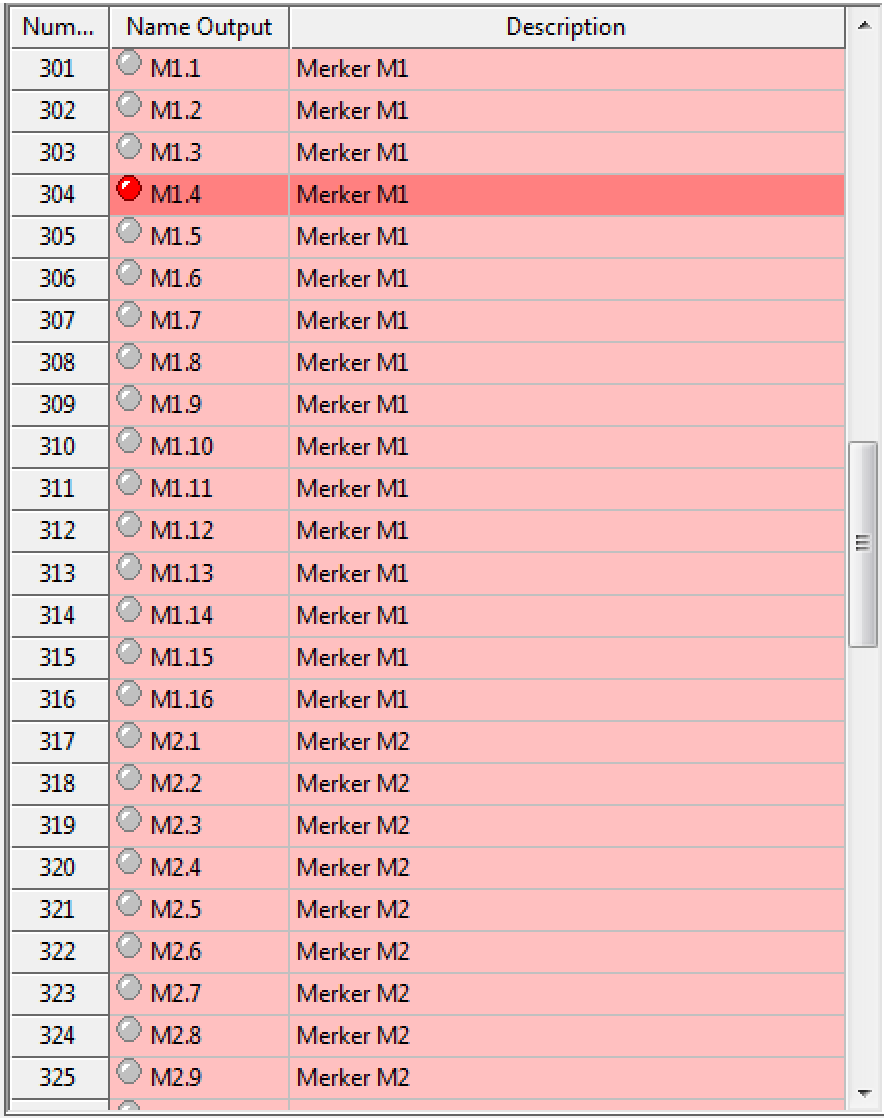


Num...	Name Out...	Description
101	○ O1	Output 1
102	○ O2	Output 2
103	○ O3	Output 3
104	● O4	Output 4
105	○ O5	Output 5
106	○ O6	Output 6
107	○ O7	Output 7
108	○ O8	Output 8
109	○ O9	Output 9
110	○ O10	Output 10
111	○ O11	Output 11
112	○ O12	Output 12
113	○ O13	Output 13
114	○ O14	Output 14
115	○ O15	Output 15
116	○ O16	Output 16
117	○ O17	Output 17
118	○ O18	Output 18
119	○ O19	Output 19
120	○ O20	Output 20
121	○ O21	Output 21
122	○ O22	Output 22
123	○ O23	Output 23
124	○ O24	Output 24
125	○ O25	Output 25

Virtual digital I/O

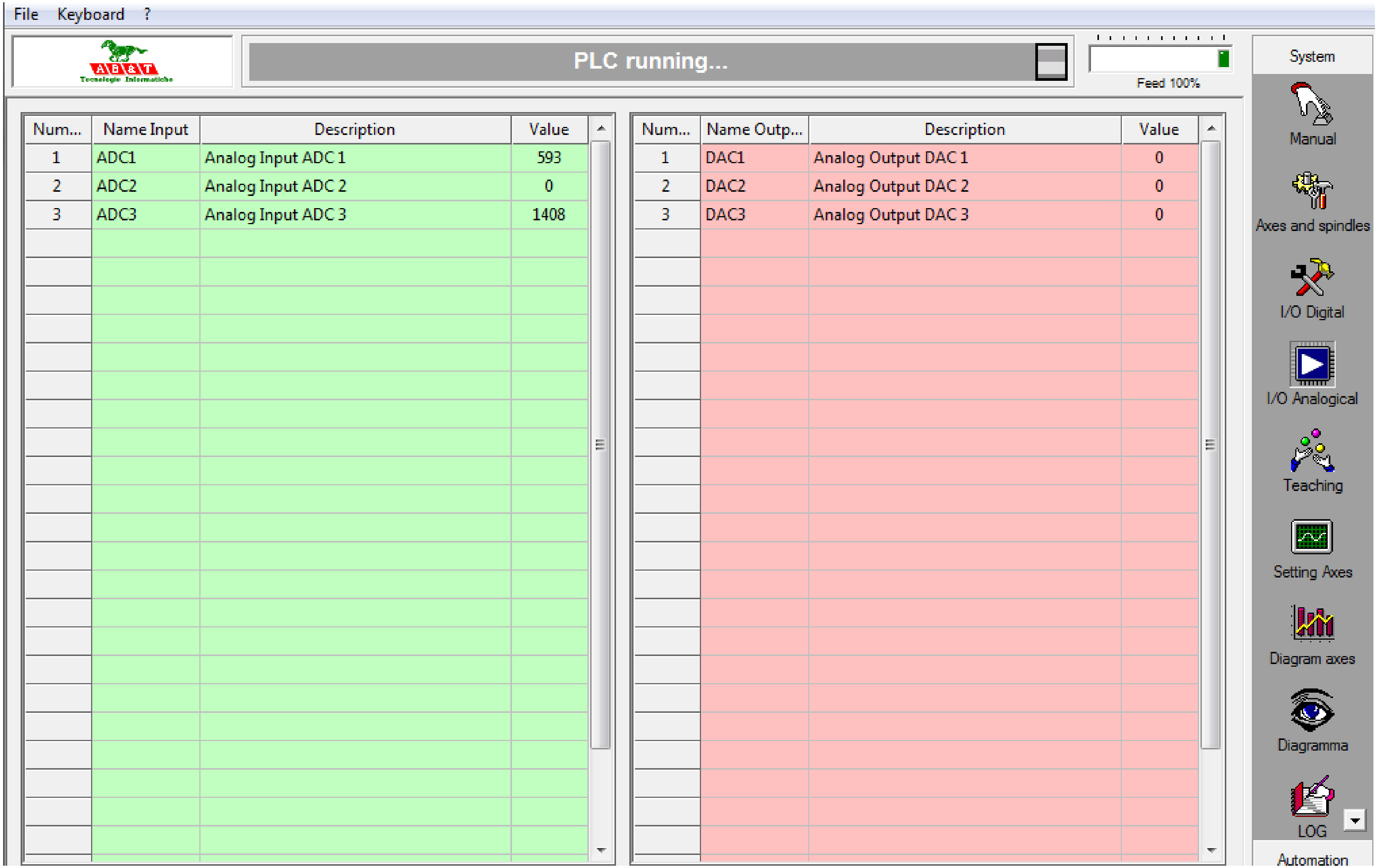


Num...	Name Input	Description
401	○ OKMovAxi...	OK to move X1 axis
402	○ OKMovAxi...	OK to move Y1 axis
403	○ OKMovAxi...	OK to move Z1 axis
404	○ OKMovAxi...	OK to move X2 axis
405	○ OKMovAxi...	OK to move Y2 axis
406	○ OKMovAxi...	OK to move Z2 axis
600	○ LAM_SK1_1	Menu 1 - Soft Key 1
601	○ LAM_SK2_1	Menu 1 - Soft Key 2
602	○ LAM_SK3_1	Menu 1 - Soft Key 3
603	○ LAM_SK4_1	Menu 1 - Soft Key 4
604	○ LAM_SK5_1	Menu 1 - Soft Key 5
605	○ LAM_SK6_1	Menu 1 - Soft Key 6
606	○ LAM_SK7_1	Menu 1 - Soft Key 7
607	○ LAM_SK8_1	Menu 1 - Soft Key 8
608	○ LAM_SK1_2	Menu 2 - Soft Key 1
609	○ LAM_SK2_2	Menu 2 - Soft Key 2
610	○ LAM_SK3_2	Menu 2 - Soft Key 3
611	○ LAM_SK4_2	Menu 2 - Soft Key 4
612	○ LAM_SK5_2	Menu 2 - Soft Key 5
613	○ LAM_SK6_2	Menu 2 - Soft Key 6
614	○ LAM_SK7_2	Menu 2 - Soft Key 7
615	○ LAM_SK8_2	Menu 2 - Soft Key 8
616	○ LAM_SK1_3	Menu 3 - Soft Key 1
617	○ LAM_SK2_3	Menu 3 - Soft Key 2
618	○ LAM_SK3_3	Menu 3 - Soft Key 3



Num...	Name Output	Description
301	○ M1.1	Merker M1
302	○ M1.2	Merker M1
303	○ M1.3	Merker M1
304	● M1.4	Merker M1
305	○ M1.5	Merker M1
306	○ M1.6	Merker M1
307	○ M1.7	Merker M1
308	○ M1.8	Merker M1
309	○ M1.9	Merker M1
310	○ M1.10	Merker M1
311	○ M1.11	Merker M1
312	○ M1.12	Merker M1
313	○ M1.13	Merker M1
314	○ M1.14	Merker M1
315	○ M1.15	Merker M1
316	○ M1.16	Merker M1
317	○ M2.1	Merker M2
318	○ M2.2	Merker M2
319	○ M2.3	Merker M2
320	○ M2.4	Merker M2
321	○ M2.5	Merker M2
322	○ M2.6	Merker M2
323	○ M2.7	Merker M2
324	○ M2.8	Merker M2
325	○ M2.9	Merker M2

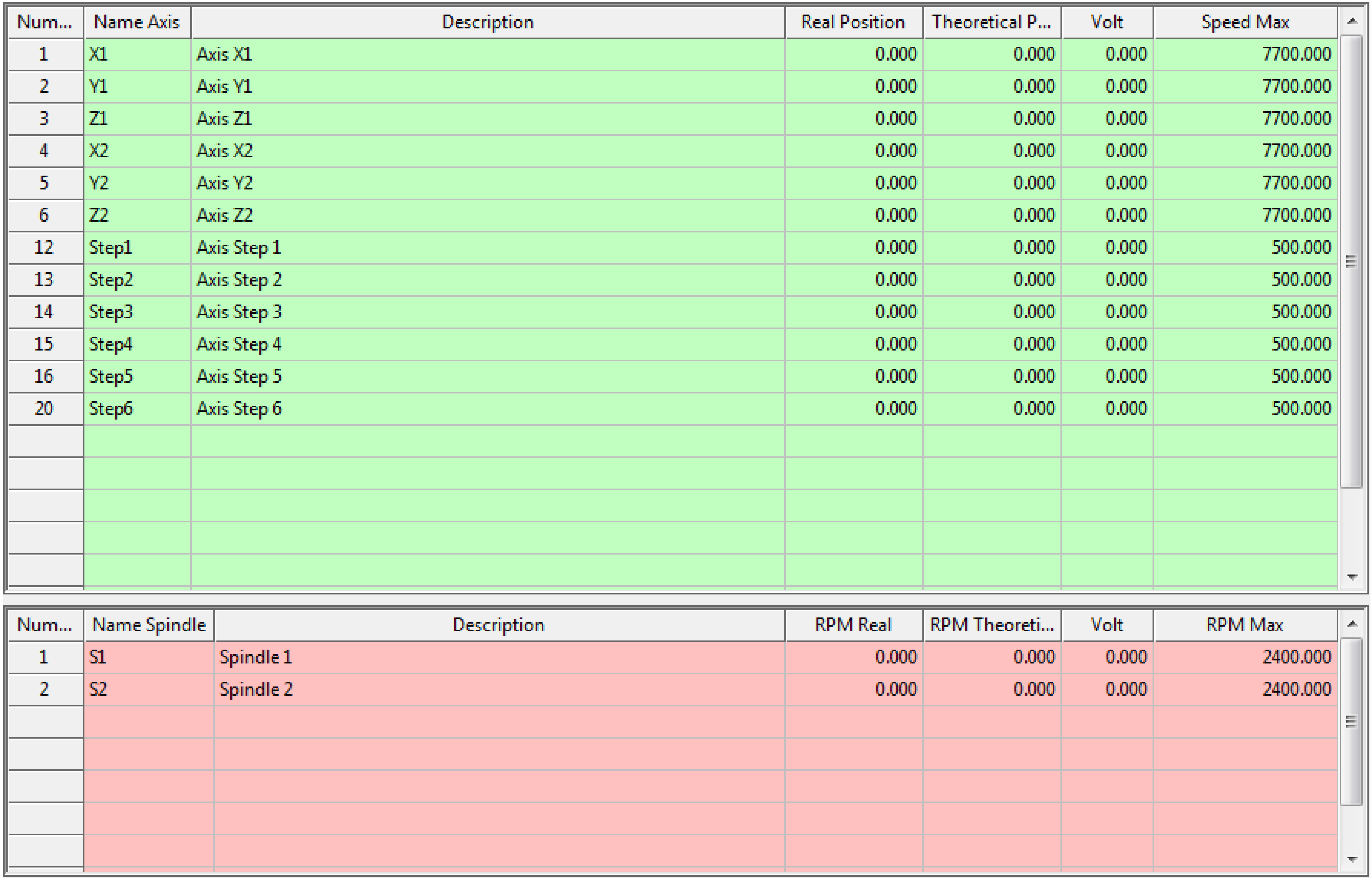
Analog input and output



Num...	Name Input	Description	Value
1	ADC1	Analog Input ADC 1	593
2	ADC2	Analog Input ADC 2	0
3	ADC3	Analog Input ADC 3	1408

Num...	Name Outp...	Description	Value
1	DAC1	Analog Output DAC 1	0
2	DAC2	Analog Output DAC 2	0
3	DAC3	Analog Output DAC 3	0

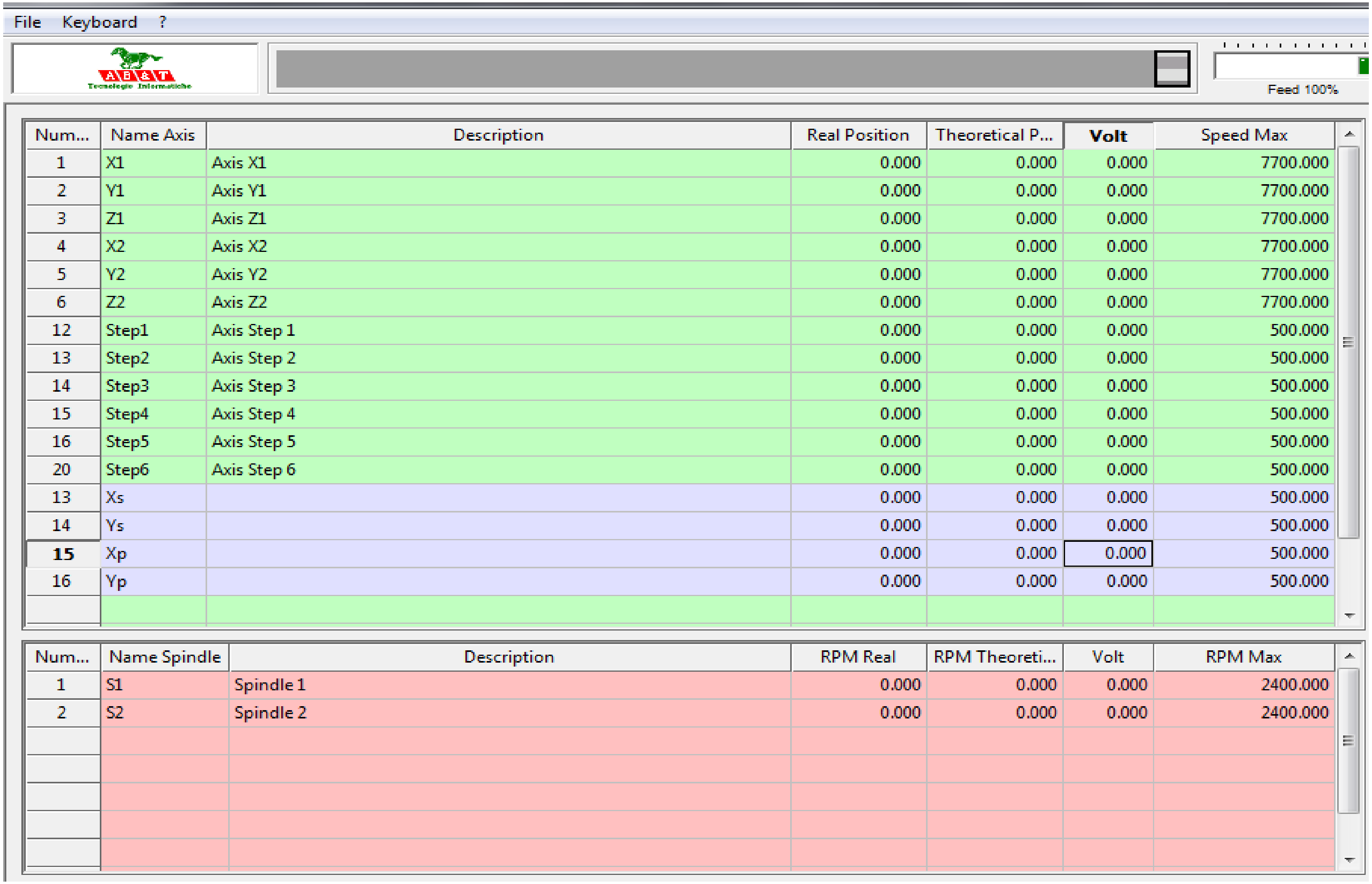
Physical axes and Spindles



Num...	Name Axis	Description	Real Position	Theoretical P...	Volt	Speed Max
1	X1	Axis X1	0.000	0.000	0.000	7700.000
2	Y1	Axis Y1	0.000	0.000	0.000	7700.000
3	Z1	Axis Z1	0.000	0.000	0.000	7700.000
4	X2	Axis X2	0.000	0.000	0.000	7700.000
5	Y2	Axis Y2	0.000	0.000	0.000	7700.000
6	Z2	Axis Z2	0.000	0.000	0.000	7700.000
12	Step1	Axis Step 1	0.000	0.000	0.000	500.000
13	Step2	Axis Step 2	0.000	0.000	0.000	500.000
14	Step3	Axis Step 3	0.000	0.000	0.000	500.000
15	Step4	Axis Step 4	0.000	0.000	0.000	500.000
16	Step5	Axis Step 5	0.000	0.000	0.000	500.000
20	Step6	Axis Step 6	0.000	0.000	0.000	500.000

Num...	Name Spindle	Description	RPM Real	RPM Theoreti...	Volt	RPM Max
1	S1	Spindle 1	0.000	0.000	0.000	2400.000
2	S2	Spindle 2	0.000	0.000	0.000	2400.000

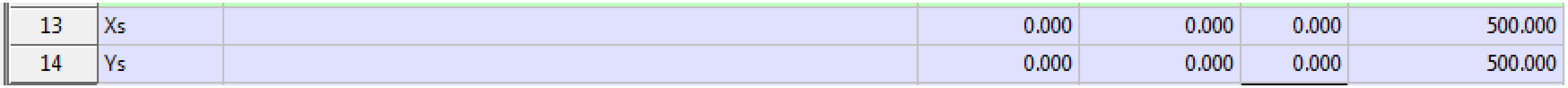
Physical, virtual axes and Spindles



Num...	Name Axis	Description	Real Position	Theoretical P...	Volt	Speed Max
1	X1	Axis X1	0.000	0.000	0.000	7700.000
2	Y1	Axis Y1	0.000	0.000	0.000	7700.000
3	Z1	Axis Z1	0.000	0.000	0.000	7700.000
4	X2	Axis X2	0.000	0.000	0.000	7700.000
5	Y2	Axis Y2	0.000	0.000	0.000	7700.000
6	Z2	Axis Z2	0.000	0.000	0.000	7700.000
12	Step1	Axis Step 1	0.000	0.000	0.000	500.000
13	Step2	Axis Step 2	0.000	0.000	0.000	500.000
14	Step3	Axis Step 3	0.000	0.000	0.000	500.000
15	Step4	Axis Step 4	0.000	0.000	0.000	500.000
16	Step5	Axis Step 5	0.000	0.000	0.000	500.000
20	Step6	Axis Step 6	0.000	0.000	0.000	500.000
13	Xs		0.000	0.000	0.000	500.000
14	Ys		0.000	0.000	0.000	500.000
15	Xp		0.000	0.000	0.000	500.000
16	Yp		0.000	0.000	0.000	500.000

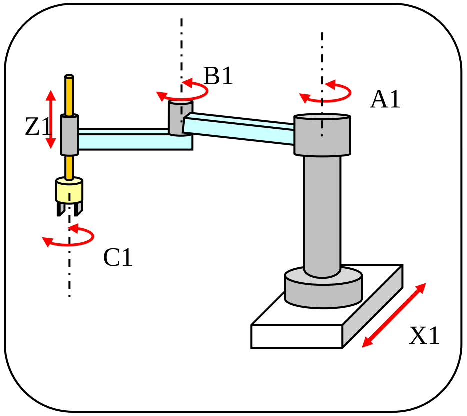
Num...	Name Spindle	Description	RPM Real	RPM Theoreti...	Volt	RPM Max
1	S1	Spindle 1	0.000	0.000	0.000	2400.000
2	S2	Spindle 2	0.000	0.000	0.000	2400.000

Virtual axes for SCARA

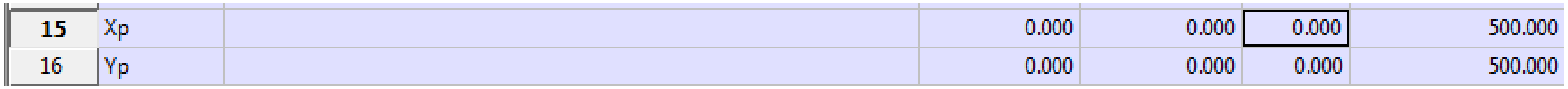


13	Xs		0.000	0.000	0.000	500.000
14	Ys		0.000	0.000	0.000	500.000

```
[Xs]
i=VIRTUAL_AXES_NAME( "Xs" , "Ys" )
b={
Description="SCARA"
Kind_Axis="ARM"
Kind_Axis_0=0x00010000            // Type SCARA Kind_Axis_1=0x00000000
Axis_name_ascisse="Xs"
Axis_name_ordinate="Ys"
Axis_name_1=“Step1"         // A1 AXIS ANGLE ARM
Axis_name_2=“Step2"         // B1 AXIS ANGLE FOREARM
Axis_name_3=“Step3"         // C1 AXIS  ROTARY (PULSE)
Axis_name_4=""              // X1  ADDITIONAL AXIS MOTION
Lenght_arm_1=200.0
Lenght_arm_2=200.0
Abs_offset_A=100.0
Vel_max_axis_A=20000.0
Acc_max_axis_A=200.0
Dec_max_axis_A=200.0
Abs_offset_O=100.0
Vel_max_axis_O=20000.0
Acc_max_axis_O=1000.0
Dec_max_axis_O=1000.0
e=}
```

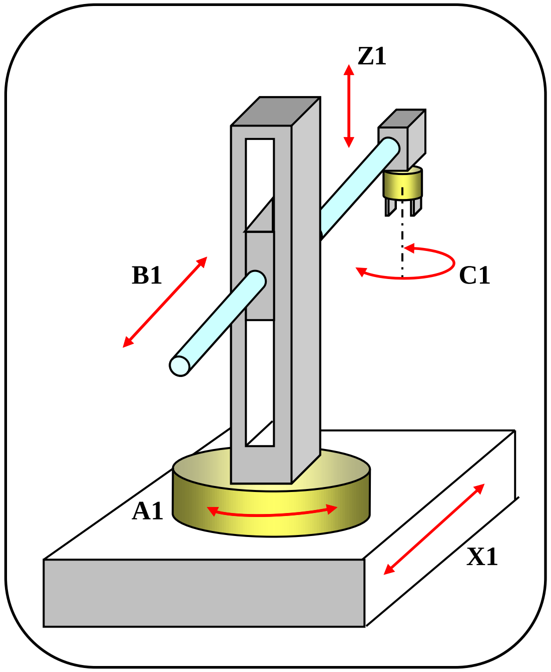


Virtual axes for CYLINDRICAL

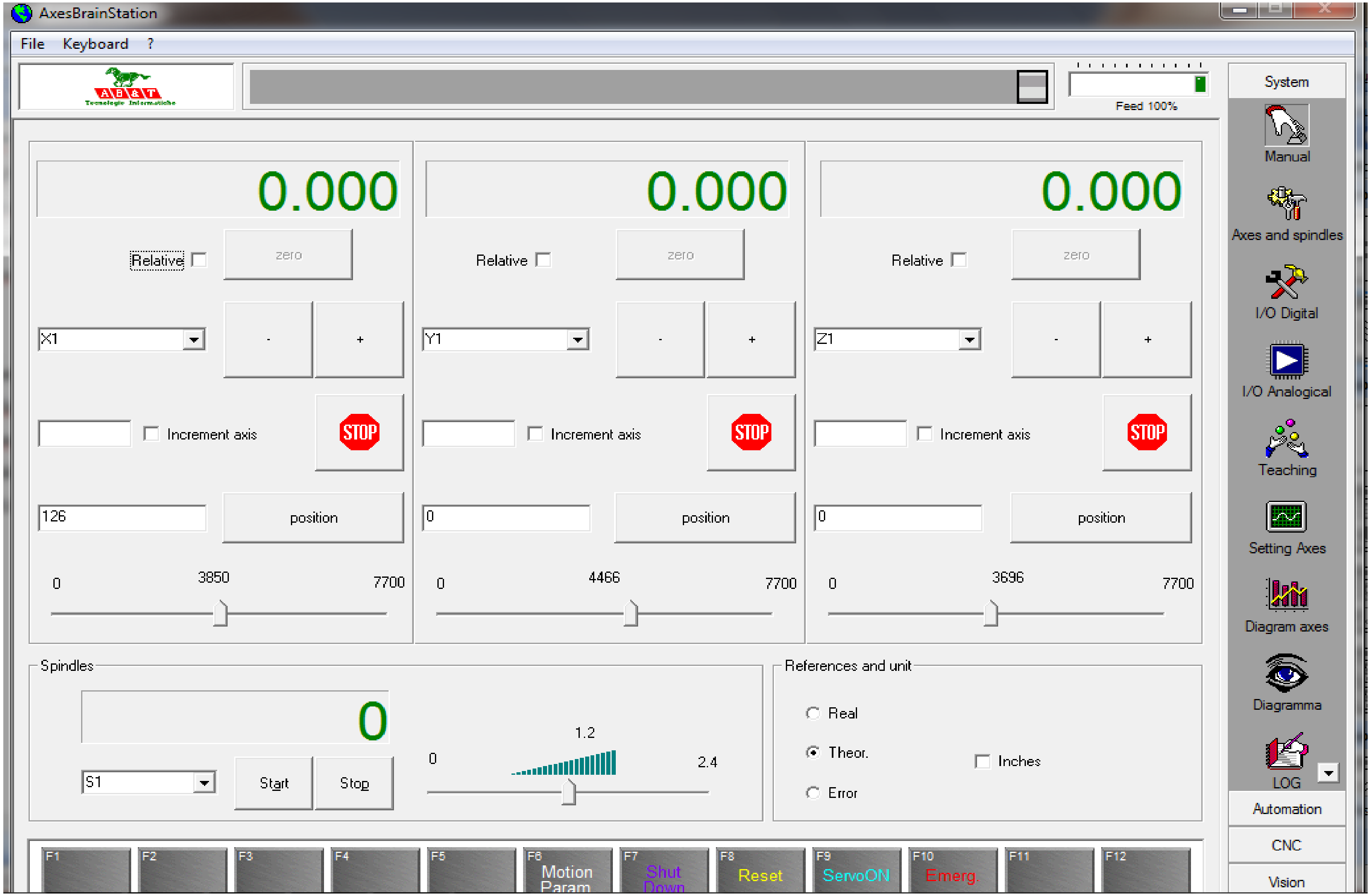


15	Xp		0.000	0.000	0.000	500.000
16	Yp		0.000	0.000	0.000	500.000

```
[Xp]
i=VIRTUAL_AXES_NAME( "Xp" , "Yp" )
b={
Kind_Axis="ARM"
Kind_Axis_0=0x00080000       // CYLINDRICAL SLEEVE
Kind_Axis_1=0x00000000
Axis_name_ascisse="Xc"
Axis_name_ordinate="Yc"
Axis_name_1=“Step4"          // A1  AXIS ANGLE ARM
Axis_name_2=“Step5"          // B1 AXIS LINEAR  (SLEEVE)
Axis_name_3=“Step6"          // C1 AXIS  ROTARY (PULSE)
Axis_name_4=""               // X1 ADDITIONAL AXIS MOTION
Lenght_arm_1=000.0
Lenght_arm_2=200.0
Abs_offset_A=150.0
Vel_max_axis_A=50000.0
Acc_max_axis_A=1000.0
Dec_max_axis_A=1000.0
Abs_offset_O=100.0
Vel_max_axis_O=50000.0
Acc_max_axis_O=1000.0
Dec_max_axis_O=1000.0
e=}
```



Manual system motion axes



AxesBrainStation

Feed 100%

	X axis	Y axis	Z axis
Display	0.000	0.000	0.000
Relative	□	□	□
Axis	X1	Y1	Z1
Increment axis	□	□	□
Position	126	0	0
Slider	0 – 3850 – 7700	0 – 4466 – 7700	0 – 3696 – 7700

Spindles: 0, S1, slider 0 – 1.2 – 2.4

References and unit: ○ Real ● Theor. ○ Error □ Inches

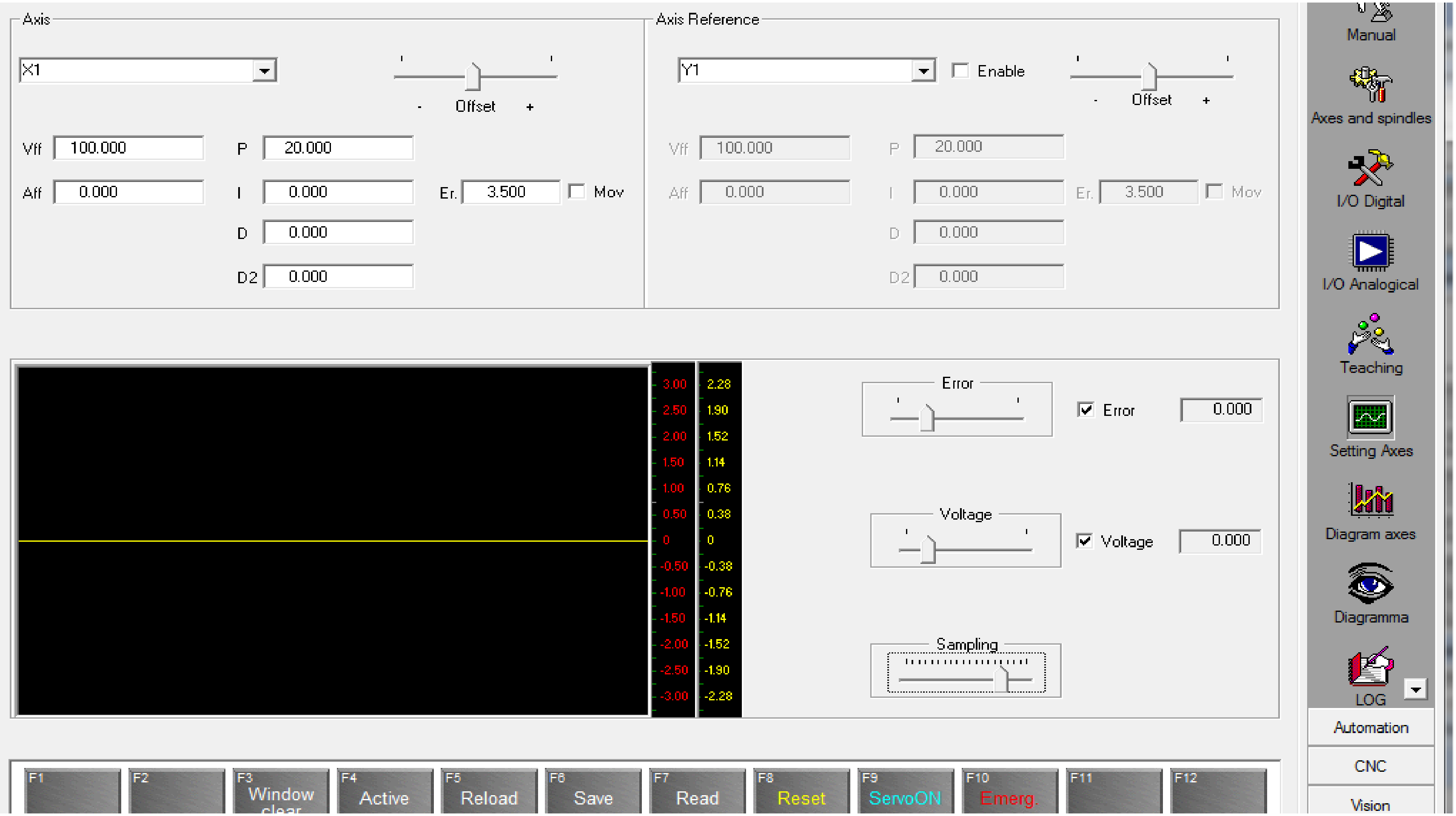
Setting axes +-10Volt PID

The analog +-Volt is a velocity reference, the error of position is used to correct the velocity by PID feedback .

1) Proportional error
2) Integrative error
3) Derivative error

Volt= Kc*(P*error+I*Sum of errors+D*Variation of error)

PID Calibration



Axis

X1

Vff 100.000

P 20.000

Aff 0.000

I 0.000

Er. 3.500 ☐ Mov

D 0.000

D2 0.000

Axis Reference

Y1 ☐ Enable

Vff 100.000

P 20.000

Aff 0.000

I 0.000

Er. 3.500 ☐ Mov

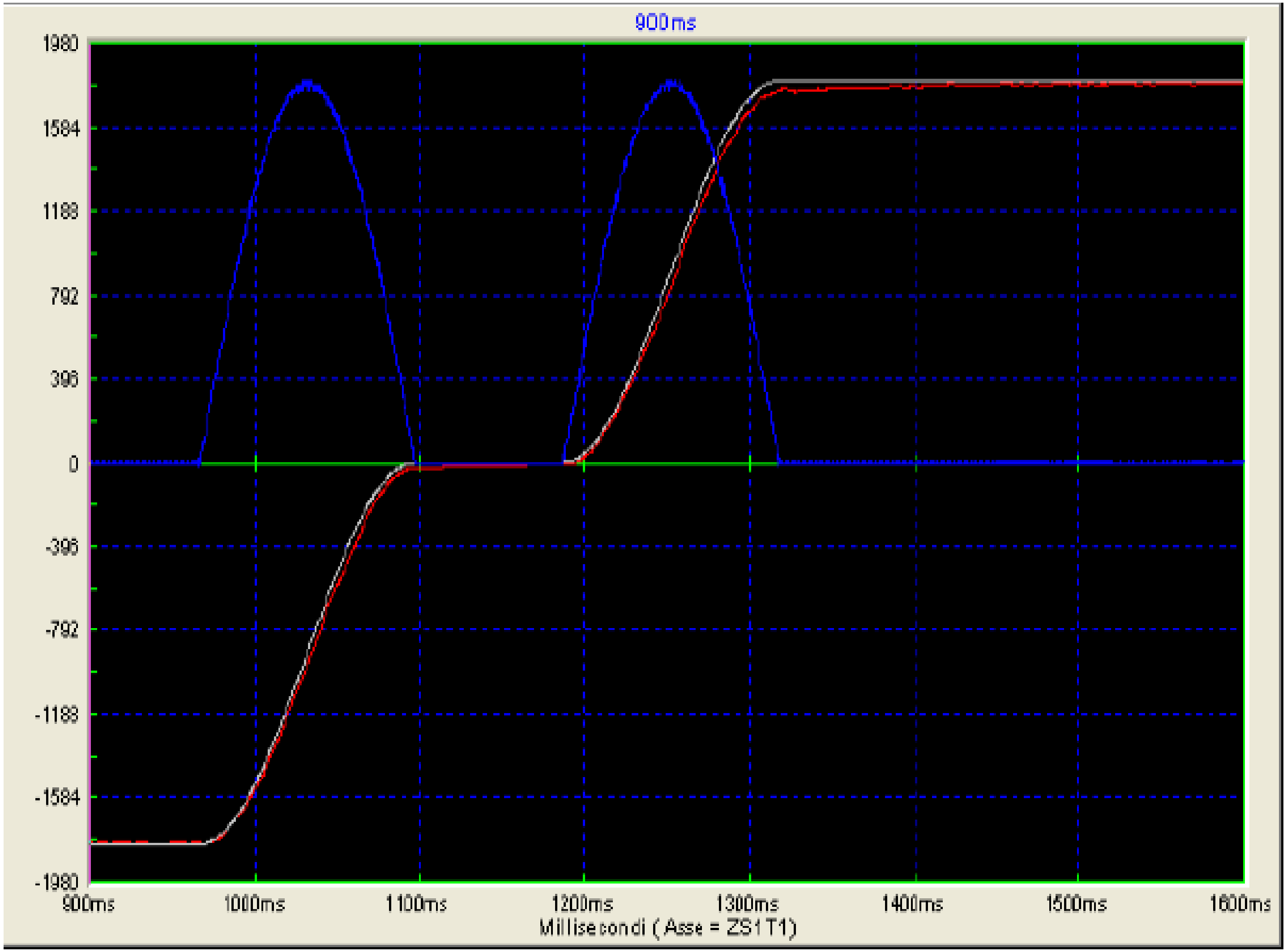
D 0.000

D2 0.000

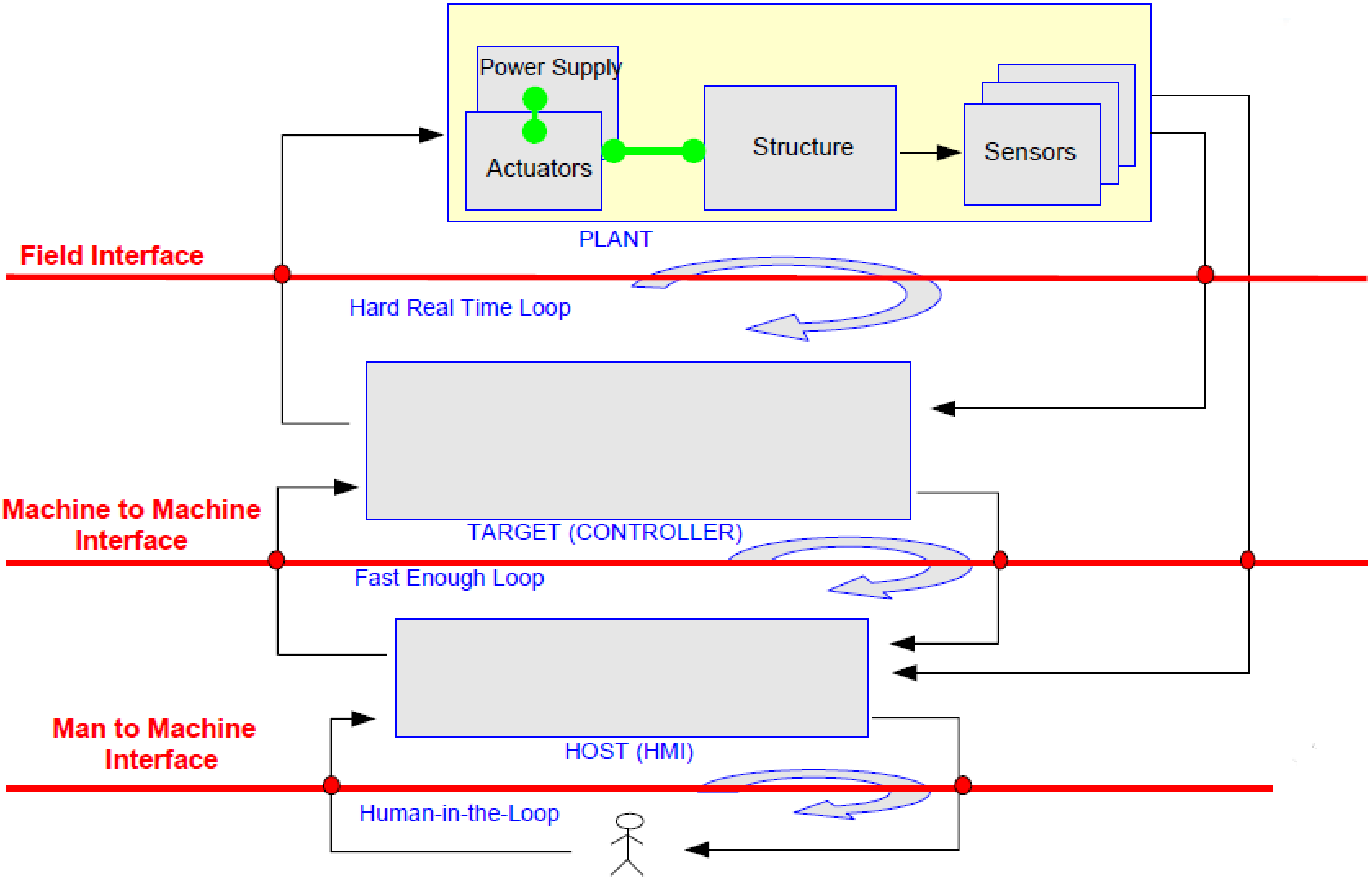
☑ Error 0.000

☑ Voltage 0.000

Chart for an axis



Structure mechatronics

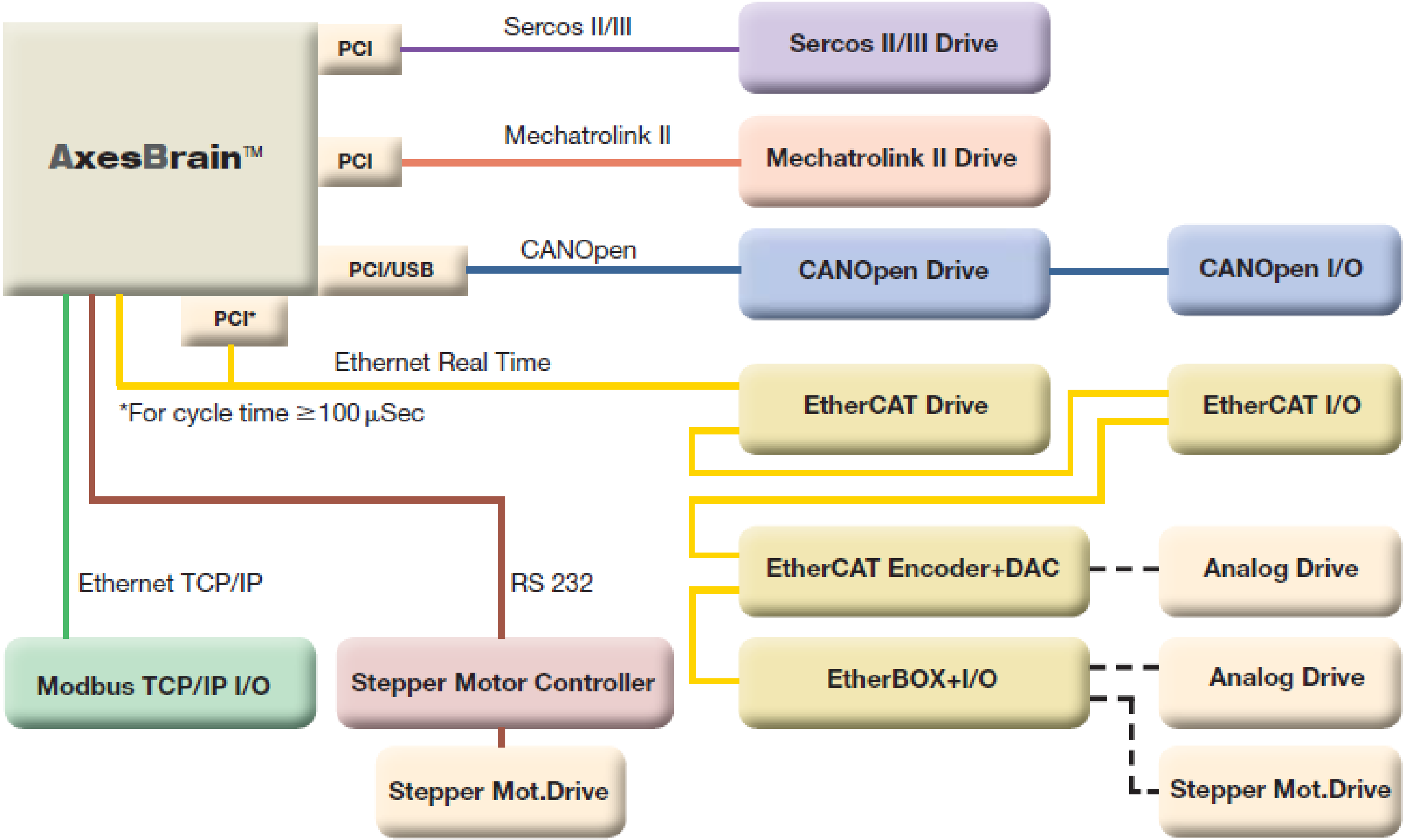


Types of openings

Open top to bottom:
Ability to use the most common fieldbus and drive both analog and digital (fieldbus interface)

Opening up:
possibility of using high level languages to create their own user interface (Man-to-machine interface)

Open top to bottom



Opening up

The Distributed Component Object Model (DCOM known by the acronym, English for distributed component object model) is a computer technology introduced by Microsoft in 1996.

DCOM allows you to make remote procedure calls across a network, taking care of all the mediations necessary, independently of the language, presents to the application of specific services, which in general can be used by applications "Customers" on the same PC or PC remote.
You can then use languages like VC + +, VB, C #. Net, etc ... to create their own HMI

AxesBrain™
One mind, many tasks at once

AxesBrain ™ is a software component for the motion control, with Multitask capabilities for automation and Multiprocess capabilities for the CNC

The winning of AxesBrain ™ is its ability to handle multiple processes, multiple axes and multiple tasks in parallel.
In fact you can run to 32 fi CNC ISO processes simultaneous and activities up to 1024 GP-PLC simultaneously.
These are particularly useful feature for transfer, machines with automatic loading-unloading and special machines in general, where processes are required parallel working.

AxesBrain ™ is a control designed to connect to all major fieldbus handling axis and the management of I / O.
It also connects in digital mode by ethernet to drive analog.This flexibility offers a wide choice that guarantees a reduction in costs.

AxesBrain™ features

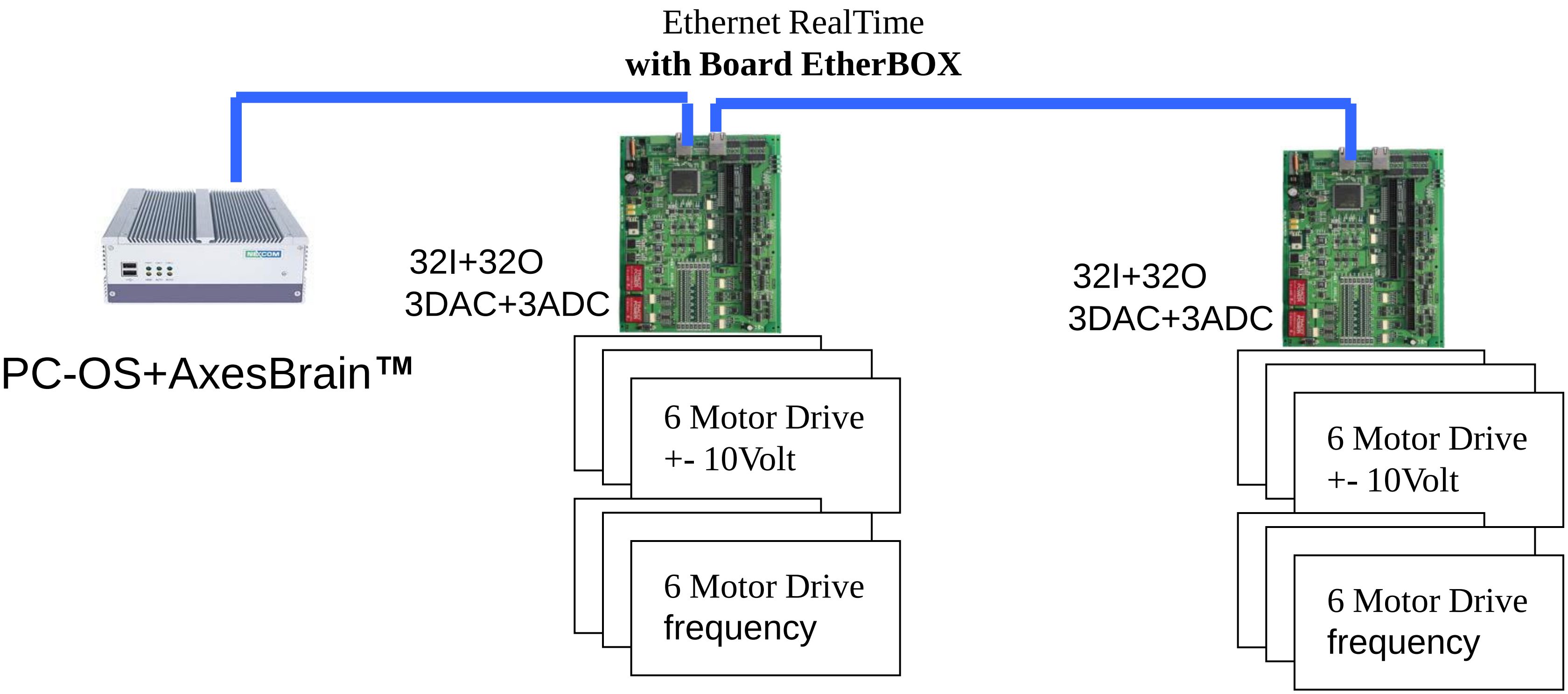
- CNC-ISO (milling, lathe)
- 1024 GP-PLC Tasks
- ISO 32 CNC Processes
- Transformation axes in the plane
- 64 axes (16 axes interpolated)
- 4096 I / O
- Linear compensation, quadrature, matrix
- Gantry
- Anti-collision
- Electronic Cam

Realtime Ethernet technology

The technology is based on a few points:

1) For the wiring you use the Ethernet cable
2) The master (typically a PC) transmits and receives an Ethernet frame using the "standard" the concept of frame is the same as when it transmits and receives information on the Internet Traditional
3) The slave devices do not receive and retransmit the frame next to the slave, but they see him pass.
4) Finally, the FRAME returns to the Master who receives the complete data of all slaves.

How to combine the traditional world with the Ethenet RealTime solution



Ethernet RealTime
with Board EtherBOX

PC-OS+AxesBrain™

32I+32O
3DAC+3ADC

6 Motor Drive
+- 10Volt

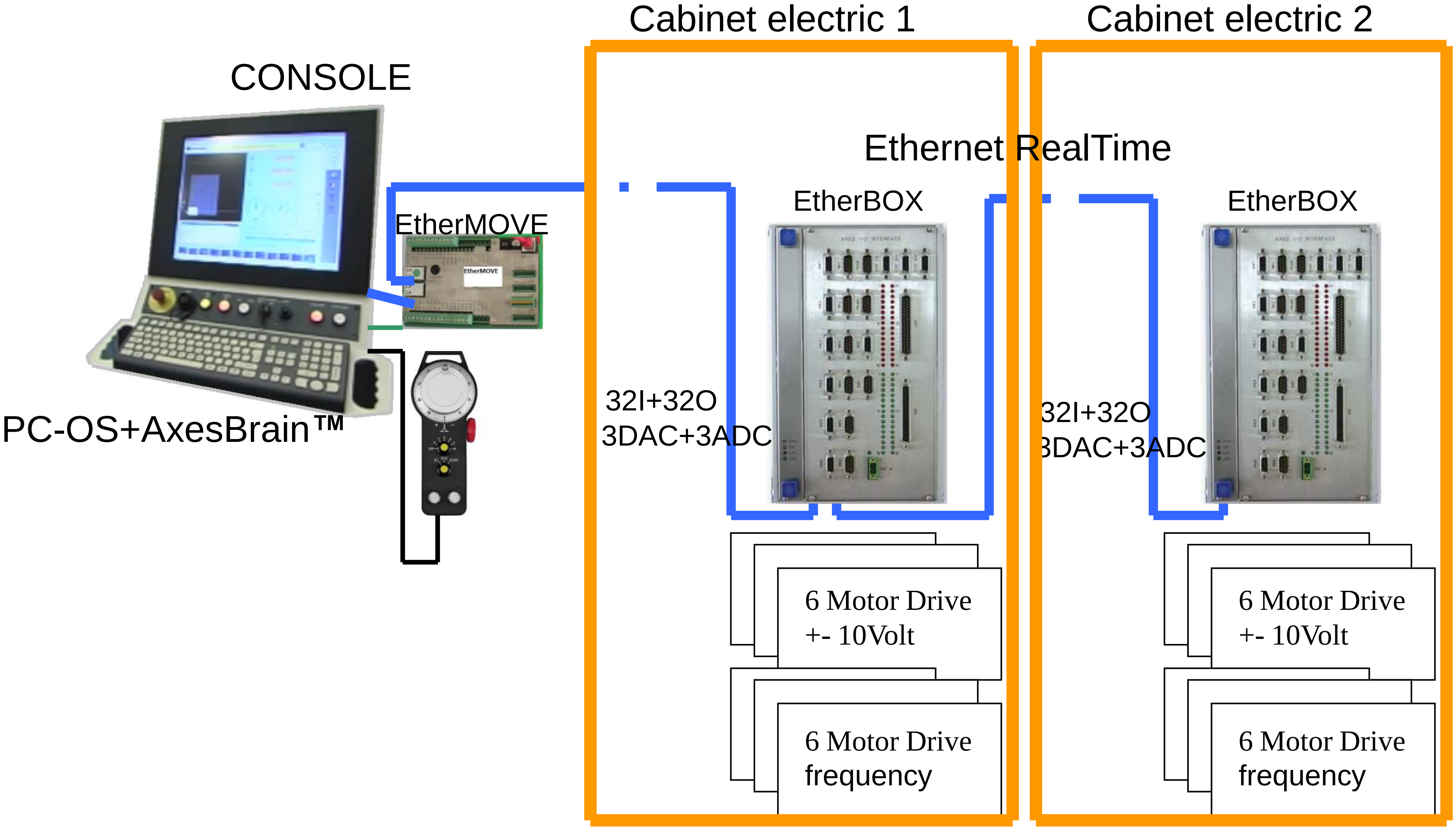
6 Motor Drive
frequency

32I+32O
3DAC+3ADC

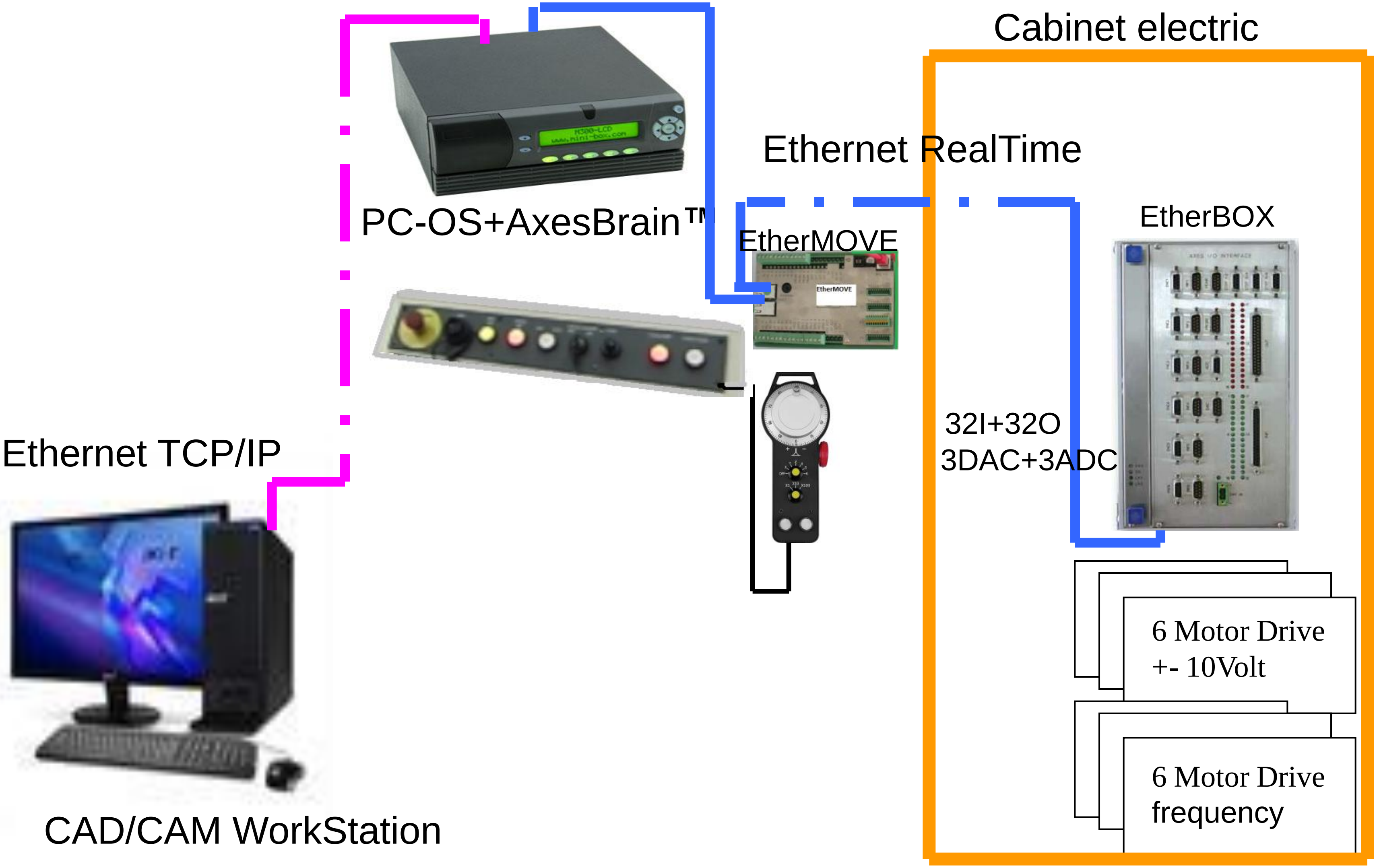
6 Motor Drive
+- 10Volt

6 Motor Drive
frequency

PanelPC + Ethernet RealTime



WorkStation +AxesBrain™ + Ethernet RealTime



Cabinet electric

PC-OS+AxesBrain™

Ethernet RealTime

EtherMOVE

EtherBOX

Ethernet TCP/IP

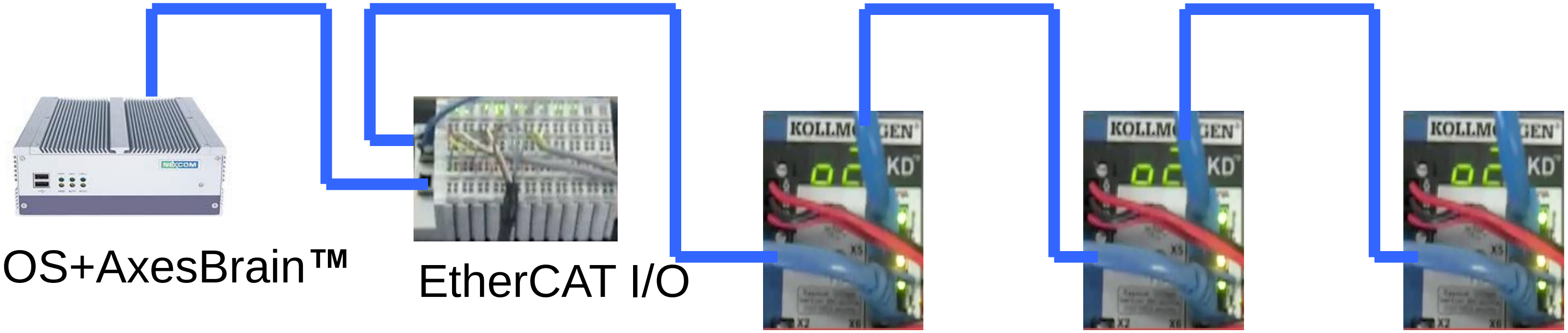
32I+32O
3DAC+3ADC

6 Motor Drive
+- 10Volt

6 Motor Drive
frequency

CAD/CAM WorkStation

EtherCAT communication standard Ethernet RealTime



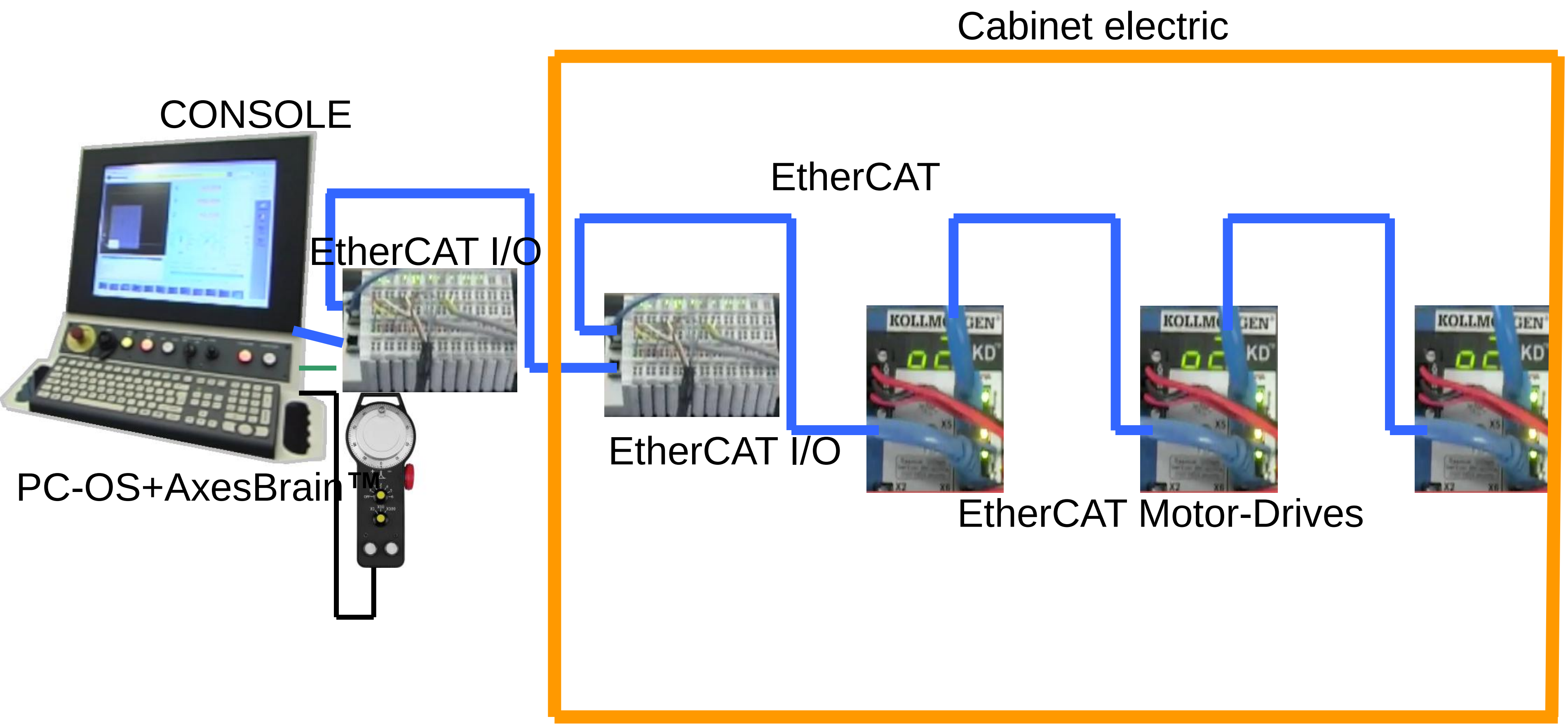
EtherCAT

PC-OS+AxesBrain™

EtherCAT I/O

EtherCAT Motor-Drives

PanelPC + EtherCAT



Cabinet electric

CONSOLE

EtherCAT

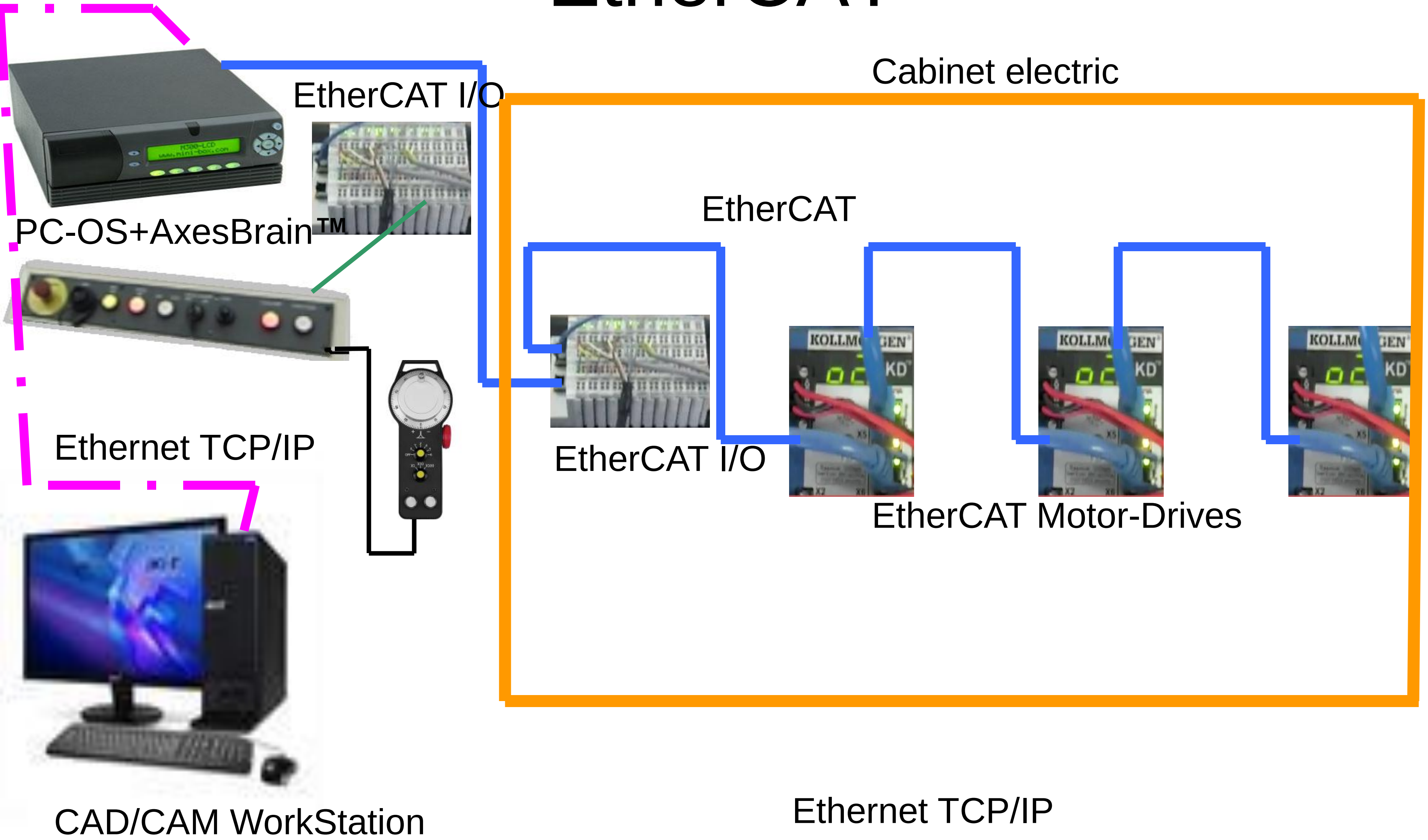
EtherCAT I/O

EtherCAT I/O

PC-OS+AxesBrain™

EtherCAT Motor-Drives

WorkStation +AxesBrain™ + EtherCAT



Ethernet TCP/IP

PROGRAMMING LANGUAGES

There are two types of languages:

Those oriented to the programming of the machine
PLC (Programmable Logic Controller), of which there are several types, some standards (IEC 61131-3), owners of other manufacturer, are used to program the functionality of the machine.
This language must be known by the applicator or the manufacturer's
GP-PLC is AxesBrain ™ programming language of the machine

Those oriented to the programming of the workpiece
ISO CNC G code has also said a common part to all controls G0, G1, G2, G3, G4 + a specific part for each manufacturer which is home to parametric test functions and subroutines, canned cycles, macros, etc. ...
This language must be known by the operator of the machine.

Language GP-PLC

It 'a proprietary language type IL (Instruction List), multitasking oriented axis movement.

For the management of type AWL PLC I / O, possibility to integrate the functions of vision VisAlgo ™.

It has the event management for synchronizing tasks

Provides message management for HMI

Language ISO-CNC G-Code

ISO CNC G code has also said a common part to all controls G0, G1, G2, G3, G4 + a specific part for each manufacturer which is home to parametric test functions and subroutines, canned cycles, macros, etc. ...

This language is used by the operator of the machine, program the machining of the part defining the tool path, the cycles that the machine must be done in several phases.

The name that identifies the location of the axes are: X Y Z A B C U V W

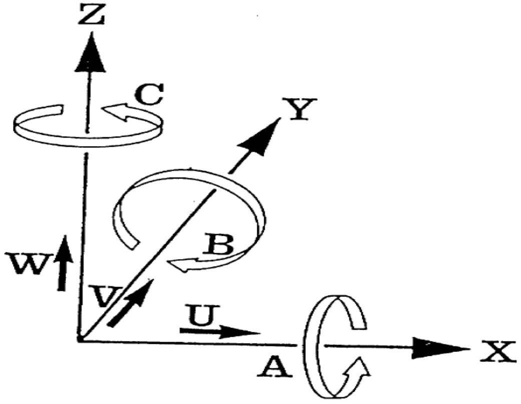


Image Processing

The cameras are in the world of the ideal solutions for some problems, let's see in detail.

1) Increase the precision of the machine through two measures

The number one trick is to make the work known through a grid, detected by video camera on a work sample

The trick number two is to mount a camera on each machine or more, to acquire two or more references on a piece placed on the equipment, so you know the real translation to be performed on the rotary machining program.

2) Checking the upstream and recognition of parts prior to machining

3) Control of downstream parts after machining

Vision System ™ VisAlgo

VisAlgo ™ is a library of functions for the recognition
and image processing

STRATEGIES FOR RECOGNITION OF OBJECTS

PATTERN MATCHING

Within an image
is searched for any
a figure learned previously,
even if rotated
than the original.

BLOB ANALYSIS

In the picture are
detected by contrast
any figure,
that you can
to calculate the center of gravity,
area, perimeter, roundness
and orientation
in the plan.

EDGE DETECTION

It is able to recognize
edges and these
figures
obtain the properties
such as thickness,
center,
rays and orientation
in the plan.

Integration with the vision

Image acquisition

Rectangles of pixels
640 x 480 768 x 574 1240 x 1000 ... .

To define a ROI

Determine the BLOB

Extract the geometric features

Pull out the figures to a similar sample (Pattern-maching)

Pull out the characteristics of position coordinates and angle

Pixels / mm

Program the "vision" through –ARI (GP-PLC) or by DLL Application

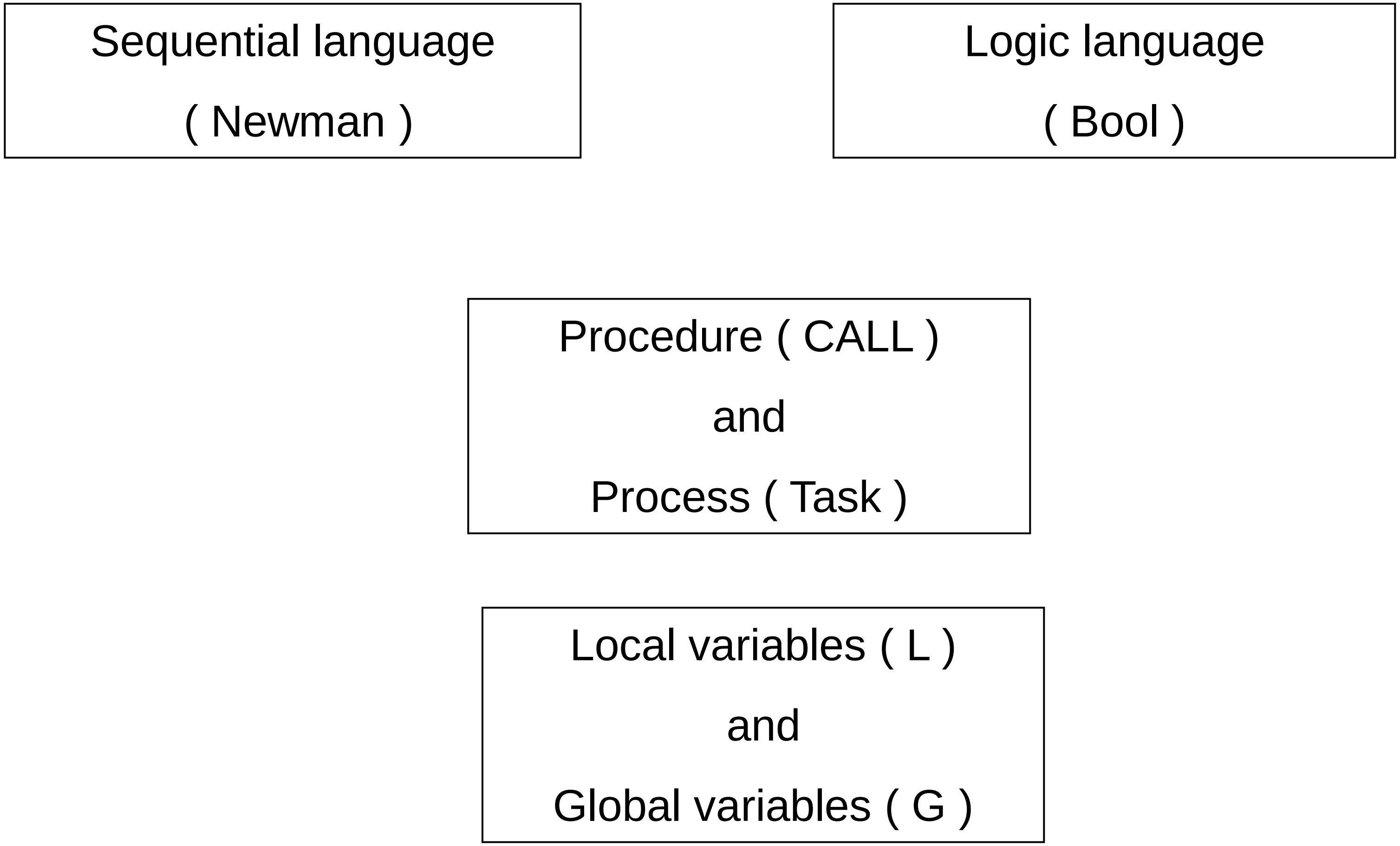
Programming language for automation GP-PLC

To describe the work cycle of a manipulator or an automatic you need a language capable of learning how to evolve the phases. There are many programming languages, most of them are "owners" of the company. The specific language that must have are multiple, parallel programming phases, synchronization between the activities planned, high integration with external devices (vision, laser, etc.).

Born from the specific CODE (LANGUAGE SIGMA) 1976 Olivetti, one of the first programming languages of special machines for assembly of parts, has been expanded to meet the modern needs of integration and flexibility. Reference to: "Robot Technology at Olivetti: the sigma system" Olivetti, Milan 1976.

One of his prerogative beyond the simple syntax is the ability to have the multiprogramming each cycle, the prerogative to perform essential tasks of assembly and manipulation of parts.

The structure of GP-PLC



Sequential language

(Newman)

Logic language

(Bool)

Procedure (CALL)

and

Process (Task)

Local variables (L)

and

Global variables (G)

How Start first GP-PLC

When AxesBrainServer start on PC automaticly start also an GP-PLC program is loaded and running, the name is found in “SISTEMA.TXT” in DAT directory.
In segment: [ParametriAUTOMAZIONE]
and parameter : NomePartProgramLancio=

Example

```
[ParametriAUTOMAZIONE]
StringaLancio=
NomePartProgramLancio=LogicaMacc.PP
```

In this case LogicaMacc.PP is loaded and runnig:

```
Loop        -TMM/100
            -NET/1
            -LDN/T1
            -TON/2,1000

            -NET/2
            -LD/T2
            -TON/1,1000

            -NET/3
            -LD/T2
            -PEX/-DIS/11,10:PLC running...
            -NOT
            -PEX/-DIS/11,10:
            -JMP/Loop
            -RET
```

Architecture GP-PLC

The architecture of the sub-system automation is the ability to perform the work cycles in parallel with synchronizing events.

Each program has its own internal proprietary area where **local variables** are allocated, which among other things, the call parameters are stored.
When the program is put into execution, by an explicit command or called by a CALL instruction or TSK, its source code is loaded into memory and automatically pre-filled, will remain in memory until an explicit command or command to delete subsystem RESET.

The programs are combined with a work owner HANDLER on which hang all the activities of the cycle, we have an almost infinite number of handlers, with this mode you can have very flexible plant configuration, such as lines of robots, machines, special multi-head, loading and unloading machines with integrated, multifunctional machines, etc.

Syntax of GP-PLC language

The language syntax is very simple a triletterale preceded by a "-" represents the instruction, a "/" is the delimiter from the parameters of instruction which can be:

1. Direct references to GLOBAL or LOCAL variables
2. Indirect references to global GLOBAL or LOCAL variables
3. Numeric expressions with references to GLOBAL or LOCAL variables
4. Mathematical expressions with references to GLOBAL or LOCAL variables
5. LABEL jump
6. Names of resources axes, spindles, input and output

The parameters are separated by commas.
The labels or label for conditional or unconditional jumps are placed before the separator "-“ instruction.
Comments are preceded by a semicolon ";"
[Label]-XXX / [parameter 1], ... [n parameter] [; this is a comment]
You can comment on multiple lines using "/ *" at the beginning of the commentary and "* /" at the end of the

Example of Syntax GP-PLC

```
            -LET/L1,500.089              ; Load value 500.089  in LOCAL variable L1
            -LET/G100,0                  ; Load value 0  in GLOBAL variable G100
BeginCount-                              ; LABEL BeginCount
            -LET/G100,G100+11.23         ; Adds the value 11.23 to the variable G100
            -JLT/G100,L1,BeginCount      ; Continue adding until the value
                                         ; of the G100 is not equal to or greater than
                                         ; indicated in L1 (500.089)

; We use the indirect method to address the Global 100

            -LET/L2,100                  ; Load value 100  in LOCAL variable L2

            -LET/G(L2),0                 ; Load value 0  in GLOBAL variable G100
BeginCB-                                 ; LABEL BeginCB
            -LET/G(L2),G(L2)+11.23       ; Adds the value to the variable G100 11.23
            -JLT/G(L2),L1,BeginCB        ; Continue adding until the value
                                         ; of the G100 is not equal to or greater than
                                         ; indicated in L1 (500.089)
```

Mathematical operators

+ sum
- subtraction
/ division
* multiplication
^ high
(Open bracket
) Parenthesis

Mathematical expressions have the following functions

abs	Absolute numbers
acos	Arc cosine
and	And boolean
asin	Arc sine
atan	Arc tangent
atanw	Arc tangent of Y, X
ceil	Rounding up a decimal to an integer
cos	Cosine
cosh	Hyperbolic cosine
deg	Transformation in degrees of an angle in radians
exp	Exponential
floor	Rounding down floor of a decimal number
logd	Decimal logarithm
logn	Natural logarithm
lshift	Shift to the left of a number
max	Maximus
min	Minimum
mod	Module of two numbers
not	Not boolean
or	Or boolean
pi	PI greek
rad	Transformation in radians of an angle expressed in degrees
rshift	Shift to the right of a number
sin	Sine
sinh	Hyperbolic sine
sqr	Square root
tan	Tangent
tanh	Hyperbolic tangent
xor	Exclusive Or boolean

Example of mathematical expression

```
-LET/L1, max (sin (rad (G1 +12), cos (rad (+12 G1 * L1/56))
; The local variable is loaded the result of L1 expression:
; max (sin (rad (G1 +12), cos (rad (+12 G1 * L1/56))
```

Note

The numbers are in hexadecimal preceded by 0x

Example:

```
-LET/L1, 0x10     ;  0x10 = 16 decimal
```

The use of the operator hexadecimal "0x" is helpful in masking the particolarmerne functions "and" and "or", and then use them later-

Example:

```
-LET/L1, and (L1, 0x8000)
-JEQ/L1, 0x8000, Bit8000Uno
```

Dimensions of the parameters can be called up

GLOBAL	32,767
LOCAL = NumeroLocali configured in the voice of the configuration file "SISTEMA.TXT" (expanded from -DIM/Number LOCAL)	
WATCH	16
DRT	6
DIS	17 lines
Columns DIS	128
NETwork	128 for instance
Timer (T)	128 for instance
Counter (C)	128 for instance

Global and Local variables

In order to perform logical operations, are required to read and write numeric variables.

The sub-system AXESBRAIN provides two types of variables:

LOCAL

GLOBAL

Each program recruits is allocated a number of variables equal to that configured in the system, are all cleared and are available to the instructions of that program, the first variables are set with the call parameters of the command execution , the variables remain in memory available for query and visualization operations.

Local

The number of spaces may be changed from that provided in the "SISTEMA.TXT" to segment [ParametriGenerali] and parameter "NumeroLocali =“.

Using -DIM/numero local education, which is defined only for that instance of the task.

A special case are the programs called by the instructions of "CAL" and "TSK" with parameters in these cases the first local variables are loaded with parameters positional calls in the same order, if there are parameters in the call LOCAL the new value will be loaded with the return of the program called.

-CAL/, routinemia: L9,12,23, G1+89, L7

when the return from "routinemia" L9 and L7 have the value defined in the routine, in this case L9 has a value of 11 and L7 will have a value of 3

In fact, the code "routinemia" is as follows:

-LET/L1, 11

-LET/L5, 3

Upon execution of the local variables of "routinemia" are:

L1 = value of the calling program L9

L2 = 12

L3 = 23

L4 = value of variable 89 + G1

L5 = L7 value of the calling program

Global

Besides the Local variables in the automation system are expected 32767 GLOBAL variables that are invoked with the letter "G" and the number thereof. All are saved to HardDisk GLOBAL, which can then be used to store persistent data.

The Global HardDisk output is stored on the system or procedure "SHUT DOWN" you can still do this with instruction SGL.
The write operation is performed with the Global COMMIT mode to ensure the integrity with the last save.

To index global or local, you can use the parenthesis followed by global or local use as an index.

Example:
And this is an example of indexed programming

```
            -LET/ L1, 1
            -LET/ G (L1), 0
here        -TMM/50
            -JNE / G (L1) 1, here   ; expects the value of global variable G1 is set to 1
```

MultiTask

An important feature in automation is being able to perform multiple tasks together, coordinate with each other or not, so we need to have the functionality of "MULTITASK".

A cycle of activities can be performed with an explicit command, or by an instruction "-TSK", the cycle or program is combined with a business owner HANDLER on which hang all the activities of the cycle, we have an almost infinite number of HANDLER.

A "TASK" can be deleted by another task or itself with the statement "-TKM" or when RESET is performed in the automation system.

The concept of HANDLER is also useful to see it as a channel on which operations are conducted continuously beginning of the movement, movement combinations, until the movements are completed.

Anticollision between axes

With this architecture we are able to see the movement system as a device with several "arms" that work together or not coordinated, dynamically aggregating groups of axes.

An interesting example may be to imagine the filling of a tray of glasses, at an early stage we have two "arms" that fill the glasses separately, the system handles the collision, and so we have two sets of axes which work separately, when the glasses are been filled the system, bringing together the two arms the way a waiter brings the tray to the unloading area.

As first revealed during the filling of glasses, the two arms of the same affecting physical axis X, thanks to the management of collision is possible to program two independent cycles of filling, synchronize the two to complete their respective stages, then program a single cycle drain tray with a unique grouping of the two arms.

Mathematical Instructions

1-LET (SET)	Set the value of a variable (LET)
2-ADD	Sum the value of a variable (added)
3 -MUL	Multiply the value of a variable
4-DIV	Divide a variable with the value of the expression (Divided)
5-NEG	Negate the value of a variable (negation)
6-LBF	Set to an array of variables at the value (Load buffer)

Control Instructions

1-JMP Jump unconditionally to a label (jump)

.2-JEQ Jump to a label if the two expressions are equal (Jump if Equal)

.3-JNE Jump to a label if the two expressions are not equal (in the Jump Not Equal)

.4-JLT Jump to a label if the value of the first parameter is less than the second (Jump if Less Then)

.5-JLE Jump to a label if the value of the first parameter is less than or equal to the second (Jump if Less then and Equal)

.6-JGT Jump to a label if the value of the first parameter is greater than the second (jump if Great Then)

.7-JGE Jump to a label if the value of the first parameter is greater than the second (and then Great Jump if Equal)

.8-JRN jump if the value of the parameter is within the range (Jump if Range)

.9-JNR jump if the value of the parameter is out of range (Jump If Not Range)

.10-JOS Skip if at least one bit of the parameter value is one (Or Jump if Bit Set)

.11-JOC Skip if at least one bit of the parameter value is zero (Or Jump if Bit Clear)

.12 JAS jump if all bits of the value of a parameter are (Jump And if Bit Set)

.13-JAC Jump if all bits of the parameter value is zero (Jump And if Bit Clear)

.14 CAL Call-part program, passing parameters (CALL)

.15-RET Return to the caller of the program (Return)

.16-END Process END (END)

.17-TSK executes in parallel a series of work (task)

.18-TKM restore and delete a cycle of work (Task manegement)

.19-DIM Dimensions variable number L of a part pogram

Motion Instructions 1 Part

.1-HOM (OMO) Origin of an axis (homing)

.2 MOV Movement-a group of linearly interpolated axes (MOVE)

.3-CIR Interpolated circular or elliptical motion in a clockwise direction of a group of axles (Right Circular)

.4-CIL Interpolated circular or elliptical motion in a counterclockwise direction of a group of axes (Left Circular)

.5-CRR Interpolated motion in a clockwise circular or elliptical axes group with a known radius (Radius Right Circular)

.6-CRL Interpolated motion counterclockwise circular or elliptical axes group with a known radius (Radius Left Circular)

.7-STC Start with a definition of handling continuous path (Start Continuous)

.8-HLC Pending the completion of handling continuous (HaLtContinuous)

.9-ABC Cancellation of continuous motion (Continuous Abort)

.10-CAP Change the parameters axis (Axis Parameter Change)

.11-HMS Management master-slave (master-slave Handling)

Motion Instructions 2 Part

.12-HEC Cam Management (Handling Electronic Cam)
.13-GEI Read details of the cam (Cam Get Electronic Information)
.14-CFR Change the dynamic parameters of an axis (Change Feed Rate)
.15-CPL Change the position loop (Loop Change Position)
.16-PRD Law PRD-axis positions (Read Position)
.17-RAV Law axis parameters (Read Axis Value)
.18-RSV Reads the speed of a spindle (Read Speed Value)
.19-SFP Sets the speed of the movement profile (Sep Feed Profile)
.20-SPD Set the speed of rotation of a spindle (SPEED)
.21-TCH Movement with touch (probe) sensor (Touch)
.22-TMT Movement with research value of the analog signal (Test Trasducer Movement)

Motion Instructions 3 Part

.23-TMS Movement with research value of the digital sensor (Sensor Movement Test)

.24-TPE Enabled the probe (Touch Probe Enable)

.25-SZP Define the position of zeros of a set machine (Set Zero Point)

.26-LZP Enable a set of zeros car (Zero Point Load)

.27-PIN (INQ) Flag on an axis incremental (Incremental Position)

.28-PAB (ABS) Flag on an axis of absolute (Absolute Position)

.29-MMA Moves an axis with a manual movement (Move Axis Manual)

.30-OPT Opens a file of points (PoINT Open file)

.31-MOR Linearly interpolated movement of an axle group advance (Re MOV)

.32-DCT Controlled movement with depth probe (Deep Touch Control)

.33-DCS Movement with depth controlled by digital input (Deep Control Sensor)

.34-GRM Commands to the axes and spindles grouped (Group Management)

I/O Instructions 1 Part

.1-WDI (WIN) Waits for a signal digital input for a given state (Wait Digital Input)

.2-WAI Waits for an input signal and analog ports to a given state
(Wait Analog Input)

.3-AIN Wait for analog inputs on the G or L (Analog Input)

.4-TDI (TES) Performs a test on a digital input signal (Test Digital Input)

.5-TDO Performs a test on a digital output signal (Test Digital Output)

.6-IDI Performs a test on a digital input signal (If Digital Input)

.7-IDO Performs a test on a digital output signal (If Digital Output)

.8-TAI Performs a test on an analog input signal(Test Analog Input)

.9-SDO (SAX) Sets or resets the digital output signals (Set Digital Output)

.10-EDO Sets or resets the digital output signals on the basis of a test
(Enanced Digital Output)

I/O Instructions 2 Part

.11-SAO(SAC) Writes the value of an analog signal output (Set Analog Output)

.12-GDI (RBI) Reads the value of a digital signal input (Get Digital Input)

.13-GDO Reads the value of a digital signal output (Get Digital Output)

.14-GAI (RAI) Reads the value of an analog input signal (Get Analog Input)

.15-WBD (BPO) Writes a block of output digital signals (digital inputs Write Buffer)

.16-RBD (BPI) Reads a block of digital input signals (Read Digital Input Buffer)

.17-CPI Waits for a digital input signal undergoes a change

.18-CDI At the changing digital input signal activates a task or process

.19-CDO At the change of digital input signal activates a task or process

.20-RDI Take action test on a digital input signal by activating a task if the test is positive (Run Digital Input)

.21-RDO Take action test on a digital output signal activating a task if the test is positive (Run Digital Output)

Synchronization Instructions

.1-EVS Sect of synchronization events (Event Set)
.2-EVC Reset the synchronization events (clear event)
.3-EVW Wait some synchronization events (Event Wait)
.4-EVG Reads the status of events (Event Get)
.5-CSA Create a synchronization for the use of an axis between multiple tasks (Create SyncroAxes)
.6-WSA synchronization waits for the use of an axis between multiple tasks (Wait Syncro Axes)
7-DSA eliminates synchronization for the use of an axis between multiple tasks (Delete Syncro Axes)

Service Instructions 1 Part

.1-FOC (AZZ) Clears the contents of a file or create if not exists (Create File Open)

.2-FWR (SCR) Writes a record to file (File write)

.3-FWA Writes a record to file (ASCII File Write)

.4-FRD (LEG) Reads a record from a file (Read Files)

.5-TIM Timer in seconds (TIME)

.6-TMM Timer in milliseconds (Time Millisecond)

.7-SWA Initialize a watch (Start Watch)

.8-RWA Read a watch (Read Watch)

.9-HWA Halt a watch (Halt Watch)

.10-CWA Continue a watch (Continue Watch)

.11-KYB Waits for an Keyboard (Keyboard)

.12-DRT Continuously displays the values of axes, global signals (Real Time Display)

.13-DIS Displays a line message (Display)

Service Instructions 2 Part

.14-HLD Send a system in the state of Cycle Stop (HOLD)

.15-PWO Send in the state of the system power on (poweron)

.16-EMC Send in the state of the system on Emergency (Emergency)

.17-LCK Lock the task and possibly a SEC report

.18-ULK Release all tasks in a state of LOCK

.19-RST system reset (RESET)

.20-SDW Shut down the system (shutdown)

.21-SOR Sorting a sequence of values (SORT)

.22-GTK Detect information related to a task or process (Get Task information)

.23-MDI Performs a ISO program - GCode (MDI)

.24-OTC Set ISO tables Origin Tool Corrector - GCode (OTC)

.25-ISO Performs a ISO program - GCode (ISO)

.26-WND Wait a reporting error state resources or spindle axis (Wait Notify Detected)

.27 WKY Waits press a button (Wait Keyboard)

.28-NHL No Hold

.29 YHL Hold Yes

Service Instructions 3 Part

.30-GDT Get Date and Time
.31-GAT Get Absolute Date and Time
.32-GLN Get Local Number
.33-GMI Motion Get Information
.34-RTC Read Timer or Counter
.35-SGL Save Global
.36-SHL Shell or application procedures
.37-G80 G80 End fixedcycle (G80)
.38-G81-89 G81 .. G89 Activate fixed cycle specified
.39-ESE Performs sequences external (Exec Sequence) system ETEL
.40-ERR View logs external (External Read Registry) system ETEL
.41-EWR Write registers external (External Write Registry) system ETEL
.42-ECM Runs an external command (External Command) system ETEL
.43-EWS Waits for a (External Wait Signal) system ETEL
.44-CLM Machine System Command to Logic ETEL
.45-SND Please issue a WAV file on 'PC audio output

Instructions for integration with other environments

.1-ARI Request execution of an instruction to the environment specified in the first parameter and waits for a response (return made with the function of "WriteServiceParametersAndContinue" subsystem automation AXESBRAIN)
(Ambient Request Instruction)

.2-SEC Set client event

Comunication Instructions 1 Part

.1-CSO	Connection to a socket (TCP / IP Socket Connect)
.2-LSO	Listen to a TCP / IP socket (Listen Socket)
.3-RSO	Read data traveling over a TCP / IP socket (Socket Read)
.4-TSO	Writes on a TCP / IP socket (Socket Write)
.5-DSO	Delete a connection to a TCP / IP socket (Socket Destroy)
.6-FSO	Clear any data received on a TCP / IP socket (Socket Free)
7-GSO	Captures information from a TCP / IP socket (get information sockets)
.8-OSL	Opens a serial port (Serial Line Open)
.9-RXL	Receive data from a serial line (Receive Serial Line)
.10-TXL	Transmits data over a serial line (Serial Line Transmit)
.11-CSL	Closes the serial port (Serial Line Close)
.12-FSL	Clear any data received from a serial line (Serial Line Free)
.13-RFB	Read data FieldBus
.13-WFB	Write data on FieldBus

Comunication Instructions 2 Part

.15-RGS	Reset line GSM / GPRS
.16-SMS	Send SMS on GSM / GPRS
.17-WMS	Wait SMS message from GSM / GPRS
.18-CGS	Makes a call on GSM / GPRS
.19-WRG	Wait a call from GSM / GPRS
.20-CTL	Please call on phone line
.21-WTL	Wait a call from the telephone line
.22-STL	Closes the telephone line
.23-GTL	Acquires a number from the telephone line
.24-PTL	Send a file recorded on the telephone line
.25-EML	Send a E-Mail

AWL GP-PLC Special Operations Ladder 1 Part

The normally open contact is closed (on) if the bit value of the address n is 1.
In AWL, the Normally Open contact is represented by operations such as:
Upload operation, combines the bit through And, combines the value of bits by OR. These operations, respectively, load the value in the value of n bits from the top of the stack, or combine with AND or OR value with the value of n bits of the top of the stack.

Normally closed contact is closed (on) if the address bit value is 0 n
In AWL, the normally closed contact is represented by operations such as:
Load the value of bits denied, combines the bit And by Denied, denied Combine the value of bits by OR.
This loads the value in the value of n bits from the top of the stack, or combine with And or Or the value of n bits of the highest value of the stack.

AWL GP-PLC Special Operations Ladder 2 Part

Direct contacts

The Normally Open Immediate contact is closed (on) if the value of bit n is 1 physical input routed.

In AWL, the Normally Open Immediate contact is represented by the operations of the type

Load the value of bits directly, And Combines bits directly through, and combines bits directly by OR.

These operations, respectively, load the value directly to the value of n bits from the top of the stack, or combine directly via AND or OR value n-bit physical input routed the highest value of the stack.

The normally closed Direct contact is closed (on) if the bit addressed physical input n is 0.

In AWL, the normally closed contact is represented by operations such as Load the value of bits directly denied, n-bit value directly denied by AND, and combines directly denied the value of bits by OR. These operations, respectively, loaded directly denied the address bit value in the value of n top of the stack, or combine directly via AND or OR value n-bit address denied the highest value of the stack.

AWL GP-PLC Special Operations Ladder 3 Part

Not Contact

Contact NOT change the status of the signals. If the current flow reaches Not the contact is blocked. If the flow does not reach the contact Not, this generates current flow.

In AWL, the operation denial of higher value than the value of the stack changes from 0 to 1 or from 1 to O.

Semantic Rules

The character '#' indicates that the value of the numeric value is interpreted as 0 or 1.

Example 1:

```
        -NET / 1
        -LD / # 1          ; the value 1 is loaded into the STACK
```

AWL PLC Instructions 1 Part

.1-NET	Network PLC
.2-LD	Load Operation
.3-LDN	Load Operation denied
.4-A	Combines the value of bits by AND
.5-AN	Combines the value of bits denied by AND
.6-O	Combines the value of bits by OR
.7-ON	Combines the value of bits denied by OR
.8-EU	Positive edge detection
.9-AND	Negative edge detection
.10-EQU	Copy the value specified in parameter top of the stack
.11-S	Set to 1 the number of points specified if the stack is 1
.12-R	Set to 0 the number of points specified if the stack is 1
.13-LPP	Fetching logic
.14-LPS	Logic Duplication
.15-LRD	Copying PLC logic
.16-ALD	Combines the first and second elements by AND

AWL PLC Instructions 2 Part

.17-OLD Combines the first and second elements by OR

.18-NOT Change the value higher

.19-LEQ Compares two values if the same charge with the stack 1 if no 0

.20-LGE Compares two values if equal or greater load with the stack 1 if no 0

.21-LLE Compares two values if equal to or less current with the stack 1 if no0

.22-AEQ Compares two values if the AND is equal to 1 with the stack

.23-AGE Compares two values if equal to or greater than 1 is the AND with the stack

.24-ALE Compares two values if equal to or less than 1 is the AND with the stack

.25-OEQ Compare two values if the OR is equal to 1 with the stack

.26-OGE Compares two values if equal to or greater than 1 is the OR with the stack

.27-OLE Compares two values if equal to or less makes the O-1 with the stack

.28-PEX Run PLC 1 in the instruction stack AXESBRAIN

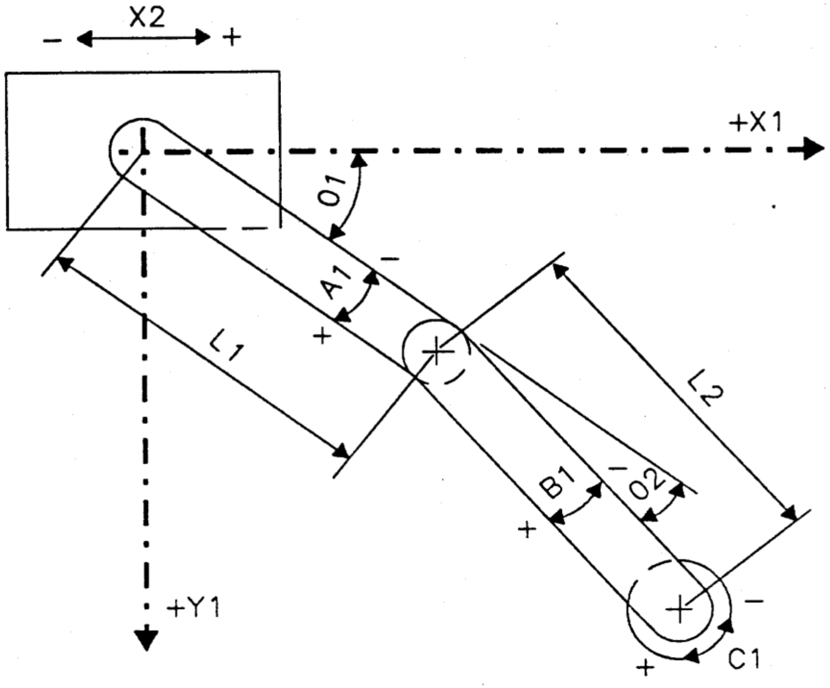
.29-TON Timer without retention

.30-TOR Timer with retention

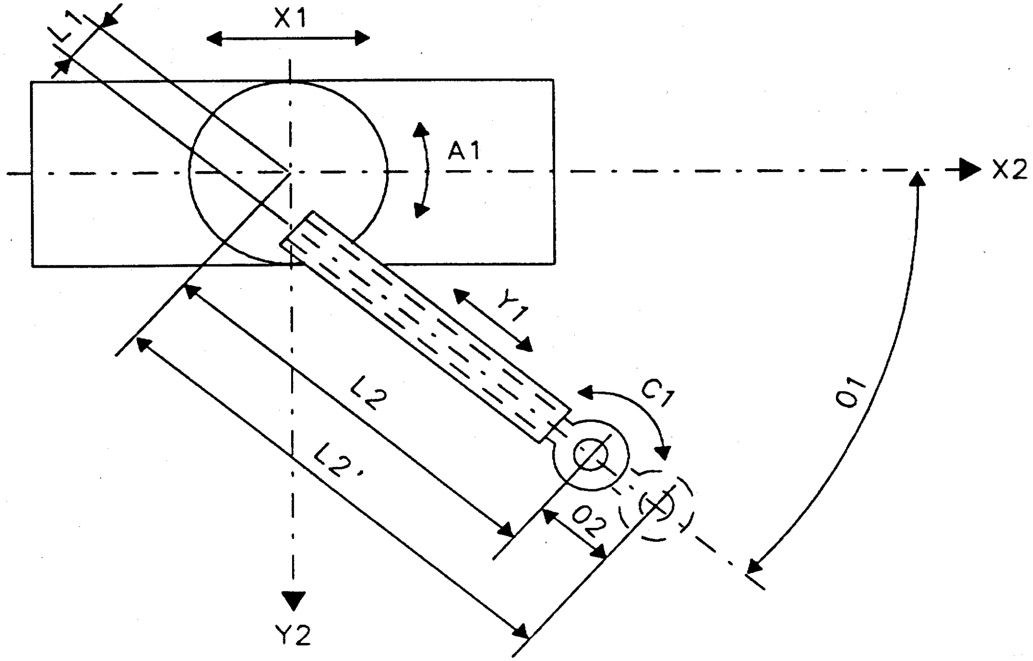
.31-CTU Counter Up

.32-CUD Counter-Up and Down

Virtual Axes SCARA



Virtual Axes Cylindrical



Control axis handwheel

The positioning of an axis in manual mode can be combined with a device called a flyer that is seen by the system as an axis of read-only.

The value read from the wheel position change the position of the combined, so you can give to the micrometer increments' axis itself.

The leaflet is seen as an axis of read-only, and through appropriate command is coupled to a shaft that will remain controlled.

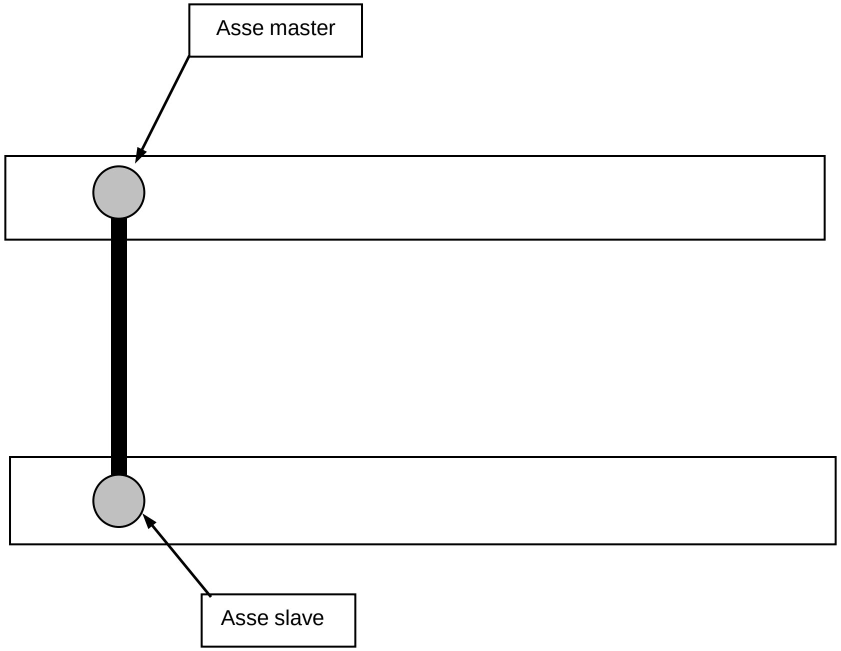
In AXESBRAIN automation language, the instruction "-HMS" allows arming and disarming of a wheel axle "master" to a positioning axis "slave".

To manage the combined wheel axle axis positioning in a "DCOM", the service must be used "WriteAxesRegister" for both axes.

Gantry

The gantry axis (gantry) is a mechanically rigid (normally a bridge structure) and thus corresponds to a single axis, but is treated as if it were from the control consists of a pair of aces (master axis and slave axis, each with their own counting systems and their operation.

One of the functions of control is to maintain the position of the "slave" as close as possible to the axis "master".

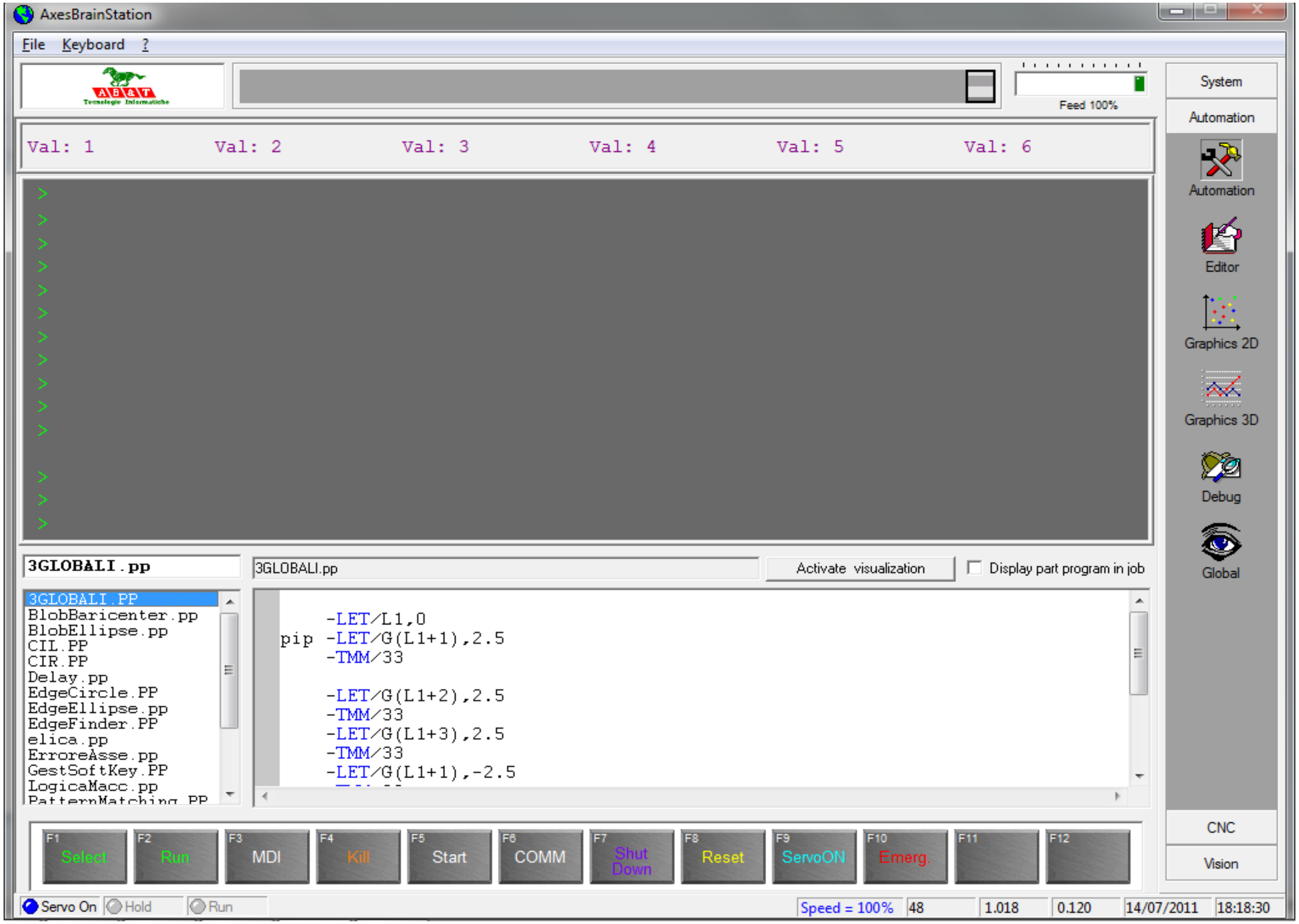


Electronic Cams

The cam allows you to match the position of an axle group to an axis "master" and a table of multiple locations.

And 'it can electronically simulate the behavior of the cams, replace the mechanical operation with a similar system consisting of a group of axles coupled to an axis "master" that can be read-only.
The laws of motion of the sellers is defined as a table of vectors, which defisse positions relative to the moving cam.
In AXESBRAIN automation language, the statement "HEC-" allows the management of electronic cams.
To manage the cams electrical environment "DCOM", the service must be used "WriteAxesRegister" for all axes.

Automation HMI Generic



Feed 100%

```
Val: 1          Val: 2          Val: 3          Val: 4          Val: 5          Val: 6
```

3GLOBALI.pp

3GLOBALI.pp

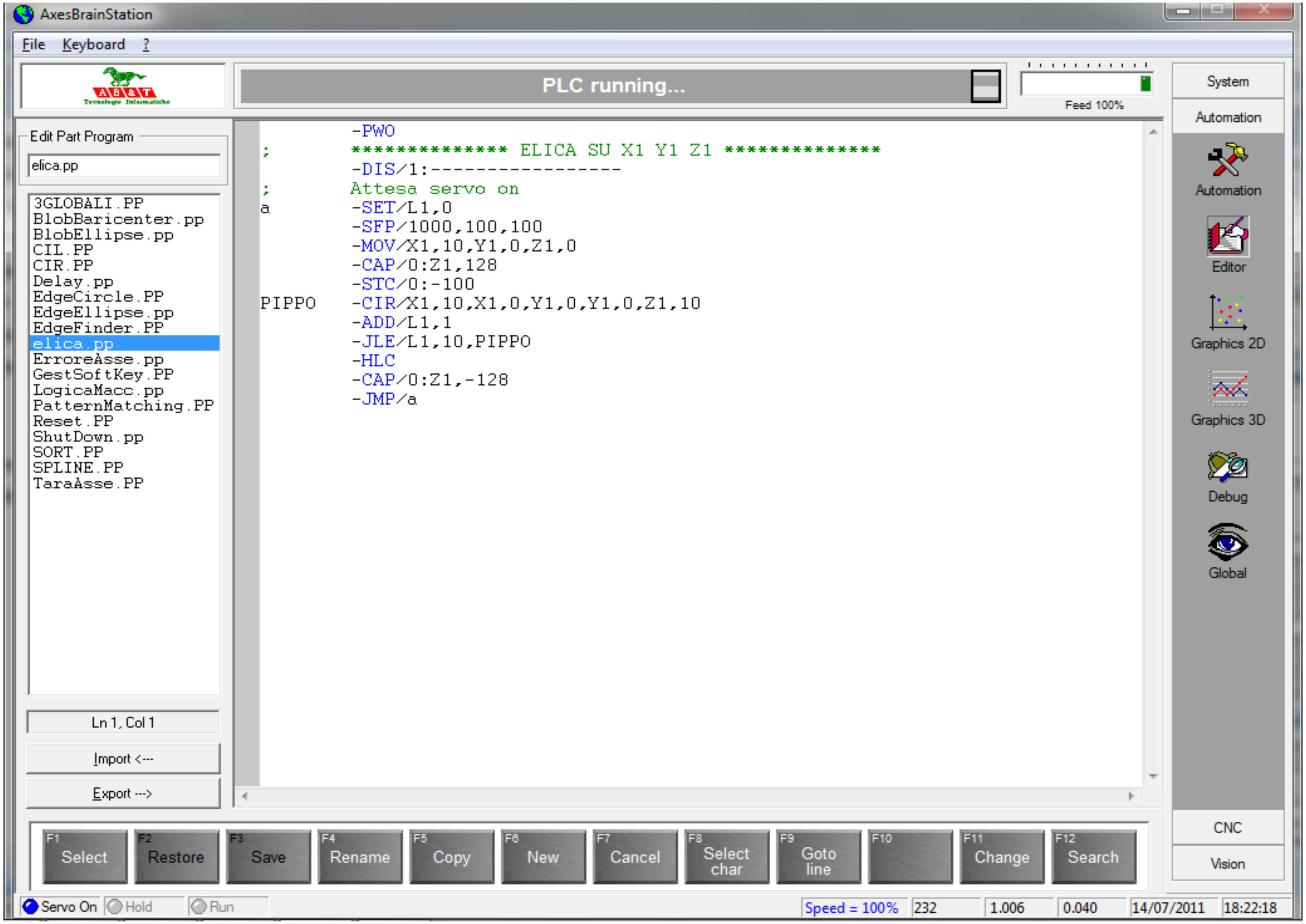
□ Display part program in job

```
3GLOBALI.PP
BlobBaricenter.pp
BlobEllipse.pp
CIL.PP
CIR.PP
Delay.pp
EdgeCircle.PP
EdgeEllipse.pp
EdgeFinder.PP
elica.pp
ErroreAsse.pp
GestSoftKey.PP
LogicaMacc.pp
PatternMatching.PP
```

```
    -LET/L1,0
pip -LET/G(L1+1),2.5
    -TMM/33

    -LET/G(L1+2),2.5
    -TMM/33
    -LET/G(L1+3),2.5
    -TMM/33
    -LET/G(L1+1),-2.5
```

Speed = 100% | 48 | 1.018 | 0.120 | 14/07/2011 | 18:18:30

Automation HMI Editor

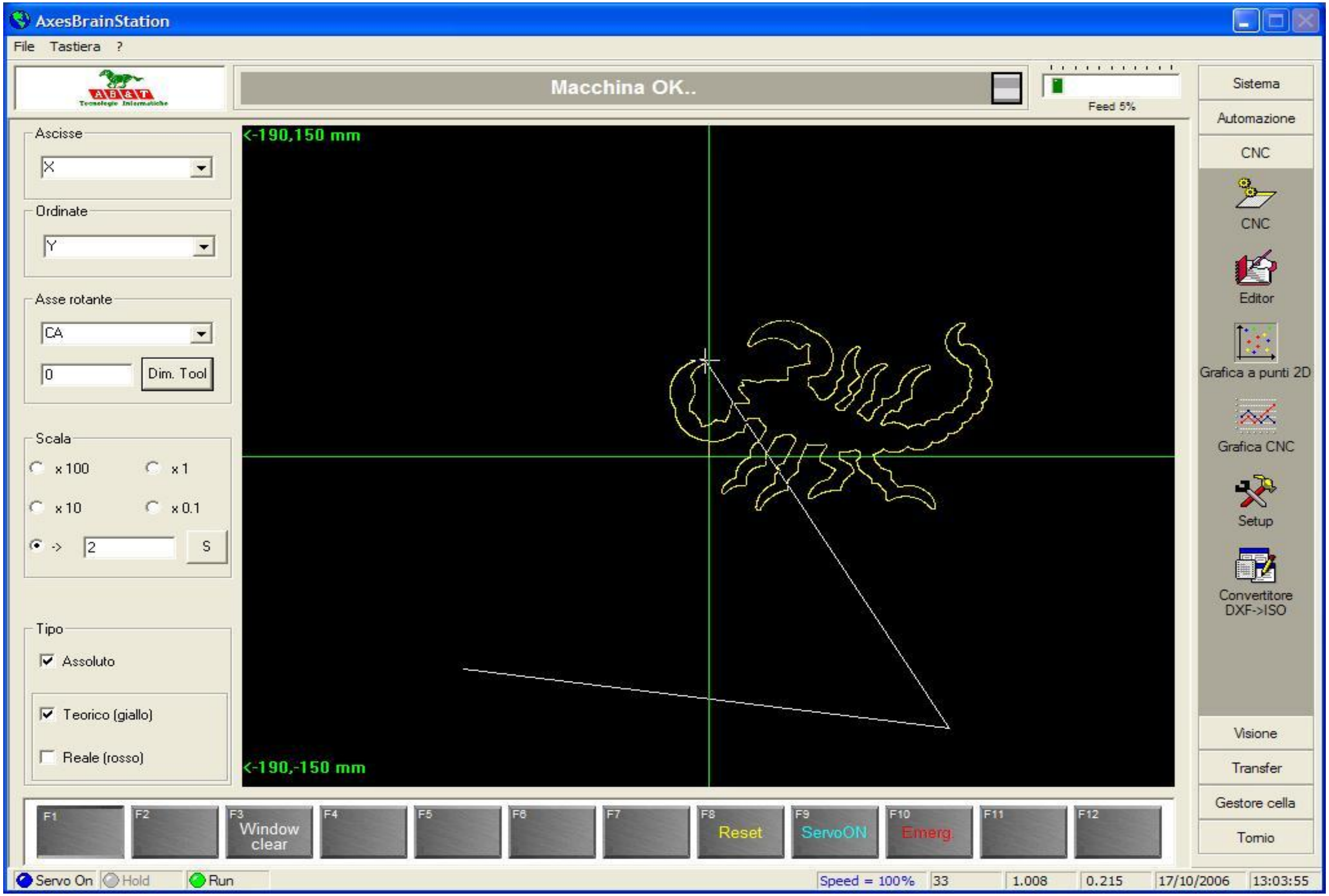


elica.pp

```
3GLOBALI.PP
BlobBaricenter.pp
BlobEllipse.pp
CIL.PP
CIR.PP
Delay.pp
EdgeCircle.PP
EdgeEllipse.pp
EdgeFinder.PP
elica.pp
ErroreAsse.pp
GestSoftKey.PP
LogicaMacc.pp
PatternMatching.PP
Reset.PP
ShutDown.pp
SORT.PP
SPLINE.PP
TaraAsse.PP
```

```
         -PWO
;        ************** ELICA SU X1 Y1 Z1 **************
         -DIS/1:-----------------
;        Attesa servo on
a        -SET/L1,0
         -SFP/1000,100,100
         -MOV/X1,10,Y1,0,Z1,0
         -CAP/0:Z1,128
         -STC/0:-100
PIPPO    -CIR/X1,10,X1,0,Y1,0,Y1,0,Z1,10
         -ADD/L1,1
         -JLE/L1,10,PIPPO
         -HLC
         -CAP/0:Z1,-128
         -JMP/a
```

Automation HMI 2D Graphics



AxesBrainStation

Macchina OK..

Feed 5%

Ascisse: X

Ordinate: Y

Asse rotante: CA

0

Scala

○ x 100 ○ x 1

○ x 10 ○ x 0.1

● -> 2

Tipo

☑ Assoluto

☑ Teorico (giallo)

□ Reale (rosso)

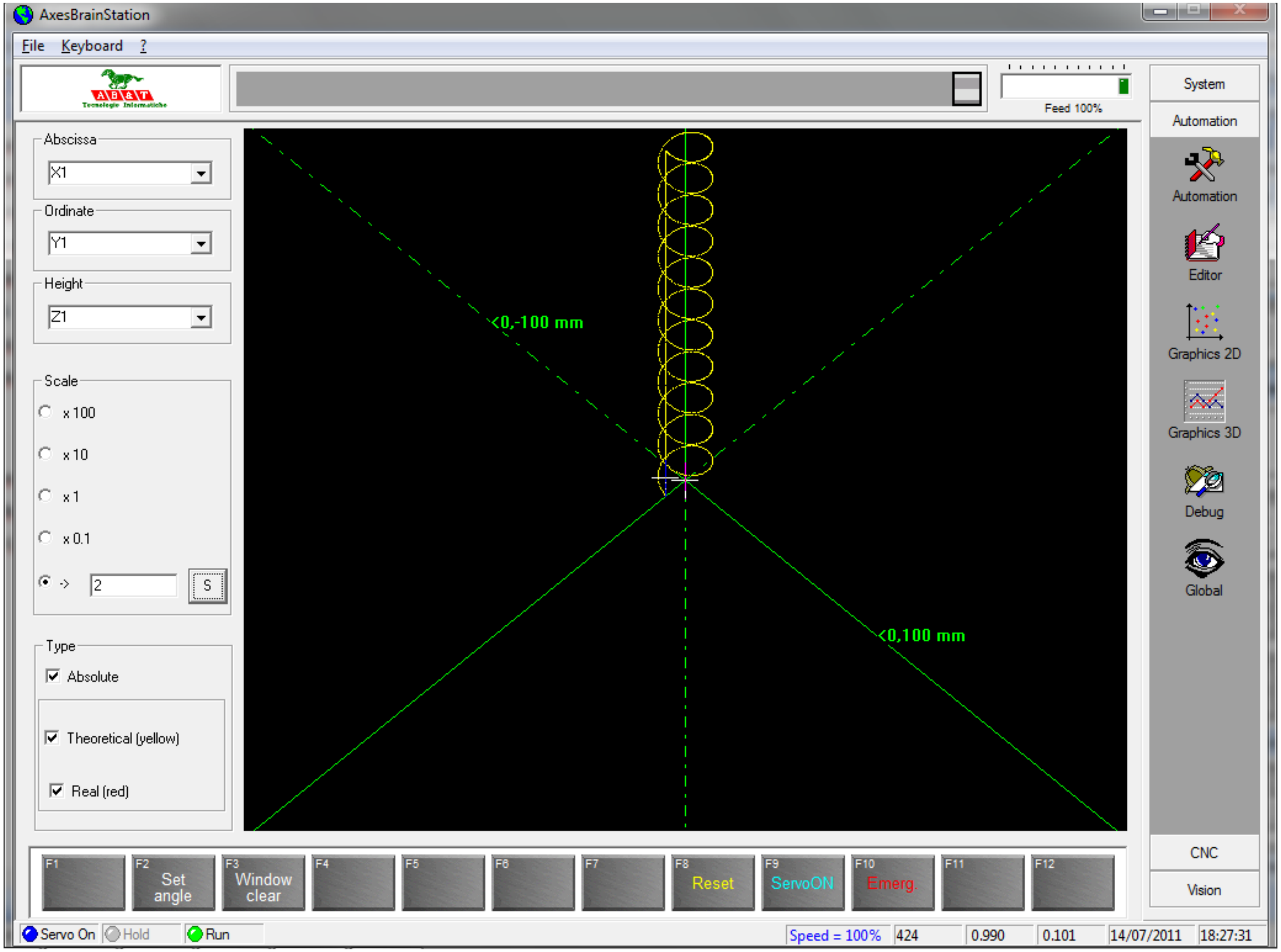
<-190,150 mm

<-190,-150 mm

● Servo On ○ Hold ● Run

Speed = 100% | 33 | 1.008 | 0.215 | 17/10/2006 | 13:03:55

Automation HMI 3D Graphics



Abscissa: X1

Ordinate: Y1

Height: Z1

Scale

○ x 100

○ x 10

○ x 1

○ x 0.1

● -> 2

Type

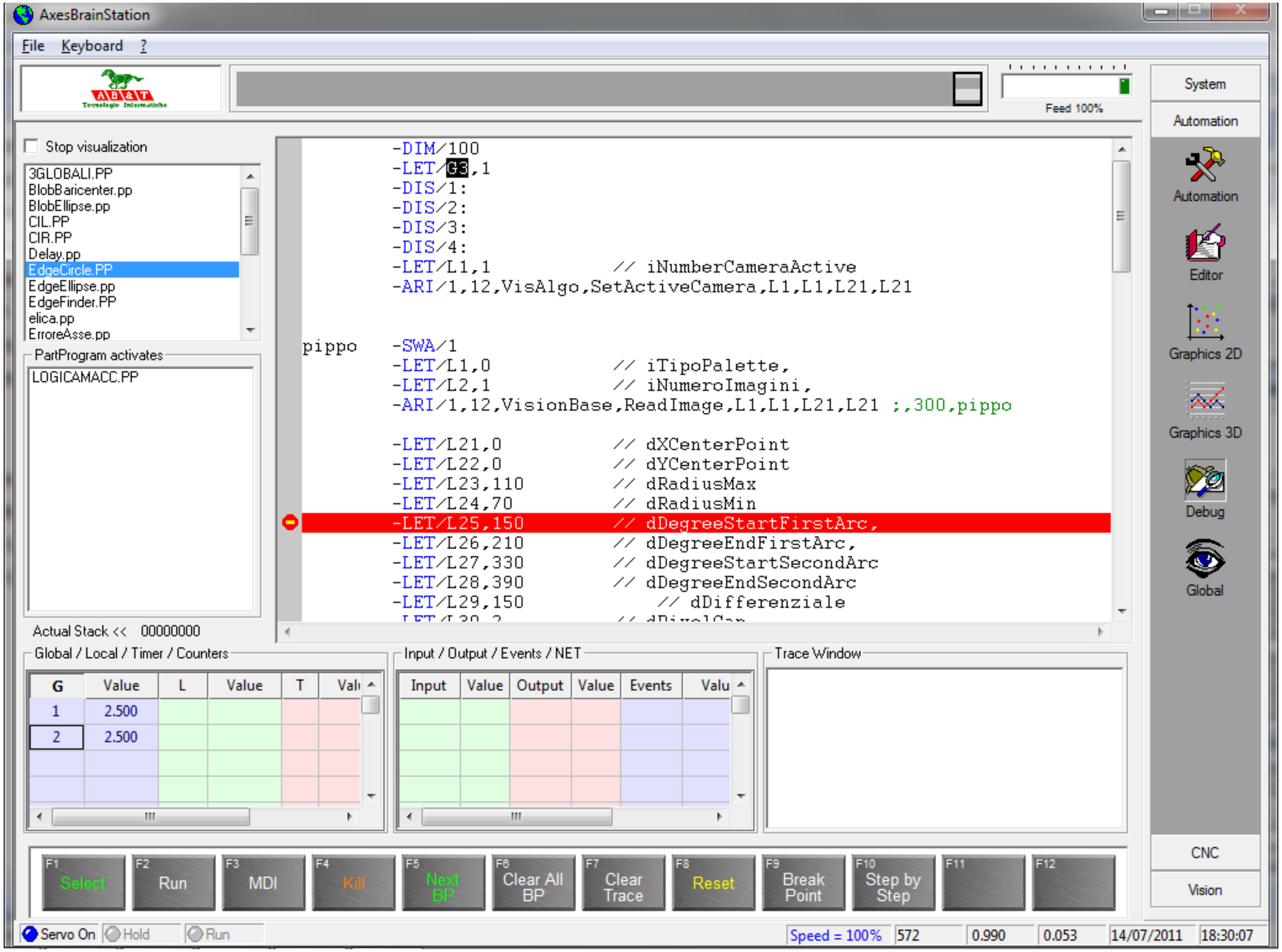
☑ Absolute

☑ Theoretical (yellow)

☑ Real (red)

● Servo On ○ Hold ● Run | Speed = 100% | 424 | 0.990 | 0.101 | 14/07/2011 | 18:27:31

Automation HMI Debug



□ Stop visualization

3GLOBALI.PP
BlobBaricenter.pp
BlobEllipse.pp
CIL.PP
CIR.PP
Delay.pp
EdgeCircle.PP
EdgeEllipse.pp
EdgeFinder.PP
elica.pp
ErroreAsse.pp

PartProgram activates

LOGICAMACC.PP

Actual Stack << 00000000

```
          -DIM/100
          -LET/G3,1
          -DIS/1:
          -DIS/2:
          -DIS/3:
          -DIS/4:
          -LET/L1,1           // iNumberCameraActive
          -ARI/1,12,VisAlgo,SetActiveCamera,L1,L1,L21,L21


pippo     -SWA/1
          -LET/L1,0           // iTipoPalette,
          -LET/L2,1           // iNumeroImagini,
          -ARI/1,12,VisionBase,ReadImage,L1,L1,L21,L21 ;,300,pippo

          -LET/L21,0          // dXCenterPoint
          -LET/L22,0          // dYCenterPoint
          -LET/L23,110        // dRadiusMax
          -LET/L24,70         // dRadiusMin
          -LET/L25,150        // dDegreeStartFirstArc,
          -LET/L26,210        // dDegreeEndFirstArc,
          -LET/L27,330        // dDegreeStartSecondArc
          -LET/L28,390        // dDegreeEndSecondArc
          -LET/L29,150            // dDifferenziale
          -LET/L30,2          // dPixelGap
```

Global / Local / Timer / Counters

G	Value	L	Value	T	Valu
1	2.500				
2	2.500				

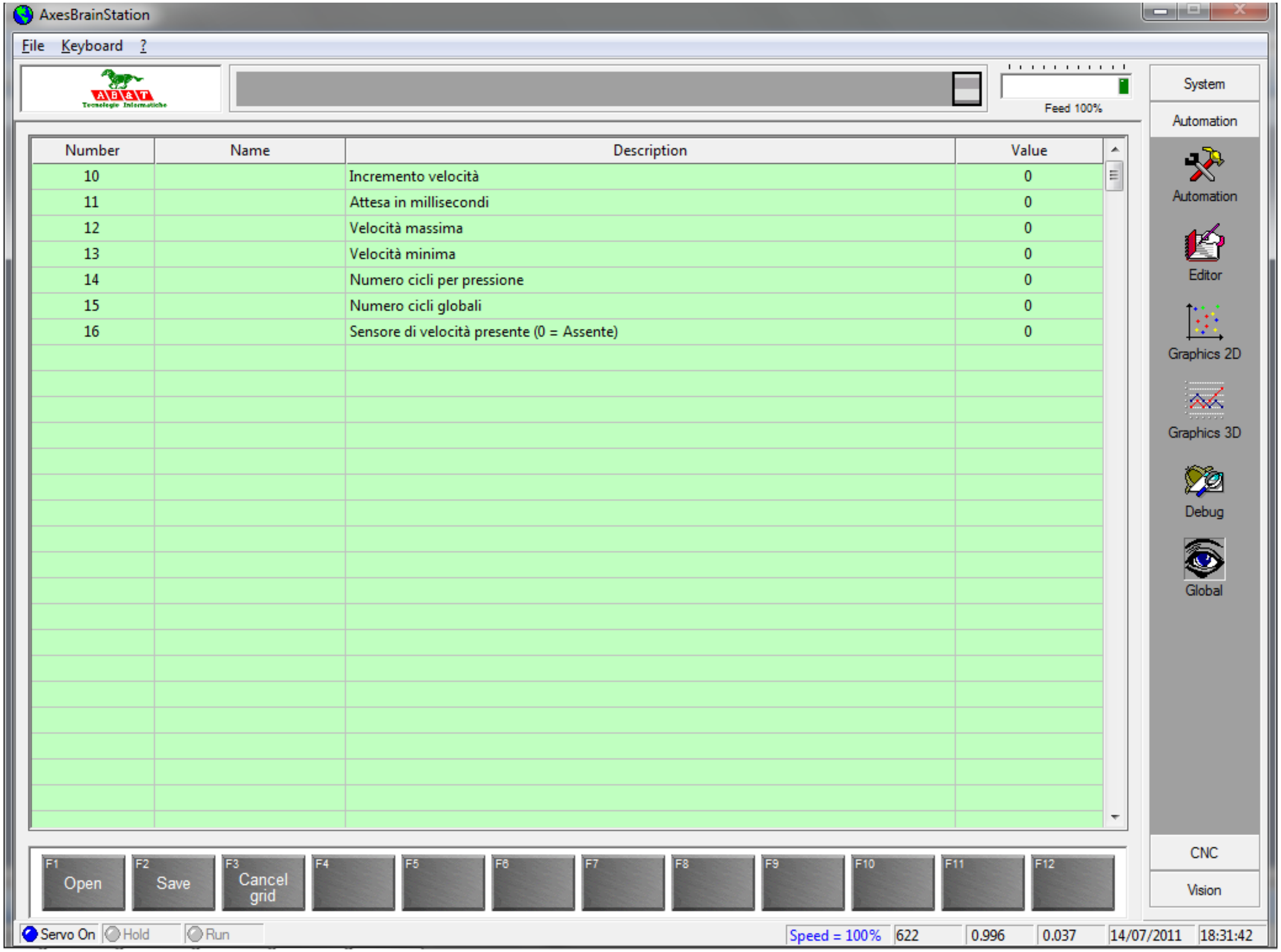
Input / Output / Events / NET

Input	Value	Output	Value	Events	Valu

● Servo On ○ Hold ○ Run

Speed = 100% | 572 | 0.990 | 0.053 | 14/07/2011 | 18:30:07

Automation HMI Globals View

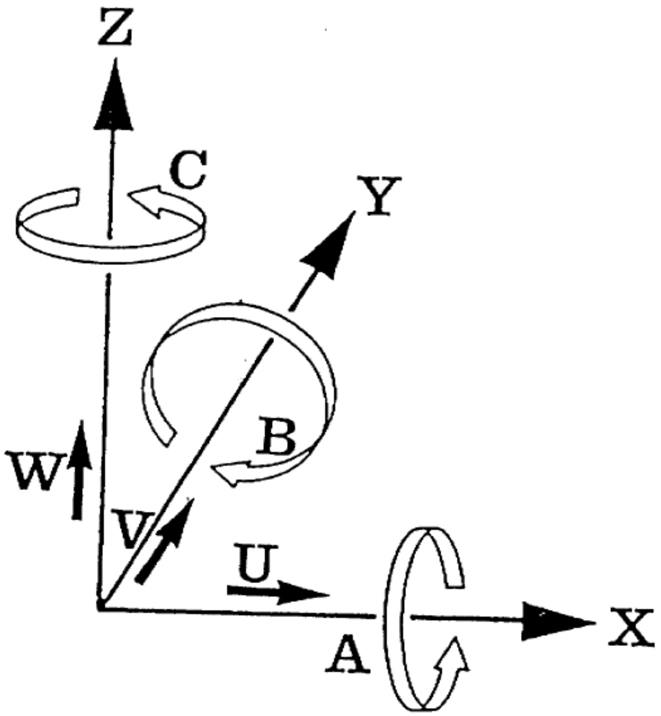


Number	Name	Description	Value
10		Incremento velocità	0
11		Attesa in millisecondi	0
12		Velocità massima	0
13		Velocità minima	0
14		Numero cicli per pressione	0
15		Numero cicli globali	0
16		Sensore di velocità presente (0 = Assente)	0

ISO G-CODE

You can have up to 32 processes simultaneously ISO CNC

1-G functions
2-M functions
3-Origins
4-Tools
5-Parameters
5-G M and Special Functions
7-Fixed cycles
8-G89 Fixed cycle
9-Program control functions



G Fucntions Part 1

G00 Rapid positioning axes
G01 Linear interpolation
G02 circular interpolation or spiral clockwise
G03 circular or helical interpolation CCW
G04 timed pause, pause time scheduled.
G08 deceleration at the end of the block that contains
G09 activation mode "Looking Forward"
G17 specific XY and Z axis perpendicular to work surface
G18 ZX as a specific work plan and Y-axis perpendicular
G19 YZ as a specific work plan and X axis perpendicular
G30 deceleration at the end of the block that contains it and reboot continuously
G32 End subroutine
G40 cancels G41 and G42
G41 activation radius, tool on the left of the profile
G42 activation radius, the right of the profile tool
G49-range value statement
G50 end rototranslation
G51 rototranslation

G Fucntions Part 2

G52 G92 shift of the origins equal
G54 X mirror
G55 Y-Mirror
G56 Z-mirrors
G57 X and Y mirrors
G58 Z and X mirror
G59 mirrors Y and Z
G60 end of the scale factor
G61 scaling factor
G62 absolute center of the circle K1 K2 Incremental
G70 Programming in inches G70
G71 mm programming
G75 programming Cartesian
G76 Polar programming
G78 Tangential to the path setting
G79 Tangential to the path setting end

G Fucntions Part 2

G80 Canned cycle cancel

G81 Canned cycle for drilling

G82 Canned cycle for counterbore

G83 Canned cycle for drilling deep

G84 Canned cycle for tapping

G85 Canned cycle for drilling

G86 Canned cycle boring

G89 canned cycle call of a part program AxesBrain

G90 Absolute programming

G91 incremental programming

G92 shift the origins

G100 - G1999 features AxesBrain

M Functions

M00 Stop
M03 Clockwise rotation of the spindle
M04 Vnti-clockwise rotation of the spindle
M05 Spindle stop
M06 Tool change
M07 Activation of the secondary coolant
M08 Vctivation of primary coolant
M09 Coolant Off
M10 Locking axis activation
M11 Locking off-axis
M13 Clockwise spindle and coolant activation
M14 Anticlockwise spindle and coolant activation
M19 Spindle orientation
M30 Program end, clears the active auxiliary functions
M31 - M1999 Customer features

Origins

The table of the Origins is used for activating or to disarm (O0) the origins during the workmanship, and it is situated in the in the file of the origins.
Every process ISO works on a table proper of **Origins,** through the session **[AbbinamentoOrigini]** of the file “sistema.txt” it is possible to specify the whole run and the containing filename the table.

Tools

The table of the tools (TOOL) is used for activating or to disarm the tools during the workmanship, and it is situated in the file of the Tool.
Every process ISO works on a table proper of **Tools (TOOL),** through the session **[AbbinamentoTOOL]** of the file “sistema.txt” it is possible to specify the whole run and the containing filename the table.

Parameters

The system allows the part program for each instance of the parameters defined by ISO 256 letter P.

The parameters P can be used instead of numerical statements of position or another as an example:

```
P34=10
P35=500
XP34Y0
G4 P35
```

They can also be used to control the different branches work with the following syntax

```
{Pm=Pn} Li
{Pm>Pn} Li
{Pm<Pn} Li
{Pm<=Pn} Li
{Pm>=Pn} Li
{Pm<>Pn} Li
```

Example:

```
L=loop
P3=P3+1
{P3<10}loop
```

G M and Special Functions

The special functions G or M or H call a GP-PLC program with these L Local variables set:

L1 = Number Z-axis with respect to the Work Plan
L2 = Spindle number
L3 = 0, or AS number AxisSpindle
L4 = Number of head defined in "Base_NumeroTesta" or 0
L5 = Spindle Speed
L6 = 1 if M, 2 if G, if H 3
L7 = G or M number of caller
L11 = K
L12 = Q
L13 = J
L14 = I
L15 = H

L16 = Number Origin
L17 = Number Tool
L18 = Number Correction

Fixed cycles

A fixed cycle drilling in an NC program is always scheduled in the following partial steps:

Assign parameters
Select the desired drive cycle
Move to the working position in X and Y (once or repeatedly)
Automatically call and execute the selected fixed cycle after reaching the working position
Clear the cycle

G89 Fixed cycle

The function G89 Fixed Cycle if declared in the file "sistema.txt" under section PartProgramG89 ParametriGenerali, activates the part program of automation.
[ParametriGenerali]
PartProgramG89 = [name of the part program automation]
For each movement if they follow the G89 function, the part program is called automation defined in the file "sistema.txt", with the passing of parameters:

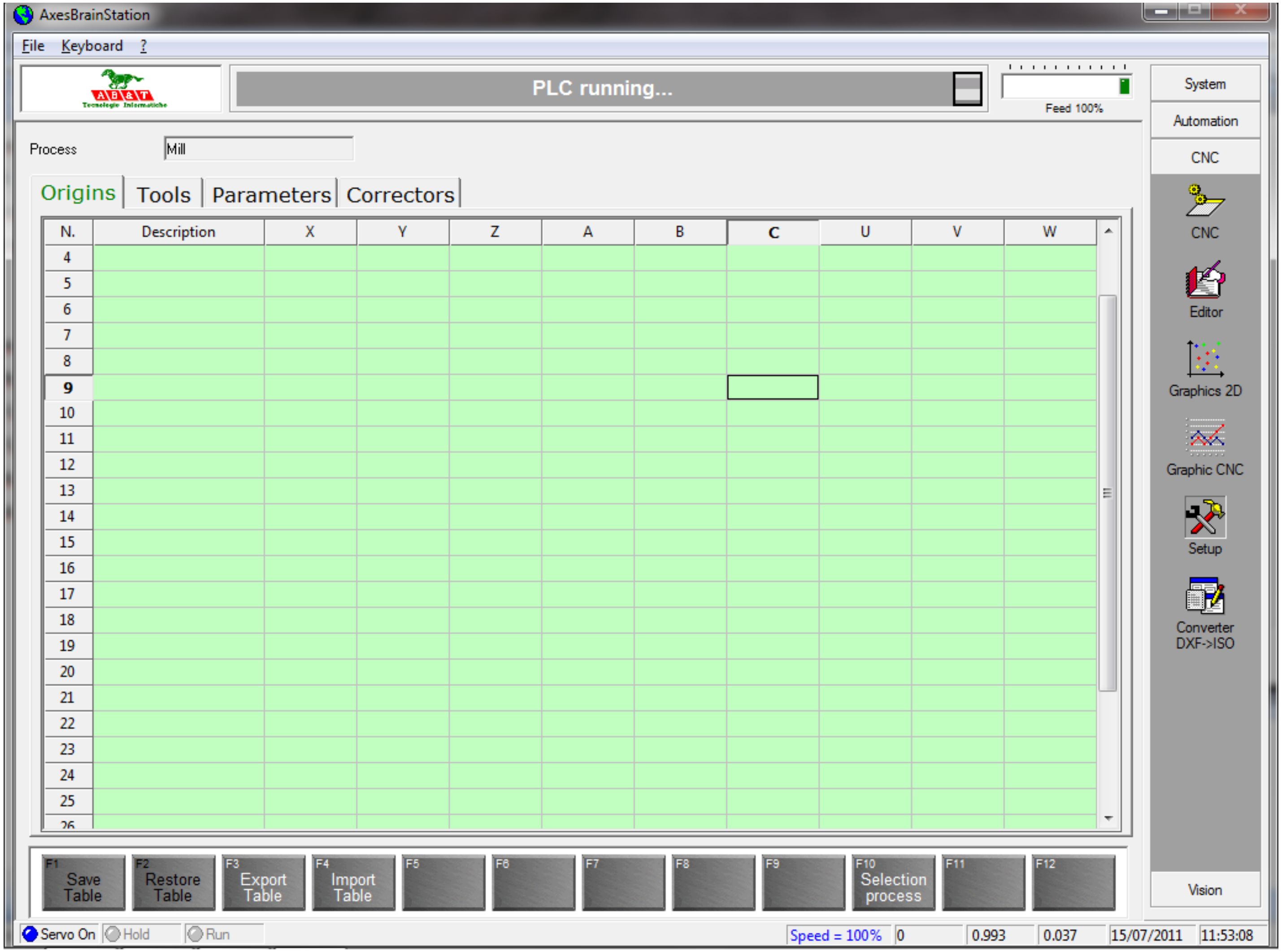
L1 = Number Z-axis with respect to the Work Plan
L2 = Spindle number
L3 = 0, or AS number AxisSpindle
L4 = Number of head defined in "Base_NumeroTesta" or 0
L5 = Spindle Speed (speed value of the active block included)
L6 = PosZ_start
L7 = PosZ_drill
L8 = PosZ_Return
L9 = VelZ_drilling or Step
L10 = Time in milliseconds, or strain rate
L11 = First PosZ_start increase from
L12 = Increment
L13 = Increased Safety

Program control functions

Patterns of part of the program
Using the ” L” codes can be repeated n times a program or part of it. The maximum number is 32767.
The part of the program you want to repeat is enclosed between a reference definition of "label" Education jump to the label followed by the number of repetitions.
The number of repetitions can be a number or a parameter.

Subroutines inside the program
Is defined as a sequence of sub-blocks that can be called from different parts of the main program (for example, the sequence of several points on which to apply the different canned, drilling, casing, drilling, etc..) Or a profile to be called several times in different locations or with different ray correctors.
The subroutine is called scheduling function L followed by the number of the sub.
The subroutines inside the main program must be scheduled at the end of it, upon the function M30.

ISO G_CODE HMI Tables Mill

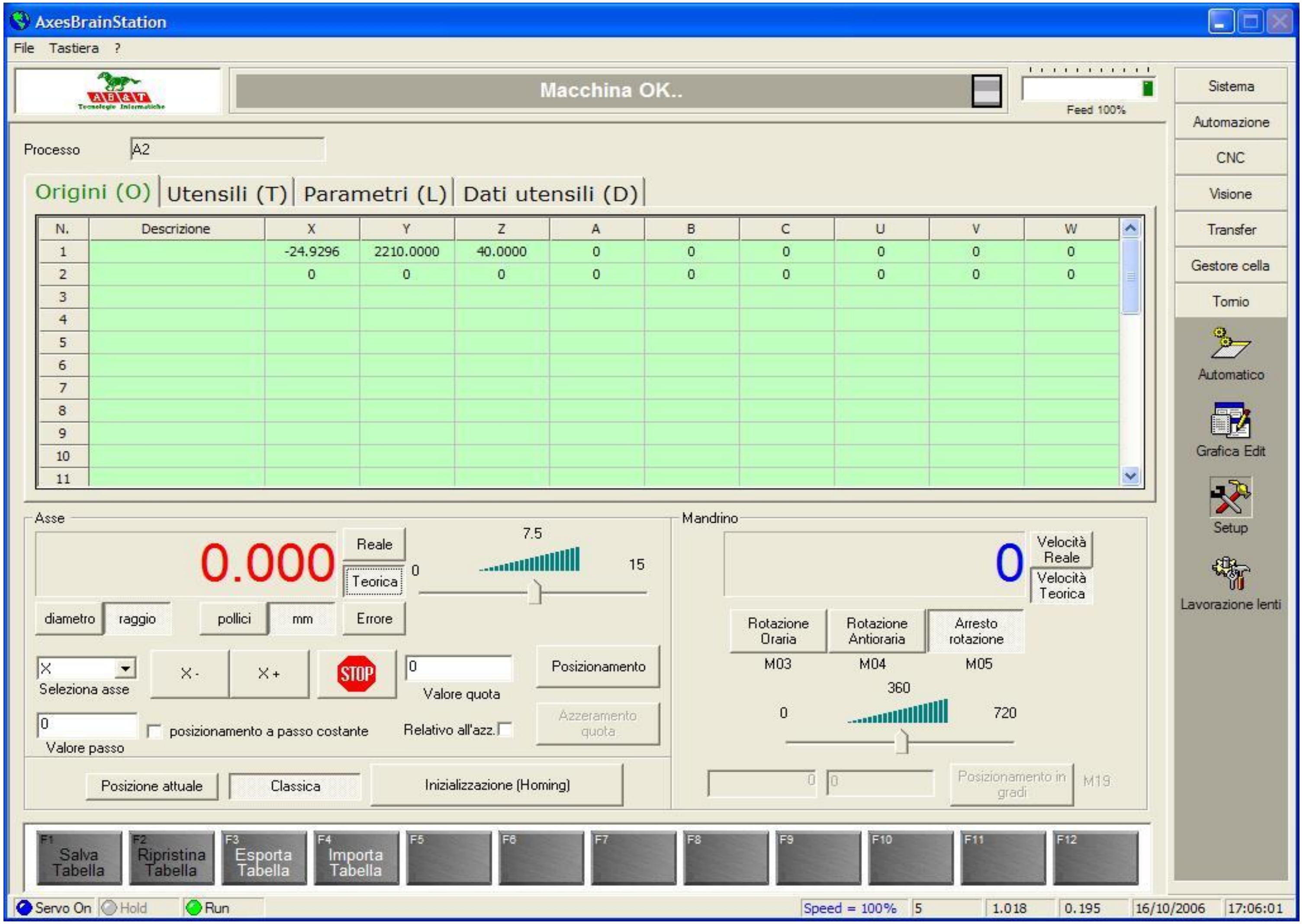


Process: Mill

N.	Description	X	Y	Z	A	B	C	U	V	W
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										
25										
26										

Speed = 100% | 0 | 0.993 | 0.037 | 15/07/2011 | 11:53:08

ISO G_CODE HMI Tables Lathe



Processo A2

N.	Descrizione	X	Y	Z	A	B	C	U	V	W
1		-24.9296	2210.0000	40.0000	0	0	0	0	0	0
2		0	0	0	0	0	0	0	0	0
3										
4										
5										
6										
7										
8										
9										
10										
11										

Asse: 0.000

0 7.5 15

Seleziona asse: X

Valore quota: 0

Valore passo: 0

□ posizionamento a passo costante

Relativo all'azz. □

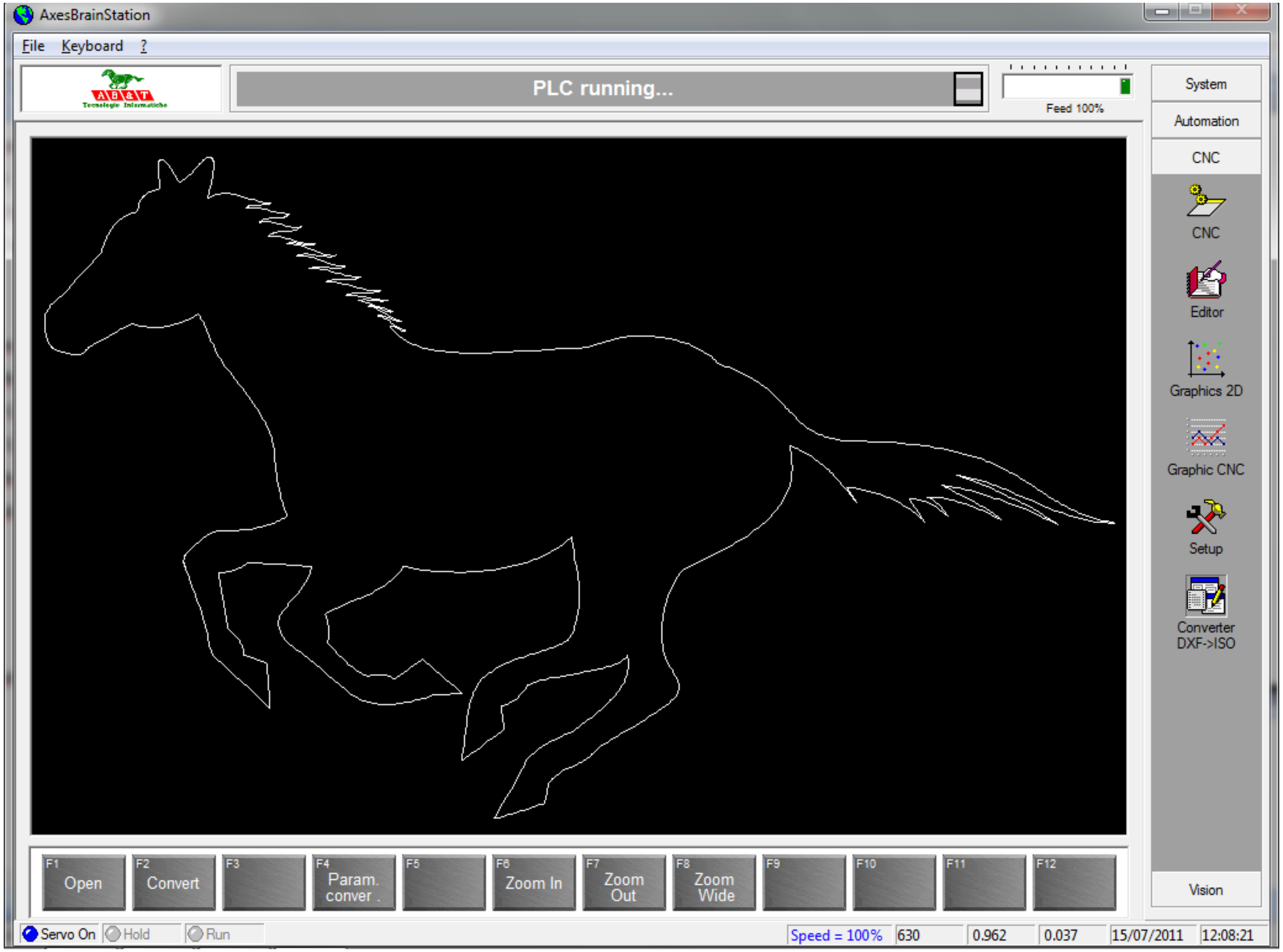
Mandrino: 0

0 360 720

0 0

Speed = 100% | 5 | 1.018 | 0.195 | 16/10/2006 | 17:06:01

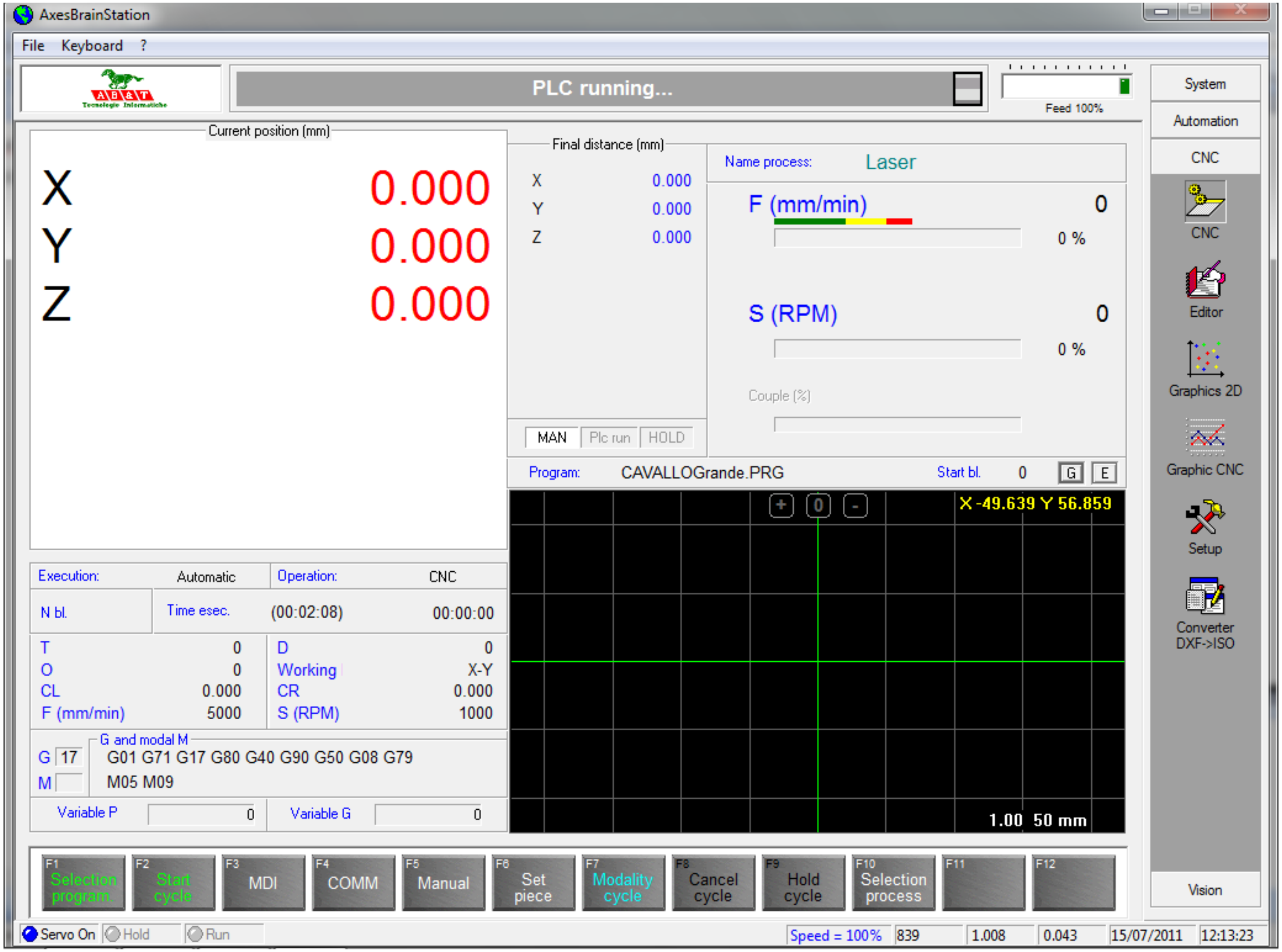
ISO G_CODE HMI DXF->ISO



PLC running...

Speed = 100% | 630 | 0.962 | 0.037 | 15/07/2011 | 12:08:21

ISO G_CODE HMI CNC Mill



AxesBrainStation

PLC running...

Feed 100%

Current position (mm)

X	0.000
Y	0.000
Z	0.000

Final distance (mm)

X	0.000
Y	0.000
Z	0.000

Name process: Laser

F (mm/min) 0

0 %

S (RPM) 0

0 %

Couple (%)

Program: CAVALLOGrande.PRG

Start bl. 0

X -49.639 Y 56.859

1.00 50 mm

Execution: Automatic

Operation: CNC

N bl.

Time esec. (00:02:08) 00:00:00

T	0	D	0
O	0	Working	X-Y
CL	0.000	CR	0.000
F (mm/min)	5000	S (RPM)	1000

G and modal M

G 17 G01 G71 G17 G80 G40 G90 G50 G08 G79

M M05 M09

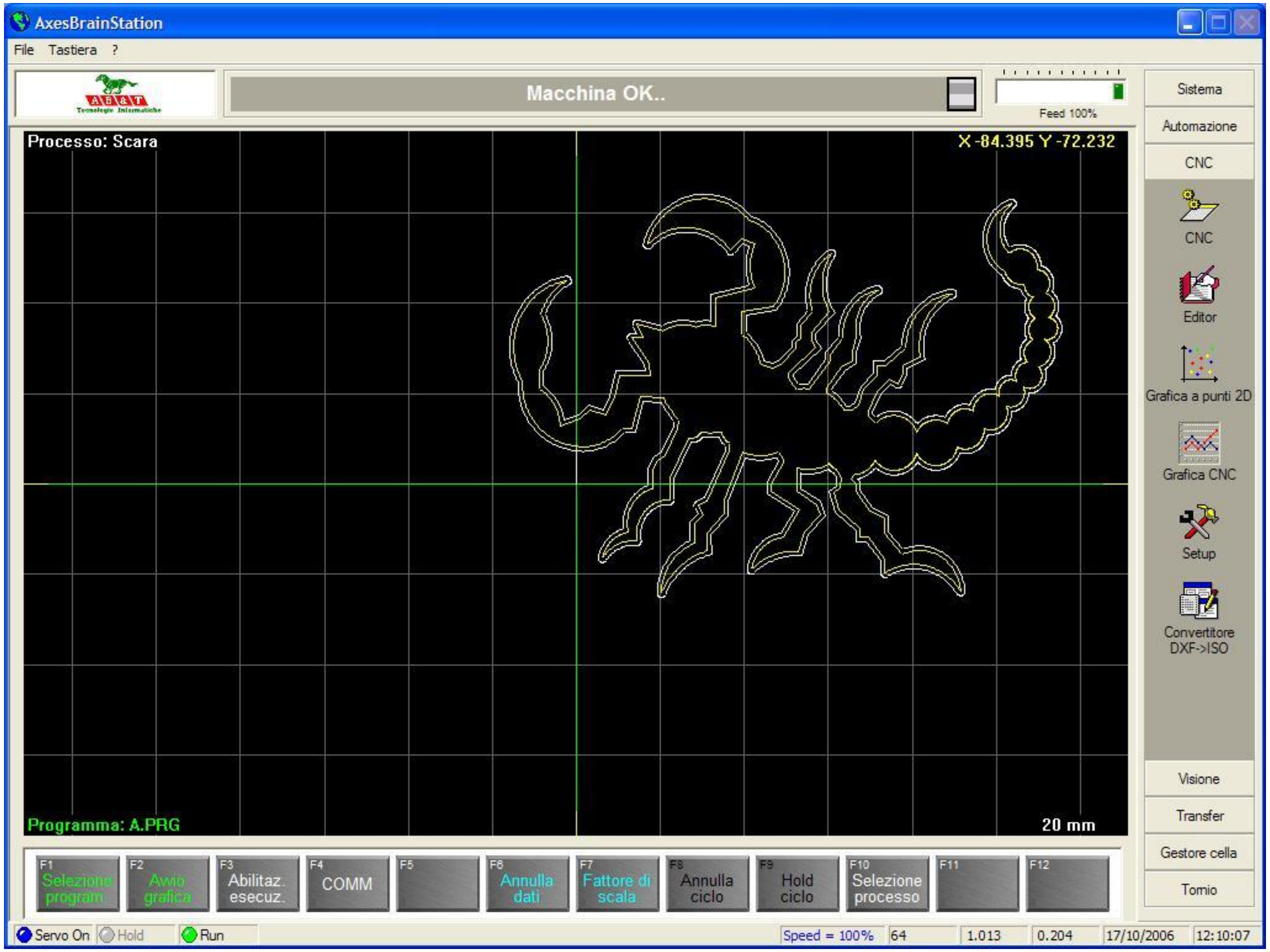
Variable P 0

Variable G 0

Servo On Hold Run

Speed = 100% 839 1.008 0.043 15/07/2011 12:13:23

ISO G_CODE HMI Grafic Mill



Macchina OK..

Processo: Scara

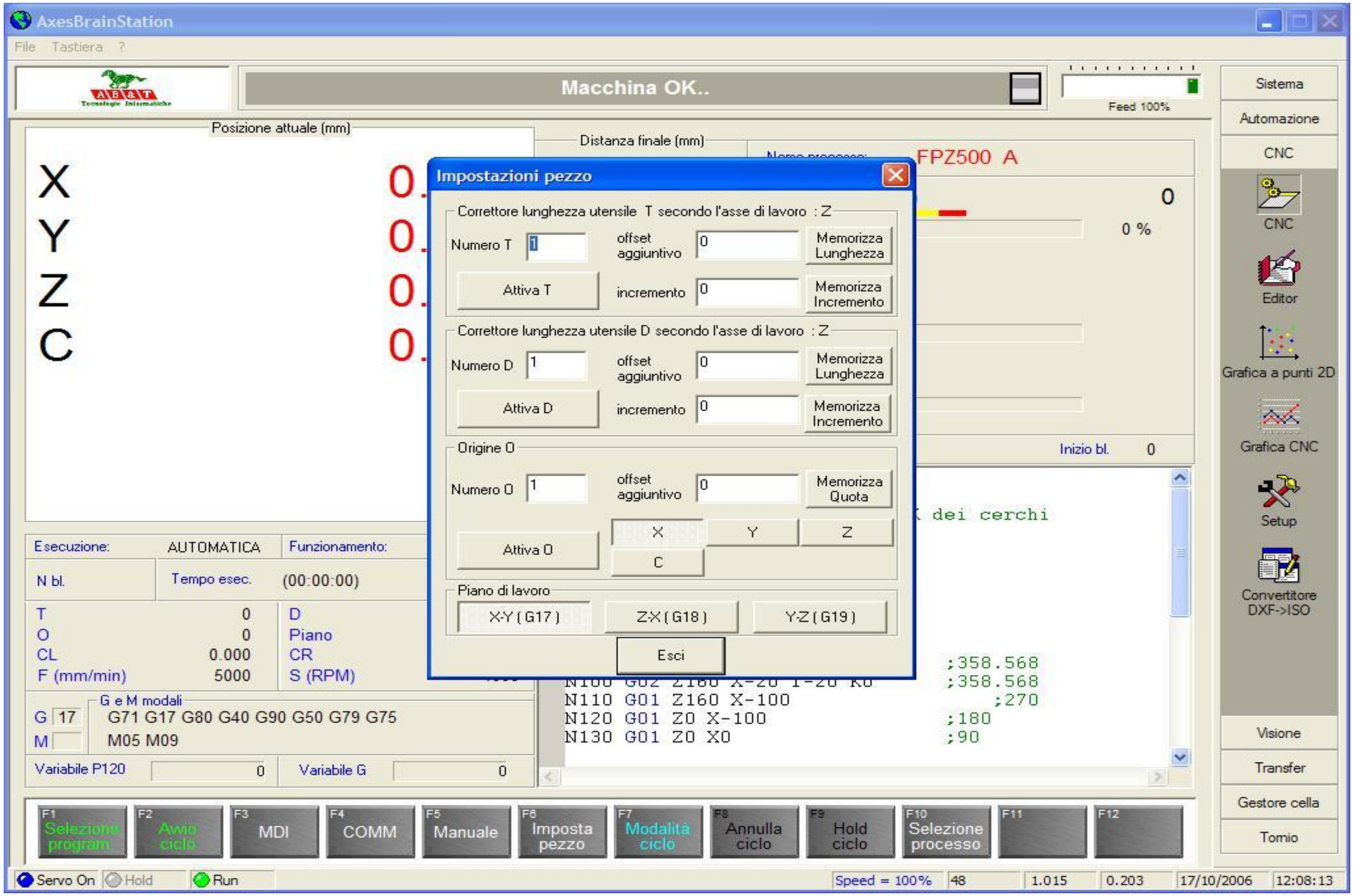
X -84.395 Y -72.232

Programma: A.PRG

20 mm

Speed = 100% | 64 | 1.013 | 0.204 | 17/10/2006 | 12:10:07

ISO G_CODE HMI manual CNC



Macchina OK..

Posizione attuale (mm)

X 0.
Y 0.
Z 0.
C 0.

Distanza finale (mm)

Nome processo: FPZ500 A

0

0 %

Inizio bl. 0

Impostazioni pezzo

Correttore lunghezza utensile T secondo l'asse di lavoro : Z

Numero T: 1 — offset aggiuntivo: 0

incremento: 0

Correttore lunghezza utensile D secondo l'asse di lavoro : Z

Numero D: 1 — offset aggiuntivo: 0

incremento: 0

Origine O

Numero O: 1 — offset aggiuntivo: 0

Piano di lavoro

Esecuzione: AUTOMATICA — Funzionamento:

N bl. — Tempo esec. (00:00:00)

T	0	D
O	0	Piano
CL	0.000	CR
F (mm/min)	5000	S (RPM)

G e M modali

G 17 — G71 G17 G80 G40 G90 G50 G79 G75

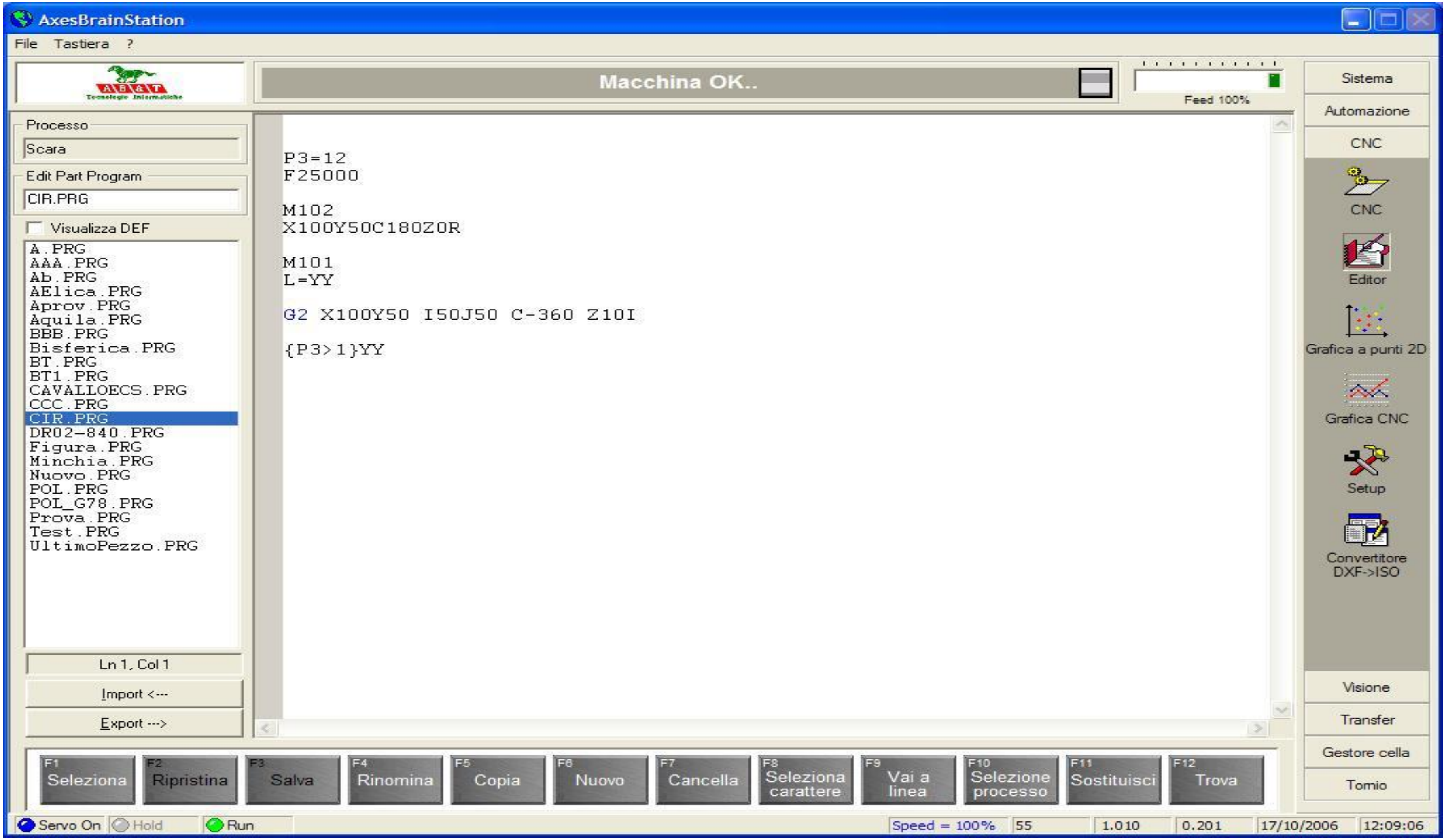
M — M05 M09

Variabile P120: 0 — Variabile G: 0

```
... dei cerchi

                                  ;358.568
N100 G02 Z160 X-20 I-20 K0        ;358.568
N110 G01 Z160 X-100                   ;270
N120 G01 Z0 X-100                 ;180
N130 G01 Z0 X0                    ;90
```

Servo On — Hold — Run — Speed = 100% — 48 — 1.015 — 0.203 — 17/10/2006 — 12:08:13

ISO G_CODE HMI Editor Mill



Macchina OK..

Feed 100%

Processo: Scara

Edit Part Program: CIR.PRG

□ Visualizza DEF

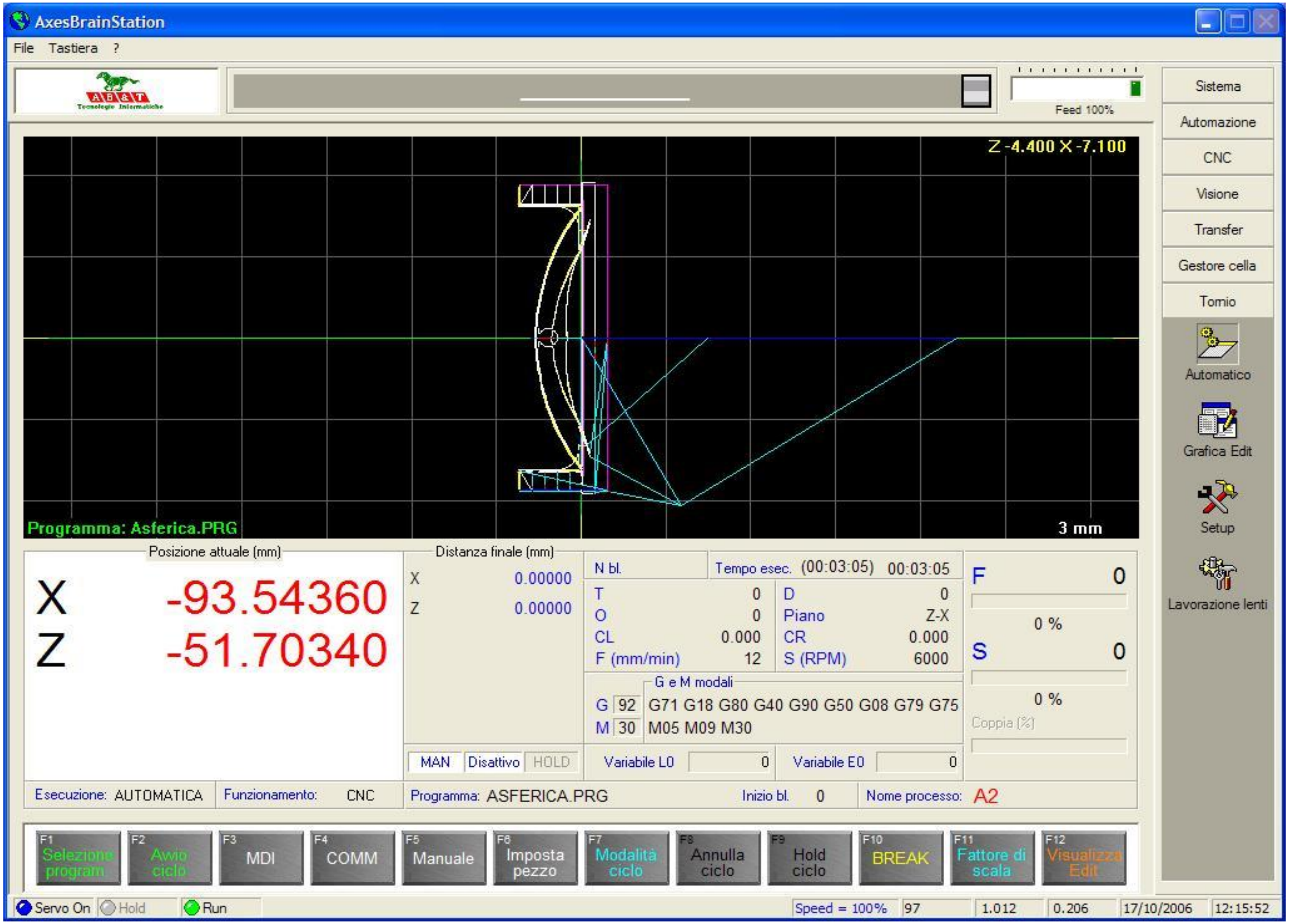
```
A.PRG
AAA.PRG
Ab.PRG
AElica.PRG
Aprov.PRG
Aquila.PRG
BBB.PRG
Bisferica.PRG
BT.PRG
BT1.PRG
CAVALLOECS.PRG
CCC.PRG
CIR.PRG
DR02-840.PRG
Figura.PRG
Minchia.PRG
Nuovo.PRG
POL.PRG
POL_G78.PRG
Prova.PRG
Test.PRG
UltimoPezzo.PRG
```

Ln 1, Col 1

```
P3=12
F25000

M102
X100Y50C180Z0R

M101
L=YY

G2 X100Y50 I50J50 C-360 Z10I

{P3>1}YY
```

● Servo On ○ Hold ● Run | Speed = 100% | 55 | 1.010 | 0.201 | 17/10/2006 | 12:09:06

ISO G_CODE HMI CNC Lathe



Z -4.400 X -7.100

Programma: Asferica.PRG

Posizione attuale (mm)

X -93.54360

Z -51.70340

Distanza finale (mm)

X 0.00000

Z 0.00000

N bl.

Tempo esec. (00:03:05) 00:03:05

T 0
O 0
CL 0.000
F (mm/min) 12

D 0
Piano Z-X
CR 0.000
S (RPM) 6000

G e M modali

G 92 G71 G18 G80 G40 G90 G50 G08 G79 G75

M 30 M05 M09 M30

F 0

0 %

S 0

0 %

Coppia [%]

Variabile L0 0

Variabile E0 0

Esecuzione: AUTOMATICA

Funzionamento: CNC

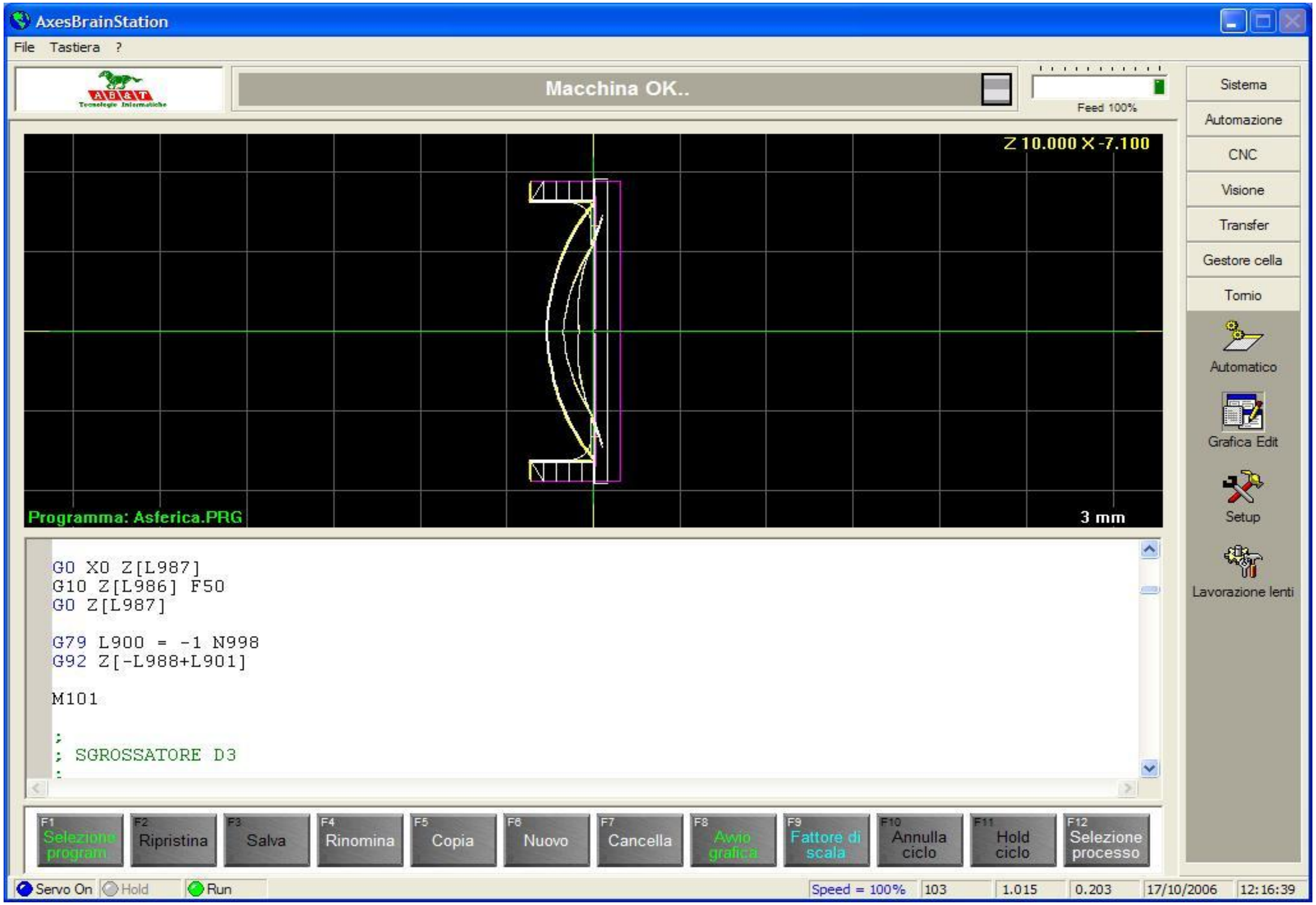
Programma: ASFERICA.PRG

Inizio bl. 0

Nome processo: A2

Speed = 100% 97 1.012 0.206 17/10/2006 12:15:52

ISO G_CODE HMI Editor Lathe



```
G0 X0 Z[L987]
G10 Z[L986] F50
G0 Z[L987]

G79 L900 = -1 N998
G92 Z[-L988+L901]

M101

;
; SGROSSATORE D3
;
```

Stepper motors and drive frequency

The pilot of the motor drive system is now a standard and consists of two inputs for the drive 5Volt, a signal called DIR is the direction of motor rotation
5Volt if (logic one) clockwise if 0Volt (logical zero) counterclockwise rotation, a second signal called PULSE, which every change of state from 0 to 5Volt causes a release of a fraction of a step motor (subway), in pilot mode called frequency.

The customization of the drive, it says how many underpasses is divided by the step (STEP), you get up to 256 underpasses in almost all drives, usually to make a round engine requires about 200 steps, with a divider so that we 256, the motor revolution is divided into 51200 shares.

If we combine a relationship to motor around 10mm, we have a subway (a pulse) of 0.0002 mm, all with a technology very economic cost of a drive-by-step starting at 120 € and an engine from 0.5 Nm cost € 40 with a motor drive cables to be compared even compared to other solutions, bringing to less than 200 €, the equivalent of drive / brushless motor and cables you get to about 800 €, but where the information of the position are available (encoder or resolver on the motor).

Divider step by Drive

To keep the cost of the application does not match an "encoder" or a ladder to read the position, therefore you lose a precision reference as the "marker", but we must be satisfied with the accuracy and repeatability of a microswitch signal given by mechanical or electronic, the lack of pace combined with the possible loss due to a possible hard mechanical means that can not be used as the axis of particularly high-speed machining, but only as an ironing service.

In the field dell'obbistica (drills homemade), is of course only use stepper motors are also used as a machining axes, but we are in another reality.

Another feature of the step motor drives to take into account is the maximum frequency of the signal PULSE, a good drive now comes as a maximum frequency of 150KHz, see what this means in our example 150000 pulses in a second means 3 rev / sec so in our example of 30mm per second, or 1.8 m / min which is a very slow speed, you have to use a divider to raise it up much less of, say, 16 instead of 256, which allows us to arrive at a reasonable speed of 28.8 m / minute, however, the positioning accuracy of 0.0002mm to 0.0015mm has grown from.

If we spend an eighth step of 57.6 m / min mm to 0,003 mm, which is a good compromise, the only flaw is that as you go down to division of the pass is lost in engine performance.

Pilot frequency for motor drives and brushless DC

The driving of motor drives using a frequency pulse instead of an analog reference + - 10V has always been adopted by Japanese manufacturers since the 60's, **this can not have** the CONTROL PID position control, greatly simplifying it.
Today many manufacturers refer to this possibility of piloting an alternative to the reference voltage, thus extending the use of axes also handling low-end PLC.
The frequency control at the bottom of the universal standard is also to say how many units of the drive to position (position control rather than speed).
So the pilot frequency, more direction, has conformed to traditional stepper motors and motion control also allowed the low-end PLC.

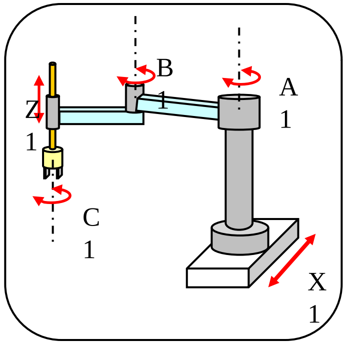
Two issues remain in this mode of driving:
1) The voltage of the two signals allows 5Volt distances greater than 1 or 2 meters between control and drive.
2) The pulsed signals with frequencies that can be up to 250Khz is easily disturbed from external sources, with a dramatic influence on the final positioning

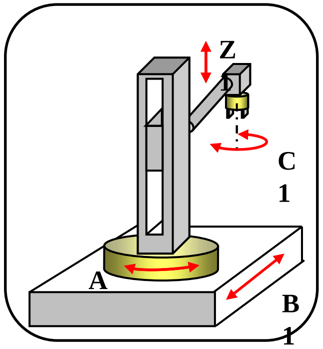
Motion Control Features Part 1

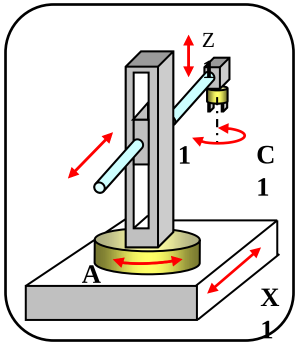
Motion control works in multi-task, clusters of axes defined by "handler" dynamic that is referred to the movement controls.
A command handling is carried out in the following phases:

a) Iinterpolation motion command which involves both axes involved algorithms:
a.1) Linear interpolation, circular, spiral, "spline", "surf"
a.2) Anti-collision between the axles.
a.3) "Gantry.
a.4) Electronic cams

b) Transformation of coordinates in your work plan so we can have different configurations or types of robots:
b.1) SCARA
b.2) SCARA ROUTER
b.3) Polar
b.4) Polar sleeve







Motion Control Features Part 2

c) Calculate the theoretical position of instantaneous
In calculating the actual position must comply with the laws of motion, accelerating, maintaining speed and finally programmed to decelerate.

The accelerations and decelerations can be:
c.1) Linear
c.2) "S_Curve"
c.3) Sinusoidal

d) Correcting the theoretical with the matrix, or vectors of linear compensation, balancing, rolling and pitching.

e) Monitoring the position of course, this feature is necessary if the command is given to the drive is speed or torque.

This capability is realized with the method of feedback PID (Proportional Derivative integrations)

DCOM

The product "AxesBrain" was developed to provide handling services to user applications, using technology "DCOM", it will be possible to have access to these services not only from the same PC, but also integrated into the local network or PC connected through the Internet.

To use the services of handling can be used two main roads or functions using direct resources axes, spindles and output-input signals, or using programmed cycles. Using programming languages are defined in procedures or courses of paths of the axes and handling and processing, in our case we have two languages available: GP-PLCL and AxesBrainISO that you can use depending on the type of application that comes to present.

The handling services are:

Direct FUNCTIONS
commands to the axes and the output signals of fattening
acquisition of values from the field, reading boards, I / O, sensors, etc..
mode settings for the trajectories, acquisitions, etc..

CYCLES processing and manipulation with programming by:
GP-PLC - proprietary language suitable to describe the cycles for the automation of handling general
AxesBrainISO - ISO standard language suitable to describe the typical cycles of milling and turning.