

SERVO SYSTEMS & PROCESS CONTROL

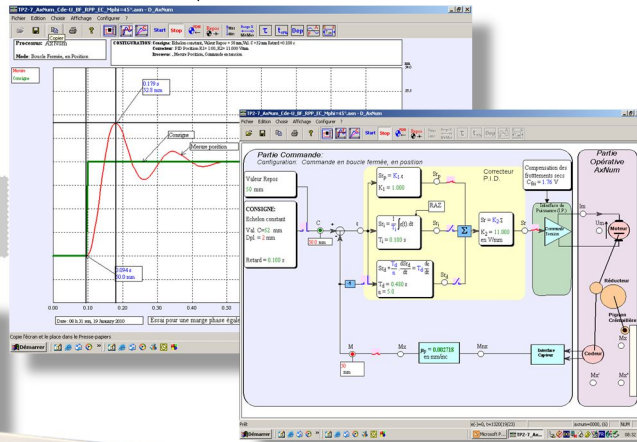


Software D_AxNum
Réf : ERD150100



6 Experiments manuals

3 Topics manuals Réf : ERD150-030 & 050 & 070
3 Reports manuals Ref: ERD150-020 : & 040 & 060
(more than 480 pages)



AXNUM : ERD 150 B



Electromechanical Monitor
Ref : ERD150000

TRAINING PURPOSES

The « AXNUM » is a major component in the industrial world. Used as a way of moving objects, it must offer a high positioning accuracy and also, a high speed (**response time, movement duration**). The AXNUM is composed by industrial components. It allows to study the different kind of servo systems with a Personal Computer (Windows environment) or with a PLC (Programmable Logic Controller).

The choice of the computer control associated with the software ERD150100 allows to make all the tests without measuring equipment: records of response curves, signal generation, presentation of block diagrams and also, the use of the results with MATLAB.

STUDIED TOPICS

- Study of sensors characteristics : position, speed, acceleration
- Study of the dynamic behaviour of a Direct Current motor / mechanical load according to the engine power mode: current, voltage
- Identification of an open loop system and modelling in the linear continuous or in discrete area (sampled or digital)
- Study of servosystem following the kind of corrector : P, PD, PID, Cascade, 'z'
- Study of servosystem with an compulsory speed profile : Step value for the position : limited ramp, "S profile" or a speed profile with a trapeze form
- Optional: D_Scil, automatic real time corrector generator,

TRAINING IN

- Technical High School
- Bachelor degree

- Polytechnics
- Master degree

- School for Engineers

ERD150000 : ELECTROMECHANICAL MONITOR

The ERD 150 000 electromechanical device is available on table-top anodized aluminum base framed that can be put in horizontal or vertical position (influence of gravity study).

Power is supplied by external transformer.

Control part

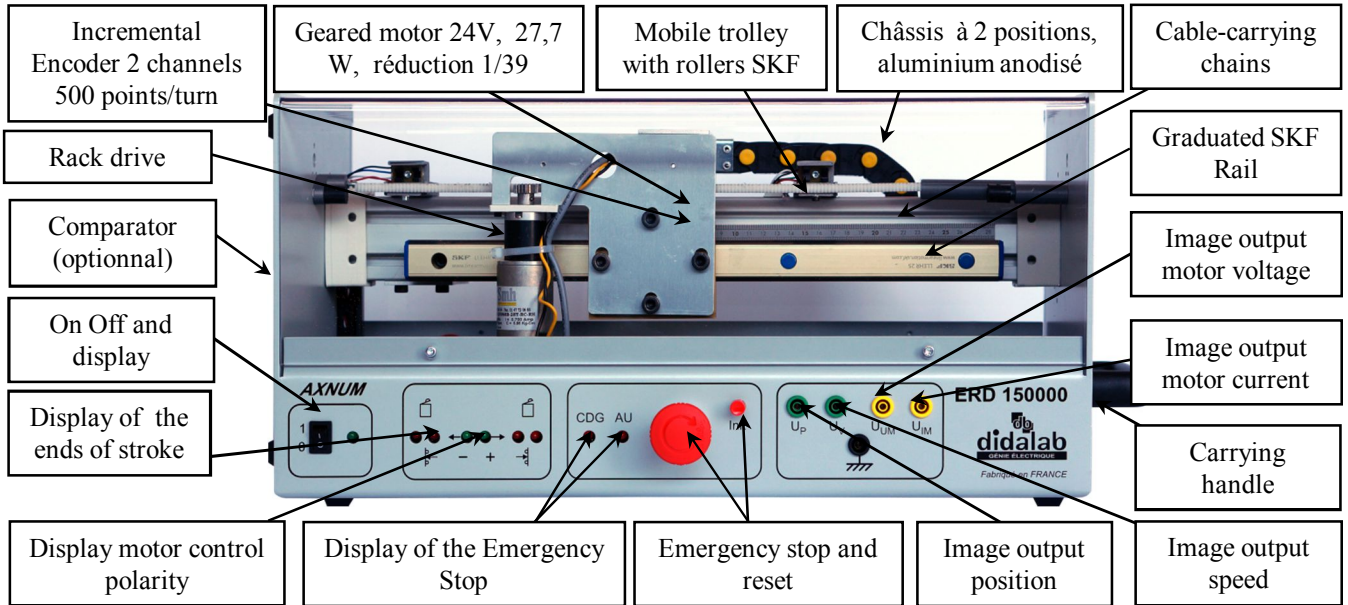
An electronic control board is equipped with high level power microprocessor carries out the system real time control and the communication PC computer (USB link, RS232 on request).

An electronic power board carries out the motor driving interfacing and the other interfaces, used in the axis control. Two controls are available: current or voltage.

Operational part

It includes a support beam on which moves a movable carriage. On it, is fixed a geared DC with a 2-channel incremental encoder.

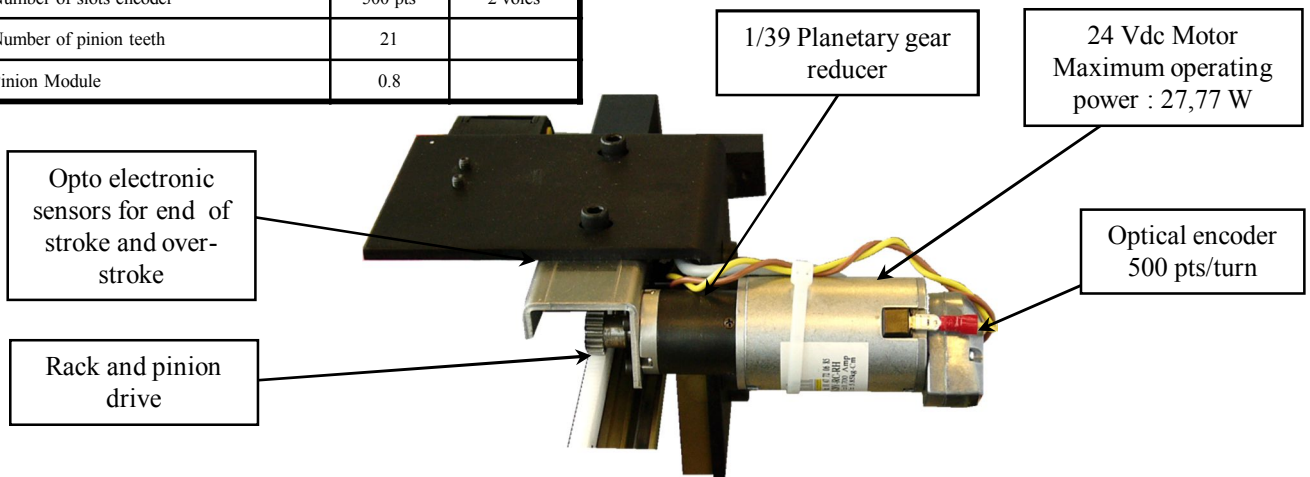
The movement transmission is effected by rack and pinion.



GEARED MOTOR TROLLEY CHARACTERISTICS

| CHARACTERISTICS | VALUE | UNIT |
|---------------------------------------|---------|---------|
| Power Supply | 24 | Vdc |
| Vacuous motor speed | 5 200 | Tr/min |
| Current with the best efficiency | 911 | mA |
| Torque constant | 4.32 | N-Cm/A |
| Maximum engine efficiency | 72.34 | % |
| Operating power at maximum efficiency | 12.94 | W |
| Reduction ratio of the gear | 1/39 | |
| Number of slots encoder | 500 pts | 2 voies |
| Number of pinion teeth | 21 | |
| Pinion Module | 0.8 | |

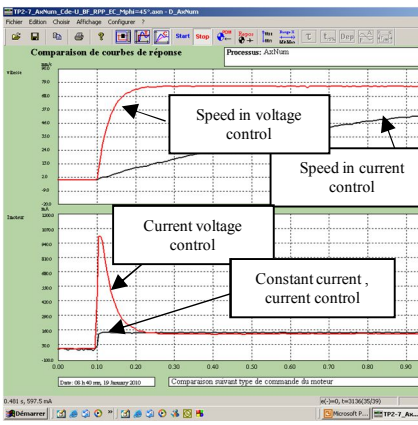
The trolley is driven by an « SMH » DC geared motor, which is an industrial type. It consists of a DC motor coupled to a reducer and a 2 channels incremental encoder in phase quadrature.



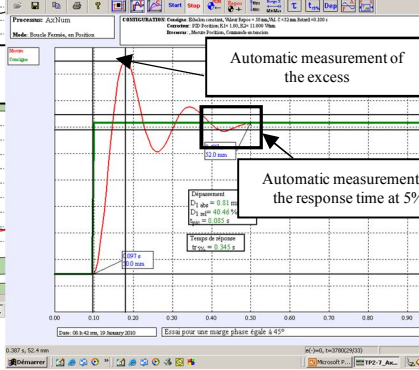
ERD150100 : PROGRAM UNDER WINDOWS « D_AxNum »

- Can be operated under Windows (Professional editions), it enables the control of the servosystem via USB Link.
 - It enables the User the configuration of the system, via an ergonomic graphic interface:
 - Selection of the system structure: speed or position open/close loop.
 - Selection of the control type and characteristic values: constant step, limited ramp, sine, speed trapezoid signals
 - Selection of the corrector and its adjustments (P, PI, PID, Cascade, "Z" corrector, Corrector programmed in «C»...)
 - Selection of the power interface type (current or voltage)
 - Selection of the acquisition and recording parameters (Choice of sampling periods)
 - Selection of the measurements units (mm or digital increments for the position and mm/s or digital increments for the speed)
 - It also enables the structured running of the experimental work:
 - Time response display of one (or several) characteristics parameters: position, speed, acceleration, motor current, motor voltage, control signal, overflow, corrector output etc...
 - modification of the time diagram scales (zoom in X, or Y)
 - Determination of the automatic control characteristic values:
 - constant step : time constant, 5% response time, absolute overlap, relative overlap,
 - sine excitation : average value, amplitude, frequency, period
 - response in a harmonic system : ratio of medium values, ratio of the amplitudes, phase shift
 - saving the configuration of the current test with the response curves of various recordable sizes
 - comparing the result of the on-going trial with results previously recorded
 - export curves to be used by other processing such as Excel and MATLAB
 - allow modelling in the linear range thanks to a compensation of dry friction
- Optional: Creating a corrector, programmed in "C" language integrated in the acquisition environment of the "AxNum"**
 (See documents ERD 150 400)

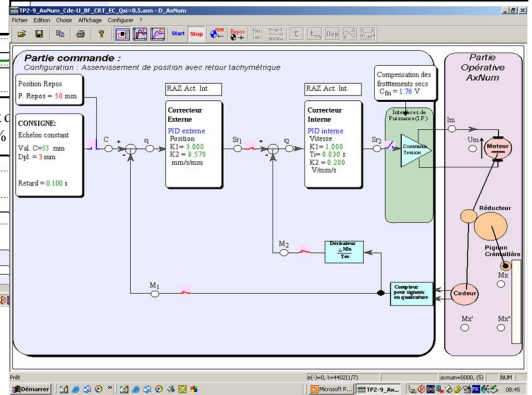
Comparison screen between OL responses in voltage control mode and current mode.



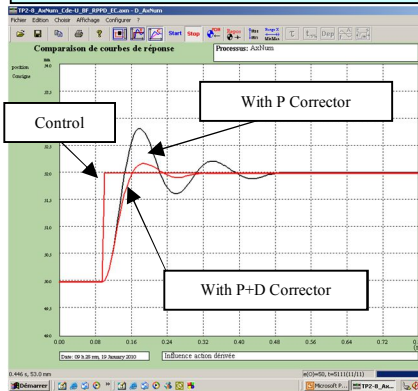
Response in closed loop of a position servo system with automatic calculation of the response time in the 5% zone and the overlap



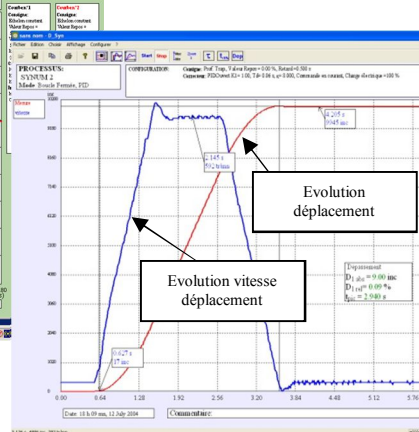
Parameter screen: Example of a position servo system with tachometric return corrector



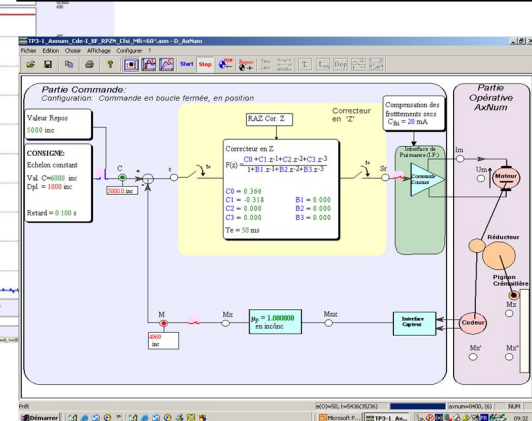
Comparison of curves: Proportionnal and Proportional Derivate closed loop position control.



Closed loop position control response with trapezoid control, speed and position curves



Parameter screen: Example of speed control by « Z » corrector.



Experiments manuals « topics » and « reports » :

ERD150030/40 Manual of Practical reports and topics, level 1 (Last year of high school) + Lesson (118 pages)

- Experiment n° 1-1 Open loop Identification (behaviour analysis following the type of excitation: step, ramp, sine)
 Experiment n° 1-2 Study of closed loop, P corrector
 Experiment n° 1-3 Study of closed loop, P+D corrector,
 Experiment n° 1-4 Study of closed loop, with a profile step value
 Experiment n° 1-5 Study of sensors used in digital axis control (Structure et characteristics)
 Resources manual : **Some theory on Servosystems** (Structure, behaviour, characterization, correction ...)

ERD150050/60 Manual of Practical reports and topics, level 2 (Bachelor degree, engineer school) + Lesson (180 pages)

- Experiment n° 2-1 Characterization in open loop, power interface: current control.
 TP n° 2-2 Position control, P corrector
 TP n° 2-3 Position control, P+D corrector
 TP n° 2-4 Position control, and a profile as excitation mode
 TP n° 2-5 Position control with Proportional correction and a non-linear load
Several Practical works with a voltage controlled motor
 TP n° 2-6 Position control, P corrector,
 TP n° 2-7 Position control, P + D corrector,
 TP n° 2-8 Position control, P + D corrector,
 TP n° 2-9 Position control with digital Proportional correction and tachymetric return
 Resources manual : **Some theory on Servosystems in continuous system** (Laplace's transform, laws)

ERD150070/80 Manual of Practical reports and topics, level 3 + Lesson (Digital range) (184 pages)

- Several Practical works with a current controlled motor*
 TP n° 3-1 Characterization in open loop n° 1 (current control) in digital range
 TP n° 3-2 Position control, digital Z P corrector,
 TP n° 3-3 Position control, digital P corrector + digital Zero,
 TP n° 3-4 Position control, corrector : P + Zero + digital pole
Several Practical works with a voltage controlled motor
 TP n° 3-5 Characterization in open loop n° 2 (voltage control) in digital range
 TP n° 3-6 Position control, corrector : P + digital,
 TP n° 3-7 Position control, corrector : P + digital Zero,
 TP n° 3-8 Position control with digital C corrector under D_Scil
 Resources manual : **Some theory on discrete Servosystems**

Standard configurations :

ERD150B, « DIGITAL AXIS, SPEED and POSITION SERVO CONTROL » package, including :

| Reference | Designation | Qty |
|-----------|---|-----|
| ERD150000 | Electromechanical monitor for experimental study of a numeric axis | 1 |
| ERD150100 | PC control program « D_AxNum » | 1 |
| ERD150020 | Manual of Practicals reports, level 1, (Last year of High School) (44 pages), available on the CDROM | 1 |
| ERD150030 | Manual of Practicals, level 1 (Last year of High School) + Course (74 pages), available on the CDROM | 1 |
| ERD150040 | Manual of Practical reports, level 2, (Bachelor /Master degree) (100 pages), available on the CDROM | 1 |
| ERD150050 | Manual of Practicals, level 2, (Bachelor /Master degree) + Course (80 pages), available on the CDROM | 1 |
| ERD150060 | Manual of Practical reports, level 3, (digital range) (86 pages), available on the CDROM | 1 |
| ERD150070 | Manual of Practicals, level 3, (digital range) + Course (98 pages), available on the CDROM | 1 |
| EGD000006 | USB Cable : « AA » | 1 |
| EGD000005 | 24 Vdc, 2.9 A Power Supply | 1 |

ERD150S, « DIGITAL AXIS, SPEED AND POSITION SERVO-CONTROL, REALTIME PROTOTYPING» package including :

| | | |
|-----------|--|---|
| ERD150B | « DIGITAL AXIS, SPEED and POSITION SERVO CONTROL » , package | 1 |
| ERD150800 | Software module for rapid prototyping (see documentation) | 1 |

Packing :

1 case. Dimensions: 60 x 30 x 50 cms
 Weight : 8 Kg