

Short-Course

Solar PV System Installation and Maintenance

NTQF Level III

Learning Guide -26

Unit of Competence	Monitor PV System Installation and Maintain
Module Title	Monitor PV System Installation and Maintain
LG Code	EIS PIM3 M16 LO2-LG 26
TTLM Code	EIS PIM3 TTLM 0120v1

LO2. Check PV System installation and maintenance Status-26

This learning guide is developed to provide you the necessary information, knowledge, skills and attitude regarding the following content coverage and topics:

- Checking PV system parameter using tools, measuring instruments, and materials
- Accomplishing Installation and maintenance monitoring
- Performing tasks without causing damage to the components

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to:-

- Check PV system parameter using tools, measuring instruments, and materials
- Accomplish Installation and maintenance monitoring
- Perform tasks without causing damage to the components

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below:
3. Read the information written in the information Sheet 1 (page: 41), Sheet 2 (page: 44), Sheet 3 (page: 47)
4. Accomplish the Self-Check 1 (page: 43), Self-Check 2 (page: 46), Self-Check 3 (page: 49)





LO2. Check PV System installation and maintenance Status




Information Sheet 1	Checking PV system parameter using tools, measuring instruments, and materials
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1 Checking PV system parameter using tools, measuring instruments, and materials

The following instruments, tools and material can be used to check PV systems.

Table 1: Measurement Equipment, Tools and Material

Test Equipment	Parameters to measure	Image
Multimeter (the measurement of voltage and amperage as well as resistance)	String Voltages Battery Voltages Ground resistance etc.	
DC Clamp meter for current measurements non-invasive	String currents Battery current Load currents	
PV Analyser to measure open circuit voltages, short circuit currents, IV curves, insulation resistances etc.	Open circuit voltages Short Circuit currents IR curves Irradiation Insulation resistance	
Hydrometer to measure Lead Acid battery acid levels. Testing for the specific gravity of electrolyte in the battery is an accurate way to measure and compare the state of charge of each individual cell.	Battery specific gravity See EIS PIM3 M15 LO2 Information Sheet 7	

Test Equipment	Parameters to measure	Image
Thermal imager to find bad connections and problems on PV modules	'Hot' connections, Problems on PV modules See EIS PIM3 M15 LO2 Information Sheet 7	
Camera to take photos of conditions on site for record purposes. A camera on the phone can also be used		
Smartphone can be used to take photos, to send information to the installer and even as inclinometer and compass with the correct application		
Monitoring Checklist or protocols to monitor: <ul style="list-style-type: none"> - PV Modules - Batteries - Charge Controller - Inverter - General system 		

Self-Check - 1	Written Test
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Instruction: Follow the below selected instruction

The following are true or false items, write true if the statement is true and write false if the statement is false.

N°	Questions and answers
1	A multimeter can be used to measure battery acid levels
	True or false:
2	A Thermal imager can find bad connections and problems on PV modules
	True or false:

Note: the satisfactory rating is as followed

Satisfactory	2 points
Unsatisfactory	Below 2 points

Answer Sheet

Score = _____

Rating: _____

Name

Date

Information Sheet 2	Accomplishing Installation and maintenance monitoring
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2 Accomplishing Installation and maintenance monitoring

2.1 Introduction

Monitoring and maintenance of the PV installation should follow a schedule and be performed according to specific protocols and checklists or forms and with the appropriate PPE and safety considerations (see LO1).

2.2 Where to measure and monitor

Figure 15 show some typical measure and monitor points for an off-grid PV system with charge controller, batteries and off-grid inverter. In certain instances, hybrid systems may be used where the inverter and charge controller is combined into one unit. The principles still stay the same however.

2.2.1 Measuring voltage

Voltage is normally measured using a multimeter. The following are important considerations:

- Make sure that the multimeter battery is not depleted – check for low battery indicator;
- Make sure that the correct type of voltage is selected on the multimeter e.g. DC or AC;
- Make sure that the multimeter scale is correct for the expected voltage
- Use the appropriate PPE when doing measurements e.g. gloves and protective eyewear;
- Make sure that the 'peak hold' function is not activated as it may hold a previous measurement;
- Make sure not to cause short circuits between positive and negative terminals and do not touch live wires.

2.2.2 Measuring Current

Measuring current is normally done using a clamp meter. The following are important considerations:

- Make sure that the meter battery is not depleted – check for low battery indicator;
- Make sure that the correct type of current is selected on the meter e.g. DC or AC;
- Use the appropriate PPE when doing measurements e.g. gloves and protective eyewear;
- The clamp must go over ONE of the wires (not both);
- Make sure not to cause short circuits between positive and negative terminals and do not touch live wires.

2.2.3 Measure battery Specific Gravity

See LO1 information sheet 2 for the correct procedure

2.2.4 Install measurements

The use of a PV analyser is not normal for routine monitoring and maintenance by the owner of the system. It will normally be used by qualified technicians as it involves disconnecting the strings.

Thermal image analysis also requires proper analysis by qualified personnel and is not normally done by the owner of the system.

In general, any measurements that require the disconnection of wires needs to be done by the installer of the system and not the owner.

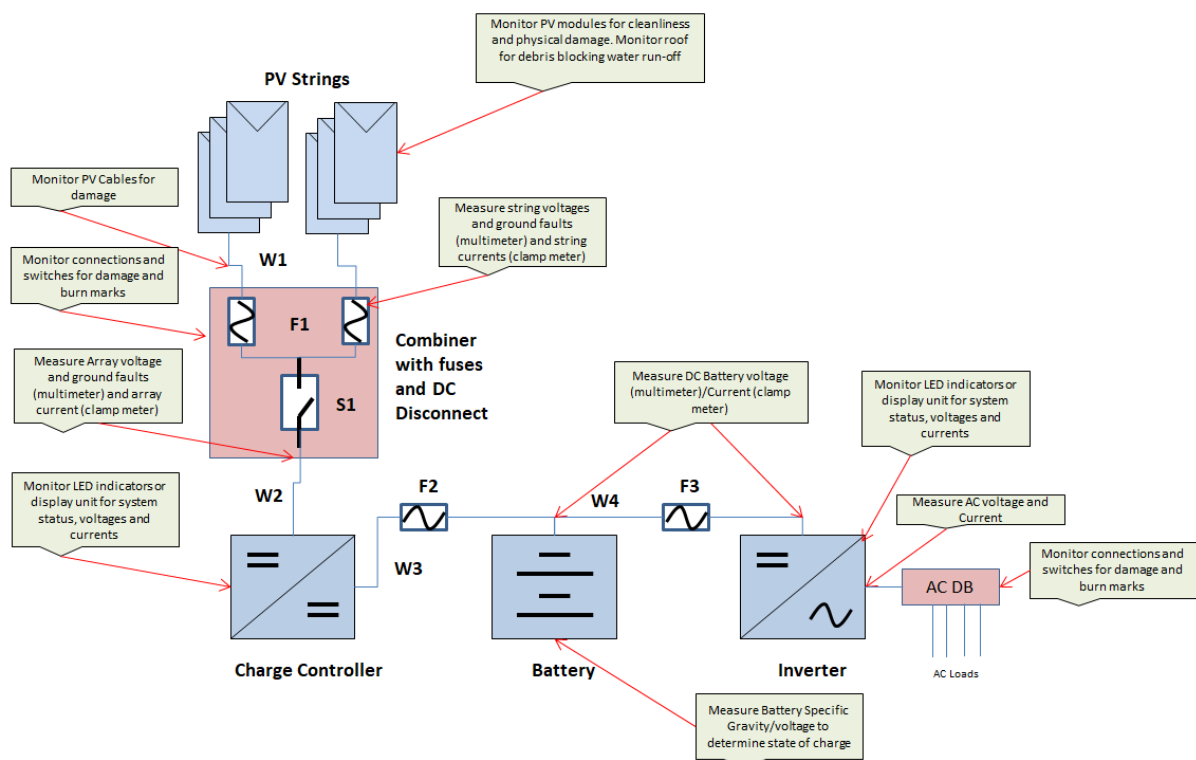


Figure 1: Typical measuring and monitoring points

Self-Check - 2	Written Test
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Instruction: Follow the below selected instruction

Answer all the questions listed below

N°	Questions and answers
1	Name 4 considerations when using a multimeter to measure voltage

Note: the satisfactory rating is as followed

Satisfactory	3 points
Unsatisfactory	Below 3 points

Answer Sheet

Score = _____

Rating: _____

Name

Date

Information Sheet 3

Performing tasks without causing damage to the components

3 Performing tasks without causing damage to the components

It is important to prevent breaking a working system when doing routine maintenance and monitoring. As a general rule no cables should be disconnected when doing measurements, no cables should be changed, proper isolation procedures should be followed and short circuits should be avoided.

To prevent causing damage to the installations, always use:

- The correct tools for the job;
- The correct handling of the equipment;
- The correct procedure as per manufacturer's specifications;
- The correct safety equipment;

3.1 Cleaning PV modules

PV Modules are particularly prone to damage caused by bad handling. Micro cracks in solar cells are a genuine problem for PV modules because they cause weaker performance. When cleaning modules, no one should step onto the modules.

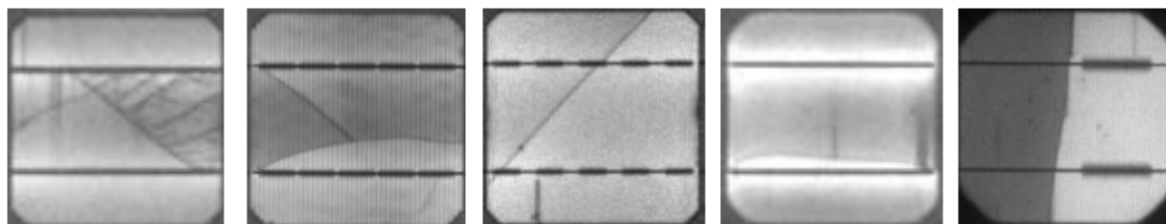


Figure 2: Micro cracks

The following precautions should be taken:

- Wear gloves when handling modules.
- Do not put objects on the modules.
- Do not walk on modules.
- Do not use chemicals to clean modules unless approved by the manufacturer.
- Do not spray cold water on the modules when they are hot. Try to clean modules in the early morning before they get too hot.
- Avoid high-pressure cleaners.
- Do not dry-clean modules;
- Do not use abrasive materials.



Figure 3: Do not walk on modules

3.2 Batteries

Lead-acid batteries produce hydrogen which is flammable in the presence of oxygen. Never smoke close to batteries as it can cause an explosion.

Proper safety precautions must be taken whenever you are near your battery bank. Use thick gloves and protective eyewear and remove all metal items. A metal object dropped onto battery terminals can cause serious harm to the battery and the inspector.

Do not tip lead acid batteries as the leaking acid can cause serious harm.

3.3 Roof

Preventative maintenance and monitoring may involve getting on the roof to inspect the PV system. Care must be taken not to damage the roof in the process – causing water leaks. Some roof types are prone to damage e.g. slate tiles, thin metal roofs and clay roofs. There should be proper instructions on how and where to walk on the roofs (e.g. walking where the roof is supported instead of stepping in the middle of tiles) to prevent damage.

Self-Check - 3	Written Test
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Instruction: Follow the below selected instruction

Answer all the questions listed below

N°	Questions and answers
1	Name 4 considerations when using a multimeter to measure voltage

Note: the satisfactory rating is as followed

Satisfactory	4 points
Unsatisfactory	Below 3 points

Answer Sheet

Score = _____
Rating: _____

Name

Date