CHAPTER 5

RESULTS

5.1 Testing the Controller

The controller built was tested for stability and steady state error. Two low - pass circuits were used to detect the change of pulse-width which corresponds to the change of the angu--lar position, as shown in Figure 5.1

The input is a 180° step input. Since the control unit used is a 1K-ohm potentiometer, the 180° step input then corresponds to a change from 1K-ohm to 500-ohm.

For steady state error test, a square pulses was applied by depressing the switch at an appropreate intervals. The posi--tional error corresponds to the different in height of the adja--cent pulses.

The test results are shown in Figure 5.2, 5.3, 5.4, 5.5 . Figure 5.6 is the response at critical sampling period, which was obtained by varying the sampling period until the system started to oscillate.

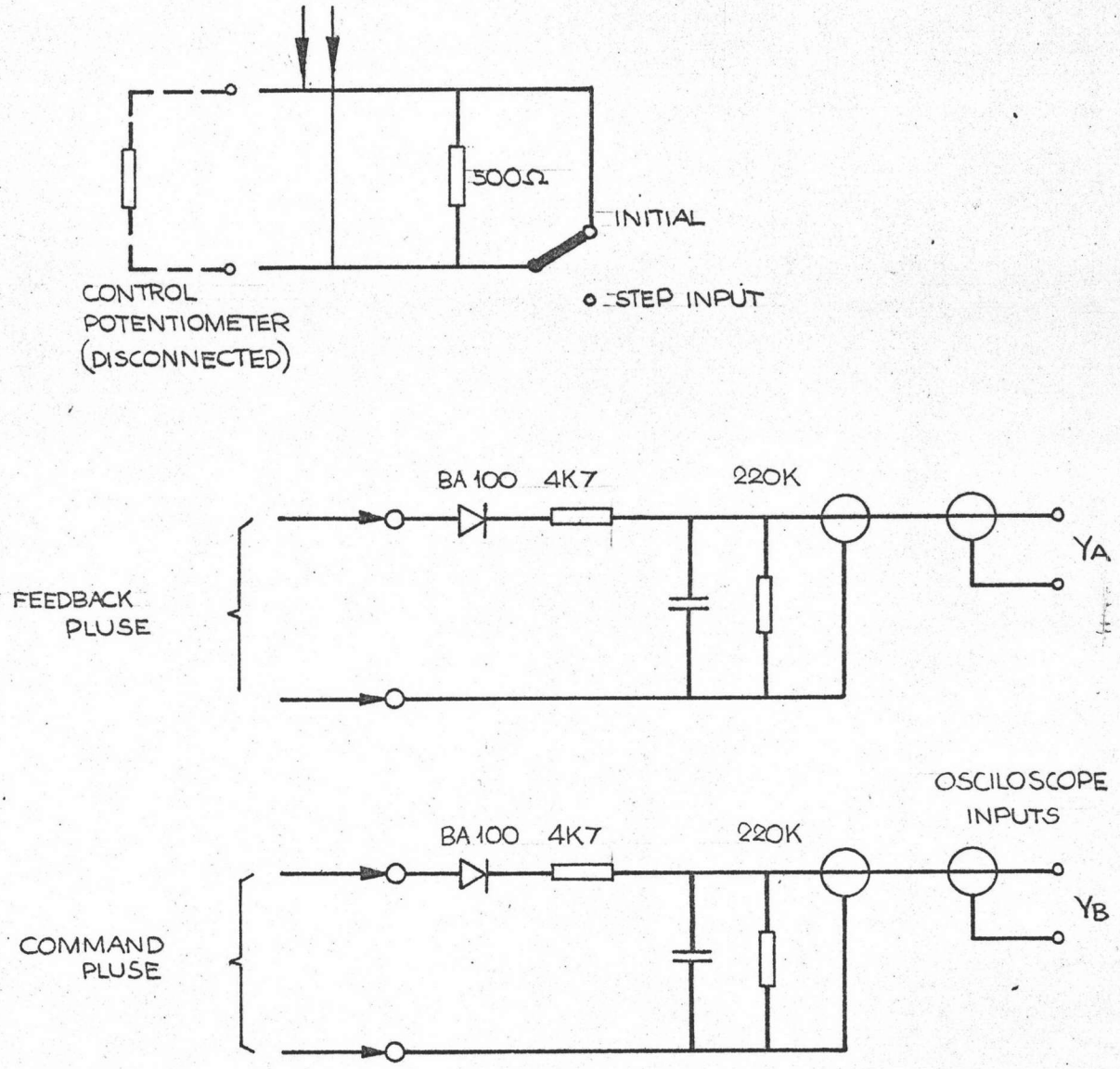

FIGURE 5.1 TESTING

5.2 The Results.

The stability of the system is evident by inspection of Figure 5.2, 5.4, 5.6 and 5.7. For T = 2 ms the system is very stable with very little over-shoot. For T = 20 ms the over-shoot is increased but still stable. For T = 48 ms the system is liable to oscillate, and at approximately T = 50 ms the system is oscillating.

The steady state error from Figure 5.3 and 5.5 can be found as shown in the following tabulation :

Figure 5.3	1st. Pulse	2nd Pulse	3rd Pulse
Height (mm.)	21.2	21.6	21.4
average height	$= \frac{1}{3}(21.2+21.6+21.4)$	$= 21.4$	
maximum error	$= 21.6 - 21.2$	$= 0.4$	
% error	$= \frac{0.4}{21.4} \times 100 \times \frac{1}{2}$	$= \pm 0.93\ \%$	

Figure 5.5	1st. Pulse	2nd Pulse	3rd Pulse
Height (mm)	24	24.1	23.2
average height	$= \frac{1}{3}(24+24.1+23.2)$	$= 23.73$	
Maximum error	$= 24.1 - 23.2$	$= 0.9$	
% error	$= \frac{0.9}{23.73} \times 100 \times \frac{1}{2}$	$= \pm 1.9\ \%$	

5.3 Summary of the Results.

The design and test results are shown below:

	Design	TEST RESULTS
Steady State error	±1%	±0.93% for T = 2ms ±1.9 % for T = 20ms
Stability, T = 2ms	Stable	Stable
T = 20ms	Stable	Stable
T = 50ms	Unstable	Unstable
Critical Sampling period	30 ms	48 ms

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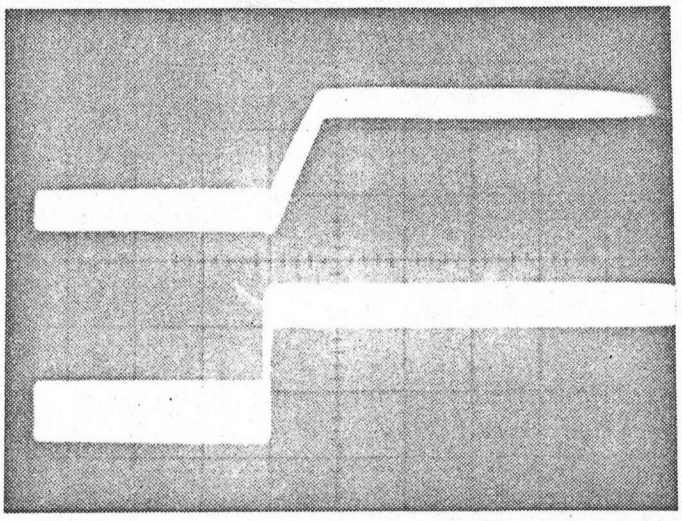

Figure 5.2, 180° step response at T = 2ms

Upper trace = output

Lower trace = input

Time base = 0.5 sec./div.

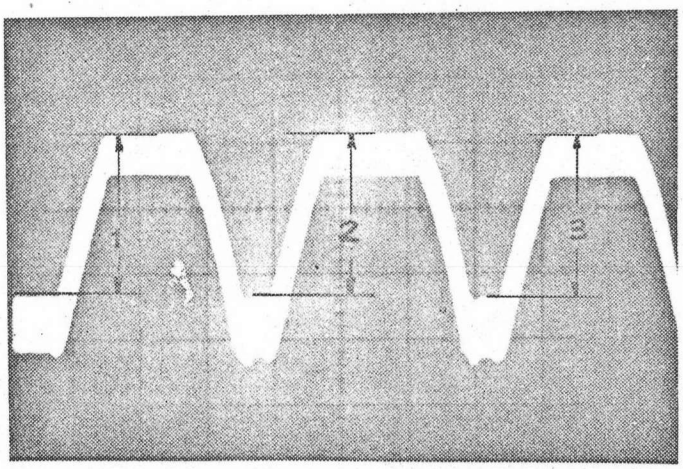

Figure 5.3, Square Pulse response, T = 2 ms.

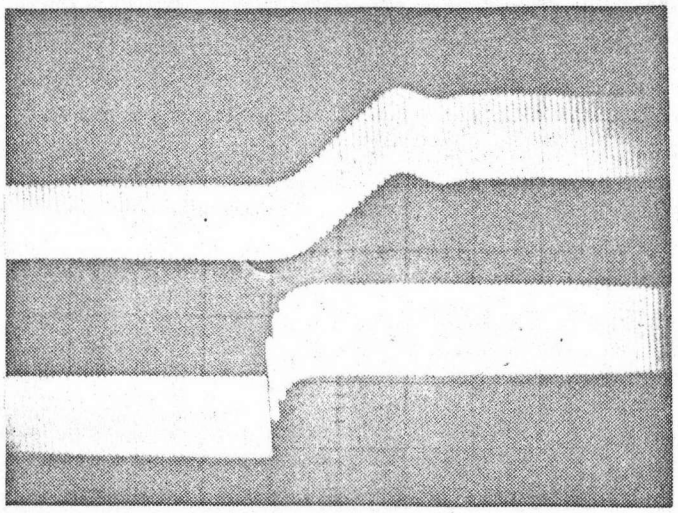

Figure 5.4, 180° Step response at T = 20 ms
Upper trace : output
Lower trace : input
Time base : 0.5 sec./div.

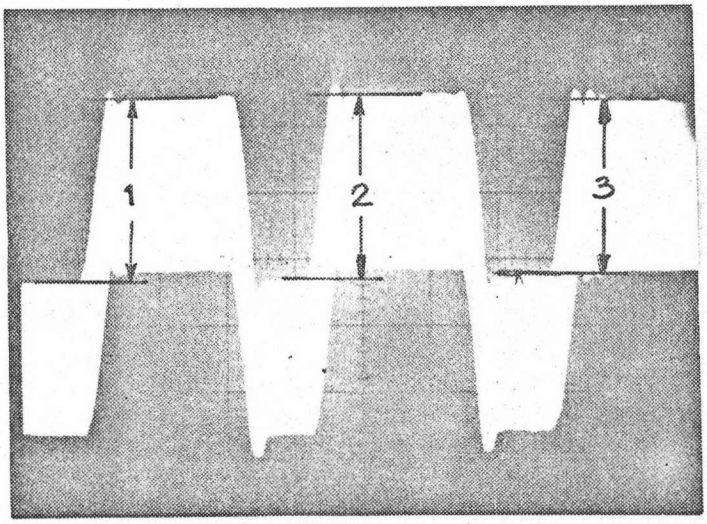

Figure 5.5, Square Pulse response, T = 20 ms.
Time base = 0.5 sec./div.

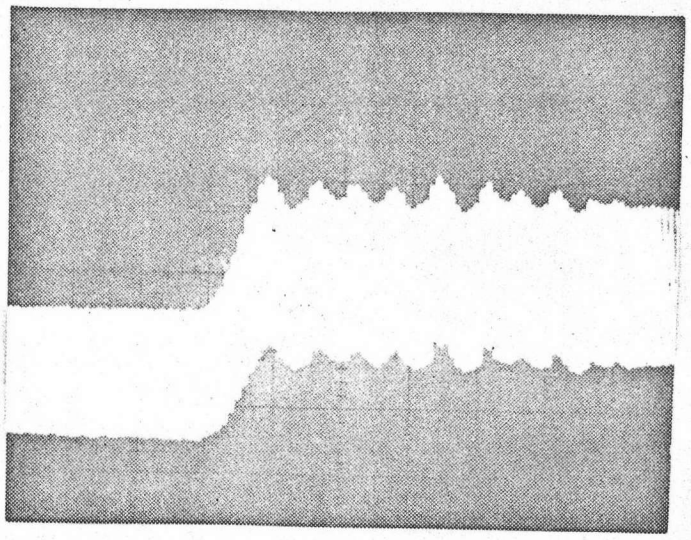

Figure 5.6, 180° step response at T = 48 ms.
Time base = 0.5 sec./div.

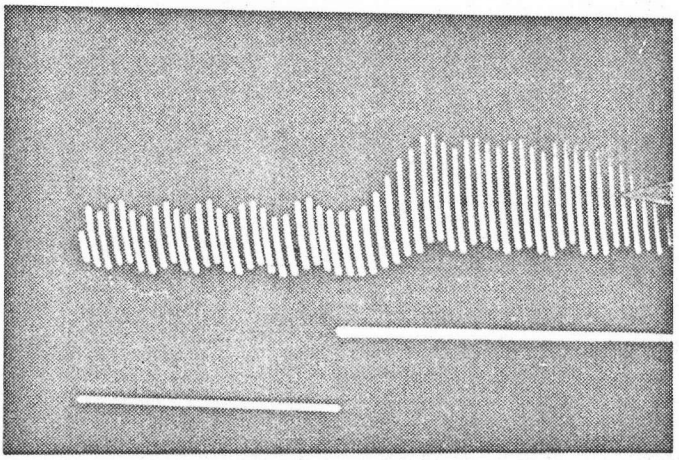

Figure 5.7 Step response at T = 50 ms./div.