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AUTOMATED I-V CHARACTERISTIS CURVE PLOTTER FOR POTENTIOSTAT

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ABSTRACT

The Hokuto Model HA-301 is a versatile, high precision instrument capable of controlling potentials of currents in a wide variety of electrochemical operations. It possesses potentiostat function. The basic function of the potentiostat is to maintain the potential of a working electrode at a desired fixed value or to control that potential under a defined functional variation with respect to a reference electrode. Function Generator (FG) is designed especially for electrochemical usages. By connecting FG to potentiostat controlled potentials with desired waveforms can be easily obtained. Automatic polarization systems that measure and record the relationships of potentials and currents of a certain electrode sample can be easily constituted by combining HB-104, a potentiostat and an x/y recorder or plotter [1]. Without a recorder or plotter, FG is useless and without that it's taken too much time to take down readings. It can be affected to the stability of the electrochemical sample and sample can be corroded when the time pass. As a solution for that, Automated I-V characteristic curve plotter was made to plot the output of the FG.

Keywords: Electrochemical, Potentiostat, Function Generator, Plotter

1. INTRODUCTION

Automated I-V characteristic curve plotter was made in order to achieve the easier the operation than normal operation method in electrochemical operations. By connecting FG to potentiostat controlled potentials or currents with desired waveforms can be easily obtained. Without a plotter or recorder the FG is useless and taking too much time to take down observations and it will be affected to stability of the cell. By using this equipment the observation can be taken less than five minutes and it is more low cost than professional plotters. All the function keys on the FG also included in this project without the scanning rate key. It's hard to get the minimum settings for the each multipliers of the plotter as same as the FG because of the limitation of analog bit resolution of the microcontroller.

2. EXPERIMENTAL

This plotter machine was built as a supportive equipment for FG. In here AT mega 2560 microcontroller were used to control the whole machine process and it receives coordination data from FG and non-inverting level shifter amplifiers and instrumentation amplifiers were used to linearly amplify the signal and clamp the output voltage of the FG. These two voltages were sampled by the microcontroller and the sampled size will be converted to the pulses by microcontroller and this pulses will be fed to the stepper modules. Steppers are calibrated as number of turns proportional to the number of pulses generated by the microcontroller. Two stepper motors were used to control the x and y axis and they have integrated gears, so the torque and resolution are increased without complicating the control and for the z axis 12 V solenoid was used.15 inch ball bearing drawer runners and timing belts were used to run the x and y axis.

All the function keys in the FG were also included in this project, except the scanning rate key. Voltage (x-axis) range and Current (y-axis) range can be selected using dip switches on the circuit. Total block diagram of the project as follows.

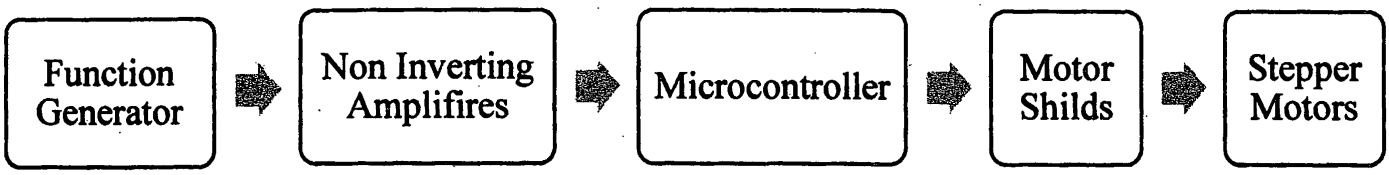

Figure 2: Block Diagram of the System

3. RESULTS AND DISCUSSION

Final outcome of this project is the automated I-V characteristic curve plotter for potentiostat FG. Although there were thirteen waveforms available in FG, only several waveforms were included in this project. Initial and upper potentials should be selected on FG and the full scale range should be selected relevant to the above two potentials on both FG and plotter. The scan speed should be selected in range mV/min due to the slow operation speed of stepper motors. To power up the whole system 12 V, 2 A power supply was used and for the non-inverting amplifier with 2.5 V reference voltage circuit was used to clamp the input signal.

Considering the strengths of this project are low cost than commercial available plotters, very fast than traditional manual method, low time consuming and time affect is low to the stability of the cell. Also there are several limitation of this project, which are minimum settings of the

plotter is larger than the FG minimum setting, Scanning rate key is not included in this project and plotter cannot be operated as fast as FG and size of the plotter was larger than the A4 size.

4. CONCLUSION

The automated I-V characteristic curve plotter was made as a supportive equipment for the FG and potentiostat machine at the university laboratory. Without an automated plotter or recorder, FG is useless and it's take too much time to observation. As a solution for that automated plotter was made and have several advantages over the usual method. As an undergraduate this project was a great opportunity and challenge for me and it help to improve my theoretical and practical knowledge in a field of electronic and mechanical.

5. ACKNOWLEDGEMENTS

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REFERENCES

[1]. Product Manuals of Potentiostat and Function Generator.