Incremental Conductance Method

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Incremental Conductance MPPT Technique FOR PV System

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ABSTRACT: Nowadays solar energy has great importance. Because it is easily available resource for energy generation. But the only problem is efficiency of solar system. And to increase its efficiency many MPPT techniques are used. Large number of papers were published on Maximum Power Point techniques (MPPT). And therefore many techniques are available for use. These techniques differs in many aspects. Incremental conductance is one of the important technique in this system and because of its higher steady-state accuracy and environmental adaptability it is widely implemented tracked control strategy. This paper presents details of Incremental Conductance algorithm with simulation results obtained using MATLAB and SIMULINK.

Keywords: MPPT, Incremental Conductance, PV cell, Algorithm, simulation.

2 major problems of PV generation systems:

- Conversion efficiency is very low (9/17%)
- Amount of electric power generated by solar arrays changes continuously with weather conditions.
- Also, solar cell VI characteristic is non linear and varies with irradiance and temperature.

5 level H bridge cascade multilevel inverter used to obtain AC output voltage from the DC boost output voltage.

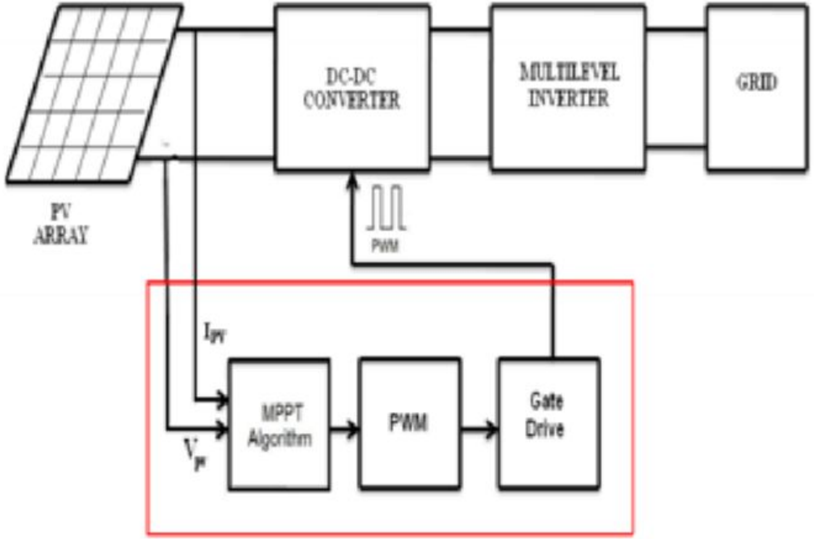


Fig. 3. System Configuration of PV System

This equation shows the dependence of PV current on temperature and hence the dependence of power drawn from th
PV array.

The basic equation that describes the I-V Characteristics of the PV model is given by the following equation:

$$I = I_L - I_o\left(e^{\frac{q(V + IR_s)}{kT}} - 1\right) - \frac{V + IR_s}{R_{sh}}$$

Where:

I	Cell Current (A).
I_L	Light Generated Current (A).
I_o	Diode Saturation Current.
Q	Charge of Electron = 1.6x10-19 (Coul).
K	Boltzmann Constant (J/K)
V	Cell Output Voltage (V)
R_s , R_{sh}	Cell Series and Shunt Resistance (Ohms).

The disadvantage of the perturb and observe method to track the peak power under fast varying atmospheric condition is overcome by IC method . The IC can determine that the MPPT has reached the MPP and stop perturbing the operating point. If this condition is not met, the direction in which the MPPT operating point must be perturbed can be calculated using the relationship between dl/dV and –I/V This relationship is derived from the fact that dP/dV is negative when the MPPT is to the right of the MPP and positive when it is to the left of the MPP. This algorithm has advantages over P&O in that it can determine when the MPPT has reached the MPP, where P&O oscillates around the MPP. Also, incremental conductance can track rapidly increasing and decreasing irradiance conditions with higher accuracy than P and O

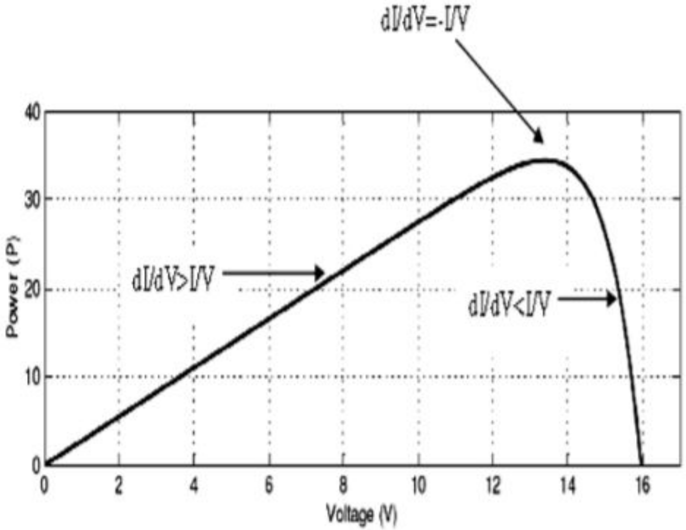


Fig. 4: Graph Power versus Voltage for IC Algorithm

$$\frac{dI}{dV} = -\frac{I}{V} \text{ at } MPP \quad (1)$$

$$\frac{dI}{dV} > -\frac{I}{V} \text{ left of } MPP \quad (2)$$

$$\frac{dI}{dV} < -\frac{I}{V} \quad \text{right of } MPP \quad (3)$$

V. INCRIMENTAL CONDUCTANCE MPPT ALGORITHM

This method exploits the assumption of the ratio of change in output conductance is equal to the negative ou Conductance Instantaneous conductance. We have,

$$P = V\,I$$

Applying the chain rule for the derivative of products yields to

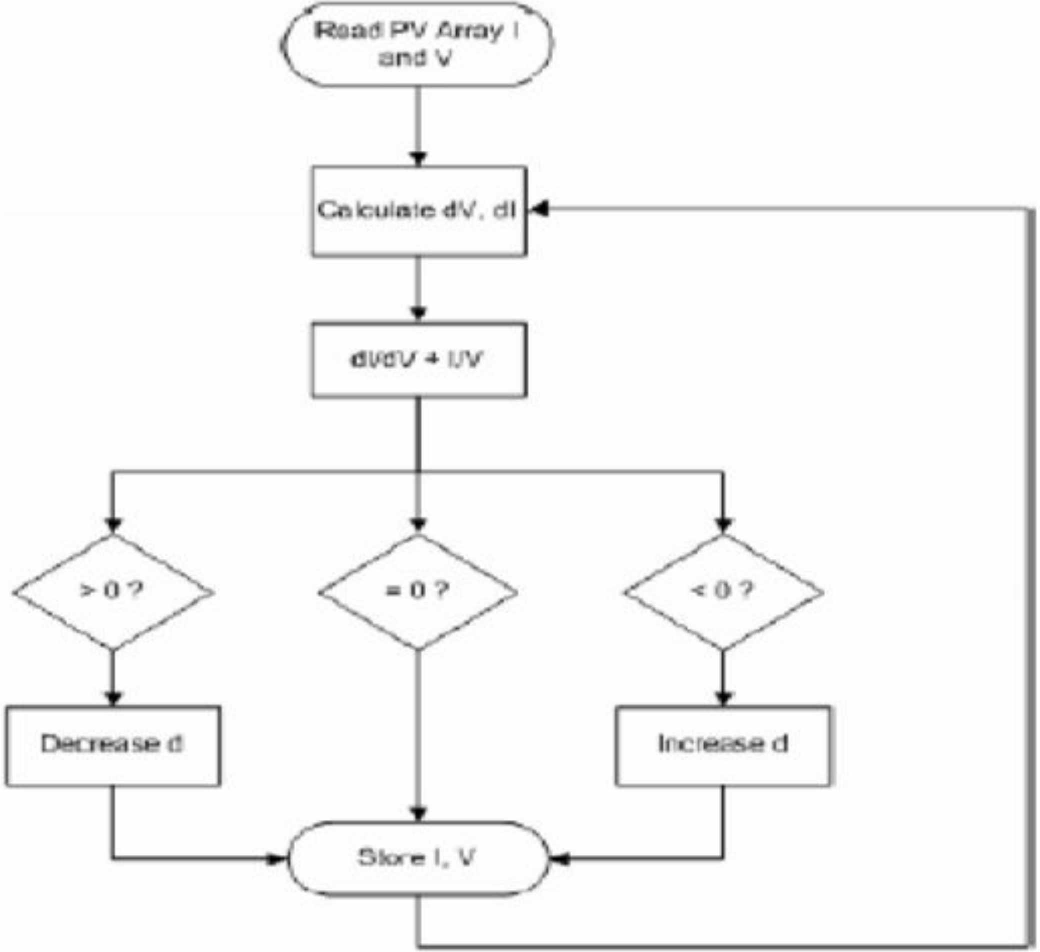
$$\partial P/\partial V = [\partial(VI)]/\ \partial V$$

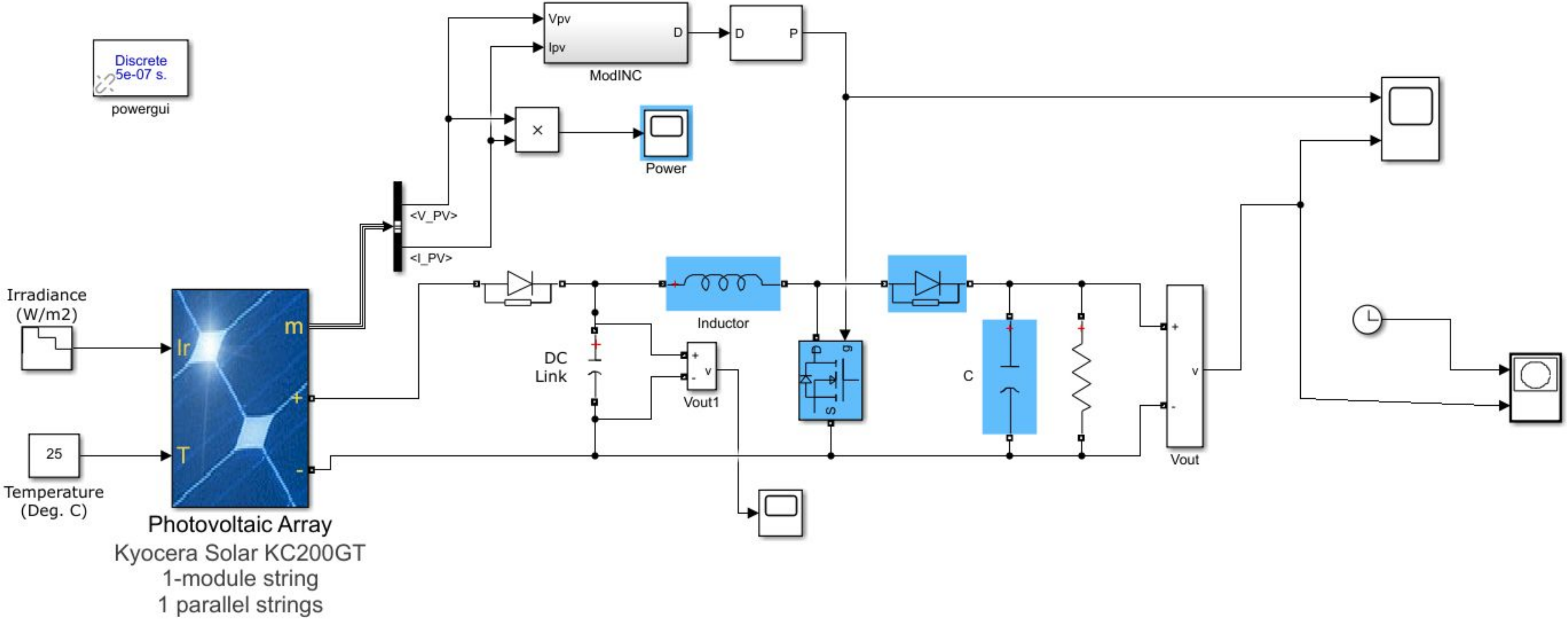
At MPP, as $\partial P/\partial V=0$

The above equation could be written in terms of array voltage V and array current I as

$$\partial I/\partial V = -\ I/V$$

The MPPT regulates the PWM control signal of the dc – to – dc boost converter until the condition: $(\partial I/\partial V) + (I/V)$ is satisfied. In this method the peak power of the module lies at above 98% of its incremental conductance. The F chart of incremental conductance MPPT is shown below.[8]


Read PV Array I and V
Calculate dV, dI
dI/dV + I/V
> 0 ?
= 0 ?
< 0 ?
Decrease d
Increase d
Store I, V


Discrete
5e-07 s.
powergui
Vpv
Ipv
D
ModINC
D
P
×
Power
<V_PV>
<I_PV>
Irradiance
(W/m2)
Ir
m
+
T
-
25
Temperature
(Deg. C)
Photovoltaic Array
Kyocera Solar KC200GT
1-module string
1 parallel strings
DC
Link
+
-
v
Vout1
Inductor
D
g
S
C
+
-
v
Vout

Block Parameters: Photovoltaic Array

PV array (mask) (link)

Implements a PV array built of strings of PV modules connected in parallel. Each string consists of modules connected in series.
Allows modeling of a variety of preset PV modules available from NREL System Advisor Model (Jan. 2014) as well as user-defined PV modu

Input 1 = Sun irradiance, in W/m2, and input 2 = Cell temperature, in deg.C.

Parameters | Advanced

Array data

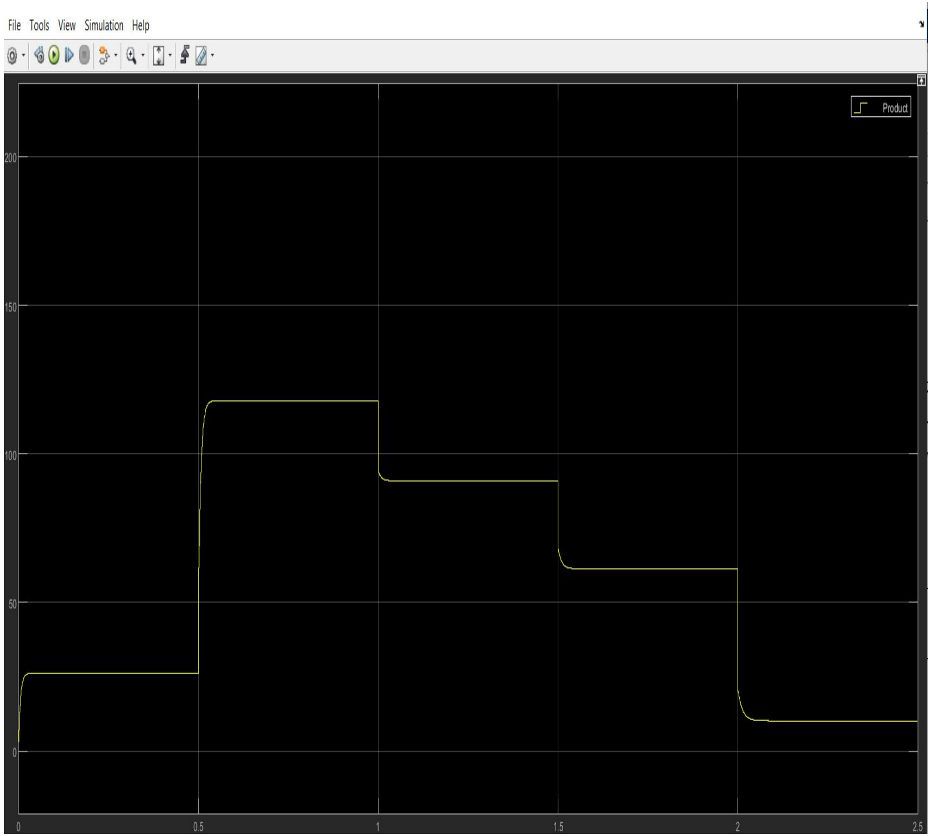
Parallel strings: 1

Series-connected modules per string: 1

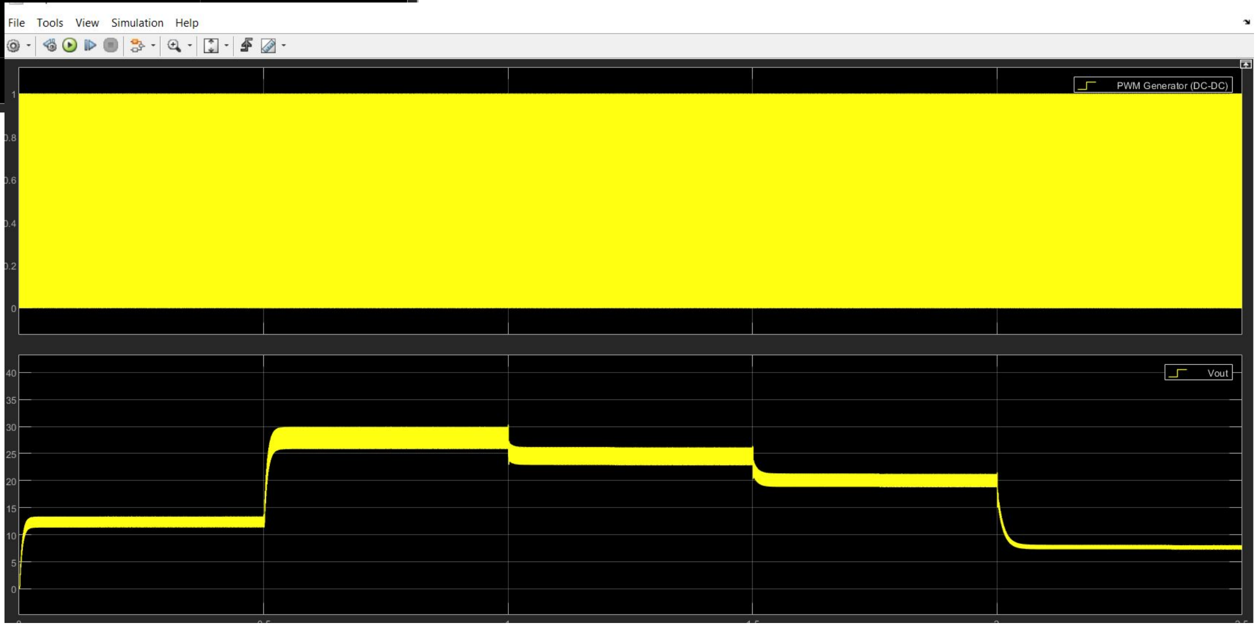
Module data

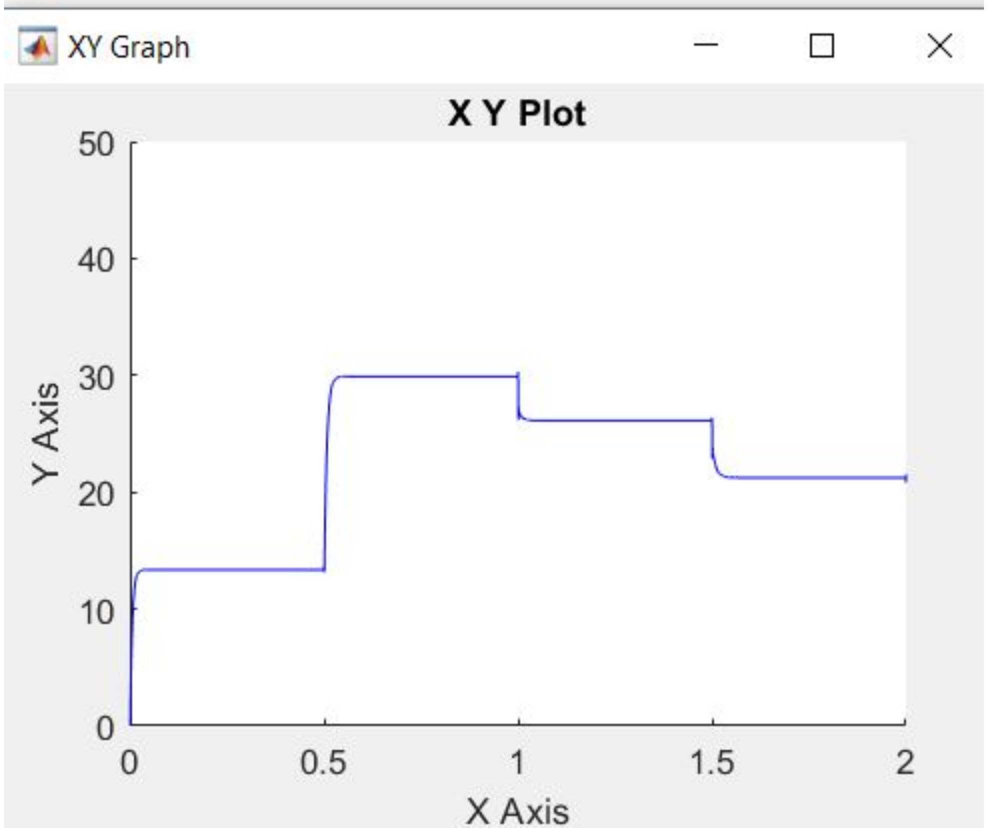
Module: Kyocera Solar KC200GT

Maximum Power (W)	200.143	Cells per module (Ncell)	54
Open circuit voltage Voc (V)	32.9	Short-circuit current Isc (A)	8.21
Voltage at maximum power point Vmp (V)	26.3	Current at maximum power point Imp (A)	7.61
Temperature coefficient of Voc (%/deg.C)	-0.35502	Temperature coefficient of Isc (%/deg.C)	0.06

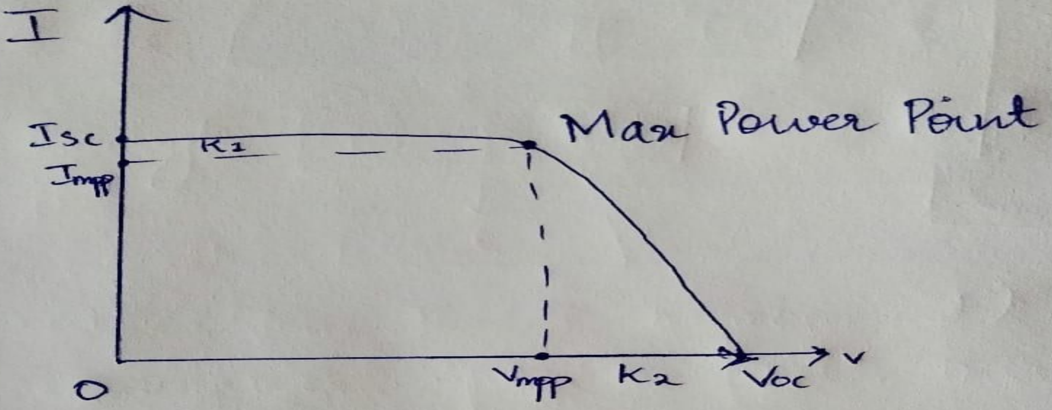



Scope
File Tools View Simulation Help
Vout1
15
10
5
0
0
0.5
1


File Tools View Simulation Help
PWM Generator (DC-DC)
1
0.8
0.6
0.4
0.2
0
Vout
40
35
30
25
20
15
10
5
0

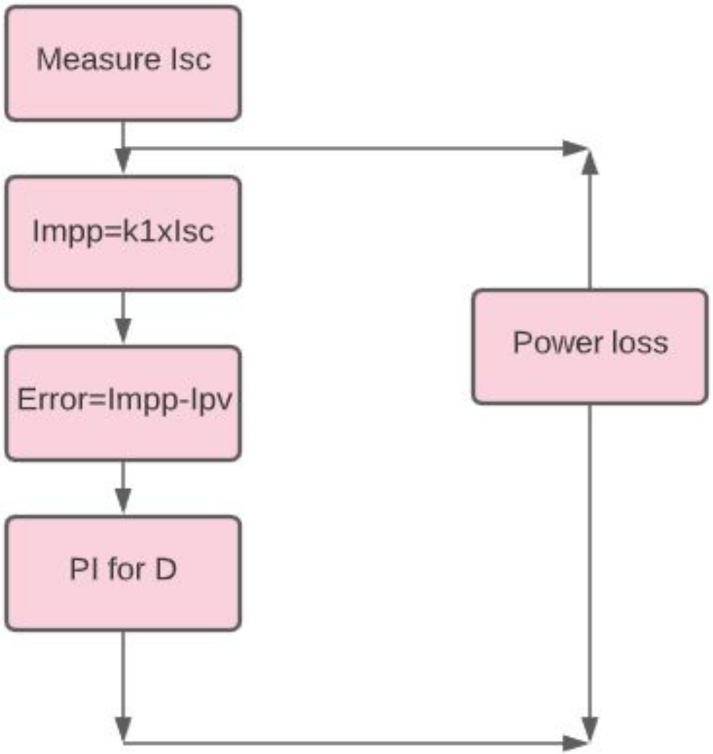

XY Graph
X Y Plot
Y Axis
X Axis
0
10
20
30
40
50
0
0.5
1
1.5
2

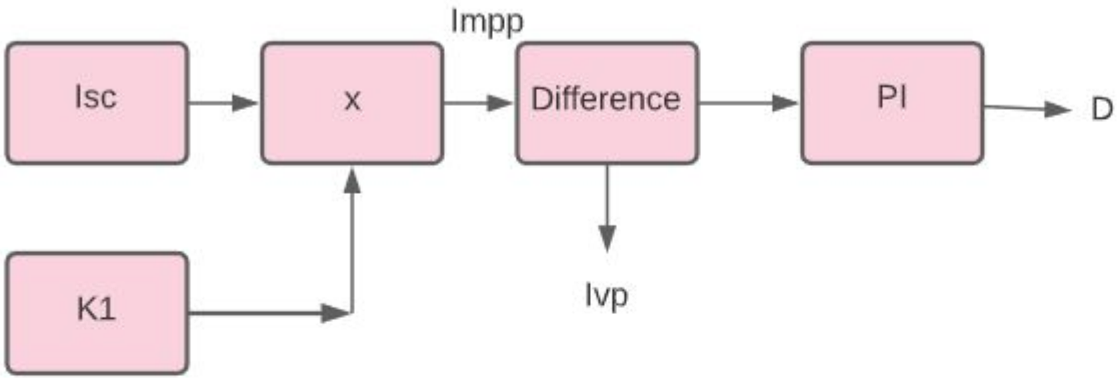
Fractional Short Circuit Current



$$\left.\begin{array}{l} I_{mpp} = k_1 I_{sc} \\ \quad \text{where } K_1 = \text{Current Factor} \\ \quad\quad (0.78 \text{ to } 0.92) \end{array}\right\} \text{FSCC}$$

$$\left.\begin{array}{l} V_{mpp} = K_2 V_{oc} \\ \quad \text{where } K_2 = \text{Voltage Factor} \\ \quad\quad (0.7 \text{ to } 0.9) \end{array}\right\} \text{FOCV}$$


Measure Isc
Impp=k1xIsc
Error=Impp-Ipv
PI for D
Power loss


Impp
Isc
x
Difference
PI
D
K1
Ivp