



REGISTERED NATIONAL STANDARD

UNIT OF COMPETENCY

Title:	Understand electronics fundamentals ¹				
TQF Level:	4	Credits:	6	Version:	1
National standard code:	NS119-04				
Associated qualification (and code):	National Certificate in Sustainable Energy (Solar) Level 4				
Approval date:	10 th June 2026	Review date:	10 th June 2031		
Purpose:	<p>This unit standard involves imparting knowledge on electronic fundamentals, in particular:</p> <ul style="list-style-type: none"> • Understanding internal electronic components of inverter/solar controllers • Demonstrate <i>direct current</i> (DC) cable and <i>communication</i> (COMMs) cable termination skills • Demonstrate diodes and rectifier circuits • Explain microprocessor fundamentals and chips used 				

¹ Note, due to safety issues inherent in working with electricity, all training and assessment activities must be in accordance with local industry and regulatory requirements.

Learning Outcome 1 (LO1)	Develop knowledge on power conversion equipment
Performance Standards	<p>1.1 Explain internal circuitry of common types of inverters/solar controllers used in solar systems;</p> <p>1.2 Explain power semiconductors (MOSFETs/IGBTs) for switching, transformers for voltage adjustment, and inductors/capacitors for filtering;</p> <p>1.3 Demonstrate inverter comms port and cables used;</p> <p>1.4 State common inverter/solar controller component failure and rectification.</p>
Learning Outcome 2 (LO2)	Develop knowledge on power rectifiers
Performance Standards	<p>2.1 Explore different types of rectifiers;</p> <p>2.2 Understand the different types of diodes used in rectifiers; <i>(Range include but not restricted to schottky diodes (low voltage drop, high speed), Fast Recovery Diodes (FRDs) for high-frequency rectification, and Ultra-Fast Recovery Diodes.)</i></p> <p>2.3 Demonstrate by-pass and blocking diodes used for solar applications;</p> <p>2.4 Describe single and three-phase single way bridge rectifiers. Show input and Output waveforms.</p>
Learning Outcome 3 (LO3)	Understand <i>direct current</i> (DC) cables and <i>communication</i> (COMMs)
Performance standards	<p>3.1 Outline dc cable voltage ratings, material used, insulation and sheathing;</p> <p>3.2 Demonstrate cables used for solar dc wiring and battery wiring;</p> <p>3.3 Practice crimping of dc cables with connectors;</p> <p>3.4 Practice lugging of battery cables;</p> <p>3.5 Practice identification and termination of COMMs cable such as RS 485 and Ethernet.</p>
Learning Outcome 4 (LO4)	Introduce fundamentals of microprocessors
Performance standards	<p>4.1 Identify the microprocessors components;</p> <p>4.2 Develop knowledge and skills of microprocessor system within a solar inverter; <i>(Range include but not restricted to how the memory section works, how to program the microprocessor and how input and output devices are connected.)</i></p> <p>4.3 Identify range of microprocessor support chips commonly found in electronic equipment including inverters;</p> <p>4.4 Demonstrate replacement techniques.</p>

Pre-requisites	N/A
Co-requisites	N/A
Underpinning skill and knowledge	<p>The following knowledge and skills underpin this unit standard:</p> <p>Knowledge:</p> <ol style="list-style-type: none"> 1. Basic knowledge of dc systems 2. Basic knowledge of semi-conductor devices <p>Skills</p> <ol style="list-style-type: none"> 3. Safe working principles and equipment handling skills 4. Basic electronic skills 5. Basic fault-finding skills
Assessment requirements	<p><u>Methods of assessment:</u></p> <p>A range of assessment methods should be used to assess students' knowledge and application of skills. These shall include but not restricted to the following:</p> <ol style="list-style-type: none"> a) Direct observation of students performing certain tasks stated under context of assessment; b) Oral questions to test relevant skills and knowledge during observation (e.g., Interviews) c) Written assessment such as tutorial exercises on important topics. d) Practical assessment: <p>Assessment of skills to identify electronic components, rectify, terminate solar dc cables and battery cables, demonstrate diode use and rectifier circuits, identify microprocessor chips, etc.</p> <p><i>The student needs to be competent in the practical assessment.</i></p>
Moderation arrangements	<ol style="list-style-type: none"> 1. Training providers must have their own moderation system approved by TNQAB before accreditation is granted: <ol style="list-style-type: none"> a) Relevant internal moderation processes are documented; b) Assessment is planned for each unit, and moderation processes are integrated into such plan 2. External moderation is conducted by the National Qualifications unit of TNQAB for all unit components of national qualifications: <ol style="list-style-type: none"> a) Samples of assessed activities are submitted for moderation;

	<p>b) Moderation (external) forms are available on request from the National Qualifications unit of TNQAB.</p>
<p>Resource requirements</p>	<ol style="list-style-type: none"> 1. Access to inverter/solar controller electronic components, DC cables, COMMs cable and termination tools, microprocessor chips and accessories, etc. 2. Worker’s tools <ul style="list-style-type: none"> • Insulated screw-drivers • Insulated pliers • Soldering iron • Termination tools • Crimping tool 3. Testing equipment <ul style="list-style-type: none"> • Digital multimeter • Clamp meter 4. Personal Protection Equipment <ul style="list-style-type: none"> • Safety shoes • Safety glasses <p>Recommended textbook:</p> <ol style="list-style-type: none"> i. Timothy L. Skvarenina, Purdue University, The Power Electronics Handbook or any locally available text book on power electronics suited for electricians. ii. Australia and New Zealand standards: AS/NZS 3000
<p>Requirements to complete this unit</p>	<p>To demonstrate competence, the person studying this unit is:</p> <ol style="list-style-type: none"> 1. Required to demonstrate all LOs to the expected standards of performance; 2. Required to attain an Achieved Grade (Competent) to fulfil the requirements of the Unit Standard. The person is required to be competent in the practical assessment to attain a pass grade in this unit. 3. Eligible to three (3) attempts in the practical assessment to achieve the required competency within 14 days of the first attempt. <p>Failure to achieve the required competency level after three (3) attempts of the specific part of the assessment will require the person studying this Unit to re-enrol for the same Unit.</p>

Important notes and definitions

Notes:

1. All activities associated with this unit standard must comply with the requirements of national codes of practice, regulations and legislation for workplace health, safety, and environmental protection and any subsequent amendments.
2. Assessors must comply with Tonga national assessment and moderation requirements.
3. The delivery of all units of competencies must be in sequential order and ensure that the pre-requisites requirements are met.

Definitions:

1. **COMM** (*short for communication*) refers to the data connections and protocols that allow electrical devices to transmit and receive information. It is the backbone of modern power systems, connecting equipment so it can be monitored, controlled, and automated in real time.
2. **DC cables** (*Direct Current cables*) specialized electrical wires designed to carry a constant, unidirectional flow of electricity. They maintain steady polarity without changing direction, making them highly efficient for systems that store energy, run on electronics, or rely on clean energy generation.
3. **Diode** is an electronic component that acts as one-way valve for electric current. It allows electricity to flow easily in one direction but blocks it from flowing in reverse.
4. **Fast recovery diode (FRD)** is a specialized semiconductor that allows current to flow in one direction but is designed to switch off almost instantly. It minimizes energy loss and overheating in high-frequency circuits by drastically reducing the time it takes to stop reverse current flow.
5. **IGBT (Insulated Gate Bipolar Transistor)** is a specialized electronic semiconductor device used primarily as a fast, highly efficient switch. It functions like a heavy-duty dimmer switch for electricity, turning on and off thousands of times per second to control or convert electrical power.
6. **Microprocessor** is the 'brain' of a modern electrical device. It is a tiny computer chip that controls the flow of electricity, gathers data, and makes automated decisions.
7. **MOSFET (Metal-Oxide-Semiconductor Field-Effect Transistor)** is an electronic component that acts as a

	<p>precise switch or amplifier. It controls the flow of electricity.</p> <p>8. <i>Rectifier</i> is an electrical device that converts Alternating Current (AC) into Direct Current (DC). It works like a one-way valve, allowing electrical current to flow in only one direction.</p> <p>9. <i>Schottky diode</i> is a specialized electronic component that allows current to flow in only one direction.</p> <p>10. <i>Ultra-fast recovery diode</i> is a semiconductor that stops conducting current in reverse much faster than standard diodes.</p>
<p>Public comments on unit</p>	<p>Please contact TNQAB National Qualifications Unit (email EnquireNQ@tnqab.to or Telephone 28136) if you like to discuss or suggest changes to the details of this unit.</p>