جامعة خليفة
Khalifa University

# Weekly Progress Report Presentation

## NOVEL OPTIMIZED GLOBAL MAXIMUM POWER POINT TRACKING TECHNIQUE FOR SINGLE-STAGE GRID CONNECTED PV SYSTEM

BY

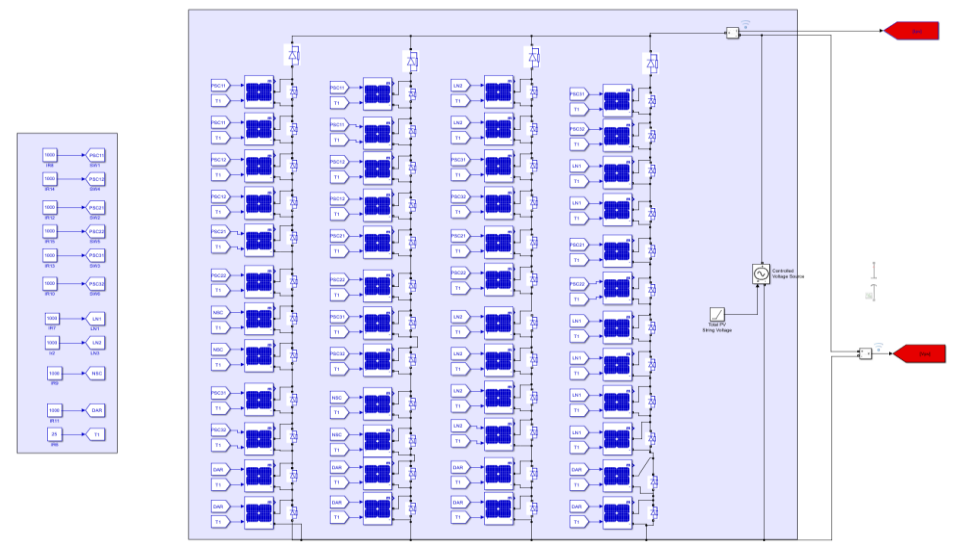
MAHMUD OMER

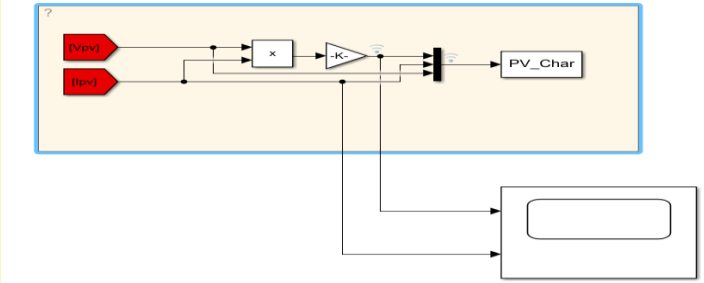
# ❑ PV Array output characteristics under NSC & GMPPT Using PSO Algorithm

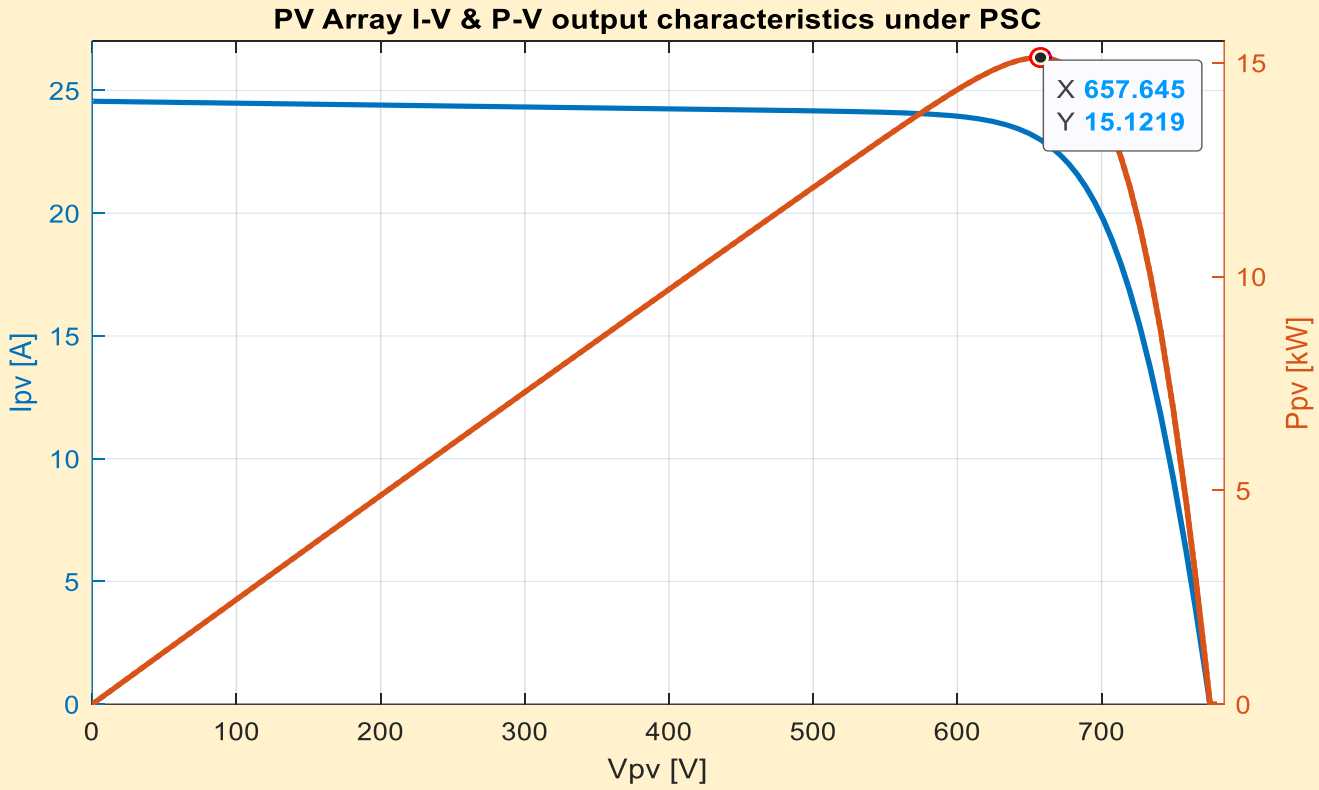
## Case 1: MPPT using PSO , Particle Initialization

**Array type:** **SunPower SPR-315E-WHT-D:**

**Array Size:** **15.1 kW, 4 parallel strings, 12 series modules/String**





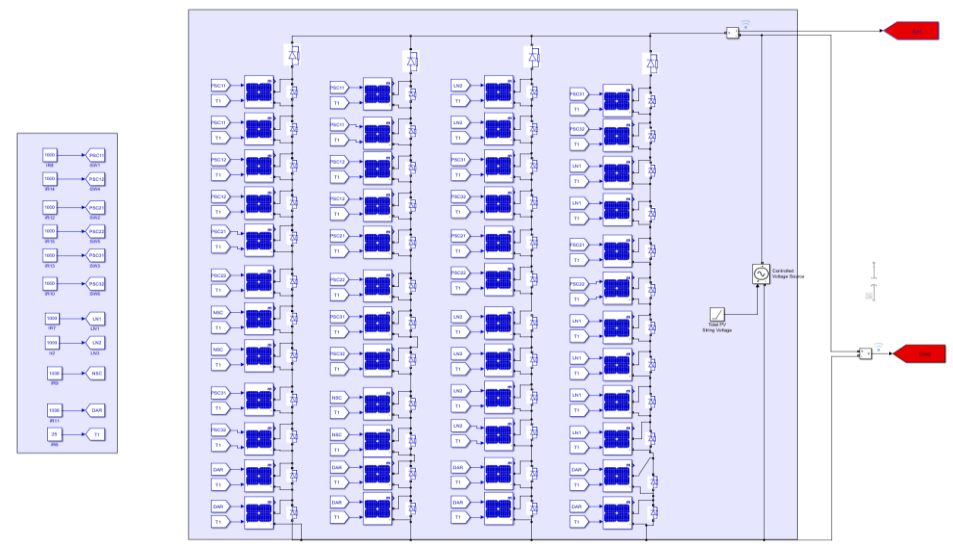



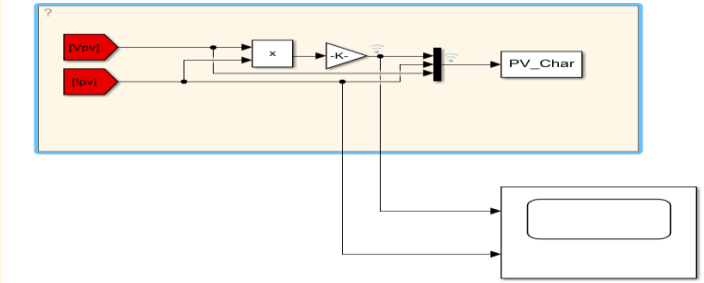
# ❑ PV Array output characteristics under NSC & GMPPT Using PSO Algorithm

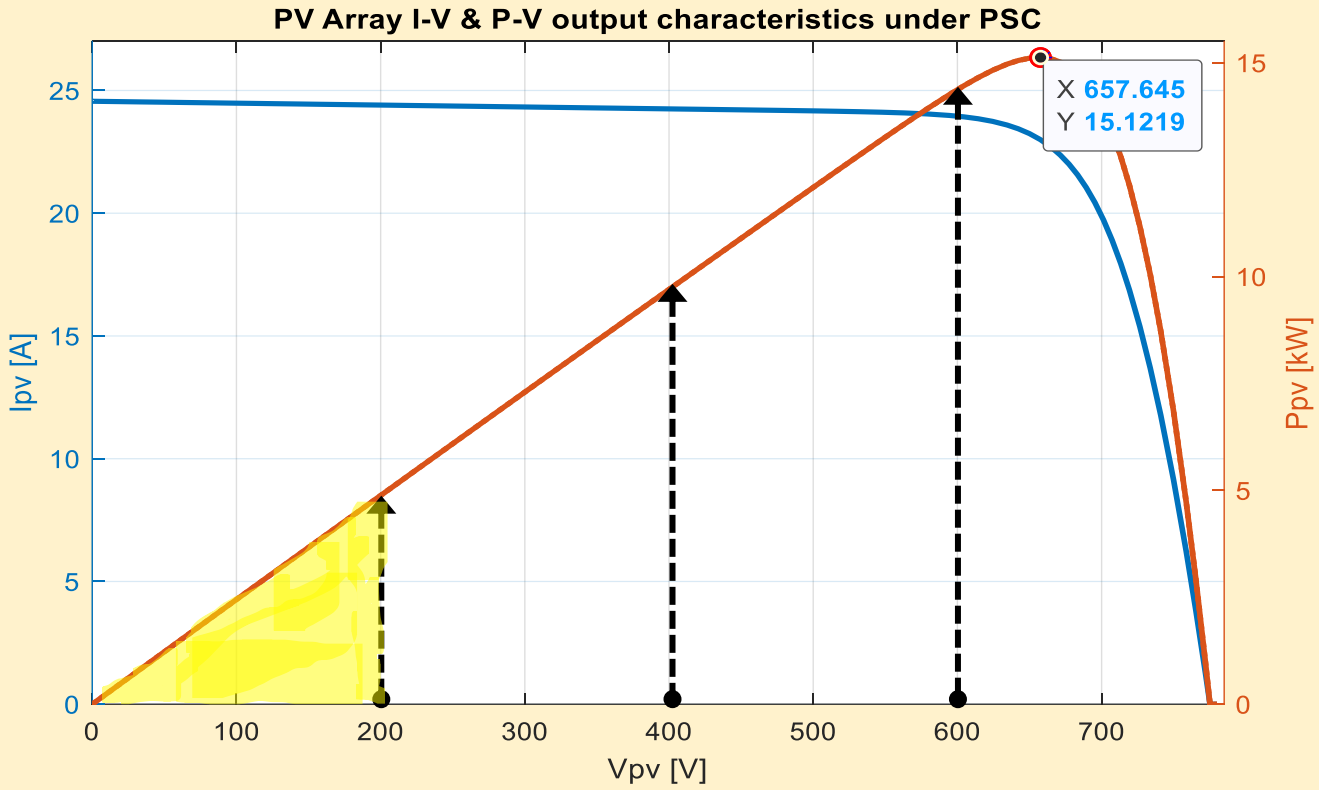
## Case 1: MPPT using PSO , Particle Initialization

**Array type:** **SunPower SPR-315E-WHT-D:**

**Array Size:** **15.1 kW, 4 parallel strings, 12 series modules/String**





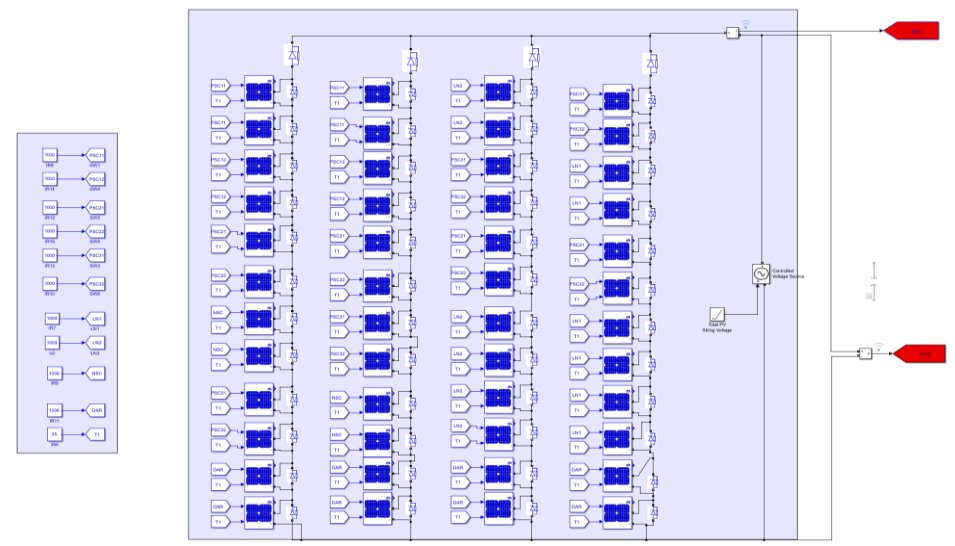

ParticlePosition(i,1) = unifrnd(((i-1)*(1/nPop)*(Vmax- Vmin)+Vmin), ((i)*(1/nPop)*(Vmax-Vmin)+Vmin));

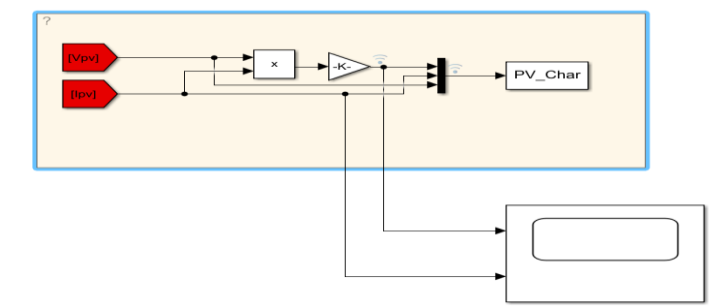
# ❑ PV Array output characteristics under NSC & GMPPT Using PSO Algorithm

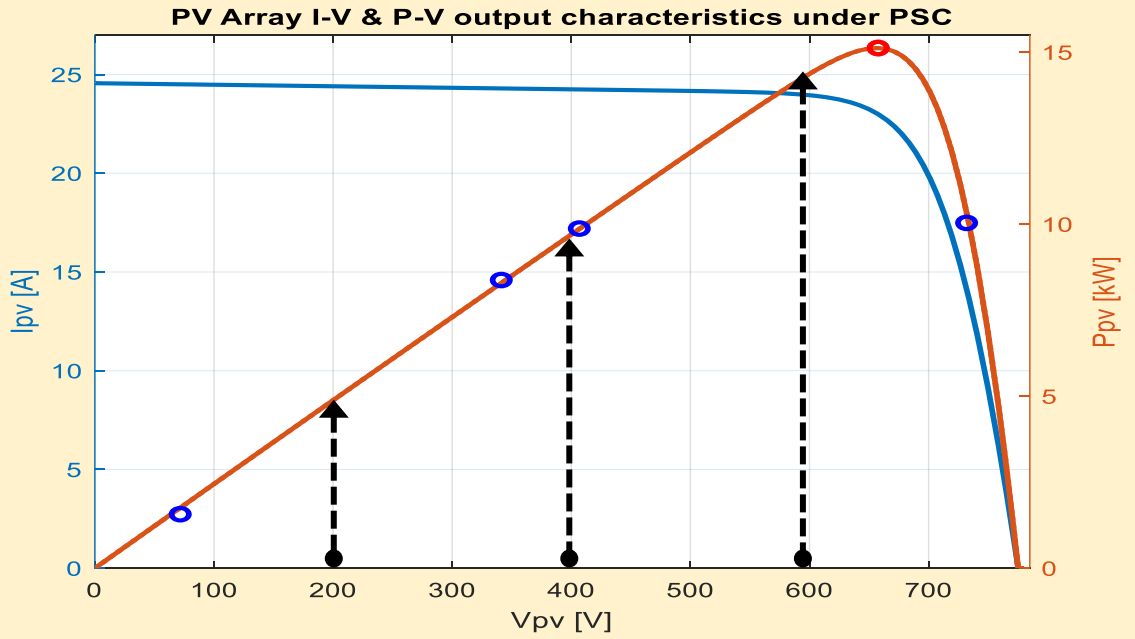
## Case 1: MPPT using PSO , Particle Initialization

**Array type:** **SunPower SPR-315E-WHT-D:**

**Array Size:** **15.1 kW, 4 parallel strings, 12 series modules/String**





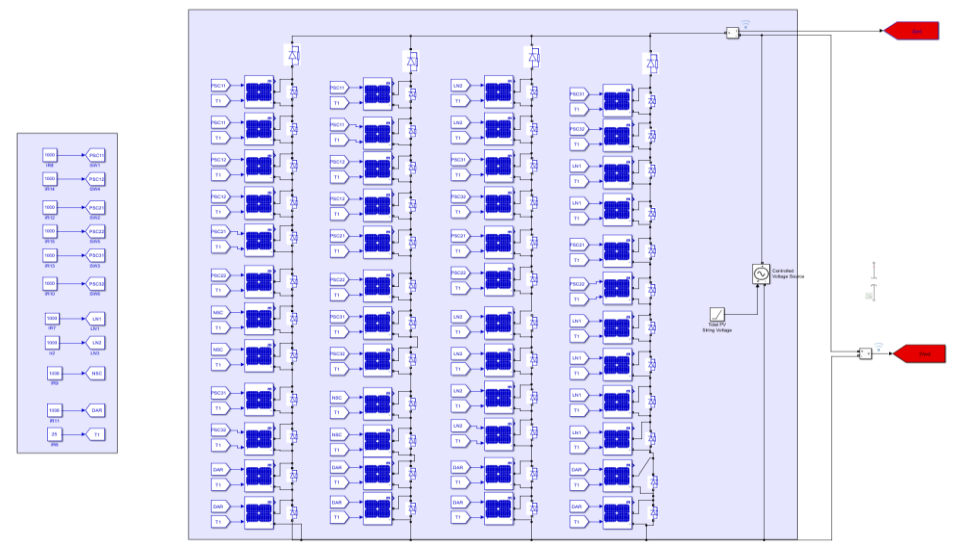

ParticlePosition(i,1) = unifrnd(((i-1)*(1/nPop)*(Vmax- Vmin)+Vmin), ((i)*(1/nPop)*(Vmax-Vmin)+Vmin));

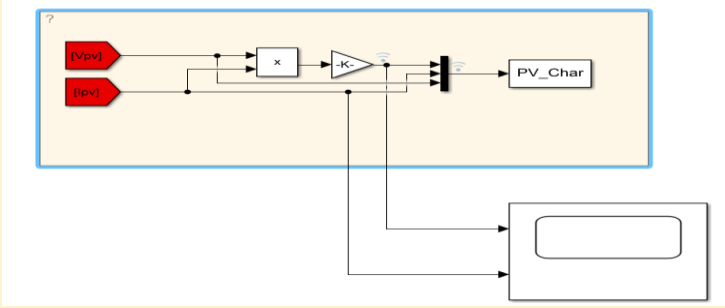
# ❑ PV Array output characteristics under NSC & GMPPT Using PSO Algorithm

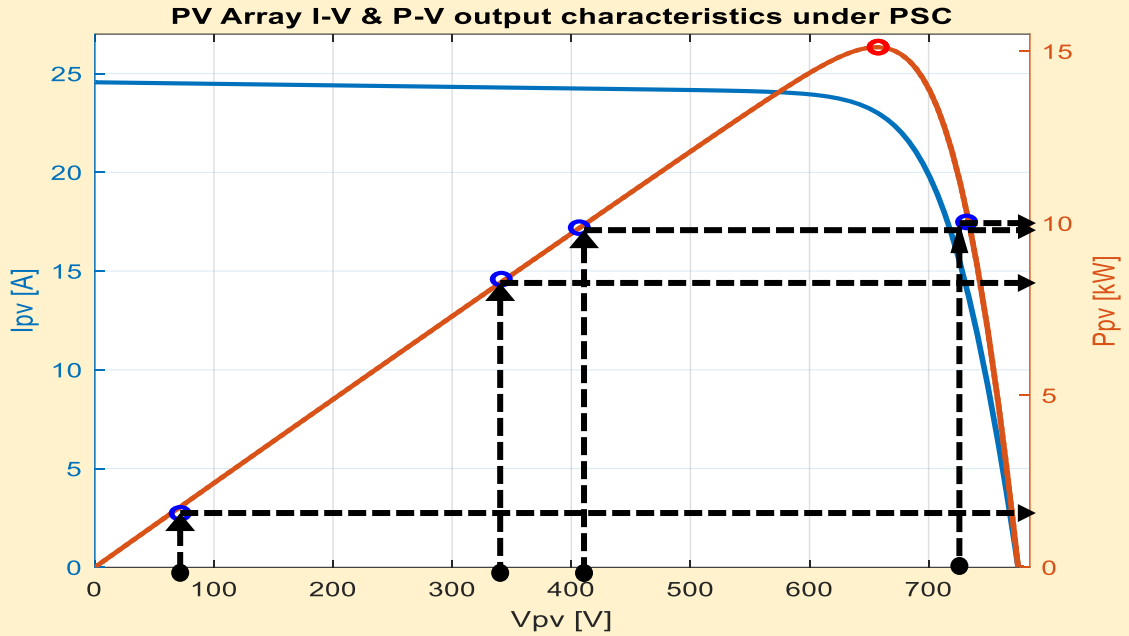
## Case 1: MPPT using PSO , Particle Initialization

**Array type:** **SunPower SPR-315E-WHT-D:**

**Array Size:** **15.1 kW, 4 parallel strings, 12 series modules/String**





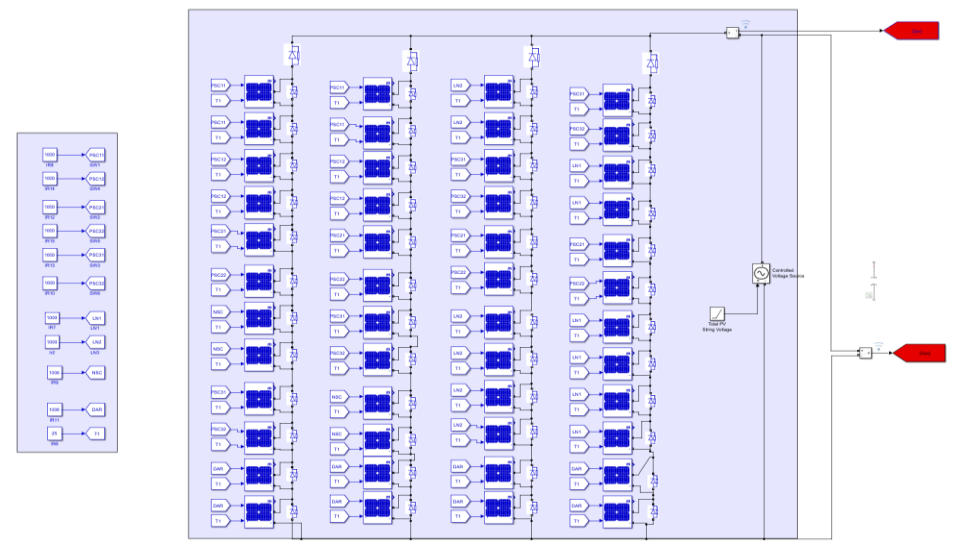

```
ParticlePosition =zeros(nPop,MaxIt);          % Particle position in the voltage curve
ParticleVelocity = zeros(nPop,MaxIt);         % Particle Velocity towards personal best
ParticleSolution = zeros(nPop,MaxIt);         % Power corresponding to particles position
ParticleBestPosition =zeros(nPop,MaxIt);      % Personal best position of particle
ParticleBestSolution = zeros(nPop,MaxIt);     % Power corresponding personal best of a particle
GlobalBestSolution = zeros(1,MaxIt);          % initialize global best solution and particle position
GlobalBestPosition = zeros(1,MaxIt);
```

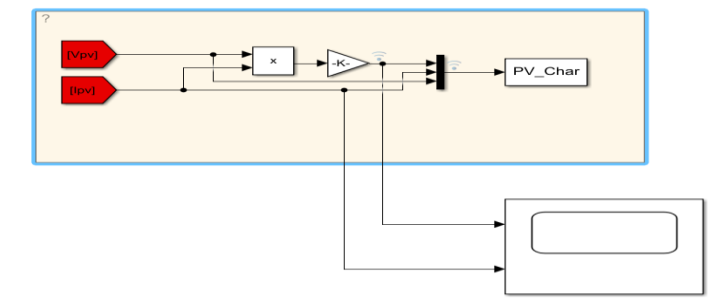
# ❑ PV Array output characteristics under NSC & GMPPT Using PSO Algorithm

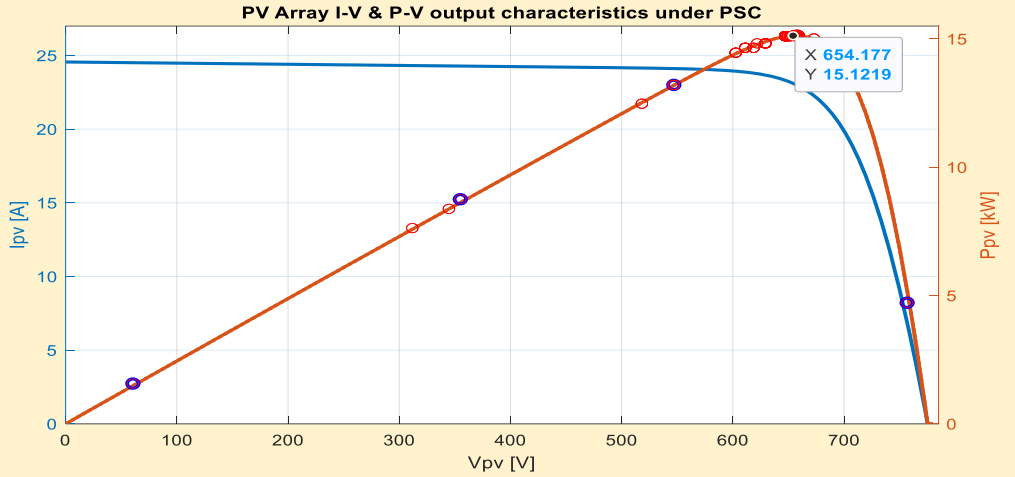
## Case 1: MPPT using PSO , Particle Conversion to MPP

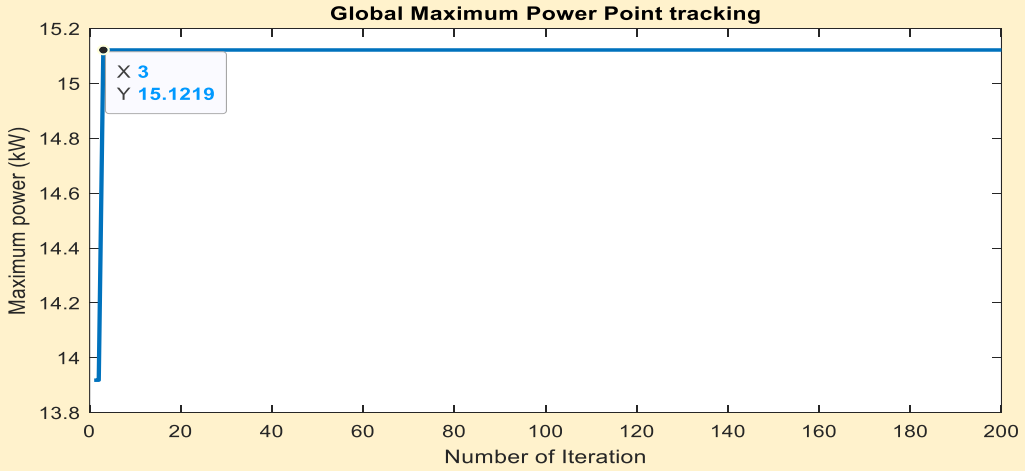
**Array type:** **SunPower SPR-315E-WHT-D:**

**Array Size:** **15.1 kW, 4 parallel strings, 12 series modules/String**





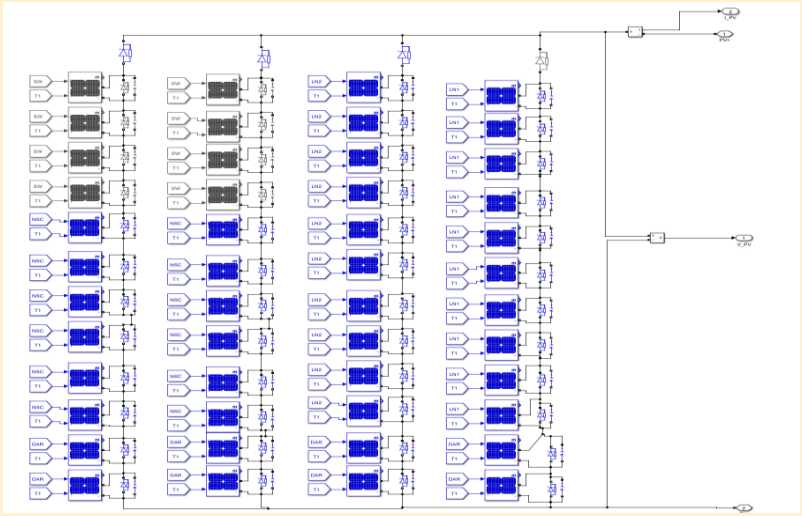

```
Convergence_time =

    0.0243
```

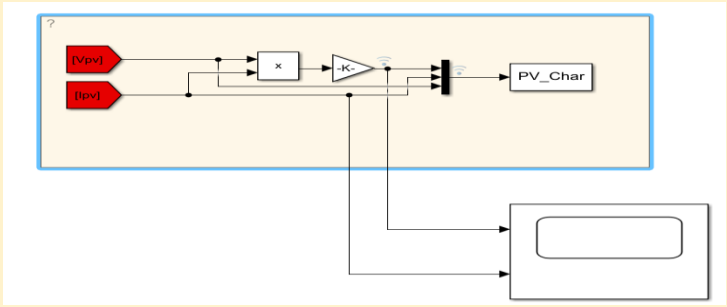
# ❑ PV Array output characteristics under NSC & GMPPT Using PSO Algorithm

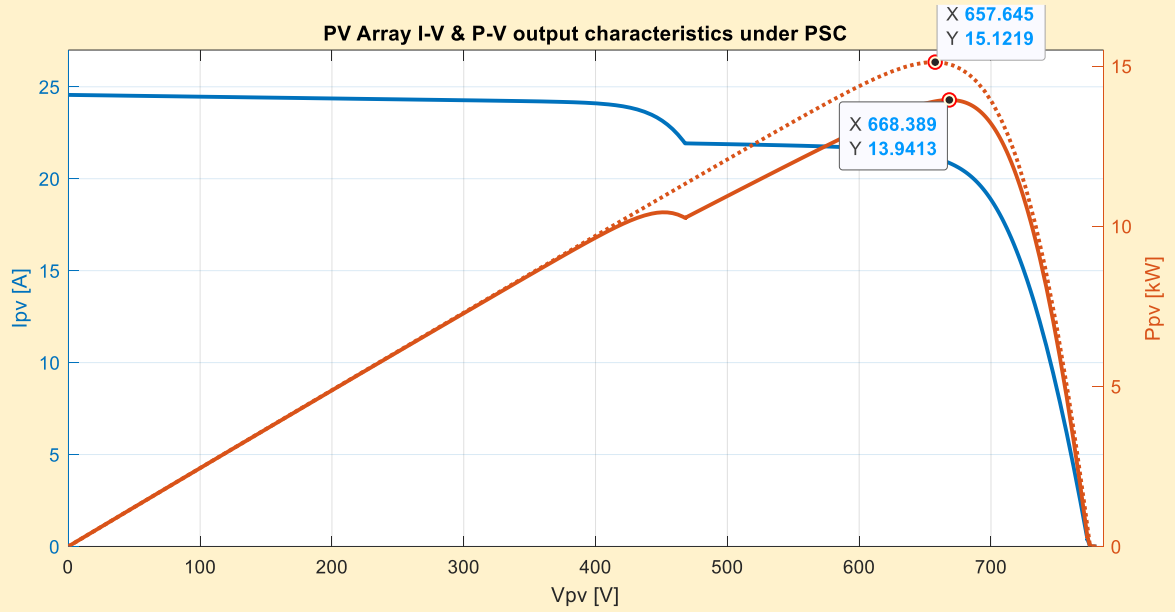
## Case 2: MPPT using PSO , Particle Conversion to MPP

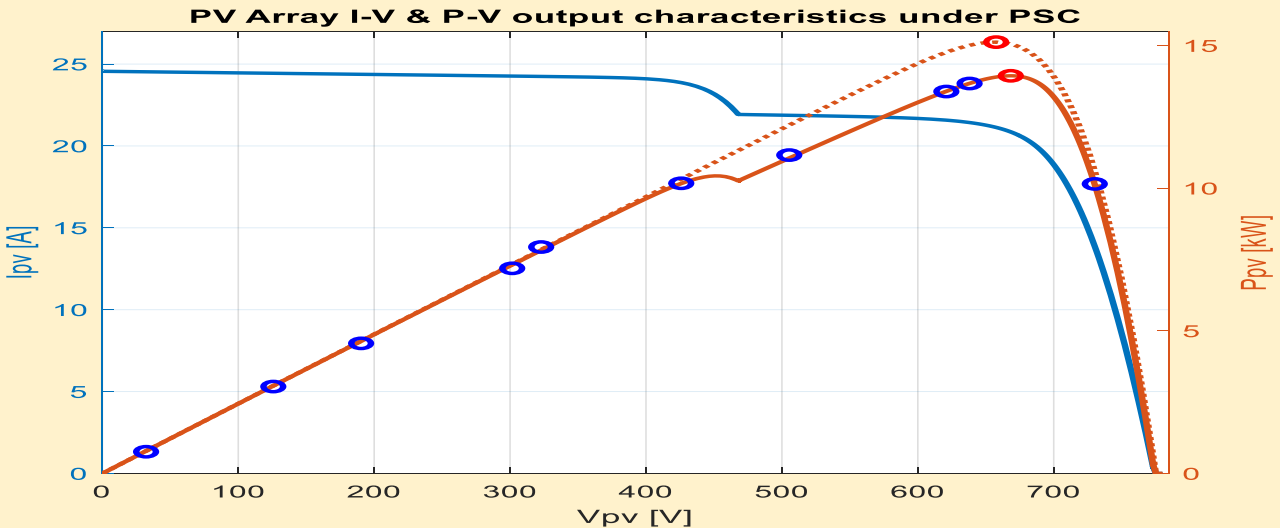
**Array type:** **SunPower SPR-315E-WHT-D:**

**Array Size:** **15.1 kW, 4 parallel strings, 12 series modules/String**





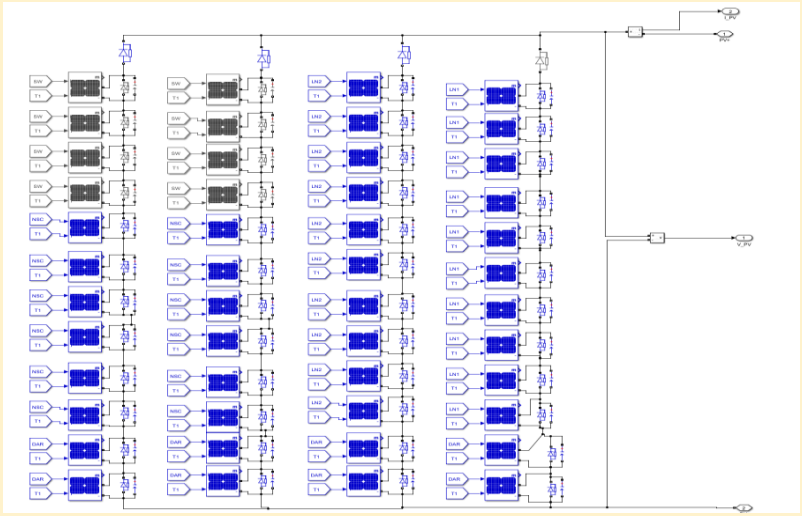



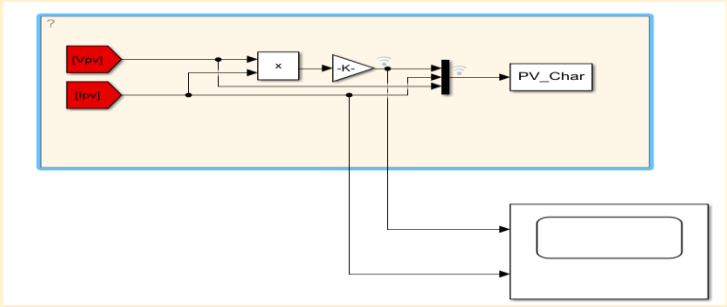
# ❑ PV Array output characteristics under NSC & GMPPT Using PSO Algorithm

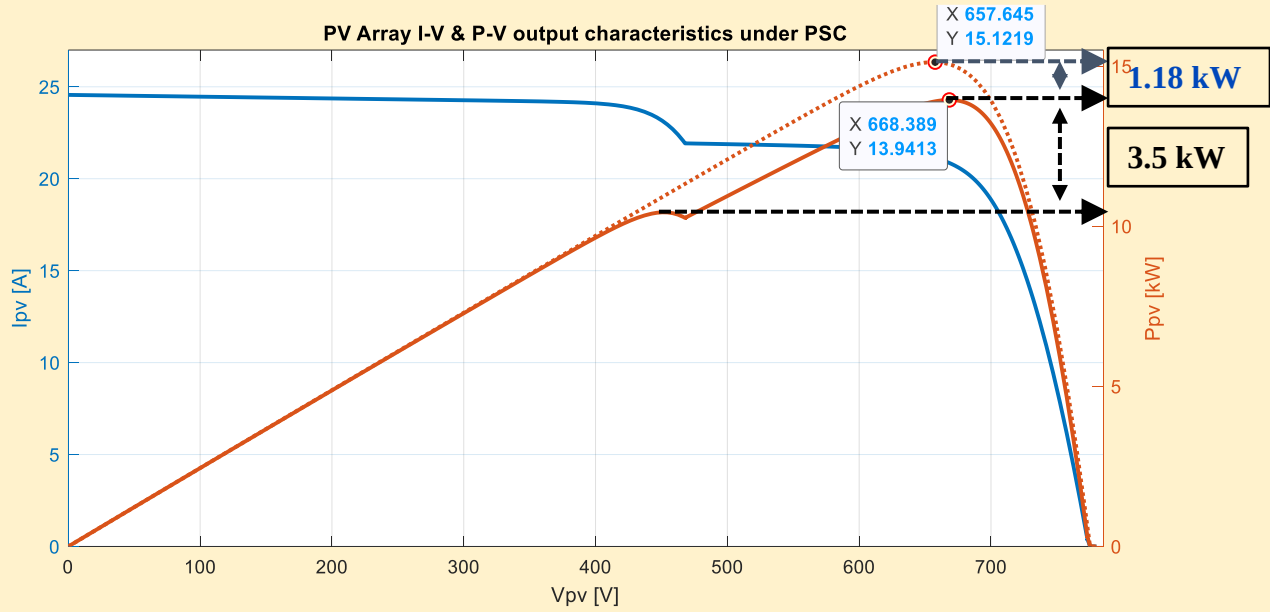
## Case 2: MPPT using PSO , Particle Conversion to MPP

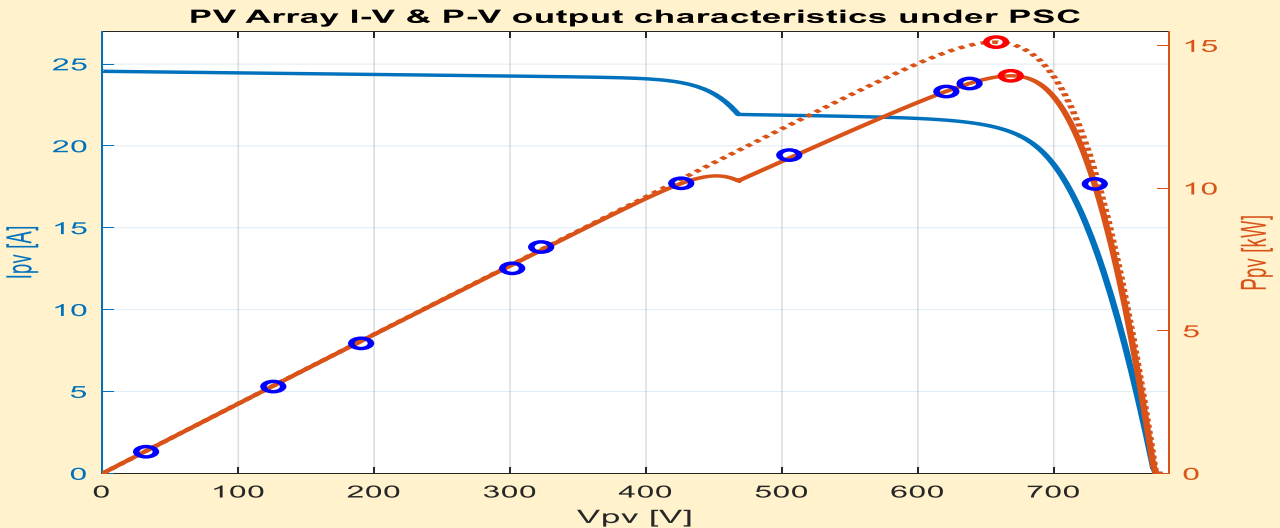
**Array type:** **SunPower SPR-315E-WHT-D:**

**Array Size:** **15.1 kW, 4 parallel strings, 12 series modules/String**





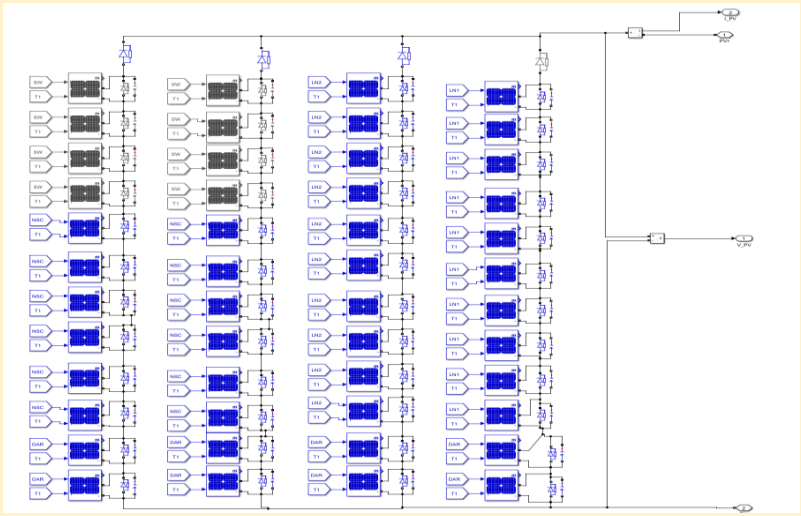



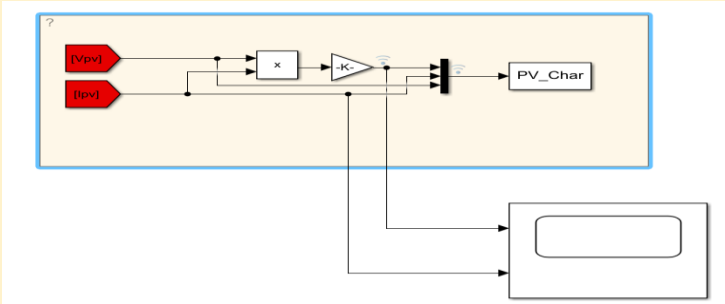
# PV Array output characteristics under NSC & GMPPT Using PSO Algorithm

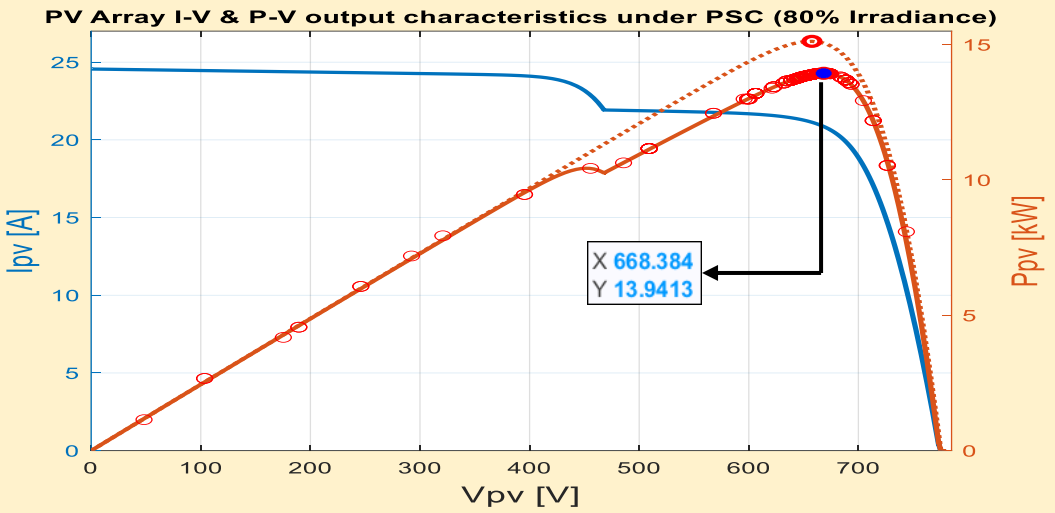
## Case 2: MPPT using PSO , Particle Conversion to MPP

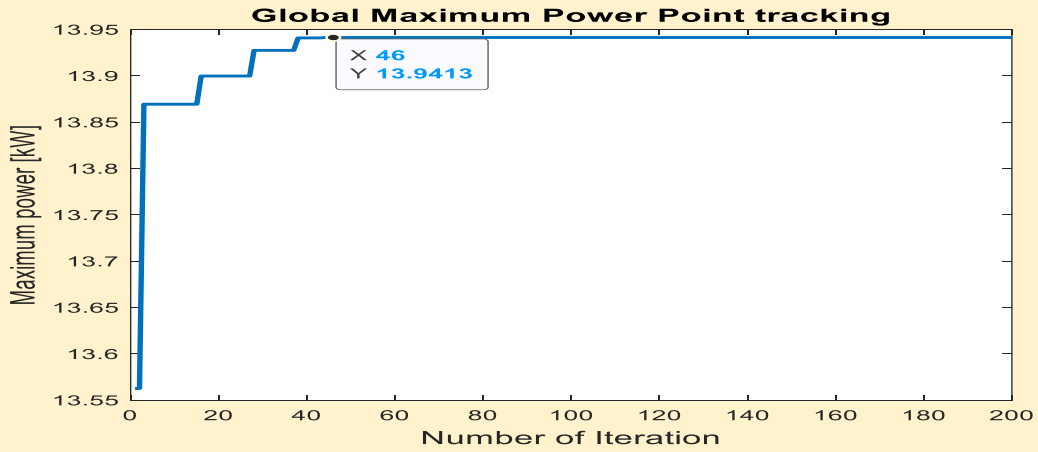
**Array type:** **SunPower SPR-315E-WHT-D:**

**Array Size:** **15.1 kW, 4 parallel strings, 12 series modules/String**





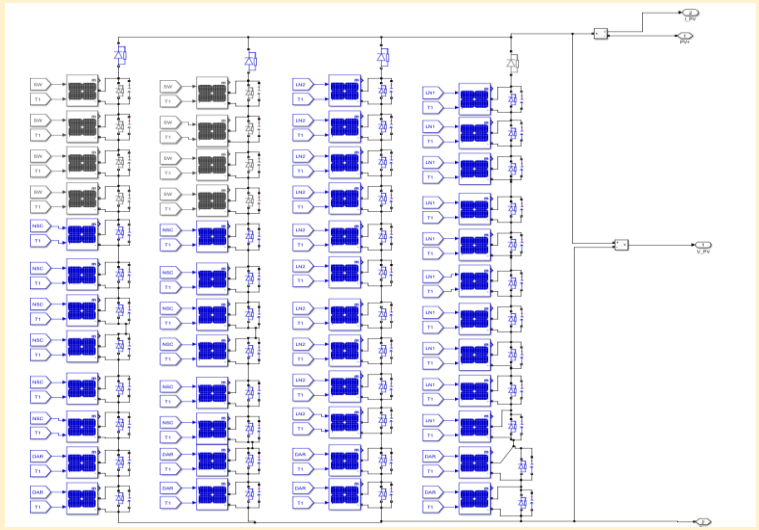

```
Convergence_time =

    0.0541
```

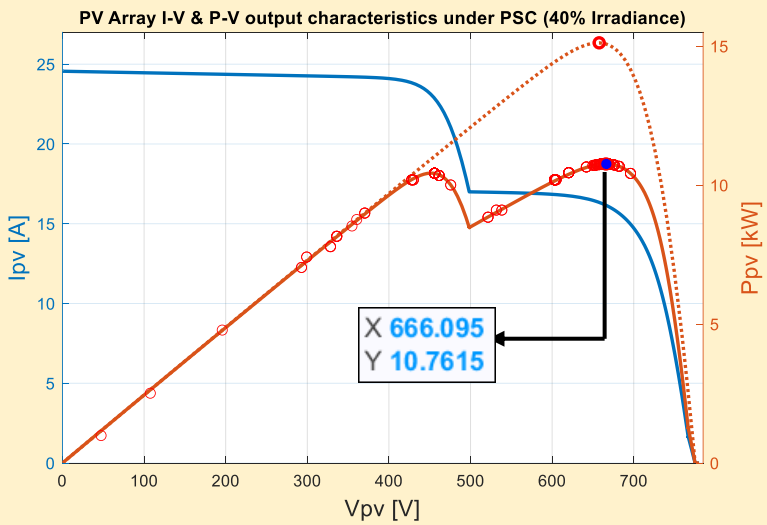
# ❑ PV Array output characteristics under NSC & GMPPT Using PSO Algorithm

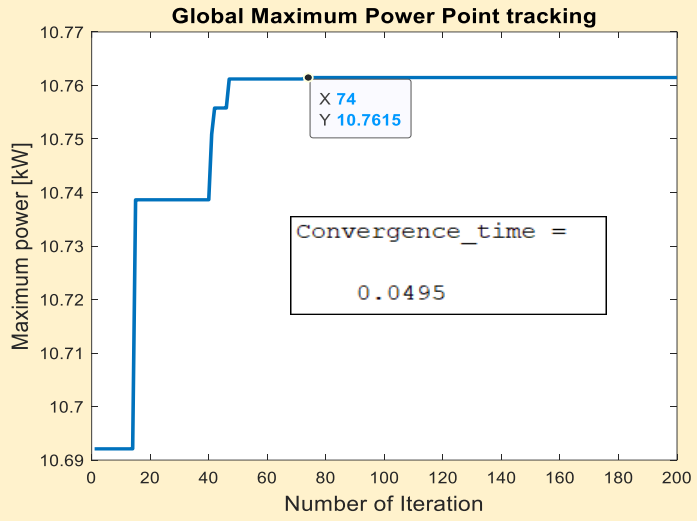
## Case 2: GMPPT using PSO

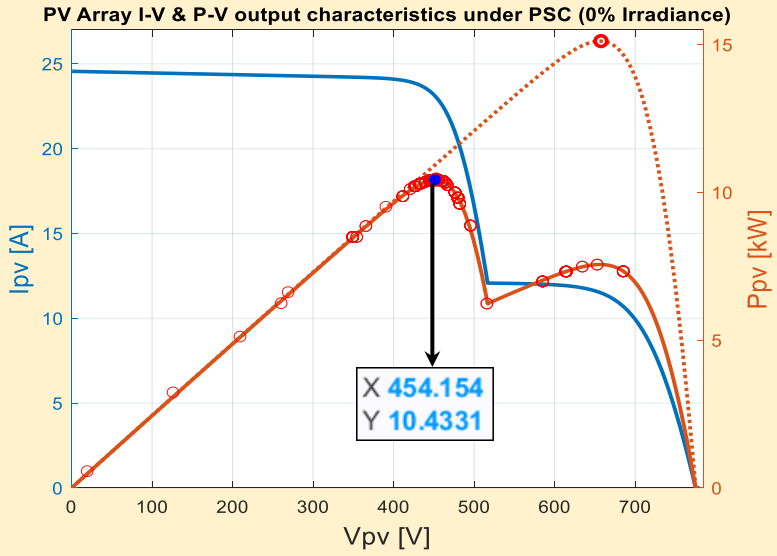
**Array type:** **SunPower SPR-315E-WHT-D:**

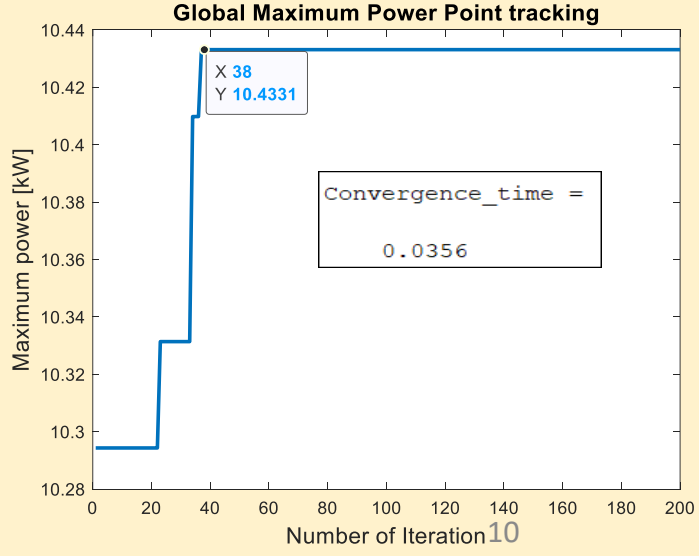
**Array Size:** **15.1 kW, 4 parallel strings, 12 series modules/String**





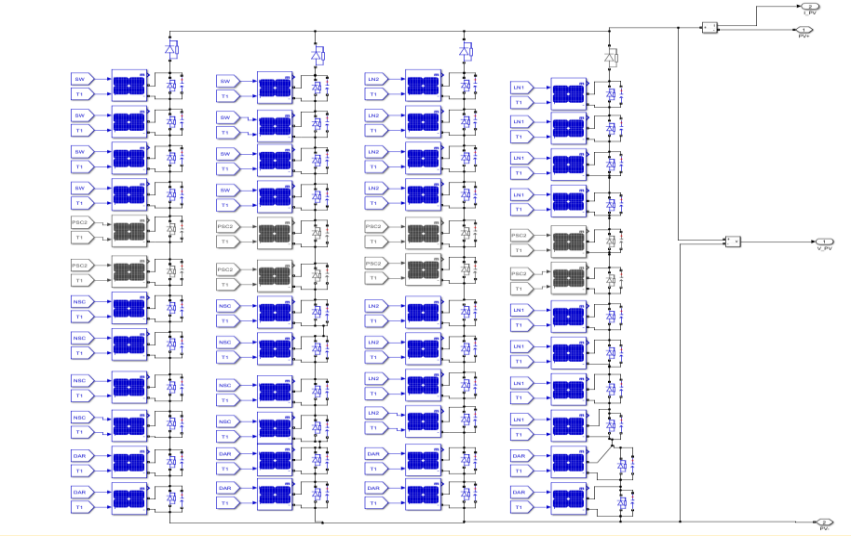



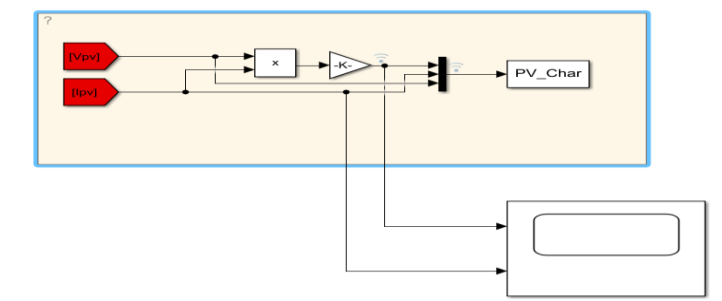
# ❑ PV Array output characteristics under NSC & GMPPT Using PSO Algorithm

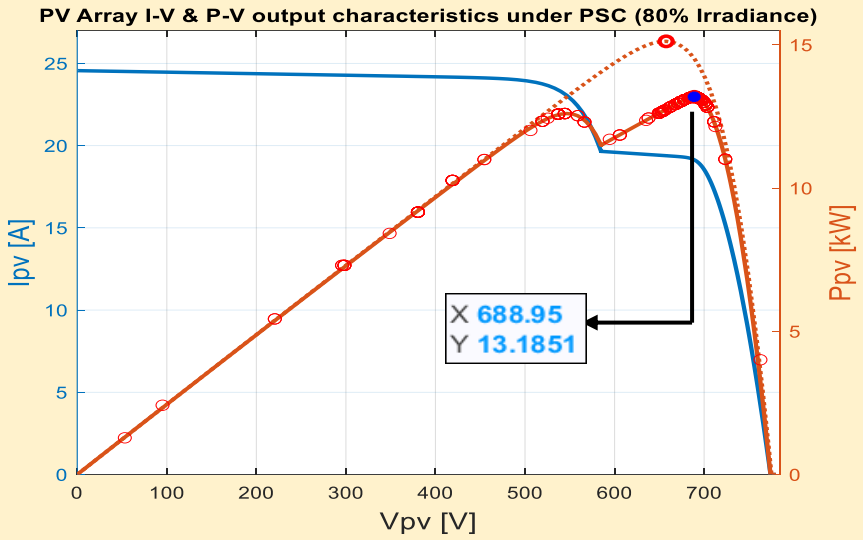
## Case 3: GMPPT using PSO

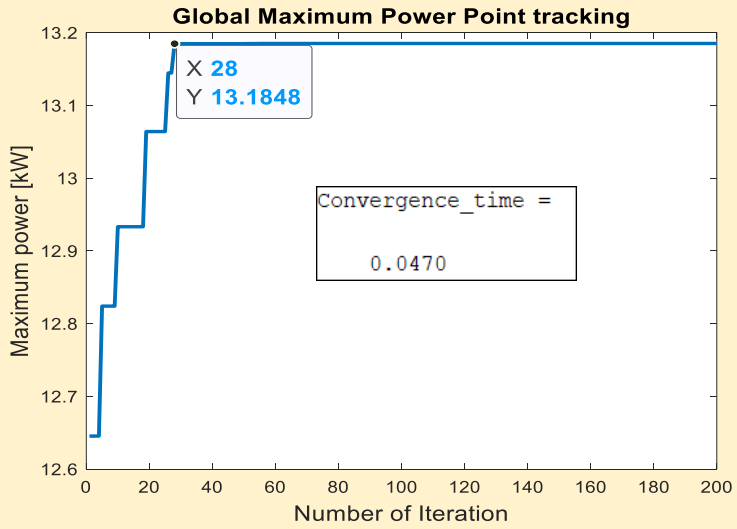
**Array type:** SunPower SPR-315E-WHT-D:

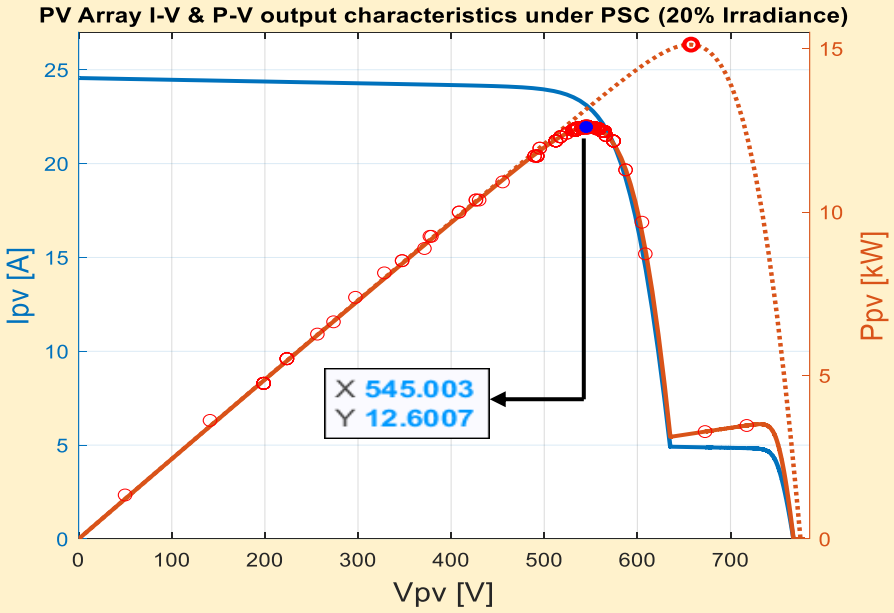
**Array Size:** 15.1 kW, 4 parallel strings, 12 series modules/String

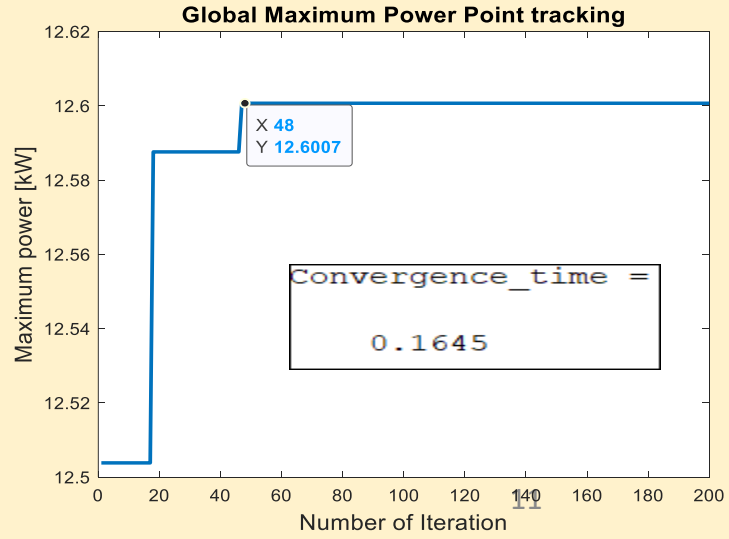




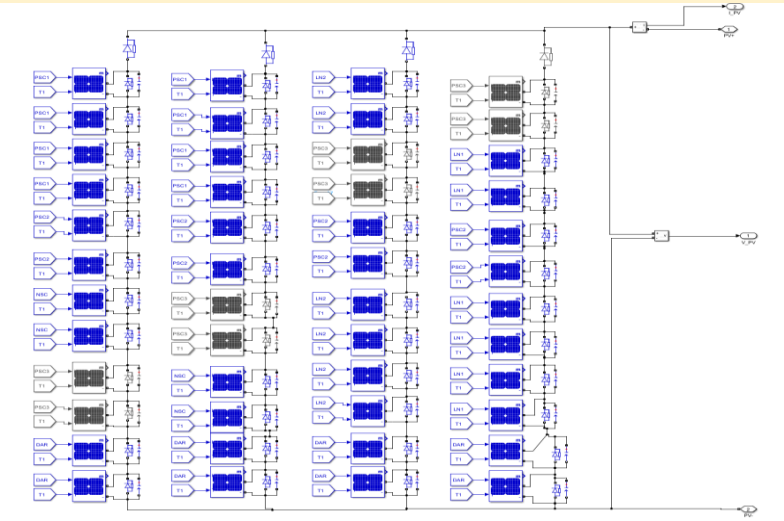



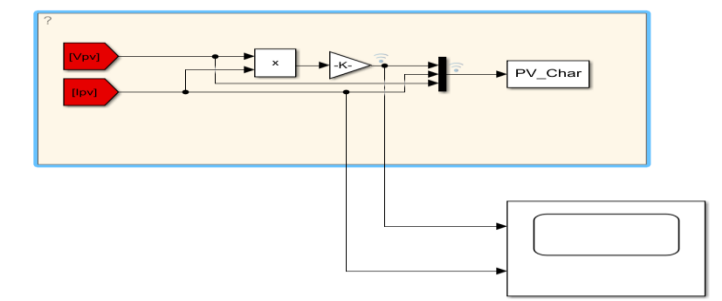
# ❑ PV Array output characteristics under NSC & GMPPT Using PSO Algorithm

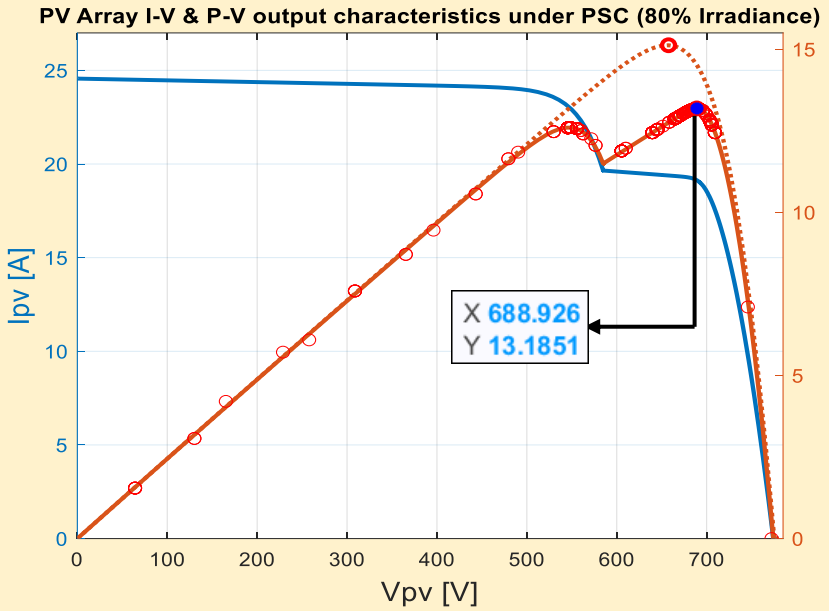
## Case 4: GMPPT using PSO

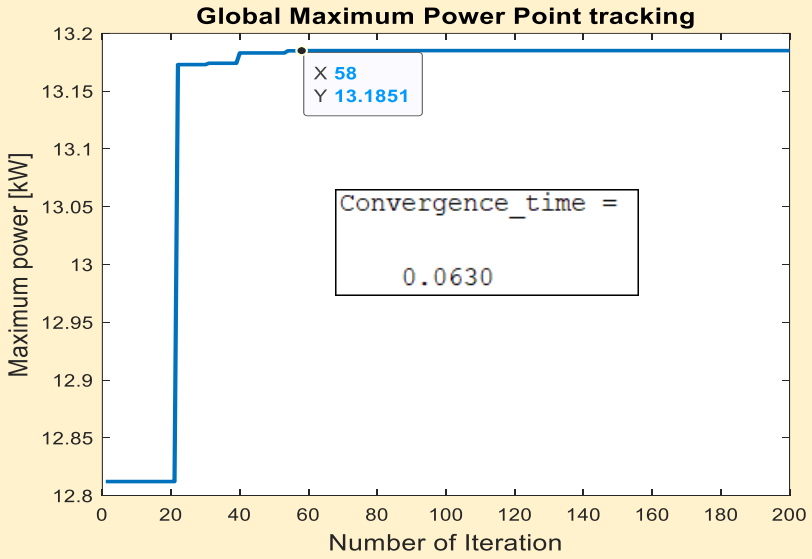
**Array type:** SunPower SPR-315E-WHT-D:

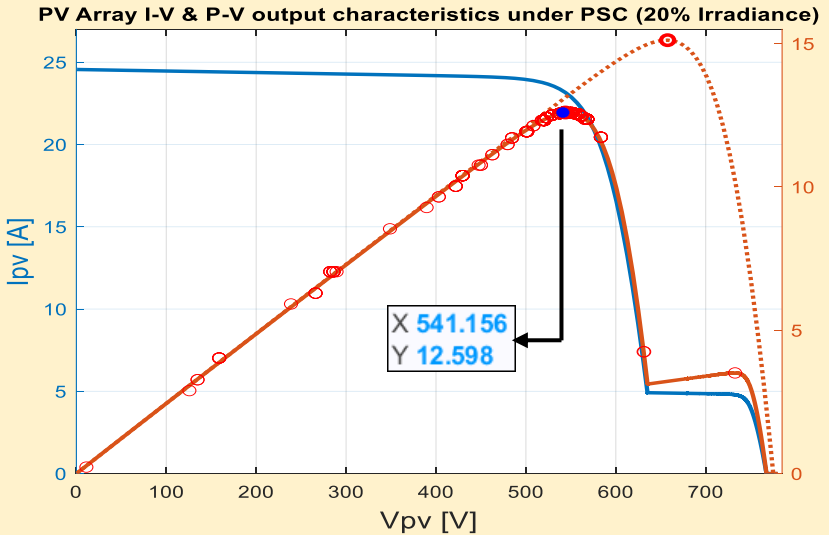
**Array Size:** 15.1 kW, 4 parallel strings, 12 series modules/String

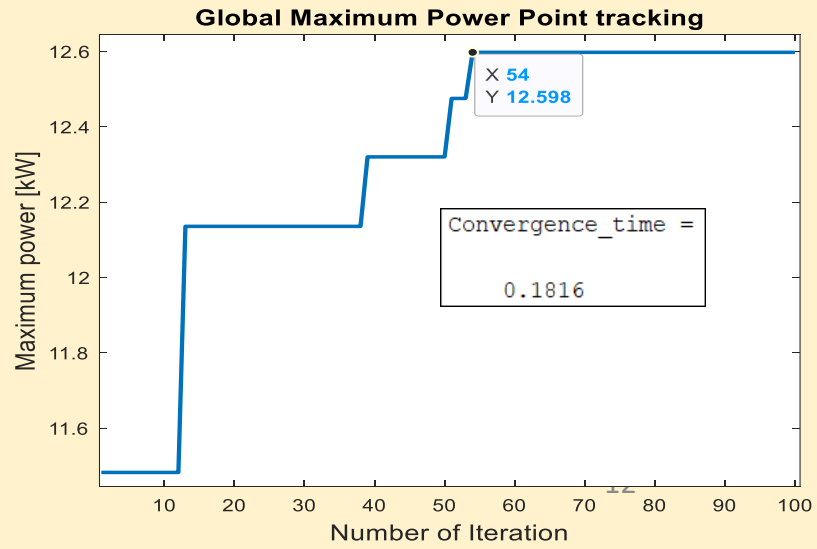




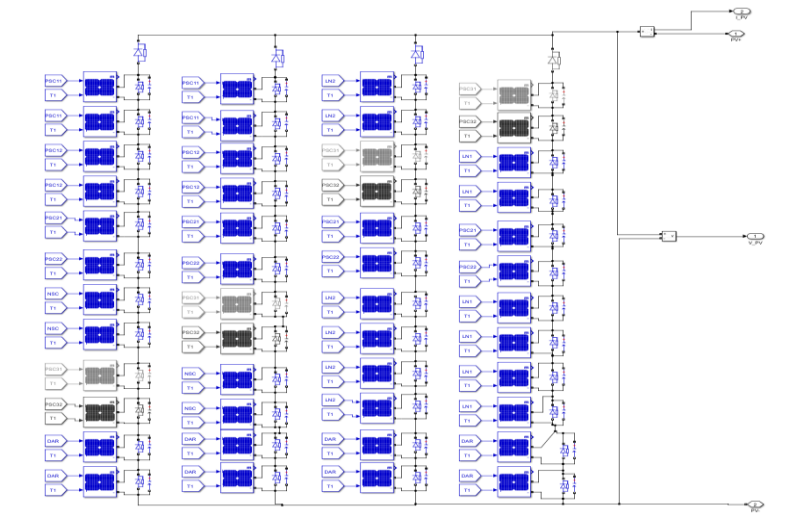



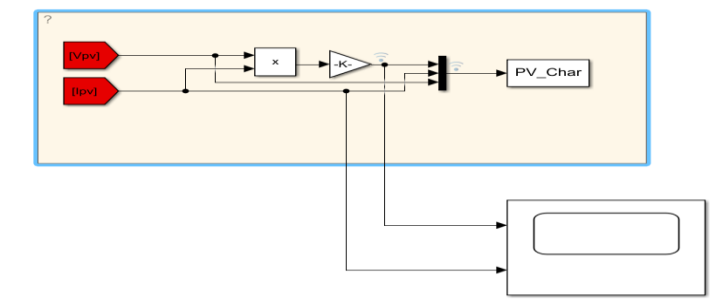
# ❑ PV Array output characteristics under NSC & GMPPT Using PSO Algorithm

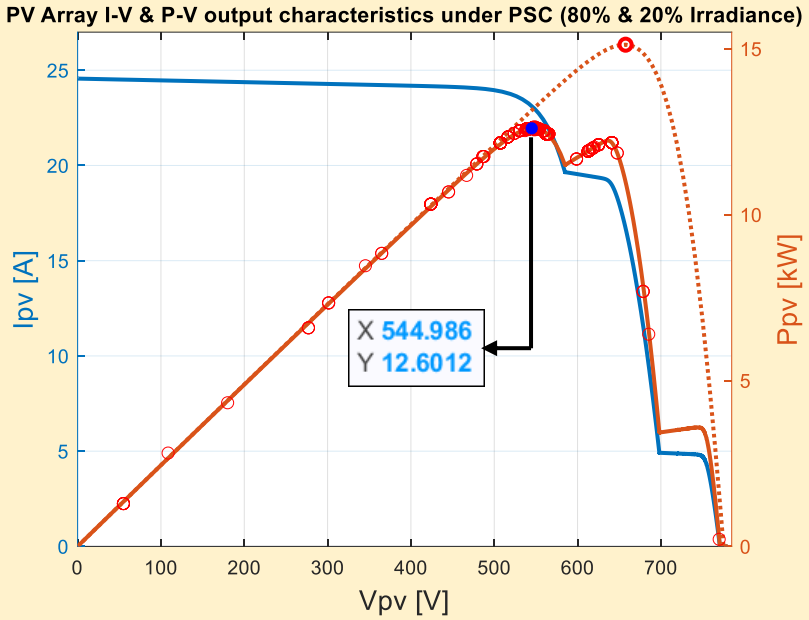
## Case 5: GMPPT using PSO

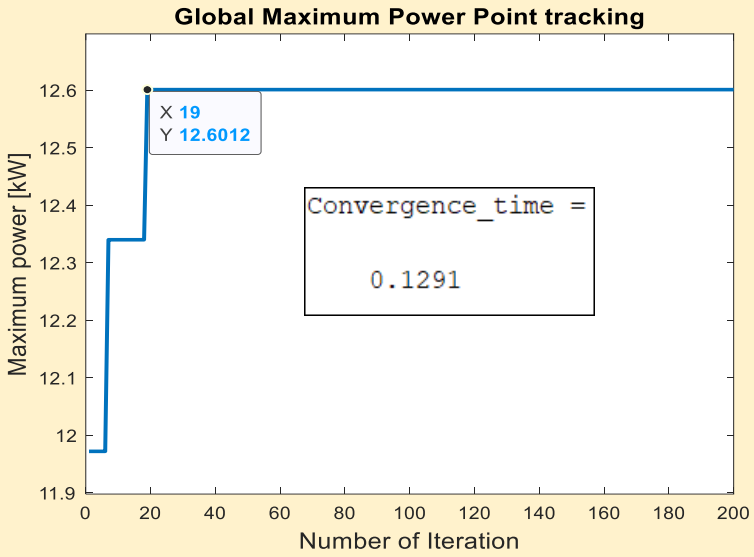
**Array type:** SunPower SPR-315E-WHT-D:

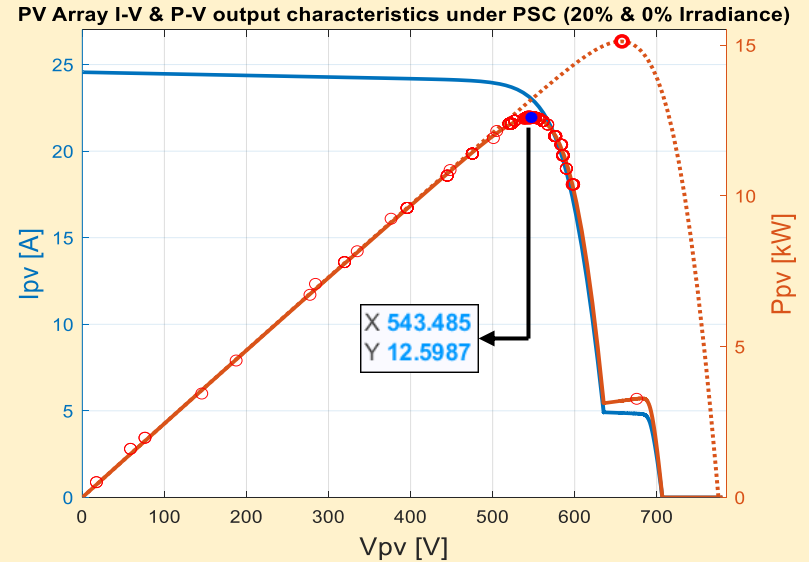
**Array Size:** 15.1 kW, 4 parallel strings, 12 series modules/String

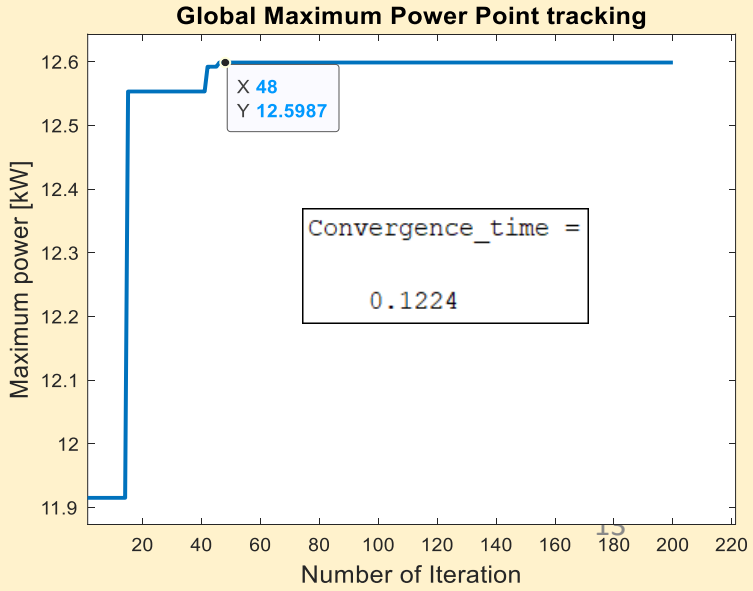




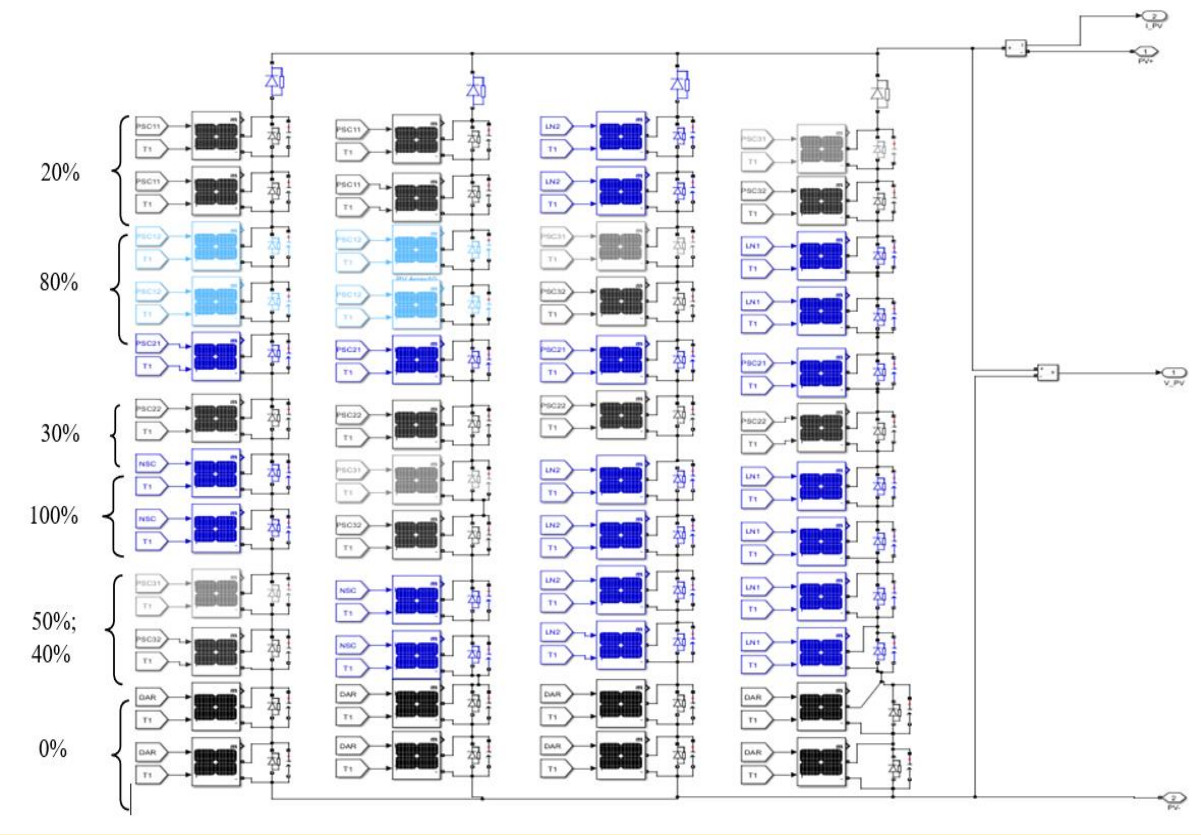



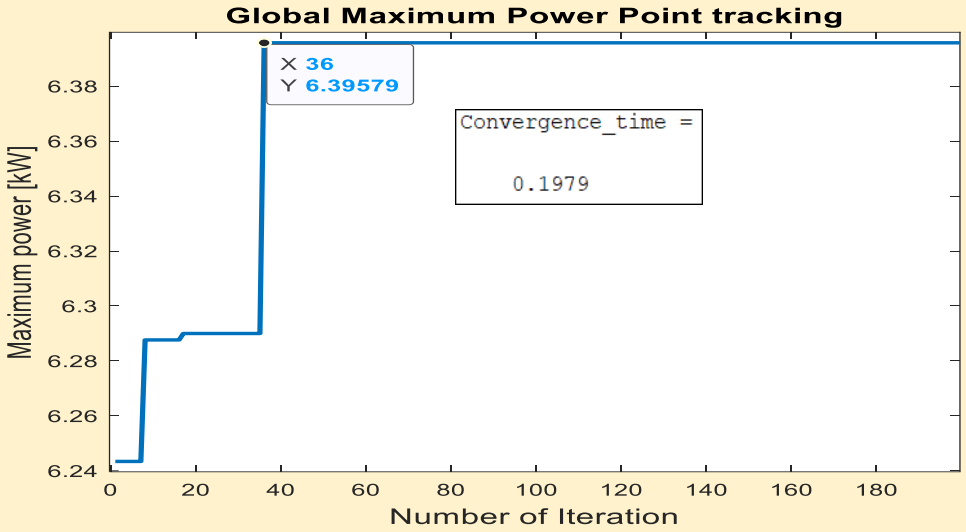
# ❑ PV Array output characteristics under NSC & GMPPT Using PSO Algorithm

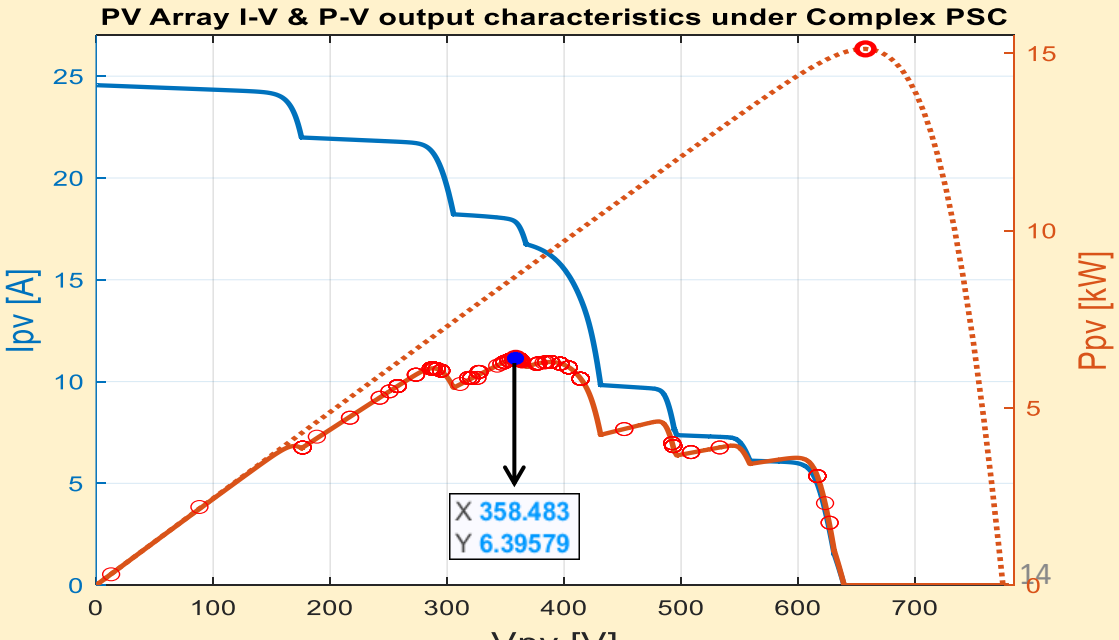
## Case 6: GMPPT using PSO

**Array type:** **SunPower SPR-315E-WHT-D:**

**Array Size:** **15.1 kW, 4 parallel strings, 12 series modules/String**



# GMPPT Algorithms for Single stage PV System: Literature Review

| Literature | Journal and date of publication | MPPT Technique used |
|---|---|---|
| "Control and Performance Analysis of a Single-Stage Utility-Scale Grid-Connected PV System" | IEEE SYSTEMS JOURNAL, VOL. 11, NO. 3, SEPTEMBER 2017 | This paper highlights that "most of the previous work have investigated about two-stage PV system" MPPT<br><br>The paper itself doesn't address Partial shading and it uses IC to track MPPT |
| "Modelling Guidelines and a Benchmark for Power System Simulation Studies of Three-Phase Single-Stage Photovoltaic Systems" | IEEE TRANSACTIONS ON POWER DELIVERY, VOL. 26, NO. 2, APRIL 2011 | Doesn't consider PSC and it uses P & O and IC for the model MPPT |
| "Modified particle swarm optimisation-based maximum power point tracking controller for single-stage utility-scale photovoltaic system with reactive power injection capability" | IET Renewable Power Generation, ISSN 1752-1416, January 2016 | Consider Partial shading and uses PSO algorithm<br><br>This paper highlights that "Moreover, most of the PSO algorithms, presented in previous works, have been implemented and tested for PV system with two-stage or dc–dc converter scheme" |

# GMPPT Algorithms for Single stage PV System: Literature Review

| | | |
|---|---|---|
| "Real-time implementation of three-phase single-stage SPV grid-tied system using TL-VSC" | IET Renewable Power Generation, ISSN 1752-1416, August 2017 | Incremental conductance maximum power point tracking (IC-MPPT) |
| "Control Issues in Single-Stage Photovoltaic Systems: MPPT, Current and Voltage Control" | IEEE TRANSACTIONS ON INDUSTRIAL INFORMATICS, VOL. 8, NO. 2, MAY 2012 | It doesn't consider PSC , uses P &O And IC MPPTs |
| "A Single-Stage Three-Phase Photovoltaic System with Enhanced Maximum Power Point Tracking Capability and Increased Power Rating" | IEEE TRANSACTIONS ON POWER DELIVERY, VOL. 26, NO. 2, APRIL 2011 | It divides the PV array into two subarrays to mitigate the issues of PS |
| "Multi-Objective Single-Stage SPV System Integrated to 3P4W Distribution Network Using DMSI-Based Control Technique" | IEEE TRANSACTIONS ON INDUSTRY APPLICATIONS, VOL. 54, NO. 3, MAY/JUNE 2018 | It Uses P&O For MPPT |
| "Grid Integration of Three-Phase Single-Stage PV System Using Adaptive Laguerre Filter Based Control Algorithm Under Nonideal Distribution System" | IEEE TRANSACTIONS ON INDUSTRY APPLICATIONS, VOL. 55, NO. 6, NOVEMBER/DECEMBER 2019 | It Uses P&O For MPPT |
| "A novel nonlinear sliding mode controller for a single stage grid-connected photovoltaic system" | ELSEVIER, ISA Transactions 107 (2020) 329–339 | Perturb and Observe (P & O) MPPT algorithm is employed in this paper |