



# **Technical requirements for connection of small capacity distributed generation via inverters to Vector's network**

## **Standard ENS4009**

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## I. DOCUMENT CONTROL

<b>Document Author</b>	Rob Charlton	Principal Protection Engineer
<b>Document Owner</b>	John Welch	Manager of Planning
<b>Approved By:</b>	Cristiano Marantes	Head of Engineering
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Approved Versions	Date	Revision Notes
1.0	13 May 2013	Initial publication
2.0	10 November 2014	Alignment of configuration settings to EN50438 and inclusion of three phase inverters to 30kW
3.0	14 October 2016	Alignment with AS/NZS 4777.1 2015, introduction of 5kW limit for single phase connection

## II. ROLES AND RESPONSIBILITIES

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Document Contributors	<ul style="list-style-type: none"> <li>People responsible for content/sections within a controlled document</li> </ul>
Reviewed By:	<ul style="list-style-type: none"> <li>Validating accurate and complete content</li> </ul>

### III. RELATED DOCUMENTS

External Document No.	Document Title (Title & Description)
Electricity (Safety) Regulations	Electricity (Safety) Regulations 2010 <a href="http://www.legislation.govt.nz/regulation/public/2010/0036/latest/DLM27_63501.html?src=qs">http://www.legislation.govt.nz/regulation/public/2010/0036/latest/DLM27_63501.html?src=qs</a>
AS 4777.1:2005	Grid connection of energy systems via inverters Part 1: Installation requirements
AS/NZS 4777.1:2016	Grid connection of energy systems via inverters Part 1: Installation requirements
AS/NZS 4777.2:2015	Grid connection of energy systems via inverters Part 2: Inverter requirements
EN 50438:2013	Requirements for micro-generating plants to be connected in parallel with public low-voltage distribution networks <sup>1</sup>
EEA PQ – 2013 rev 3.8	EEA (NZ) Power Quality Guidelines <a href="http://www.eea.co.nz/Attachment?Action=View&amp;Attachment_id=1280">http://www.eea.co.nz/Attachment?Action=View&amp;Attachment_id=1280</a>
AS/NZS 3000:2007	New Zealand Wiring Rules
Electricity Industry Participation Code	Electricity Industry Participation Code (2010) – Part 6 Connection of Distributed Generation <a href="http://www.ea.govt.nz/code-and-compliance/the-code/">http://www.ea.govt.nz/code-and-compliance/the-code/</a>

<sup>1</sup> Vector envisages imported inverters pre-set to the default settings specified in EN 50438 will be easier for prospective DG applicants to comply with Vector's protection settings.

#### IV. DOCUMENT METADATA

<b>Document Security Level</b>	<p>Public Domain</p> <p>Information that is publicly available and is not sensitive and does not need to be labelled.</p>
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<b>Purpose</b>	<p><input checked="" type="checkbox"/> Planning</p> <p><input type="checkbox"/> Engineering Design</p> <p><input type="checkbox"/> Maintenance</p> <p><input checked="" type="checkbox"/> Operation</p> <p><input type="checkbox"/> Retirement/Disposal</p> <p><input checked="" type="checkbox"/> Information</p>

## 1. INTRODUCTION

### 1.1 Purpose

The purpose of this standard is to describe the technical requirements for the connection of small scale generation using single or three phase inverters to Vectors network. Application of these devices will typically be used to connect solar, batteries or wind generation within residential dwellings.

### 1.2 Scope

The scope of this standard includes:

- a) Vector's technical requirements for small scale distributed generation by inverters of 5kW<sup>(2)</sup> or less connected to a Vector's 230V single phase supply, or 30kW or less, balanced across three phases connected to Vector's 400V three phase supply.

The following is excluded from the scope of this standard:

- b) The connection of inverters with capacities greater than 30kW three phase, or the connection of single phase inverters with capacities in excess of 5kW, to the single phase network.

## 2. HEALTH, SAFETY AND ENVIRONMENT

The use of inverters having connections to Vectors network pose a potential safety risk.

The potential for the inverter to export electricity onto the network either under normal operation or abnormal (e.g. fault) conditions, creates a potential risk to other connected customers or personnel working onto the network.

Within this standard we have adopted the use of New Zealand standards and regulations to ensure consistency of application. The area where we deviate from the standards is the adoption of protection configuration settings that are either required to meet New Zealand operating conditions (voltage and frequency) or are necessary for compatibility with Vectors network. Changes have been kept to a minimum in the interests of standardisation and to ensure ease of implementation.

It is important the technical requirements specified in this standard are implemented to ensure the safe operation of the inverter equipment, safety of other appliances connected to the network and the safety of personnel.

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<sup>(2)</sup> The maximum permissible phase imbalance for both single and three phase inverter installations is 21.7A (ref AS/NZS 4777.1 2016 sec 3.4.4.2) or 5kW. While AS4777.1 2005 specifies 10kVA as the upper limit for single phase inverters, inverters with outputs in excess of 5kW must only be used as part of a balanced three phase installation.

### 3. STATUS OF STANDARDS

#### 3.1 AS/NZS standards

New standards are in the process of being updated reflecting the New Zealand-only configuration settings applicable for the New Zealand environment. To facilitate the transition to these newer standards, Vector will continue to accept inverters configured in accordance AS 4777.1:2005, subject to the specific voltage and frequency requirements outlined in Section 4, until AS/NZS 4777.1:2016 and AS/NZS 4777.2:2015 are gazetted.

##### 3.1.1 AS 4777.1:2005 – Grid connection of energy systems via inverters - Part 1: Installation requirements

AS 4777.1:2005 "Grid connection of energy systems via inverters – Part 1: Installation requirements" has been gazetted under the Electricity (Safety) Regulations and compliance is mandatory. However as an Australian standard there are features that are incompatible with the New Zealand power supply environment. The New Zealand requirements are highlighted in this technical standard.

##### 3.1.2 AS/NZS 4777.2:2015 – Grid connection of energy systems via inverters - Part 2: Installation requirements

Under the Electricity Industry Act 2010, the Electricity Authority has amended the Electricity Industry Participation Code (EPIC) to adopt AS/NZS 4777.2:2015 "Grid connection of energy systems via inverters – Part 2: Inverter requirements" as of 20 October 2016<sup>3</sup>. This standard has still to be gazetted under the Electricity (Safety) Regulations but compliance with this standard will meet Vectors requirements.

##### 3.1.3 AS/NZS 4777.1:2016 – Grid connection of energy systems via inverters - Part 1: Installation requirements

A revised AS/NZS 4777.1:2016 "Grid connection of energy systems via inverters – Part 1: Installation requirements" was published on the 30 September 2016 and is expected to supersede AS 4777.1:2005<sup>4</sup>. This standard specifies the New Zealand and Australian voltage and frequency differences, and compliance with the New Zealand requirements of this standard will meet Vector's requirements.

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<sup>3</sup> <https://www.ea.govt.nz/dmsdocument/21271>

<sup>4</sup> A new AS/NZS 4777.1: 2016 "Grid connection of energy systems via inverters – installation requirements" has a six months transition period from the date of publication.

## 4. VOLTAGE AND FREQUENCY SETTINGS

To ensure compatibility with Vectors network, voltage and frequency protection settings each inverter will comply with one of the following three requirements:

### 4.1 AS 4777.1:2005

Inverters configured to AS 4777.1:2005 must comply with the frequency and voltage settings in Table 1:

Single stage inverters	Maximum acceptable disconnection (trip) time in seconds	Minimum acceptable setting	Maximum acceptable setting
Over-voltage <sup>5</sup>	0.5s		253V
Under-voltage	2s	180V	
Over-Frequency (> 50 Hz)	2s		52Hz
Under-Frequency (< 50 Hz)	2s	45Hz	47.5Hz
Two stage inverters	Maximum acceptable disconnection (trip) time in seconds	Minimum acceptable setting	Maximum acceptable setting
Over-voltage Stage 1	3 s	-	253V
Over-voltage Stage 2	0.2 s	-	265V
Under-voltage (< 230 V)	2 s	180V	-
Over-Frequency (> 50 Hz)	2 s	52Hz	-
Under-Frequency (< 50 Hz)	2 s	47Hz	47.5Hz

Table 1: New Zealand-only settings for single and two stage inverters

### 4.2 European Standard EN50438

Vector envisages imported inverters pre-set to the default settings specified in EN 50438 will be easier for prospective distributed generation applicants to comply with Vector’s protection settings. Inverters configured to European standard EN 50438 will be accepted on Vectors network.

### 4.3 AS/NZS 4777.2:2015

Inverters configured to the New Zealand settings in accordance with AS/NZS 4777.2 2015 will be accepted on Vectors network. Inverters configured to Australia-only settings are unacceptable.

<sup>5</sup> The over-voltage stage 1 setting can be based on either a 10 minute moving-average voltage reading as per ENS 50438 standard or exceeding the setting range up to the maximum acceptable disconnection time.



## **5. INSTALLATION, TESTING, COMMISSIONING AND MAINTENANCE**

The owner must ensure that the inverter is installed by a registered electrician in accordance with AS/NZS 3000. On completion of the installation Vector requires a copy of the Certificate of Compliance (COC) referencing installation of the inverter in accordance with AS 4777.1, and provide documented confirmation of the New Zealand-only settings (voltage and frequency) by way of a schedule or screen-shot of the relevant configuration settings.

If the inverter is subsequently replaced, or alterations are made to the inverter installation, an updated Certificate of Compliance and settings schedule (or screen-shot verifying the correct settings have been installed) must be forwarded to Vector. The replacement inverter must meet Vector's technical standards applicable at the time of replacement.

The owner must ensure that each inverter is functional at all times and kept in good working order. If the inverter malfunctions, it must immediately be disconnected from Vector's network until it has been checked and tested by a suitably qualified person.