

**PROCEDURE  
FOR THE TESTING AND COMMISSIONING OF GRID-  
CONNECTED PHOTOVOLTAIC SYSTEMS IN MALAYSIA**

**Part 2 - SYSTEMS GREATER THAN 12 kWp AND LESS THAN 72 kWp**



**SUSTAINABLE ENERGY DEVELOPMENT AUTHORITY (SEDA)  
MALAYSIA**

**2014**

# TABLE OF CONTENTS

<b>1. PRE-COMMISSIONING CHECKLIST AND TEST .....</b>	<b>2</b>
1.1 INFORMATION ABOUT PROJECT .....	3
1.2 CHECKLIST FOR GENERAL INSPECTION .....	4
1.3 CHECKLIST FOR PV MODULE MOUNTING STRUCTURE & CIVIL FOUNDATION .....	6
1.4 CHECKLIST FOR DC JUNCTION BOX OR STRING MONITORING BOX .....	7
1.5 CHECKLIST FOR EARTHING & LIGHTNING ARRESTOR .....	8
1.6 CHECKLIST FOR PV MODULE INSPECTION .....	9
1.7 CHECKLIST FOR INVERTER INSPECTION .....	10
1.8 CHECKLIST FOR AC DISTRIBUTION BOX .....	11
1.9 CHECKLIST OF CABLE IDENTIFICATION AND CABLE ROUTING INSPECTION .....	12
1.10 CABLE INSULATION TEST .....	13
1.11 STRING FUSE CONTINUITY AND STRING OPEN CIRCUIT VOLTAGE TEST .....	14
1.12 STRING DC SHORT CIRCUIT CURRENT TEST .....	15
1.13 ISOLATION DEVICE FUNCTIONAL TEST .....	16
<b>2. TESTING AND COMMISSIONING CHECKLIST.....</b>	<b>17</b>
2.1 INFORMATION ABOUT PV MODULE .....	18
2.2 INFORMATION ABOUT PV ARRAY.....	19
2.3 INFORMATION ABOUT INVERTER.....	20
2.4 INVERTER FUNCTIONAL TEST .....	21
2.5 ACCEPTANCE TEST .....	22
<b>3. RELIABILITY RUN TEST .....</b>	<b>23</b>
3.1 PERFORMANCE RATIO TEST .....	24

## 1. PRE-COMMISSIONING CHECKLIST AND TEST

Prior to commissioning, the service provider of the GCPV systems must perform the pre-commissioning checks.

This activity shall be conducted by the competent persons as stated at the end of the checklist, whilst adhering to the relevant laws and regulations.

A copy of the completed pre-commissioning checklist and test results must be submitted to SEDA and Distribution Licensee (DL) for application of Testing and Commissioning.

**During the pre-commissioning checks, the GCPV systems shall not be engaged to the grid.**

The pre-commissioning checks consist of the following (**mandatory minimum**):

1. Information about Project
2. Checklist for General Inspection
3. Checklist for PV Module Mounting Structure & Civil foundation
4. Checklist for DC Junction Box or String Monitoring Box
5. Checklist for Earthing & Lightning Arrestor
6. Checklist for PV Module
7. Checklist for Inverter
8. Checklist for AC Distribution Box
9. Checklist of Cable identification and cable routing inspection
10. Cable insulation test
11. String fuse continuity and string open circuit voltage test
12. String DC short circuit current test
13. Isolation device functional test

## 1.1 INFORMATION ABOUT PROJECT

<b>Table 1.1 Information about project</b>	
Project details	
FIT application number	
Project description	
Site GPS coordinates (Latitude, Longitude)	
Site address	
Date of inspection (dd_mmm_yyyy)	
Customer details	
Name	
Full postal address	
Mobile phone number/Ground phone number	
Email address	
Installation details	
Date of completion of installation	
Date of planned connection to grid	
Import meter reading (kWh) at pre-comm session	
Export meter reading (kWh) at pre-comm session	
Remarks	

## 1.2 CHECKLIST FOR GENERAL INSPECTION

Table 1.2 Checklist for General Inspection			
Description	If the job has been done satisfactorily, please tick ✓ in the box. If not applicable, write 'NA' in the box.		Date of inspection: (dd_mmm_yyyy)
Instructions	This form shall be filled-up for each sub-array connected to one inverter	Inverter ID:	Sub-array ID:
<b>A. General</b>	i.	All necessary safety equipment are available at the site	<input type="checkbox"/>
	ii.	Array frame correctly fixed and stable	<input type="checkbox"/>
	iii.	All cable entries are weather proof	<input type="checkbox"/>
	iv.	PV module location, perimeter, gate, control room & switch yard, plant internal road location as per approved layout drawing	<input type="checkbox"/>
	v.	Components comply with standards and are selected as per design & not damaged	<input type="checkbox"/>
	vi.	Equipment accessible for inspection, operation & maintenance	<input type="checkbox"/>
	vii.	Equipment & accessories are connected as per approved drawing	<input type="checkbox"/>
	viii.	Protective measures for special locations have been addressed (if applicable)	<input type="checkbox"/>
	ix.	Equipment & protective measures are appropriate to external influence	<input type="checkbox"/>
	x.	System installed to prevent mutual detrimental influence	<input type="checkbox"/>
	xi.	All cables are identified and connected as per approved drawing	<input type="checkbox"/>
	xii.	All cables are selected for current carrying capacity and voltage drop as per approved design	<input type="checkbox"/>
	xiii.	Conductors routed are in safe zone or protected against mechanical damage	<input type="checkbox"/>
	xiv.	All tagging are appropriate.	<input type="checkbox"/>
	xv.	All signages are appropriate.	<input type="checkbox"/>
	xvi.	All relevant documents are available.	<input type="checkbox"/>
	xvii.	Emergency procedure displayed at site	<input type="checkbox"/>
	xviii.	PV system schematic displayed at site	<input type="checkbox"/>

<b>B. DC Side</b>	<ul style="list-style-type: none"> <li>i. Adequate physical separation of AC, DC &amp; communication cables <input type="checkbox"/></li> <li>ii. All DC components are sized for rated operation at maximum DC system voltage <input type="checkbox"/></li> <li>iii. All DC cables are meant for solar PV applications and as per design document <input type="checkbox"/></li> <li>iv. PV string fuse or DC breaker are available in the combiner boxes <input type="checkbox"/></li> </ul>
<b>C. Protection against over voltage &amp; Electric Shock</b>	<ul style="list-style-type: none"> <li>i. Live parts are insulated and protected by barrier/enclosure, placed out of reach <input type="checkbox"/></li> <li>ii. Surge protection devices are available <input type="checkbox"/></li> <li>iii. External lightning protection system is available <input type="checkbox"/></li> <li>iv. PV frame grounding correctly integrated with existing installation <input type="checkbox"/></li> </ul>
<b>D. AC Side</b>	<ul style="list-style-type: none"> <li>i. Inverter protection setting as per local regulation (labelling &amp; identification mark) <input type="checkbox"/></li> <li>ii. Protection setting by installers displayed at site (maximum current, range of voltage and frequency) <input type="checkbox"/></li> </ul>
Comments:	

### 1.3 CHECKLIST FOR PV MODULE MOUNTING STRUCTURE & CIVIL FOUNDATION

Table 1.3 Checklist for PV Module Mounting Structure & Civil Foundation			
Description	If the job has been done satisfactorily, please tick ✓ in the box. If not applicable, write 'NA' in the box.		Date of inspection: (dd_mmm_yyyy)
Instructions	This form shall be filled-up for each sub-array connected to one inverter	Inverter ID:	Sub-array ID:
i.	Mounting structure and jointing materials as per approved drawing		<input type="checkbox"/>
ii.	Foundation dimensions as per approved drawing		<input type="checkbox"/>
iii.	Switch yard civil foundation as per approved drawing		<input type="checkbox"/>
iv.	The material for structure has corrosion proof coating (check for availability of factory test certificate)		<input type="checkbox"/>
v.	Structures are correctly fixed at specific tilt and orientation as per design document		<input type="checkbox"/>
vi.	No crack found in the foundation and/or mounting structure		<input type="checkbox"/>
vii.	Structures are designed based on the maximum wind load of the location (check for availability of structure engineer certificate)		<input type="checkbox"/>
viii.	No rust (for steel) or discoloration (for aluminium) found in the structure materials (e.g. frame, clamp, bolt and nuts, etc.)		<input type="checkbox"/>
ix.	Water drainage is available		<input type="checkbox"/>
Comments:			

## 1.4 CHECKLIST FOR DC JUNCTION BOX OR STRING MONITORING BOX

Table 1.4 Checklist for DC Junction Box or String Monitoring Box			
Description	If the job has been done satisfactorily, please tick ✓ in the box. If not applicable, write 'NA' in the box.		Date of inspection: (dd_mmm_yyyy)
Instructions	This form shall be filled-up for each sub-array connected to one inverter	Inverter ID:	Sub-array ID:
i.	DC Junction/String Monitoring Box connection diagram is available at the inside of the cover		<input type="checkbox"/>
ii.	Wiring is as per approved schematic		<input type="checkbox"/>
iii.	String fuses or DC circuit breakers are available		<input type="checkbox"/>
iv.	Metal casings are earthed as per design document		<input type="checkbox"/>
v.	All boxes are properly fixed at appropriate locations as per design document		<input type="checkbox"/>
vi.	Surge protections devices are available inside the box as per design document		<input type="checkbox"/>
vii.	Box and related component & insulation rating based on maximum DC voltage		<input type="checkbox"/>
viii.	Boxes for outdoor use should be suitably rated based on Malaysia climate		<input type="checkbox"/>
Comments:			

## 1.5 CHECKLIST FOR EARTHING & LIGHTNING ARRESTOR

Table 1.5 Checklist for earthing & lightning arrestor			
Description	If the job has been done satisfactorily, please tick ✓ in the box. If not applicable, write 'NA' in the box.		Date of inspection: (dd_mmm_yyyy)
Instructions	This form shall be filled-up for each earthing pit and each lightning arrestor	Earth pit ID:	Lightning arrestor ID:
<p>i. Earthing location as per approved drawing <input type="checkbox"/></p> <p>ii. Earthing conductor properly connected to metal parts of all structures <input type="checkbox"/></p> <p>iii. All array frames (for framed modules) and structures are earthed and bonded properly <input type="checkbox"/></p> <p>iv. Earthing &amp; lightning arrestor are installed as per design document <input type="checkbox"/></p>			
Comments:			

## 1.6 CHECKLIST FOR PV MODULE INSPECTION

Table 1.6 Checklist for PV module			
Description	If the job has been done satisfactorily, please tick ✓ in the box. If not applicable, write 'NA' in the box.		Date of inspection: (dd_mmm_yyyy)
Instructions	This form shall be filled-up for each sub-array structure	Structure ID:	Sub-array ID:
i.	PV modules are fixed on the structure as per design drawing		<input type="checkbox"/>
ii.	PV modules are properly levelled on the structure		<input type="checkbox"/>
iii.	PV modules conform to relevant IEC standards as per design document		<input type="checkbox"/>
iv.	Inter-module connectors are properly crimped & securely connected		<input type="checkbox"/>
v.	PV modules are connected with correct polarity		<input type="checkbox"/>
vi.	Non-metallic isolator is present between each PV module frame & structure (if they are made from different metals)		<input type="checkbox"/>
vii.	Installation of PV modules are done as per manufacturer's guidelines		<input type="checkbox"/>
Comments:			

## 1.7 CHECKLIST FOR INVERTER INSPECTION

Table 1.7 Checklist for inverter			
Description	If the job has been done satisfactorily, please tick ✓ in the box. If not applicable, write 'NA' in the box.		Date of inspection: (dd_mmm_yyyy)
Instructions	This form shall be filled-up for each inverter	Inverter ID:	
i.	Inverter is installed as per manufacturer's guideline		<input type="checkbox"/>
ii.	Sufficient ventilation is available around the inverter (as per manufacturer's guideline)		<input type="checkbox"/>
iii.	Inverter conforms to relevant IEC standards (or equivalent) as per design document		<input type="checkbox"/>
iv.	Inverter unit is properly fastened to floor/wall surfaces		<input type="checkbox"/>
v.	Inverter is properly earthed		<input type="checkbox"/>
vi.	Inverter incoming/outgoing cables are properly tagged		<input type="checkbox"/>
vii.	Inverter incoming/outgoing cables are properly connected as per drawing		<input type="checkbox"/>
viii.	The connections for phase sequence L1, L2 & L3 are in proper order (for three phase inverters)		<input type="checkbox"/>
ix.	The connections for L and N are in proper order (for single phase inverters)		<input type="checkbox"/>
x.	Inverter for outdoor use shall be suitable rated based on Malaysia climate.		<input type="checkbox"/>
xi.	Gap maintained between power cables and signal cables routing as per design document		<input type="checkbox"/>
xii.	The auxiliary power cables are connected properly		<input type="checkbox"/>
xiii.	All cable terminations are done properly		<input type="checkbox"/>
xiv.	Proper labelling of all the cables and components are done		<input type="checkbox"/>
xv.	Inverter factory settings are as per local utility guidelines		<input type="checkbox"/>
Comments:			

## 1.8 CHECKLIST FOR AC DISTRIBUTION BOX

Table 1.8 Checklist for AC Distribution Box (ACDB)			
Description	If the job has been done satisfactorily, please tick ✓ in the box. If not applicable, write 'NA' in the box.		Date of inspection: (dd_mmm_yyyy)
Instructions	This form shall be filled-up for each ACDB	ACDB ID:	
i.	ACDB is properly mounted as per design document		<input type="checkbox"/>
ii.	Sufficient free space available around each ACDB		<input type="checkbox"/>
iii.	ACDB is properly earthed as per design document (if applicable)		<input type="checkbox"/>
iv.	The connections for phase sequence L1, L2 & L3 are in proper order (for three phase inverters)		<input type="checkbox"/>
v.	The connections for L and N are in proper order (for single phase inverters)		<input type="checkbox"/>
vi.	Incoming/outgoing cables are properly connected as per approved schematic diagram		<input type="checkbox"/>
vii.	All cable terminations are done properly		<input type="checkbox"/>
viii.	Proper tagging of all cables and components are done		<input type="checkbox"/>
ix.	All cable glands are properly secured & tightened		<input type="checkbox"/>
x.	Boxes for outdoor use shall be suitably rated based on Malaysia climate		<input type="checkbox"/>
Comments:			

## 1.9 CHECKLIST OF CABLE IDENTIFICATION AND CABLE ROUTING INSPECTION

Table 1.9 Checklist for cable identification & route inspection		
Description	If the job has been done satisfactorily, please tick ✓ in the box. If not applicable, write 'NA' in the box.	Date of inspection: (dd_mmm_yyyy)
i. All cable routed areas are properly marked on the ground		<input type="checkbox"/>
ii. All power cable route & locations are as per drawing		<input type="checkbox"/>
iii. All cables are properly tagged		<input type="checkbox"/>
iv. All DC cables are meant for solar PV applications and as per design document		<input type="checkbox"/>
v. Cable caution tape is used for all underground cables as per design document		<input type="checkbox"/>
vi. All trunking and conduits are installed as per design document		<input type="checkbox"/>
Comments:		

## 1.10 CABLE INSULATION TEST

Table 1.10 Cable insulation test					
Cable ID				Date of inspection: (dd_mmm_yyyy)	
Description		References (Please state)			
Test point		All new cables			
Use appropriate tools to measure and record					
Testing is performed on new cable installations to determine if the insulation has been damaged.			Instructions: <b>SWITCH OFF / DISCONNECT</b> the following: - PV AC Main Switch (Isolator) - All AC switches - All DC switches - All DC fuses  Isolate all cables except for inter-module connection and earthing cables.		
No.	Cable from (originating)	Cable to (terminating)	Insulation resistance value	Pass	Fail
				(Please tick ✓ in the box)	
1					
2					
3					
Comments:					

## 1.11 STRING FUSE CONTINUITY AND STRING OPEN CIRCUIT VOLTAGE TEST

Table 1.11 String fuse and String Open Circuit Voltage test							
String cable ID						Date of inspection: (dd_mmm_yyyy)	
Description				References (Please state)			
Test point				Each Array Junction Box/String Monitoring Box			
Use appropriate tools to measure and record							
Test the continuity of each string fuse (Please tick ✓)					OK: <input type="checkbox"/>	Not OK: <input type="checkbox"/>	
Determine the following: <ol style="list-style-type: none"> <li>1. Measured Open Circuit Voltage (Voc_mea) of each string.</li> <li>2. Expected Open Circuit Voltage (Voc_exp) of each string.</li> <li>3. % Difference between measured and expected Voc.</li> </ol> <b>ACCEPT</b> if <ul style="list-style-type: none"> <li>• % difference of Voc (between measured Voc and expected Voc) with respect to expected Voc is within <b>±5%</b></li> <li>• Voc measured of each string is less than the maximum input voltage of the inverter</li> <li>• Polarity of all DC cables (string and array) is correct</li> </ul>					Solar irradiance should be at least <b>350 Wm<sup>-2</sup></b> when performing this test.  Instructions: <b>SWITCH OFF / DISCONNECT</b> the following: <ul style="list-style-type: none"> <li>- PV AC Main Switch (isolator)</li> <li>- All AC switches</li> <li>- All DC switches</li> <li>- All DC fuses</li> </ul>		
String No.	Voc of string at STC (V)	Voc measured (V)	Voc expected (V)	Measured module temp (°C)	Measured Irradiance (Wm <sup>-2</sup> )	% difference of Voc	Accept (A) or Reject (R)
1							
2							
3							
4							
5							
...							
...							
Comments:							

## 1.12 STRING DC SHORT CIRCUIT CURRENT TEST

Table 1.12 String DC Short circuit current test												
String Cable ID							Date of inspection: (dd_mmm_yyyy)					
Description				References (Please state)								
Test point				All DC Junction Boxes								
Inverter No												
Use appropriate tools to measure and record												
Using appropriate method, determine the following: <ol style="list-style-type: none"> <li>1. Measured short circuit current (Isc_mea) of each string</li> <li>2. Expected short circuit current (Isc_exp) of each string</li> <li>3. % Difference between measured and expected Isc.</li> </ol> <p><b>ACCEPT</b> if</p> <ul style="list-style-type: none"> <li>• % difference of Isc (between measured Isc_mea and expected Isc_exp) with respect to Isc_exp is within <b>±5%</b></li> </ul> <p>AJB: Array Junction Box SMB: String Monitoring Box</p>							Solar irradiance should be at least <b>350 Wm<sup>-2</sup></b> when performing this test.			Instructions: <b>SWITCH OFF / DISCONNECT</b> the following: <ul style="list-style-type: none"> <li>- PV AC Main Switch (isolator)</li> <li>- All AC switches</li> <li>- All DC switches</li> <li>- All DC fuses</li> </ul>		
No.	AJB/SMB ID No.	No. of strings per AJB/SMB	String no.	Solar irradiance (Wm <sup>-2</sup> )	Measured module temp (°C)	Measured Isc of string (A)	Expected Isc string (A)	% difference of Isc	Accept (A) or Reject (R)			
Comments:												

### 1.13 ISOLATION DEVICE FUNCTIONAL TEST

Table 1.13 Isolation device test				
Description		Date of inspection: (dd_mmm_yyyy)		
Test point		All isolators, switches and fuses		
Use appropriate tools to measure and record				
Please tick ✓ in the appropriate box		Solar irradiance should be at least <b>350 Wm<sup>-2</sup></b> when performing this test.  Instructions: <b>SWITCH OFF / DISCONNECT</b> the following: - PV AC Main Switch (isolator) - All AC switches - All DC switches - All DC fuses		
No.	Description	Accept	Reject	Note
1	Confirm voltage is NOT present at array cable terminal at AJB before all fuses are engaged			
2	Confirm voltage is present at array cable terminal at AJB after all fuses are engaged			
3	Confirm voltage is NOT present at the outgoing terminal of PV DC Main Switch when the switch is in OFF position			
4	Confirm voltage is present at the outgoing terminal of PV DC Main Switch when the switch is in ON position			
5	Confirm voltage is NOT present at the outgoing terminal of AC Switch when the switch is in OFF position			
6	Confirm voltage is present at the outgoing terminal of AC Switch when the switch is in ON position			
7	Confirm voltage is NOT present at the outgoing terminal of PV AC Main Switch when the switch is in OFF position			
8	Confirm voltage is present at the outgoing terminal of PV AC Main Switch when the switch is in ON position			
Comments:				

Signature		
Date		
Name		
Designation	Chargeman/Wireman with SEDA PV certification	SEDA Malaysia GCPV System Design certificate holder

## 2. TESTING AND COMMISSIONING CHECKLIST

This activity shall be conducted by competent persons as stated at the end of the checklist whilst adhering to the provisions of all relevant laws and regulations.

After completion of pre-commissioning checklist and tests, the service provider **must perform commissioning tests** to ensure all inter-connections of the components are satisfactory.

The commissioning test comprises the following:

1. Information about PV module
2. Information about PV array
3. Information about inverter
4. Inverter functional test
5. Acceptance test

Conditions:

1. All tests **must be done in sequence**.
2. If one test in the sequence fails, the next test **shall not be performed**.
3. Failure of any test **nullifies** the entire Testing and Commissioning.

## 2.1 INFORMATION ABOUT PV MODULE

Table 2.1 Information about PV module				
Description		Visual Inspection If the job has been done satisfactorily, please tick ✓ in the box. If not applicable, write 'NA' in the box.	Date of inspection: (dd_mmm_yyyy)	
No.	Item	Details		Check (✓)
1	Module make & model			
2	Power at maximum power point (Pmp_stc)		Wp	
3	Open Circuit Voltage (Voc_stc)		V	
4	Short Circuit Current (Isc_stc)		A	
5	Fill factor at STC		-	
6	Module efficiency at STC		%	
7	Temperature coefficient for Pmp (at STC)		% per deg C	
8	Temperature coefficient for Voc ( at STC)		% per deg C	
9	Temperature coefficient for Isc ( at STC)		% per deg C	
10	Maximum system voltage		V	
11	Maximum reverse current		A	
Comments:				

## 2.2 INFORMATION ABOUT PV ARRAY

Table 2.2 Information about PV array				
Description	If the job has been done satisfactorily, please tick ✓ in the box. If not applicable, write 'NA' in the box.		Date of inspection: (dd_mmm_yyyy)	
Instructions	This form shall be filled-up for each connection to one inverter	Inverter ID:	Sub-array ID:	
No.	Item	Details		Check (✓)
1	No. of modules per string		pcs	
2	Total no. of strings		pcs	
3	Total array power at STC		Wp	
4	PV array inclination		deg	
5	PV array orientation (azimuth angle from South)		deg	
6	No. of strings per Array Junction Box/String Monitoring Box		pcs	
7	No. of Array Junction Box/String Monitoring Box		pcs	
Comments:				

## 2.3 INFORMATION ABOUT INVERTER

Table 2.3 Information about inverter				
Description		If the job has been done satisfactorily, please tick ✓ in the box. If not applicable, write 'NA' in the box.		Date of inspection: (dd_mmm_yyyy)
Instructions		This form shall be filled-up for each connection to one inverter		Inverter ID
No.	Item	Details		Check (✓)
1	Inverter model			
2	Nominal AC power rating		W	
3	Maximum AC power rating		W	
4	Maximum DC voltage		V	
5	DC voltage range		V	
6	MPPT voltage range		V	
7	No. of MPPT trackers		unit	
Comments:				

## 2.4 INVERTER FUNCTIONAL TEST

Table 2.4 Inverter functional test					
Format No				Date of inspection: (dd_mmm_yyyy)	
Description		References			
Test point		All Inverters			
Use appropriate tools to measure and record					
		Please tick ✓ in the appropriate box  Solar irradiance should be at least <b>350 Wm<sup>-2</sup></b> when performing this test.  Instructions: <b>SWITCH ON</b> the system and ensure that the inverter is operating.  <b>CAUTION:</b> Before switching on the inverter, make sure Voc measured at the inverter input terminal must be LESS THAN the maximum allowable input DC voltage of the inverter.			
No.	Description	Value	Accept	Reject	Reasons
1	Check whether the measured DC voltage falls within the allowable MPPT voltage range of the inverter				
2	Check whether the measured grid voltage and frequency are within the acceptable limit				
Comments:					

## 2.5 ACCEPTANCE TEST

Table 2.5 System acceptance test			
Inverter ID		References (please state)	Date of inspection: (dd_mmm_yyyy)
	Determine the following: <ol style="list-style-type: none"> <li>Measured AC output power of inverter, Pac_measured</li> <li>Expected AC output power of inverter, Pac_expected</li> <li>Please declare the following:               <ul style="list-style-type: none"> <li>Tolerance due to module mismatch : _____</li> <li>Soiling index : _____</li> <li>Ageing factor : _____</li> <li>Cable loss : _____</li> <li>Maximum inverter efficiency : _____</li> <li>Shading factor : _____</li> </ul> </li> <li>Acceptance Ratio (AR) : _____</li> </ol> <p>Note: AR is the ratio of Pac_measured to Pac_expected</p> <p><b>ACCEPT</b> if</p> <ul style="list-style-type: none"> <li>AR is greater than or equal to 0.9</li> </ul>		Solar irradiance should be at least <b>350 Wm<sup>-2</sup></b> when performing this test.  Instructions: <b>SWITCH ON</b> the system and ensure that the inverter is operating.

Inv No.	Irradiance (Wm <sup>-2</sup> )	Measured module temp (°C)	Temperature de-rating factor	Pac expected (W)	Pac measured (W)	AR	Accept (A) or Reject (R)
1							
2							
3							
...							
...							
If AR is not acceptable, please troubleshoot the system, rectify the fault and repeat the test until all parties are satisfied.							
Comments:							

Signature			
Date			
Name			
Designation	Wireman with SEDA PV certification	SEDA Malaysia GCPV System Design certificate holder	SEDA Representative

### 3. RELIABILITY RUN TEST

This activity shall be conducted by the competent persons as stated at the end of the checklist whilst adhering to the provisions of all relevant laws and regulations.

Upon successful completion of testing and commissioning, the reliability of the system is tested using:

- A. Performance Ratio (PR) test

Details are as follows:

- A. During the Performance Ratio (PR) test, the following real time parameters must be sampled at a maximum of **five-minute** intervals for **AT LEAST ONE COMPLETE daylight beginning one hour before sunrise and ending at least one hour after sunset**:
  1. Solar irradiance
  2. Ambient temperature
  3. Module temperature
  4. DC voltage of each central inverter or group of string inverters
  5. DC current of each central inverter or group of string inverters
  6. AC voltage from each central inverter or group of string inverters
  7. AC current from each central inverter or group of string inverters

All data shall be submitted to SEDA/SEDA Representative in csv format immediately after the test.

### 3.1 PERFORMANCE RATIO TEST

Table 3.1 Performance Ratio (PR) Test		
<b>Test point</b>	At Monitoring Station / Grid Injection Point	Date of inspection: (dd_mmm_yyyy)
<b>Test duration</b>		
Predicted annual PR at design stage:		
Using the logged data for one day during the reliability test period, determine the following parameters for the entire system:		
<ol style="list-style-type: none"> <li>1. Energy Yield, <math>Y_f</math></li> <li>2. Specific Yield, SY</li> <li>3. Performance Ratio, PR</li> </ol>		
Note:		
<ol style="list-style-type: none"> <li>1. Inverter failure <b>shall NOT occur more than once (1)</b> within the reliability test period of one day (excluding forced outages). If this happens, the test should be repeated.</li> <li>2. If the PR Test is passed the first day, it is <b>not</b> necessary to continue to the second day.</li> </ol>		

Day no.	Energy Yield (kWh)	Specific Yield (kWh kWp-1)	Performance Ratio	Accept (A) or Reject (R)	Remarks
1					
2					
3					
4					
5					
6					
7					
<b>One Week Value</b>					
Comments:					

Signature			
Name			
Date			
Designation	Wireman with SEDA PV certification	SEDA Malaysia GCPV System Design certificate holder	SEDA Representative

End of Document