



PHASE

MOTION
CONTROL

**Leading the innovation in electric force,
motion and position control for automation**

Phase Motion Control



- Started in 1985 as a R&D house for research grade special motors and drives
- Started standard motor + drive production (*Ultract*) in 1992 for OEM Customers
- Continuous innovation through applied R&D and own patents; manufacturing license sold to SBC-Elau in 1994
- Started linear and torque motor production in 1994
- New *Wave*TM linear motors without cooling introduced 1998
- Strategic decision to stop commercialization through third party and promotion of Phase brand in 1999



Phase Motion Control today



- **2001 production: average 1300 axes/month**
- **production centers: Genova, Turin (RCV), Ningbo (China)**
- **R&D in Genova, Italy headquarters**
- **New Genova headquarters opened Dec. 2000**
- **New Ningbo plant opened Dec 2001**
- **2001 group turnover 8 ME**



Company strategy



- **Competitive edge through innovation and performance - always one step ahead**
- **Magnetic, mechanical, electronic and software design integrated in all PMC products**
- **New technologies continually tested in the specialty, custom design fields and transferred to mass production**
- **Technology trends:**
 - Direct drive**
 - Linear motor**
 - Drive integrated into the motor**
 - Distributed intelligence + fieldbus control**



Company production structure



- **Standard product line for automation**
 - Ultract II brushless motors, 0.2 to 450 Nm
 - AXV programmable motion platforms
 - TK torque motors
 - Wave linear motors
- **Custom and semicustom specialty drives**
 - **Custom:**
 - Large motor drives for scientific applications (e.g. 16 m dia, 180,000 Nm ring motor)
 - Aerospace and military
 - **Semicustom: special assemblies for specific sectors**
 - plastic injection molding machines
 - resistance welding
 - textile spindles



***Ultract II* brushless motor range**



- From 0.2 to 450 Nm
- Fully mechanical rotor fastening
- 6 flange sizes
- lowest inertia, highest torque density on the market
- Size 10 and 13: cast iron front flange, servo fan cooling option
- Standard motors: no key, Wago spring type terminal block in IP 65 enclosure with metric glands (0 cost wiring!)
- Sensor options: Heidenhain ERN 1385 SINCOS encoder with 20" accuracy
- Low cost option: resolver
- Size 4,5,7: new PM safety brake with 0 backlash and very high standstill torque



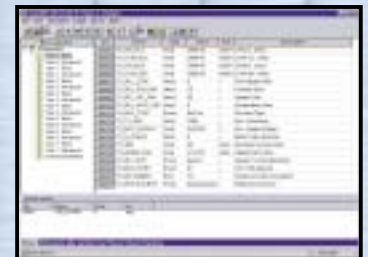
Key issues: key on shaft? Connectors?

- **Key:**
 - Key on shaft degrades performance and balancing
 - non standard but supplied on request
 - advise Customer on technical inadequacy, do not underwrite technical errors
- **Connectors vs. terminal board:**
 - we do not consider cables a profit area
 - connectors and cables can cost as much as 30% of a drive system - your Customer knows!
 - OEM manufacturers favor terminals, low volume users favor connectors
 - New high density motors may have connectors by default

AX-V programmable motion platform

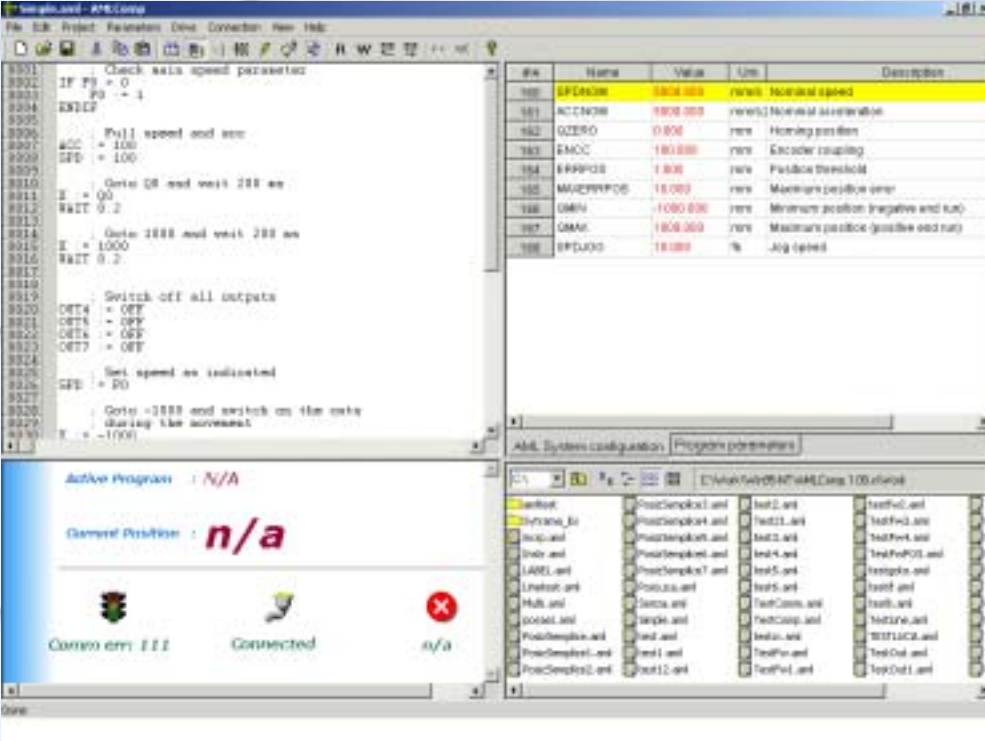


- A complete system in a drive
- Open system with IEC 1131 programming language, all application examples with source codes available
- Encoder interpolation 2^{14} , 8 kHz rate
- Multi axis PLC - LogicLab
- Intradrive synchronous communication between drives for multiaxis control
- Advanced Programming Language NC type capability AML
- about 4 times faster in direct drive than Siemens 611 U
- Supports Modbus, Canopen, Profibus
- Electronic cam, electric shaft, flying shear etc
- Suitable for linear motors, direct drives, multiaxis



AML

- CNC type programming language for all PMC drives
- Sequential motion control instructions (unlike PLC)
- User engineering units (mm, degrees etc, programmable)
- Interacts with drive PLC - both can be used together





The screenshot displays the AML software interface. The top window shows a CNC-style program with the following code:

```

9901      Check axis speed parameter
9902      IF P3 = 0
9903          P3 = -1
9904      ENDIF
9905
9906      Pull speed and acc
9907      ACC = 100
9908      SPD = 100
9909
9910      : Goto 08 and wait 200 ms
9911      I = 0
9912      WAIT 0.2
9913
9914      : Goto 1000 and wait 200 ms
9915      I = 1000
9916      WAIT 0.2
9917
9918
9919      Switch off all outputs
9920      OET4 = OFF
9921      OET5 = OFF
9922      OET6 = OFF
9923      OET7 = OFF
9924
9925      Set speed as indicated
9926      SPD = 50
9927
9928
9929      Goto -1000 and switch on the axis
9930      during the movement
9931      T = -1000
9932
9933
  
```

The bottom window shows the system configuration and status:

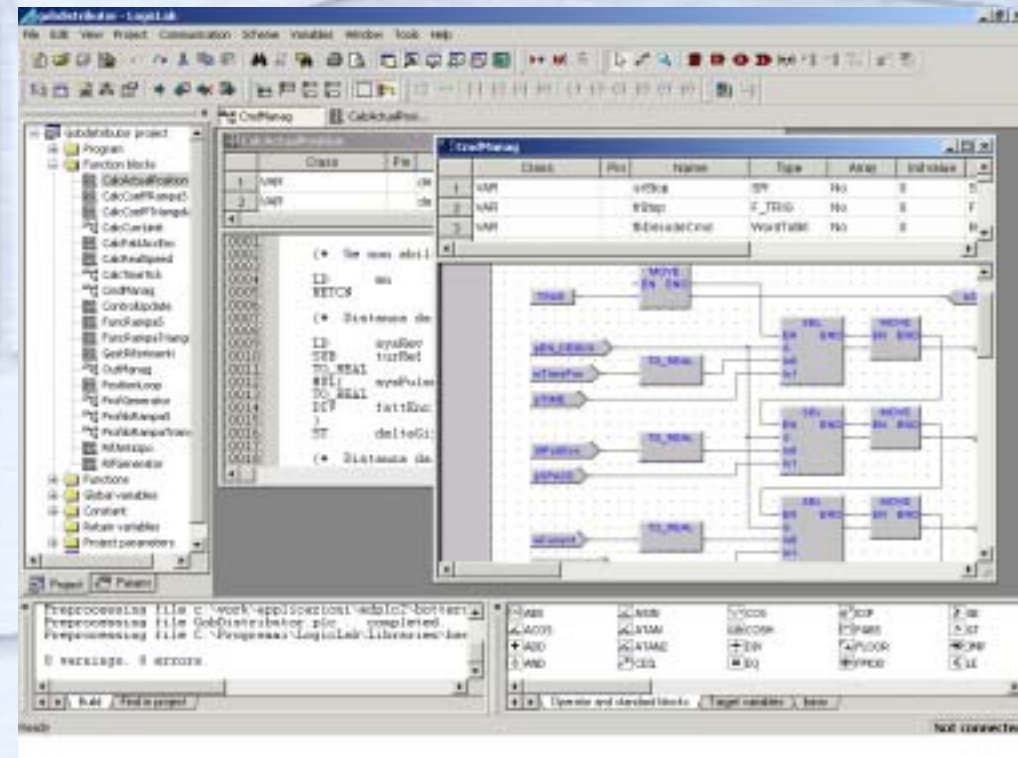
- Active Program: N/A
- Current Position: n/a
- Control err: !!!
- Connected: 
- Axis status:  n/a

The right-hand pane displays a table of system parameters:

#	Name	Value	Unit	Description
100	SPLASIM	5000.000	mm/s	Normal speed
101	ACCINSM	9000.000	mm/s ²	Normal acceleration
102	ZERO	0.000	mm	Homeing position
103	EMOC	100.000	mm	Encoder coupling
104	ERRPOS	1.000	mm	Position threshold
105	MAXERRPOS	10.000	mm	Maximum position error
106	OMIN	-1000.000	mm	Minimum position (negative end run)
107	OMAX	1000.000	mm	Maximum position (positive end run)
108	ERRDIO	10.000	%	Alg. error

Logic Lab IEC 61131 plc

- IL, FBD, LD support
- Sequential motion control instructions (unlike PLC)
- Platform independent
- Direct machine code generation - high execution speed
- Project management with libraries
- Real time debug with real time oscilloscope



TK torque motor rings



- Designed for high peak torque, more linear than ETEL-Siemens
- from 84 mm to 570 mm diameter
- torque from 2 to 5000 Nm
- customized rotor, direct cooling on outside
- Highest power density in the market



Applications:

- **GILDEMEISTER multiple spindle lathes - spindle motors**
- **FAMAR vertical lathes - spindle motor**
- **GNUTTI TRANSFER main tool table - indexer motor, direct drive**
- **FTP large NC milling machine - head orientation**
- **PIETRO CARNAGHI large lathes - direct drive**

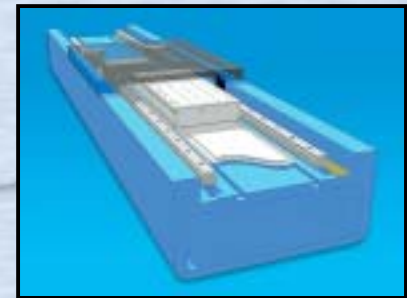
Can be used with Siemens drive if needed.

The future: *Wave* linear motor range



Simple, easy to use linear motors for positioning

- Payload 2 to 200 kg, 6 m/sec, 6g
- No cooling (only convection/conduction)
- compatible with AXV drives
- pick and place, plotters, sewing machines, woodworking, tool changers, etc
- 0.9 mm airgap, 0.3 mm assy tolerance
- cost compatible on inertial loads with rack&pinion + gearhead drives



Existing applications

- **Sytrama:** cartesian robots to load/unload presses
- **SEI:** laser plotters
- **BIESSE:** woodworking machines
- **SIPA:** loading and unloading of uP chips
- **ORSOGRILL:** metal wire bending-forming
- **others:** glass cutting, flying shears, wire guidance in textile machines,

New Ax-M platform



- **Small size (77*146*160mm)**
- **Two available sizes 4-9A and 6-14A**
- **Supports ENDAT and electronic nameplate**
- **CANOpen interface**
- **PLC and AML programming**

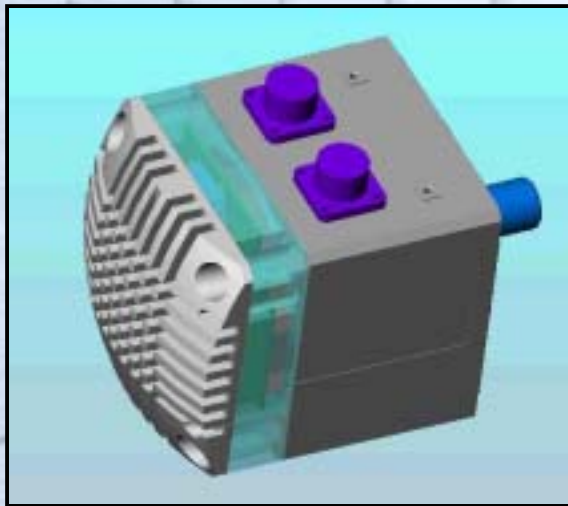
High torque density T motor series



- **New design with non laminated core, high pole count, very short length**
- **high accuracy shaft and flange**
- **hydraulic motor aspect ratio, about 30% of standard length with same flange**
- **with built-in new EQI 1327 Heidenhain multiturn absolute magnetic encoder**
- **ENDAT sensor interface**
- **double insulation**
- **Available from Jan, 2002**



TW integral motor



- **Servo drive (positioner, cam etc) assembled on motor**
- **with built-in new EQI 1327 Heidenhain multiturn absolute magnetic encoder**
- **CANOPEN interface with interpolation ability up to 6 axes**
- **3 Nm, 3000 rpm, 400 Vdc supply**
- **Double insulation**
- **IP 65 enclosure**
- **Available 4-2002**

Custom design capabilities



- 10 m diameter motors & drives for ESO- VLT
- 16 m diameter motor + drive for Grantecan
- 12 mm diameter micro actuator for Eurfighter aircraft (EFA)
- D&D for ZER....



Semicustom assemblies



derived from standard or semistandard components, tailored to specific applications with long term customer relationship

- **Special actuators for all electric plastic injection machines**
- **Special actuators for resistance spot welding in automotive**
- **Multiple spindle micro drives on CANBUS for textile**
- **Direct drive motors for knitting machines**



Worldwide support and distribution network



- R&D, Company headquarters
- Manufacturing and support
- Authorized distributor





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