

Control Systems Lab
(Experiment – 10: Controller design for DC-DC converters)

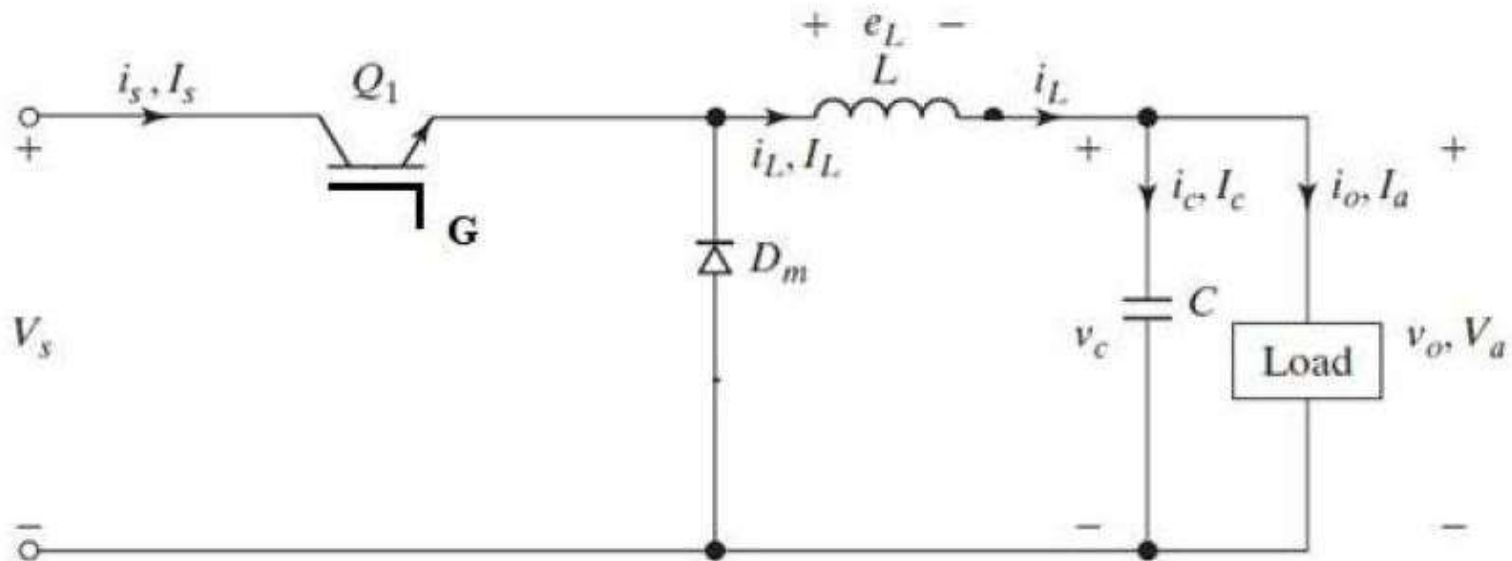
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Lab Exercise

MATLAB Simulink model of a DC-DC converter (Sec. A) and controlling it's output voltage using PID controller (Sec .B)

DC-DC Converter : A step down converter equivalent circuit



Basic theory background

- Both the input side and output side are DC : Fixed DC to variable DC
- Controllable switch (IGBT/MOSFET) is used for chopping the input DC voltage and to regulate the output
- PWM (pulse width modulation) technique is used to regulate the output as per application under a given input
- The output voltage is always less or equal to the input voltage (In case of step-down converter)
- L,C filters are used for removing the output current and output voltage ripple
- The applications are: SMPS (Switched mode power supply), battery chargers, DC pumps, Stand-alone solar PV systems etc.

Work to be done :

Sec A. MATLAB/Simulink model of DC-DC converter based on its equivalent circuit under resistive load

- DC input voltage = 12 V
- Reference (desired) output DC voltage = 10V
- R (load) = 12.5 Ohm
- L = 6 mH
- C = 5000 μ F

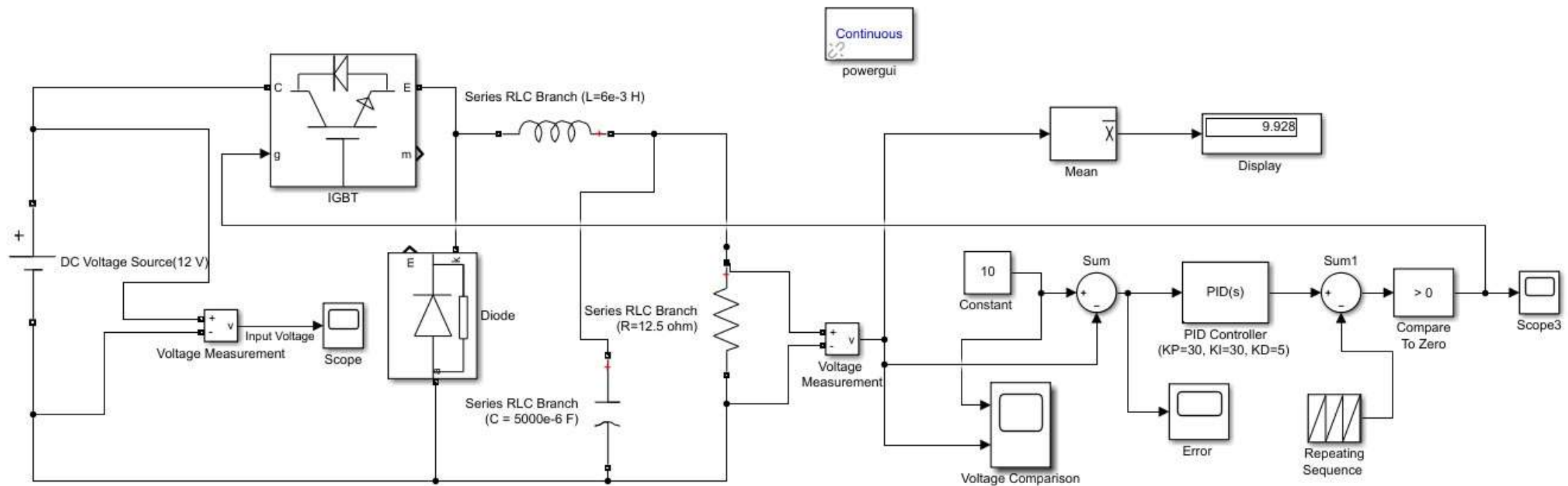
Sec B. PID Controller based voltage control

For controlling the output voltage of the DC-DC converter as per the reference, the following controller gains are to be set after tuning;

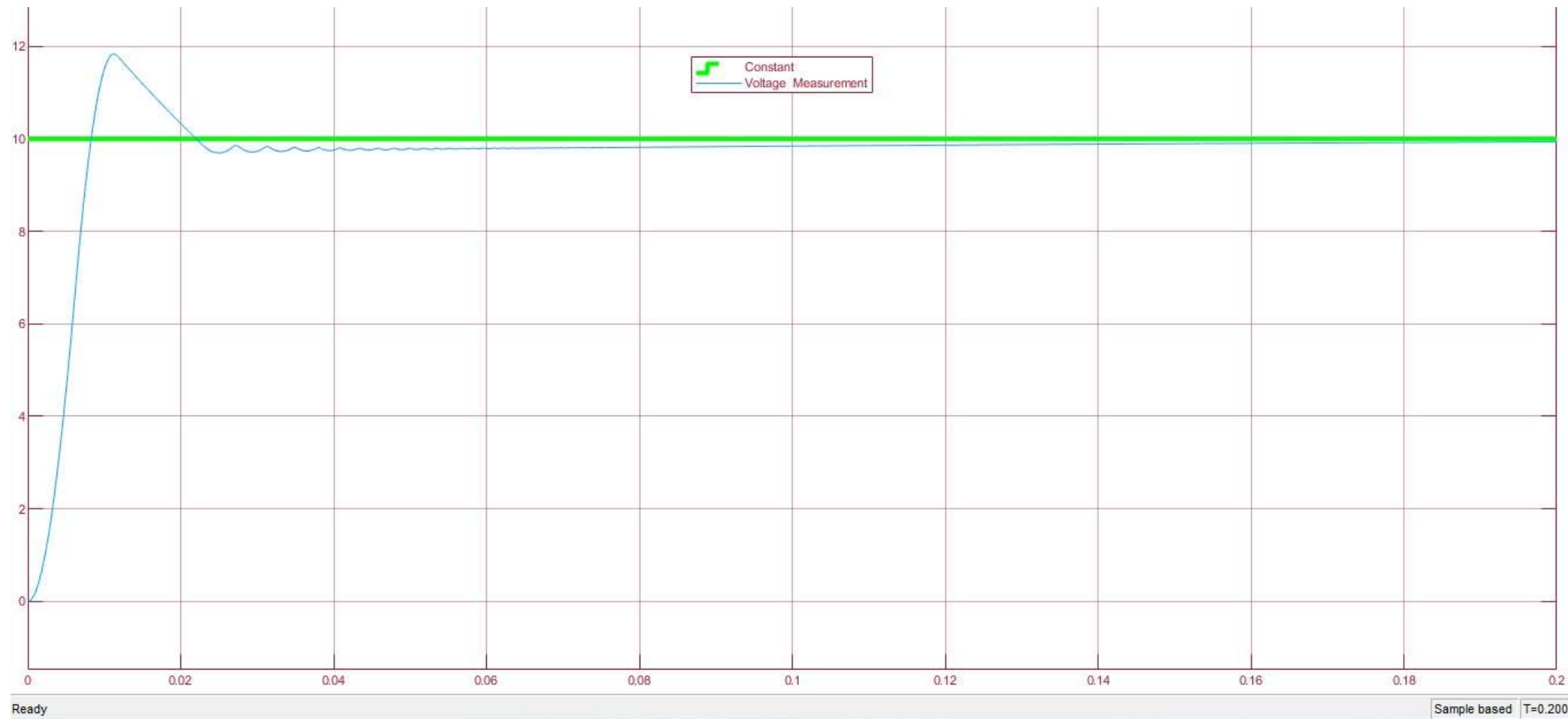
PID controller gains (Tuned): $K_p=30$, $K_i = 30$, $K_d = 5$.

Combined sec A and Sec B:

MATLAB/Simulink model of DC-DC converter output voltage control using PID controller



The desired (Green) and the actual (Blue) output voltage after using PID controller



Error between the reference (desired) output voltage and the actual output voltage : Minimized to '**zero**' with time after using PID controller

