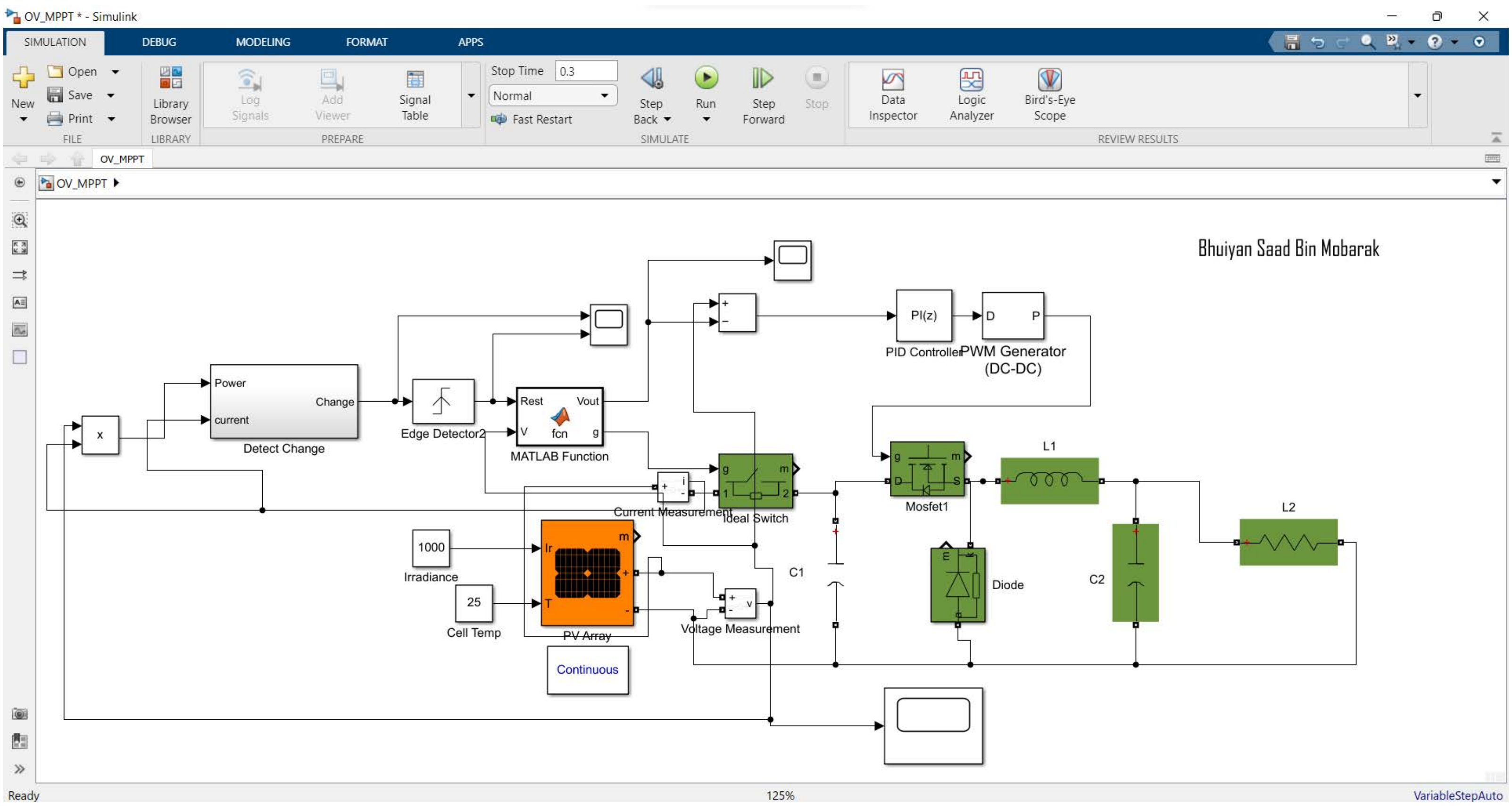
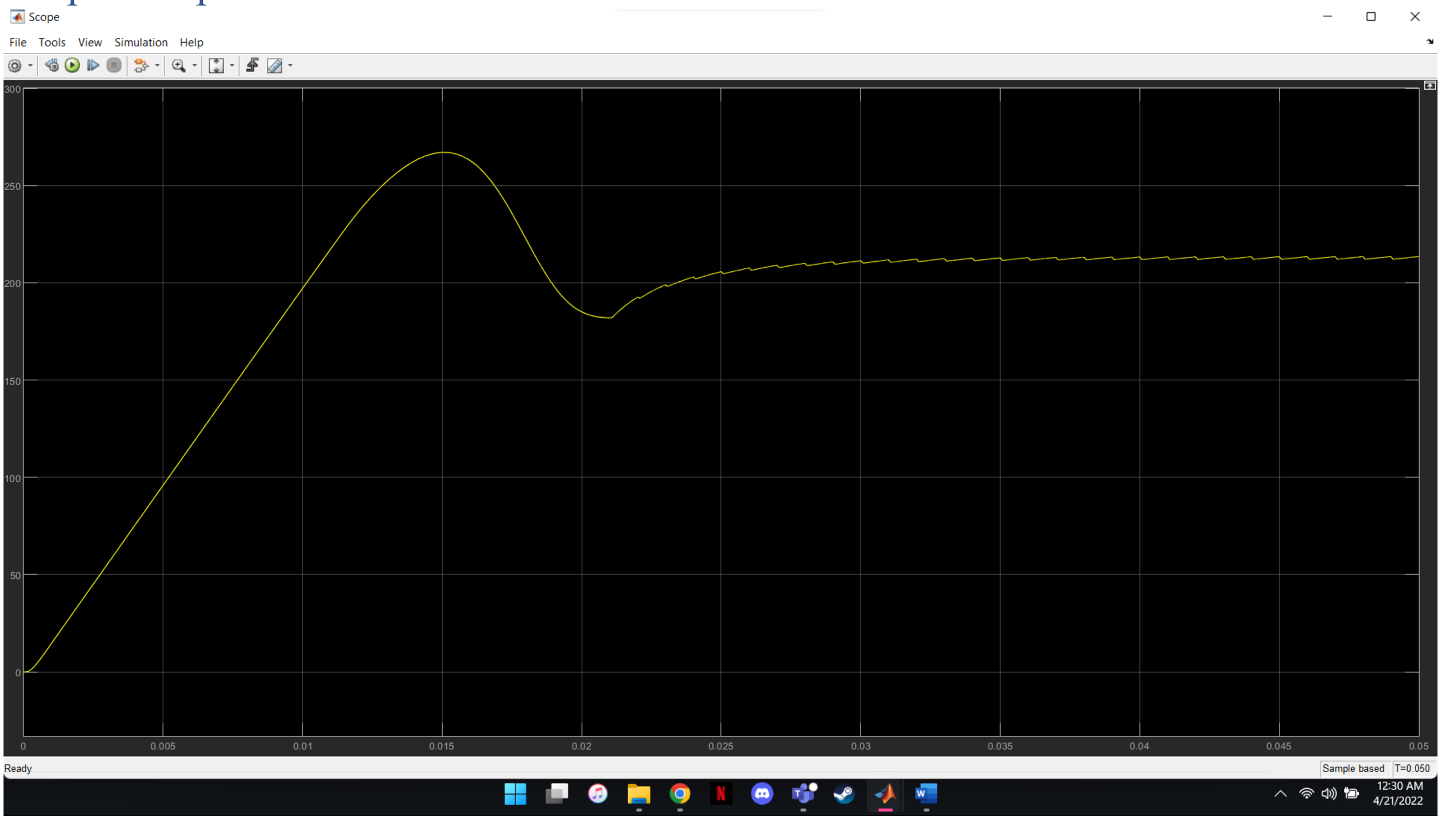
Simulation

The simulation was done in MATLAB 2021a Simulink



Output Graph



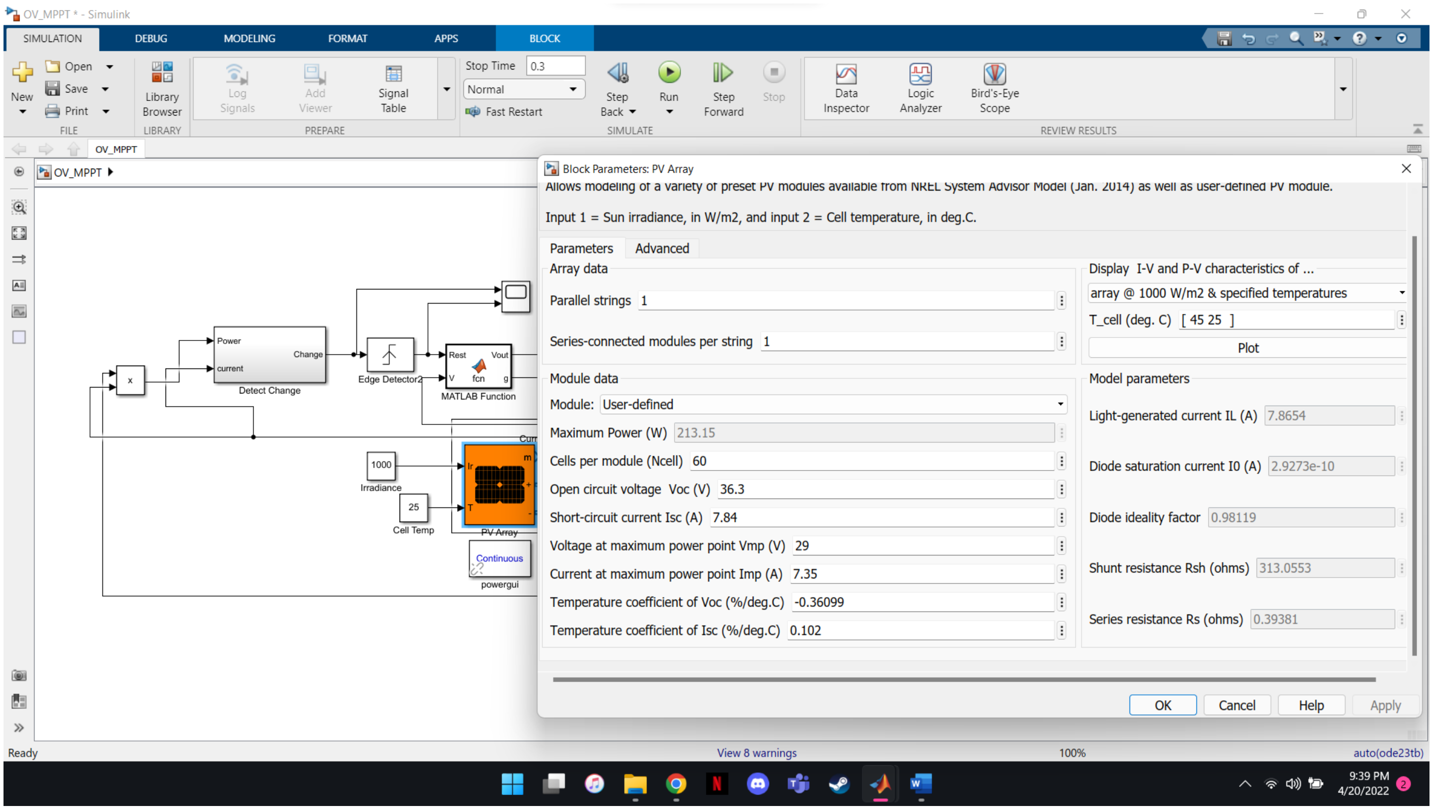
Observation From the Simulation & Output

Output voltage across the buck-boost converter and input current from the PV array were taken for Maximum Power Point Tracking. If we observe the output graph (the power curve) carefully, we will come to see that, the Power got up higher than the maximum available power of PV array for some time. It usually happens due to transient error. It can be solved by using better PID controller. In future, by using better and efficient PID controller, this output graph can be more improved.

Analysis of Different Block Parameters

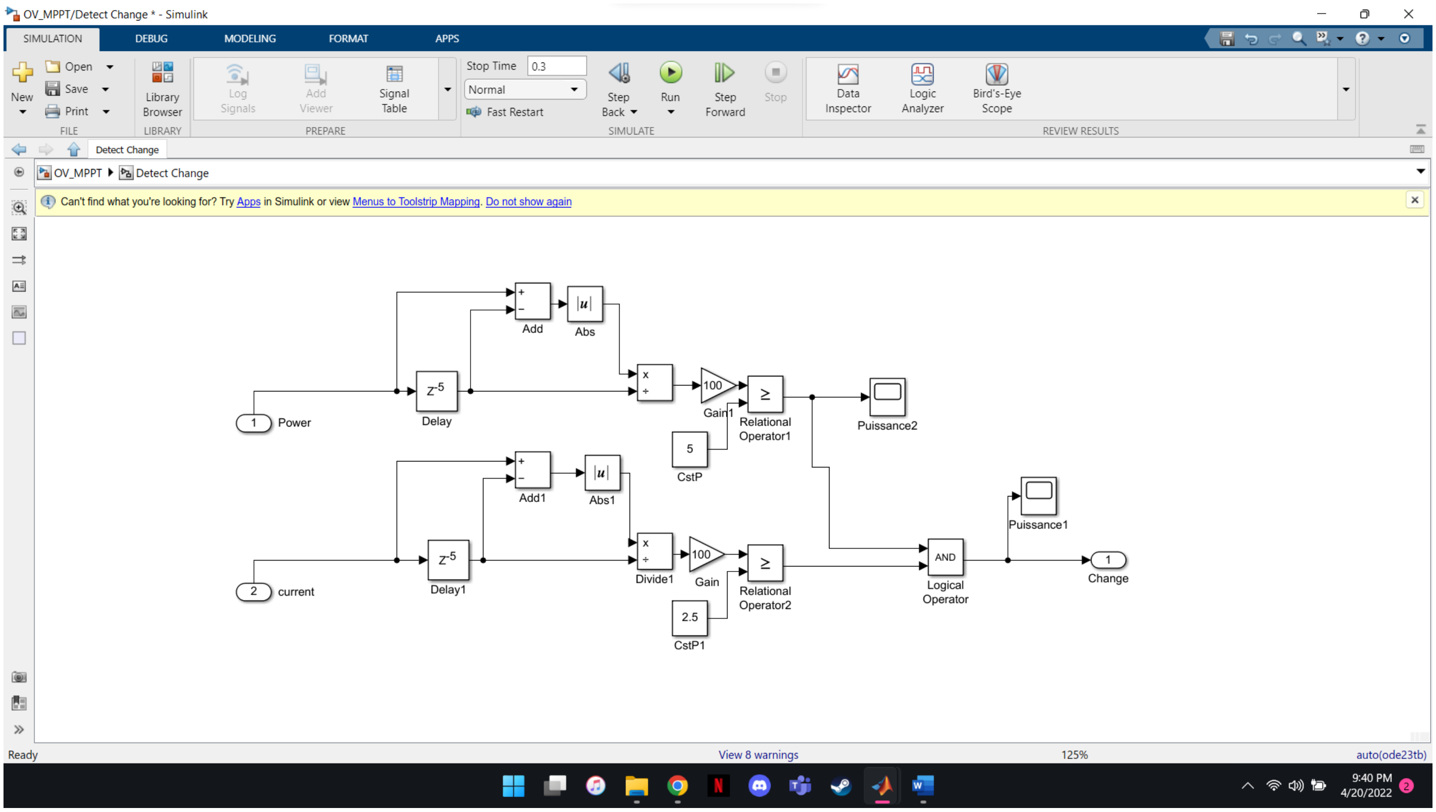
PV Array:

Here, for the PV array, 1 parallel and 1 series string were taken. Module was taken as USER DEFINED, as we took different parameters for our desired system to meet the necessary requirements. The values of open circuit voltage and short circuit current and other different parameters can be seen below from the given screenshot.

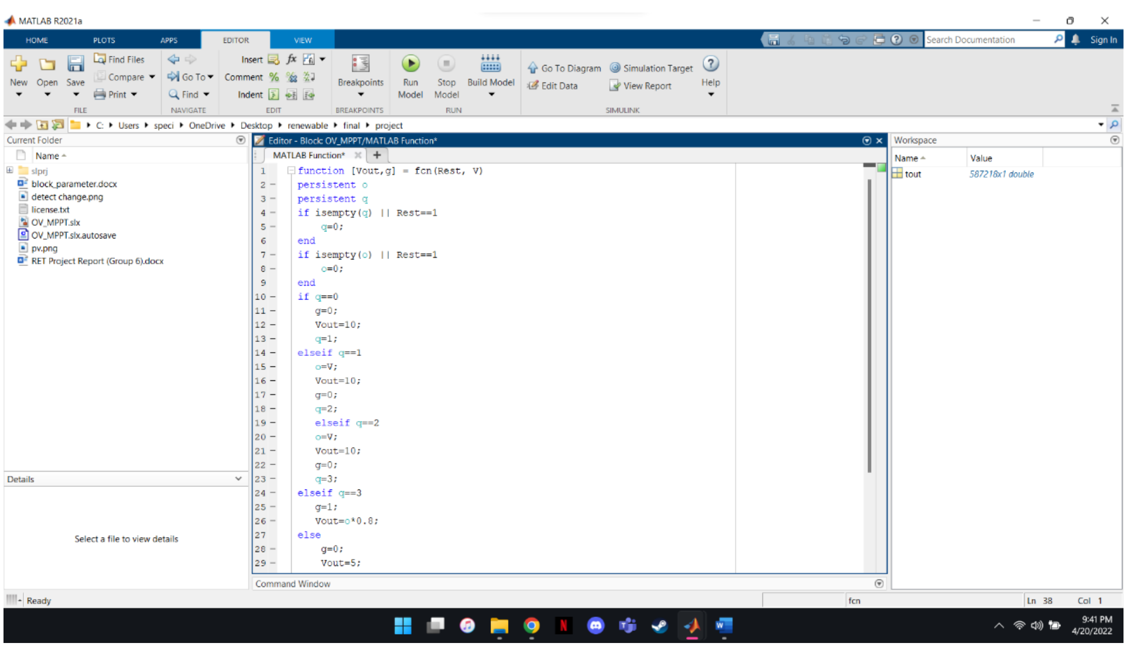


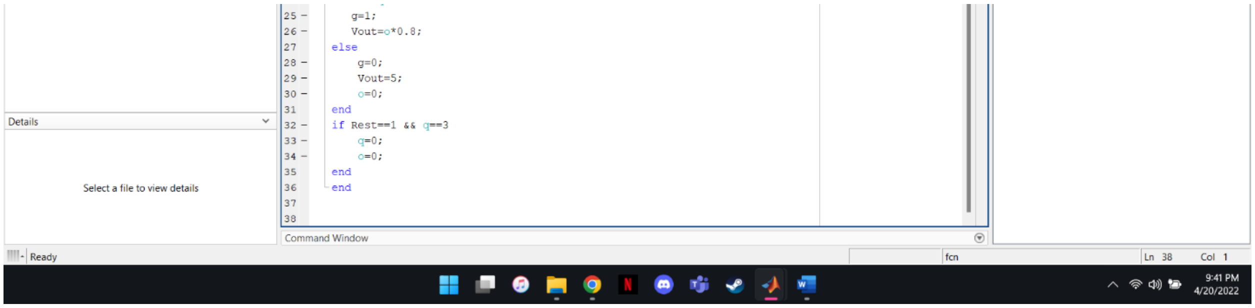
Change Detection Subsystem:

In the presence of protective diodes, detecting a failure in a solar photovoltaic (PV) array is difficult. This is due to the fact that variations in electrical parameters (due to a fault) are frequently indistinguishable from one type of fault to the next or from partial shading to fault. An open fault can look as a short-circuit fault depending on the fault situation, and extreme partial shading can also be recognized as a short-circuit fault. It's critical to distinguish between a short-circuit fault and an open fault or partial shading, as the former requires prompt treatment to avoid damage to the PV modules and a fire danger. It has been discovered that existing strategies based on transitory changes in array parameters and model comparison are unable to detect flaws under certain conditions. The use of array voltage, current, irradiance, and temperature data to identify and classify faults is proposed. For accurate fault identification, the technique computes the PV array's Thevenin equivalent resistance. The simulation results show that the suggested approach is capable of accurately detecting and classifying flaws, as well as distinguishing them from partial shading. When compared to other strategies, the findings suggest that it outperforms them.



MATLAB Function Block:





MATLAB Function is used for Maximum power point of PV array.

Function

function [Vout,g] = fcn(Rest, V)

It is a syntax of a function, which name is 'fcn'. Here Vout, g are output and Rest, V are input.

Isempty

isempty(q) || Rest==1

q=0;

isempty(o) || Rest==1

o=0;

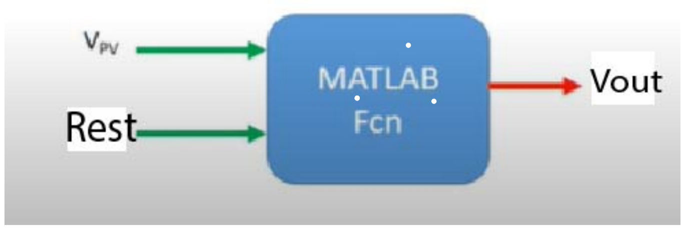
It determines whether array is empty. It returns logical 1 (true) if 'q' is empty other logical zero (false).

Persistent

persistent o

persistent q

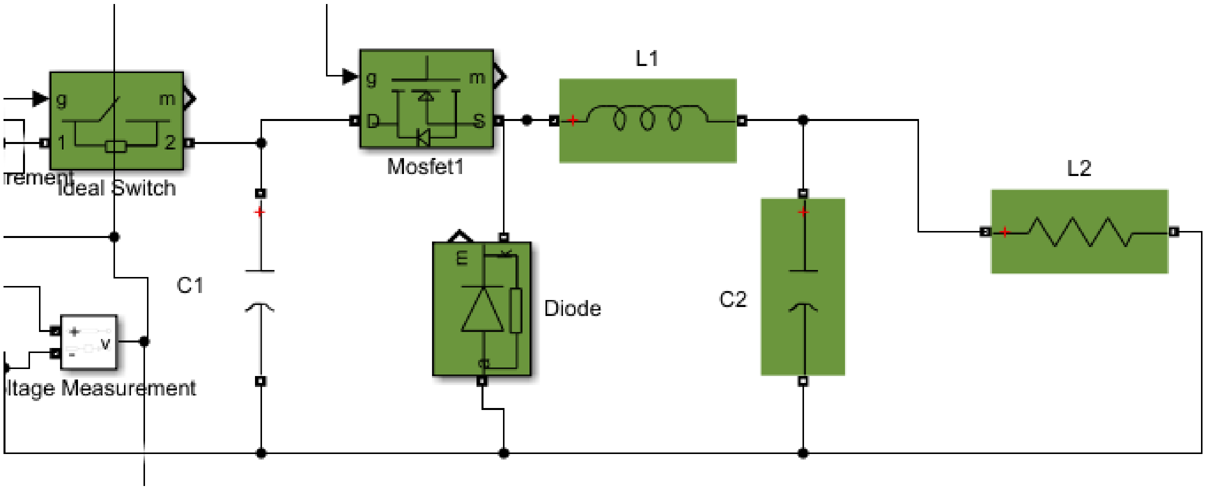
o and q are the local variables to the function in which they are declared. And their values are retained in memory between calls the function.



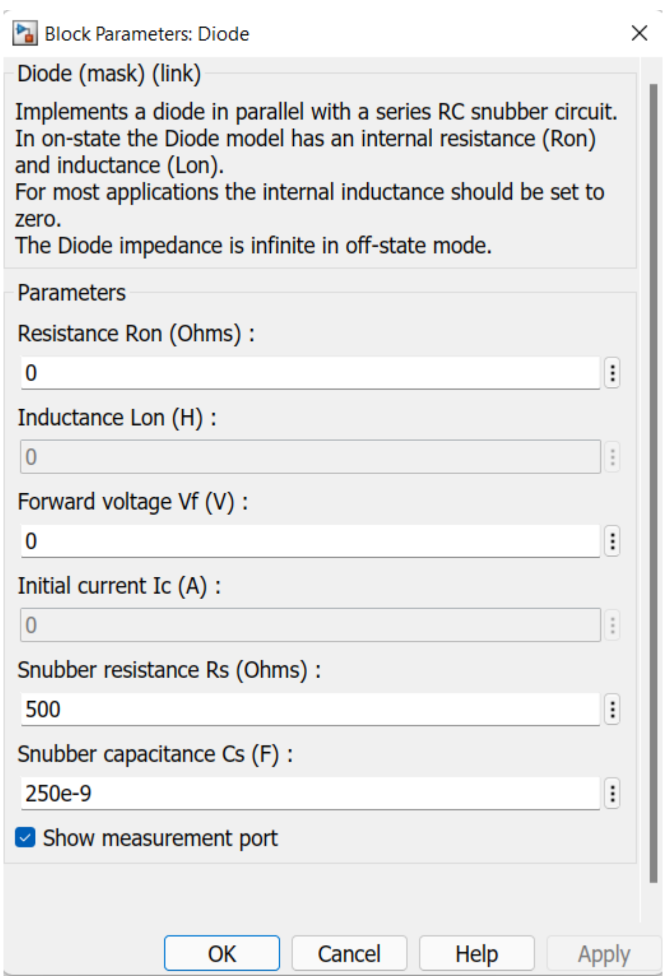
We need PV array generated Power, that's why we are using V and Rest as inputs. And Vout is output which is duty ratio for Boost converter semiconductor switch.

Buck Boost Converter

All the components colored as DARK GREEN were used combined to work as a Buck-Boost Converter.



The parameters for different blocks are given below as screenshots:



Block Parameters: Diode

Diode (mask) (link)

Implements a diode in parallel with a series RC snubber circuit.
In on-state the Diode model has an internal resistance (Ron) and inductance (Lon).
For most applications the internal inductance should be set to zero.
The Diode impedance is infinite in off-state mode.

Parameters

Resistance Ron (Ohms) :

0

Inductance Lon (H) :

0

Forward voltage Vf (V) :

0

Initial current Ic (A) :

0

Snubber resistance Rs (Ohms) :

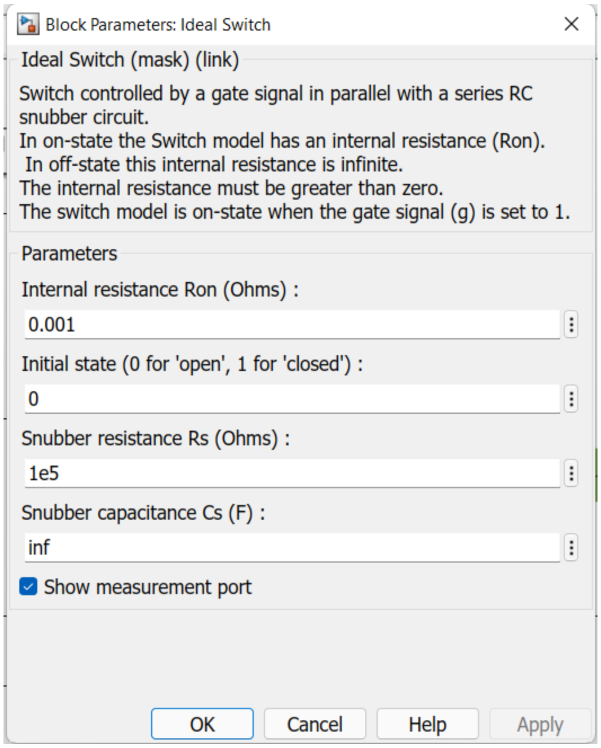
500

Snubber capacitance Cs (F) :

250e-9

Show measurement port

OK Cancel Help Apply



Block Parameters: Ideal Switch

Ideal Switch (mask) (link)

Switch controlled by a gate signal in parallel with a series RC snubber circuit.
In on-state the Switch model has an internal resistance (Ron).
In off-state this internal resistance is infinite.
The internal resistance must be greater than zero.
The switch model is on-state when the gate signal (g) is set to 1.

Parameters

Internal resistance Ron (Ohms) :
0.001

Initial state (0 for 'open', 1 for 'closed') :
0

Snubber resistance Rs (Ohms) :
1e5

Snubber capacitance Cs (F) :
inf

☑ Show measurement port

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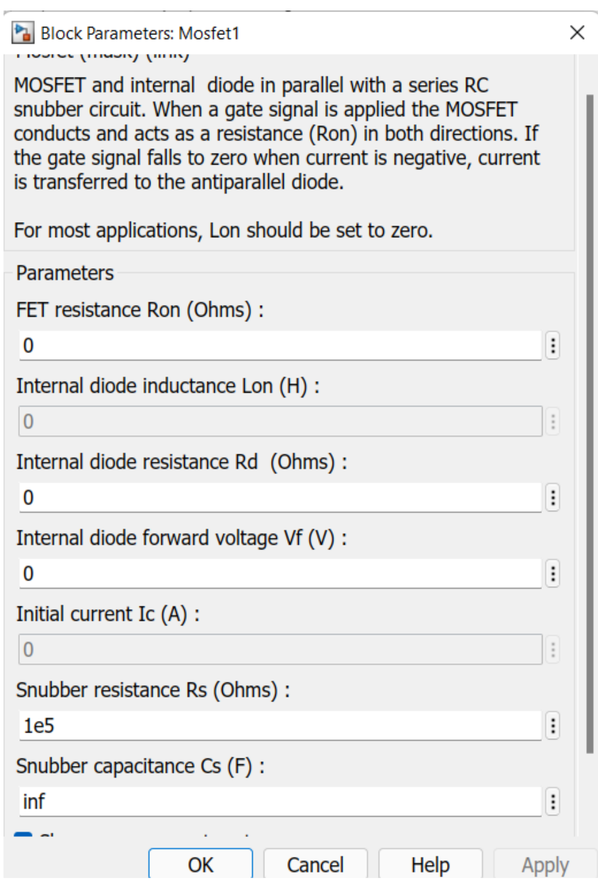


Block Parameters: Mosfet1

MOSFET and internal diode in parallel with a series RC snubber circuit. When a gate signal is applied the MOSFET conducts and acts as a resistance (Ron) in both directions. If the gate signal falls to zero when current is negative, current is transferred to the antiparallel diode.

For most applications, Lon should be set to zero.

Parameters

FET resistance Ron (Ohms) :
0

Internal diode inductance Lon (H) :
0

Internal diode resistance Rd (Ohms) :
0

Internal diode forward voltage Vf (V) :
0

Initial current Ic (A) :
0

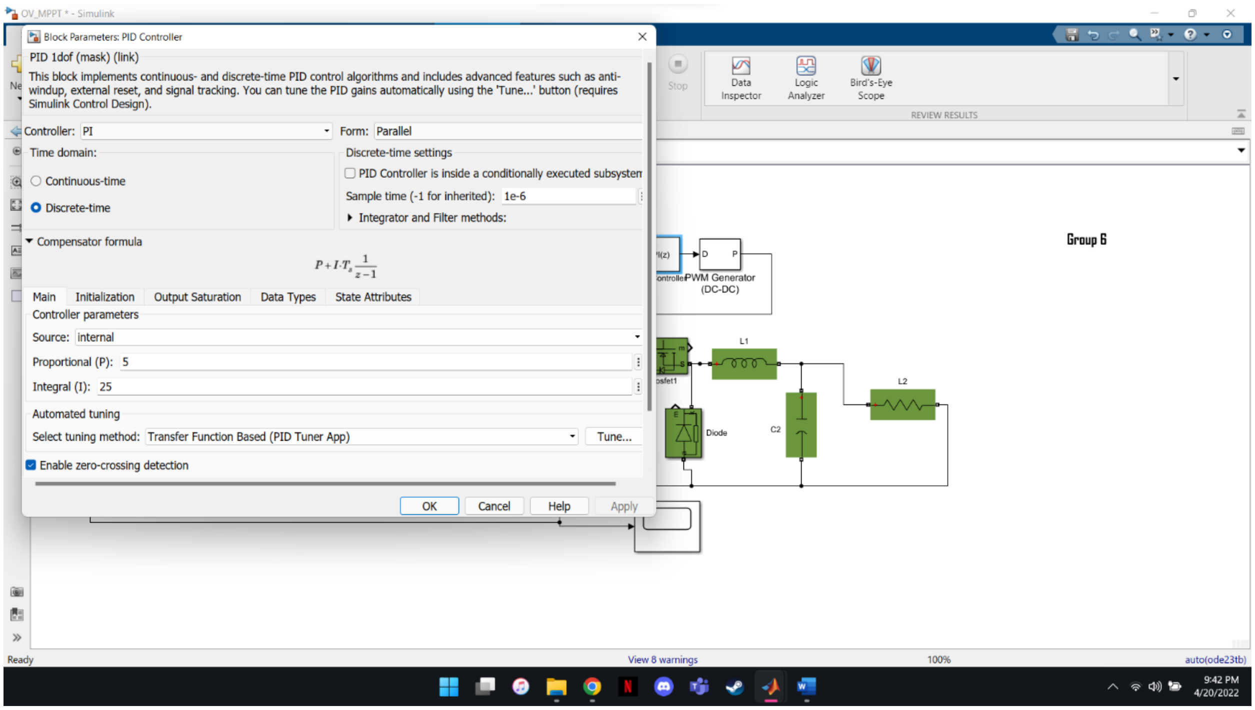
Snubber resistance Rs (Ohms) :
1e5

Snubber capacitance Cs (F) :
inf

OK | Cancel | Help | Apply

PI Controller:

PI controller is used to reach MPPT by monitoring the voltage and current of the PV array and adjusting the duty cycle of the DC/DC converter.



PWM Generator:

A PWM generator is implemented using the PWM Generator block. By rapidly alternating between complete power transmission and no power transfer, the pulse width modulation technology regulates power transfer from one electrical component to another. When the duty cycle is larger than the carrier counter value, the PWM generating block produces 1; otherwise, it outputs 0.