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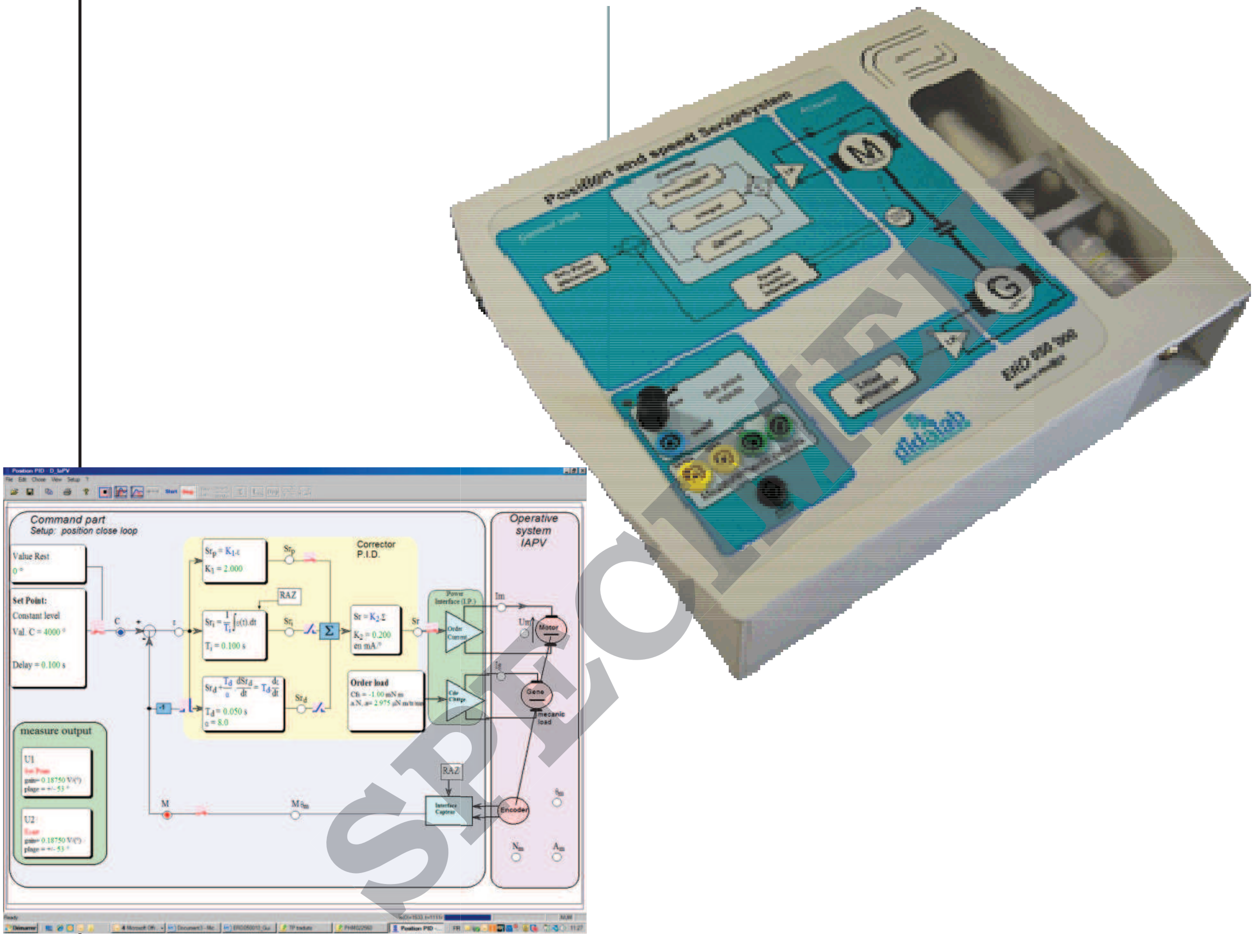
IAPV"SERVOSYSTEM

Introduction to Speed & Position ServoSystems



- Practicals -

Student's book

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SUMMARY

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TOPICS of Practical Works on IAPV system (ERD050) **Level 1 Practical n°1** File reference: TP1-1_IAPV_BO_Sujet.doc	SYSTEM CHARACTERIZATION IN OPEN LOOP (OL) → With power interface"**Current** control"-type → With fluid friction-type load → With compensation of the dry friction

Objective:

Definition of a system behaviour model, in its expected configuration, through some experiments.

Configuration:

Configure the open loop system:

Select → Control mode → Open Loop

Configure the power interface in "Current control":

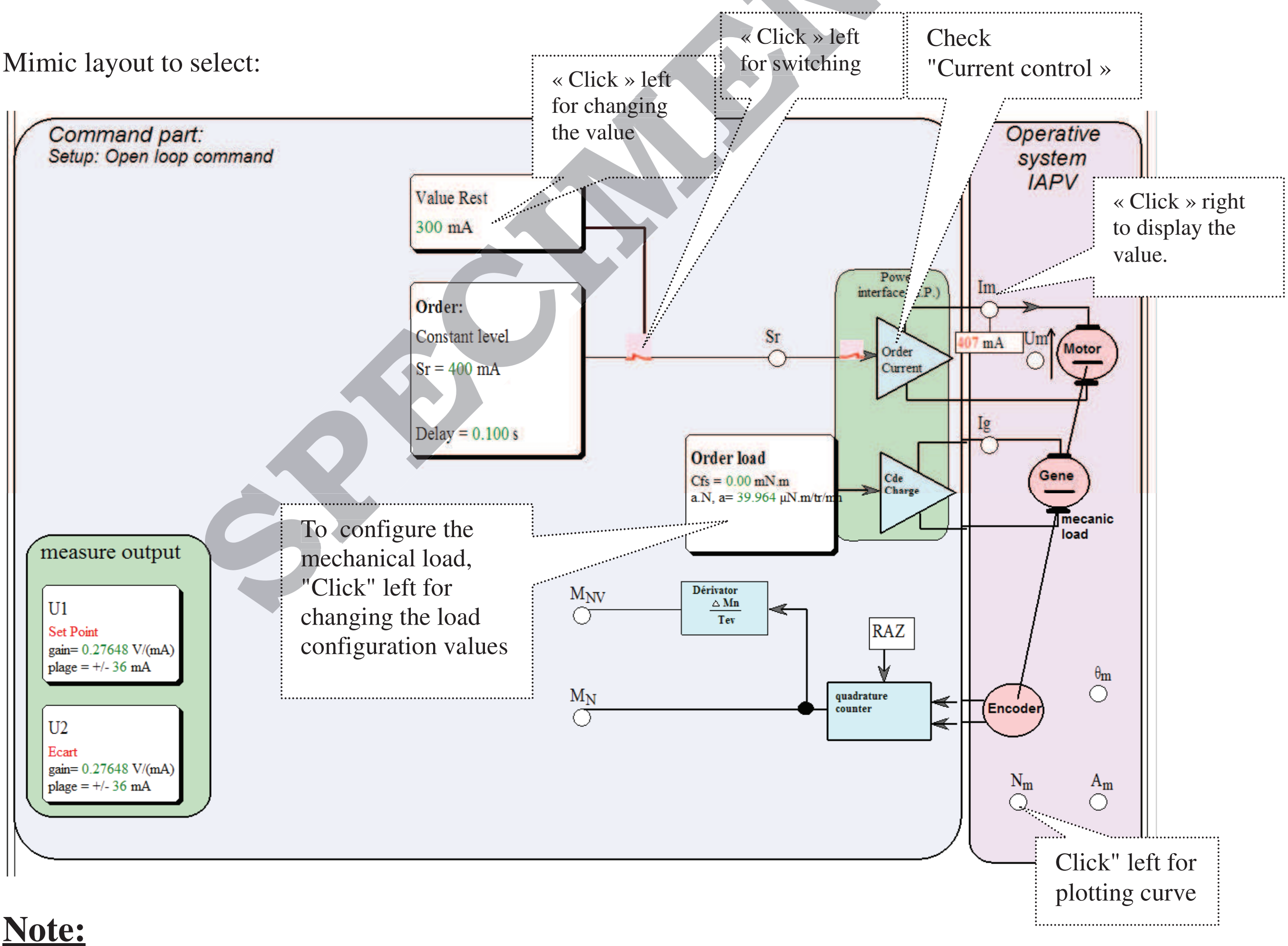
Select → Power interface → Current control

Specify the torque characteristics parameters:

"*Click*" on "*Load control*" block & activate "Dry friction torque" & "Viscous torque".

Select the following values a = 4 µ N.m/rad/s & Cfs =-7 m N.m

Mimic layout to select:



Note:

In the case of current control, the control value of the open loop system, marked "Sr", is a current set value, expressed in mAmp. This is a current servosystem that sets current into the motor armature, called Im, equal to Sr in permanent speed, in using P.I. correction.

1. CHARACTERIZATION IN STATIC RESPONSE

1.1. Plotting of the static transfer characteristic

In this case, the control value (S_r) is maintained constant (switch on "rest value"position) & the value reached by the rotation speed, N, is measured at point "MNm".

Test conditions & operating mode:

- Check the mechanical load characteristic: Cfs = -7 m.N.m a = 4 μ.N.m/$_{rev/min}$
- Specify the rest value in doing "Click left" on the "Rest value" block (Value between -500 & +500).
- Attend to the link switch between signal Sr & the power interface is closed.
- Put one probe on the measurement point, Mnm, in doing "Click right " on this point, in order to measure the speed.

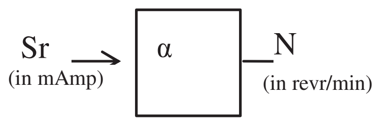
1.1.1. Experiment

☞ Fill out the following measurement chart:

Sr in mAmp.	-500	-400	-300	-200	-100	0	100	200	300	400	500
N in rev/min											

☞ Plot the static transfer characteristic: N = f (Sr) & demonstrate that one part of the latter is a straight line. Give the equation.

1.1.2. Operation:



☞ Deduce the static transfer coefficient & static block diagram if we suppose the the dry friction perfectly compensated.

2. CHARACTERIZATION IN DYNAMIC RESPONSE

2.1. Response to constant step

2.1.1. Experiment

Starting from one rest value with Sr = 200 mAmp. , apply one constant control step, value Sr = 400 mAmp. The instant when the step is applied is the origin time. Display the time / speed variation (N).

Test conditions & operating mode:

- Check the load characteristic: Csf =- 7 m.N.m & a = 4 μ.N.m/$_{rev/min}$
- Specify the rest value at 200 mAmp..
- Specify the constant step at 400 mAmp. With step time delay equal to tr = 0,1S.

- Ensure to be in Stop *mode with closed output switch.*
- Select the plotting points, MNm & Sr, with "Click left ".
- Apply the step in doing "click"on the step application switch.

- Plot the time response in doing "Click on button..
- It is possible to know the coordinates of a point in putting one "Probe". As for this, "Click/drag" from the point towards the place where the probe has to be located.
For erasing one useless probe, "Click"on it.

☞ Note down some points with a gap of about 0.2 S in putting judiciously probes.

t-tr	0									∞
$N_{(t)}$										

2.1.2. Operation:

☞ Demonstrate that the time response verify the law of behaviour:

$$N_{(t)} = N_{(0)} + (N_{(\infty)} - N_{(0)})(1- \mathrm{Exp}[-(t-tr)/\tau_m])$$

where τ_m is a constant (called time constant) which is in fact, the mechanical time constant that must be determined.

!! The time origin must be taken at the right moment of the step application !!

Note:

The time constant τ_m can be determined by the program in doing "click" on the τ button.

☞ Check if we find at the end of the transient speed (thus, in set speed) the measurement point corresponding to the static test, previously carried out.

☞ Save the measurement results in a file (hard disk):

File → Save as...

- Select the right directory, reserved for this purpose, select a file name & authorize saving.

2.1.3. Study of the influence of the viscous friction coefficient

☞ Carry out again the previous experiment for other values of the viscous friction coefficient a = 6 ; 4; 8; & 10 µ.N.m/rev/min (Csf is maintained at -7 m.N.m -> well compensated dry friction).

Plot for each experiment the time constant & the speed final value.

☞ Plot for each experiment the speed asymptotic value & the time constant & save on the hard disk.

!! Wait for the recording end -> back to "Stop" mode !!

☞ Display the 4 plotted curves on on the same diagram, with the help of the button & the experiment loading by: *File → Open*

☞ Conclude on the influence of the viscous friction coefficient.

☞ Make an experiment with a = 0 (Csf always at -7 m.N.m) & justify the appearance of the obtained curve.

2.2. Behaviour in sinusoidal response

2.2.1. Experimental plotting:

Study of the behaviour in control of $Sr_{(t)} = Sr_0 + Sr_M.\sin(\omega.t)$

Test conditions & operating mode:

- Configure the load characteristic: Csf = -7 m.N.m/$_{trevmin}$ et a = 4 µ.N.m/$_{rev/min}$

- Select the « Sine » control mode

with: C value Sr_0 = 300mAmp., average value,

Amplitude = Sr_M = 100 mA ,sinusoidal component amplitude,

$\omega = 1/\tau_l$, *sinusoidal component pulsation,*

(τ_l is the time constant, plotted during the previous experiment).

- Attend to be in Stop mode with output switch in OFF position..

– Apply the step signal, in doing "click" on the step switch.

- Select the recording points MNm & Sr in doing "Click left " on.

- Draw the time response in doing "Click left" on button..

- Plot the main characteristics in doing "Click left" on button, then, in putting probes.

☞ Plot, as soon as the speed is established, the maximum value reached by the speed, the minimum value & the speed phase difference with the control value.

2.2.2. Operation:

☞ Deduct the speed average value in permanent speed (established speed):

☞ Check if the obtained value enforce the static model, specified previously.

☞ Calculate the amplitude ratio in permanent speed (speed sinusoid amplitude / control sinusoid amplitude)

☞ Check if the experimental plotting corroborates the first order systems properties in sinusoidal response, with particularly selected pulsation.

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