AS4777-15 Standard Explanation

Executive Summary:

This document is prepared for Solis inverters using in some cases where a custom voltage response setting is required in Australia to meet local DNSP requirements.

The grid standard "AS4777-15" is prepared based on AS/NZS 4777.2:2015 and several advanced voltage response modes are also supported.
- Volt-Watt
- Volt-Var

Detailed instructions please see below sections

1.   Voltage/Frequency Protection

Setting Path:
Advanced Settings -> Select Standard -> AS4777-15

After entering the standard, several voltage/frequency protection limits are defined as below:

Parameter	Protection Limits	Comments (According to Clause 7.4, Table 13)
OV-G-V1	260	Overvoltage 1 (V>)
OVGV1-T	1.5S	(V>)Disconnection Time
OV-G-V2	265	Overvoltage 1 (V>>)
OVGV2-T	0.1S	(V>>)Disconnection Time
UN-G-V1	180	Undervoltage (V<) (V<)Disconnection Time
UNGV1-T	1.5S	
UN-G-V2	180	
UNGV2-T	1.5S	
OV-G-F1	52Hz	Over-frequency (F>) (F>)Disconnection Time
OVGF1-T	0.1S	
OV-G-F2	52Hz	
OVGF2-T	0.1S	
UN-G-F1	47Hz	Under-frequency (F<) (F<)Disconnection Time
UNGF1-T	1.5S	
UN-G-F2	47Hz	
UNGF2-T	1.5S	

2.   Sustained Overvoltage Protection

Setting Path:
Advanced Settings -> STD.Mode Settings-> 10mins Voltage Set

This setting is based on the Clause 7.5.2 of AS/NZS 4777.2:2015.
Sustained Overvoltage Protection:
Default 255V (Adjustable between 244V-258V)
Sustained Overvoltage Protection Delay:
Default 3s (Fixed, not shown on LCD)

3.   Sustained Over/Under frequency Protection

Setting Path:
Advanced Settings -> STD.Mode Settings -> Freq Derate Set

This setting is based on the Clause 7.5.3 of AS/NZS 4777.2:2015.

OverFrequency Protection (Applicable for Grid-tied Inverters):
F_Stop default 52Hz   (Adjustable between 51Hz- 52Hz)
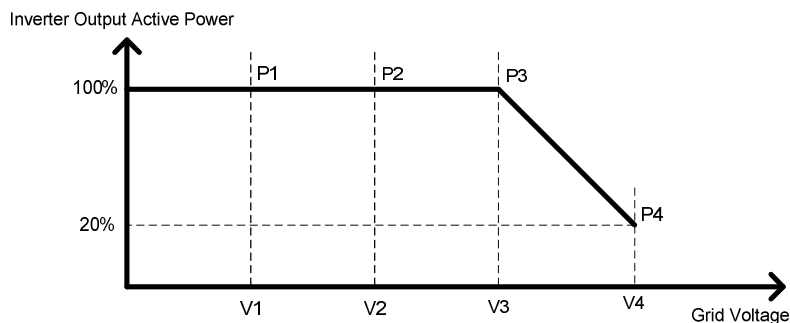**UnderFrequency Protection(Applicable for Battery Inverters)**
F_Stop_CH default 49Hz   (Adjustable between 47Hz-49Hz)

4.   Voltage Response Modes

Setting Path:
Advanced Setting -> STD.Mode Settings –> Working Mode Set

Mode 1: Volt-Watt

Description:
Inverter will change the active output power based on the grid voltage. P(U)
The settings are based on Clause 6.3.2.2 of AS/NZS 4777.2:2015

Voltage 1: 207V (Fixed)
P-Limit 1: 100% (Fixed)
Voltage 2: 220V (Adjustable between 216V-230V)
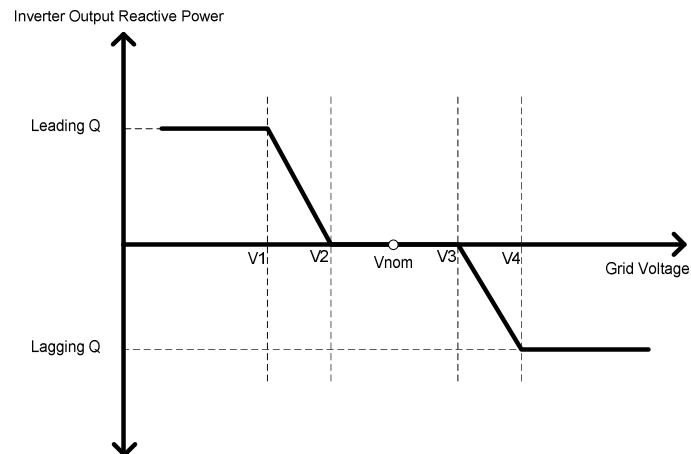P-Limit 2: 100% (Fixed)
Voltage 3: 250V (Adjustable between 235V-255V)
P-Limit 3: 100% (Fixed)
Voltage 4: 265V (Adjustable between 244V-265V)
P-Limit 4: 20% (Fixed)

Mode 2: Volt-var

Description:

Inverter will change the reactive output power based on the grid voltage. Q(U)
The settings are based on Clause 6.3.2.3 of AS/NZS 4777.2:2015

Voltage 1: 207V (Fixed)
Voltage 2: 220V (Adjustable between 216V-230V)
Voltage 3: 250V (Adjustable between 235V-255V)
Voltage 4: 265V (Adjustable between 244V-265V)
Leading: +30% (0%~+60%)
Lagging: -30% (-60%~0%)

Appendix

Different requirements of local DNSPs
(Please refer to DNSP official documents for the latest)
Table 1 – Progress with DNSP grid connection rules re Volt-Watt and Volt-var capability

State	DNSP	Grid connection rules with respect to Volt-Watt and Volt-var	Comments
Victoria	Ausnet Services	V-W and V-var capability are mandatory for grid connection in Victoria	Refer to tables 2a, 2b and 2c for details of the required settings
	Jemena		
	Citipower		
	Powercor		
	United Energy		
Queensland	Energex	V-W and V-var capability are mandatory for grid connection in Queensland	Refer to tables 3a, 3b and 3c for details of the required settings
	Ergon Energy		
South Australia	SA Power Networks	V-W and V-var capability are mandatory for grid connection in SA	Refer to tables 4a, 4b and 4c for details of the required settings
New South Wales	Ausgrid	V-W and V-var capability are mandatory for grid connection on the Ausgrid, Endeavour Energy and Essential Energy networks	Refer to tables 5a, 5b and 5c for details of the required settings
	Endeavour Energy		Refer to tables 6a, 6b and 6c for details of the required settings
	Essential Energy		Refer to tables 3a, 3b and 3c for details of the required settings
Western Australia	Horizon Power	V-W and V-var capability are mandatory for grid connection in Western Australia	Refer to tables 7a, 7b and 7c for details of the required settings
	Western Power		Refer to tables 8a, 8b and 8c for details of the required settings
Australian Capital Territory	Evoenergy	V-W and V-var capability are mandatory for grid connection in the ACT.	Refer to tables 9a, 9b and 9c for details of the required settings Final draft of guidelines is being reviewed by local regulatory bodies.
Northern Territory	NT Power and Water	V-W and V-var capability are not required.	Confirmed 8 Nov 2019 that they plan to review grid connection rules in the near future.
Tasmania	TasNetworks	V-W and V-var capability are not required. Plans to update grid connection rules in mid-2020.	Awaiting update on plans and timeline for review of connection rules.

Tables 2a to 2c – Mandatory settings for Victorian DNSPs

Table 2a: Mandatory volt-var response mode settings

Reference	Voltage (V)	Var (% rated VA)
V1	208	44% leading (exporting vars)
V2	220 (default)	0%
V3	241	0%
V4	253	44% lagging (sinking vars)

Table 2b: Mandatory volt-watt response mode settings

Reference	Voltage (V)	Power (% rated Power)
V1	207 (default)	100% (default)
V2	220 (default)	100% (default)
V3	253	100% (default)
V4	259	20% (default)

Table 2c: Sustained operation for voltage variation

Reference	Voltage (V)
V nom-max	258

Tables 3a to 3c – Mandatory settings for Queensland DNSPs and Essential Energy (NSW)

Table 3a: Mandatory volt-var response mode settings

Reference	Voltage (V)	Var % rated VA	Power factor
V1	207	44%	0.9 leading
V2	220	0%	1
V3	240	0%	1
V4	258	60%	0.8 lagging

Table 3b: Mandatory volt-watt response mode settings

Reference	Voltage (V)	Max value (P/Prated), %
V1	207	100%
V2	220	100%
V3	253	100%
V4	260	20%

Table 3c: Sustained operation for voltage variation

Reference	Voltage (V)
V nom-max	258

Tables 4a to 4c – Mandatory settings for SA Power Networks

Table 4a: Mandatory volt-var response mode settings

Reference	Voltage (V)	Var % rated VA
V1	207 (default)	31% leading (sourcing vars, 2.4% per Volt)
V2	220 (default)	0%
V3	248	0%
V4	253	44% lagging (sinking vars, 8.8% per volt)

Table 4b: Mandatory volt-watt response mode settings

Reference	Voltage (V)	Var % rated VA
V1	207 (default)	100% (default)
V2	220 (default)	100% (default)
V3	250 (default)	100% (default)
V4	265 (default)	20% (default, 5.3% per volt)

Table 4c: Sustained operation for voltage variation

Reference	Voltage (V)
V nom-max	258

Tables 5a to 5c – Mandatory settings for the Ausgrid network

Table 5a: Mandatory volt-var response mode settings

Reference	Voltage (V)	Var % rated VA	Power factor
V1	207	60% leading	0.8 leading
V2	220	0%	1
V3	248	0%	1
V4	258	60% lagging	0.8 lagging

Table 5b: Mandatory volt-watt response mode settings

Reference	Voltage (V)	Max value (P/Prated), %
V1	207	100%
V2	220	100%
V3	248	100%
V4	258	20%

Table 5c: Sustained operation for voltage variation

Reference	Voltage (V)
V nom-max	258

Tables 6a to 6c – Mandatory settings for the Endeavour Energy network

Table 6a: Mandatory volt-var response mode settings

Reference	Voltage (V)	Var % rated VA
V1	207	60% export
V2	220	0%
V3	248	0%
V4	260	60% import

Table 6b: Mandatory volt-watt response mode settings

Reference	Voltage (V)	Var % rated VA
V1	207	100%
V2	220	100%
V3	255	100%
V4	265	20%

Table 6c: Sustained operation for voltage variation

Reference	Voltage (V)
V nom-max	258

Tables 7a to 7c – Mandatory settings for the Horizon Power network

Table 7a: Mandatory volt-var response mode settings

Reference	Voltage (V)	Var % rated VA
V1	207	60% leading
V2	230	0%
V3	240	0%
V4	265	60% lagging

Table 7b: Mandatory volt-watt response mode settings

Reference	Voltage (V)	Var % rated VA
V1	207	100%
V2	220	100%
V3	254	100%
V4	265	20%

Table 7c: Sustained operation for voltage variation

Reference	Voltage (V)
V nom-max	258

Tables 8a to 8c – Mandatory settings for the Western Power network

Table 8a: Mandatory volt-var response mode settings

Reference	Voltage (V)	Var % rated VA
V1	205	30% (vars source)
V2	220	0%
V3	235	0%
V4	250	30% (vars sink)

Table 8b: Mandatory volt-watt response mode settings

Reference	Voltage (V)	Var % rated VA
V1	207	100%
V2	220	100%
V3	250	100%
V4	265	20%

Table 8c: Sustained operation for voltage variation

Reference	Voltage (V)
V nom-max	258

Tables 9a to 9c – Mandatory settings for the Evoenergy network

Table 9a: Mandatory volt-var response mode settings

Reference	Voltage (V)	Var % rated VA
V1	207	30% leading
V2	220	0%
V3	250	0%
V4	258	30% lagging

Table 9b: Mandatory volt-watt response mode settings

Reference	Voltage (V)	Var % rated VA
V1	207	100%
V2	220	100%
V3	250	100%
V4	258	20%

Table 9c: Sustained operation for voltage variation

Reference	Voltage (V)
V nom-max	258