



# GUIDE TO POWER QUALITY MODE SETTINGS

Delta Electronics Australia

Author: Ryan McKercher  
[Ryan.mckercher@deltaww.com](mailto:Ryan.mckercher@deltaww.com)

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## Document History

Revision	Note	Written	Checked	Date
P1	Preliminary	RM	--	9/02/19
P2	Volt-watt mode & AU_WP Grid code added	RM	--	16/08/19
P3	VIC quick start guide added	RM	--	6/12/2019

## Purpose

The purpose of this document is to provide a guide to installer on how to program the Delta RPI series inverters with the power quality response modes shown in AS4777.2 2014. These modes include,

- Volt-Watt Response Mode
- Volt-Var response Mode
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There is also a section to show the installer how to program the inverter with preconfigured settings to meet DNSP requirements. Note that this document does not guarantee compliance and the installer should check each setting against requirements of the grid connection agreement for each individual installation.

## Introduction

Solar PV inverters are an uncontrolled energy source and will produce an amount of power which is dependant on the amount of sunlight available, this can cause a destabilizing effect on the voltage within an electrical installation. Traditional generation sources will change their power output in response to commands sent from the DNSP or SCADA equipment, this has the effect of stabilizing the network voltage.

Power quality response modes were introduced in to AS4777.2 2014 in order to help distribution DNSP provide stability to the network with the increasing number of Solar PV Inverters being installed. Previously, if an IES was proposed and the DNSP found through network studies that the IES would either destabilize the network or cause power quality issues to other customers in the local area, the only options were to either export limit the proposed installation, impose a limit on the amount of capacity that was allowed to be installed or not allow the system to be installed at all.

Power Quality modes allow the maximum amount of solar PV generation to be installed without the need for export limitation and reduce the destabilizing effect on the network voltage.

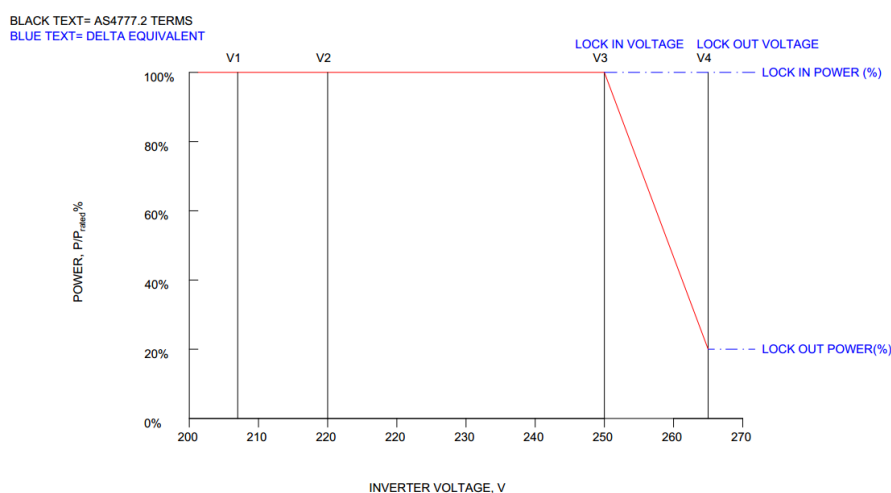
This document describes the process for programing the Delta inverter range with Volt watt and Volt Var response mode settings that may be required by your local DNSP. Please refer to your connection agreement for the specific requirements for your system, but the following documents may be helpful (current 9/2/2019) in understanding the required Volt –Var & Volt-Watt Response mode settings for your local area. There are also some pre-configured grid codes suitable for some DNSP's.

DNSP	System size	Document	Grid Code
Western Power	0-30 kVA	Network Integration Guideline: Inverter Embedded Generation	AU_WP
SAPN	0-30 kVA	TS-129	AU_SA
Ergon/ Energex	0-30 kVA	Micro Embedded Generating Units (0 - ≤30 kVA) – STNW1170	
Ergon/ Energex	30-1500 kVA	Standard for Connection of	

		Embedded Generating Systems (>30 kW to 1,500 kW) to a Distributor's LV Network-STNW1174	
<b>Ausgrid</b>	0-200 kVA & 200 kVA & above	<b>NS194 SECONDARY SYSTEMS REQUIREMENTS FOR EMBEDDED GENERATORS</b>	

## Volt Watt response mode description

This mode is enabled by default and will reduce the output power of the inverter in response to an increasing voltage at the AC terminals of the inverter. The voltage that the inverter produces a given % of the VA rating of the inverter can be adjusted using DSS software or via the LCD on the front of the inverter. By selecting the "AU\_2015" grid code, the default AS4777.2 values are programmed as per the table below. The table also shows how each of the parameters shown in AS4777.2 Cl 6.3.2.2 are named, these are the same when using DSS or the LCD screen.



VOLT WATT RESPONSE REFERENCE VALUES AS4777.2 / DELTA EQUIVALENT TERMS				
AS4777.2 Voltage Reference	Delta Reference (Voltage)	AS4777.2 Power reference	Delta Reference (Power)	AS4777.2/ AU2015 Default Value
V <sub>1</sub>	-	P/P <sub>ref</sub> (%)@ V <sub>1</sub>	-	100 %
V <sub>2</sub>	-	P/P <sub>ref</sub> (%)@ V <sub>2</sub>	-	100 %
V <sub>3</sub>	Lock in voltage (V)	P/P <sub>ref</sub> (%)@ V <sub>3</sub>	Lock in Power (V)	100 %
V <sub>4</sub>	Lock out voltage (V)	P/P <sub>ref</sub> (%)@ V <sub>4</sub>	Lock out Power (V)	20 %

## Adjusting Volt Watt mode settings

\*\*\* Note that the Volt-Watt mode parameters have different meanings for M-Series and H-Series inverters, this section applies to M6A,M10A and M30A inverters. If you are configuring the parameters of a H2.5,H3,H3A,H4A or H5A inverter, please refer to the "Victoria quick start guide for flex" on page 6.\*\*\*

1. Open CTRL (Control) tab in DSS software.
2. In the **P(U) function** section, expand the **mode** drop down box and ensure that **enabled** is selected.
3. In the **P(U) function** mode section, each field has the meaning below.

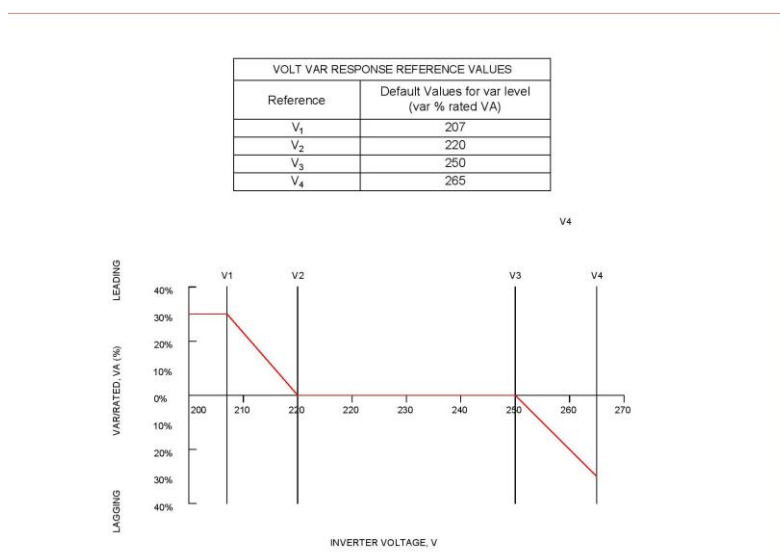
### Recovery time

Main   Config   **Ctrl**   1.

Active Power	Reactive Power	Q(U) Ctrl	Q by Night	P(U) Function
??? <input type="text"/> PM (%) ??? <input type="text"/> Ramp Up Power(%) ??? <input type="text"/> Active Power Slope ??? <input type="text"/>	Mode ?? <input type="text"/> Fixed cosφ ?? Ind <input type="text"/> Fixed Q (%) ?? Ind <input type="text"/> Response Time ?? <input type="text"/>	Q_Vmax ?? % Ind <input type="text"/> Q_Vmin ?? % Ind <input type="text"/> Vmax ?? <input type="text"/> Vmin ?? <input type="text"/> Upper(V2) ?? <input type="text"/> Lower(V1) ?? <input type="text"/> Lock-in Power ?? <input type="text"/> Lock-out Power ?? <input type="text"/> Hysteresis ?? <input type="text"/>	Const.Q_Percent ?? <input type="text"/> Q(U)_Upper_Limit ?? <input type="text"/> Q(U)_Lower_Limit ?? <input type="text"/> Q(U)_Vmin ?? <input type="text"/> Q(U)_Vmax ?? <input type="text"/> Q(U)_V1 ?? <input type="text"/> Q(U)_V2 ?? <input type="text"/> Q(U)_P_Lock_in ?? <input type="text"/> Q(U)_P_Lock_out ?? <input type="text"/> Q(U)_Hysteresis ?? <input type="text"/> Response_Delay ?? <input type="text"/>	Mode: ??? <input type="text"/> Recovery Time(s) ??? <input type="text"/> Lockin Power(%) ??? <input type="text"/> Lockout Power(%) ??? <input type="text"/> Lockin Voltage(Vac) ??? <input type="text"/> Lockout Voltage(Vac) ??? <input type="text"/> Stop Voltage ??? <input type="text"/> Pend ??? <input type="text"/> Anti-Islanding Mode (Japan) ??? <input type="text"/>

2.     
 3.

**Volt-Var response mode** – This mode is enabled by default and will sink reactive power in response to an increasing voltage (inductive) and supply reactive power in response to a decrease in voltage (capacitive). The voltage at which the inverter should sink/supply a reactive power at a given % of the VA rating of the inverter can be adjusted, the default values are given in the table below.



## Connecting PC to the Inverter

### Equipment required

The equipment required is different depending on the inverter model,

Inverter	RPI M30A,M10A,M6A, E5	RPI H2.5A, H3A,H4A,H5A	RPI Mini - H2.5A, H3A,H4A,H5A
Equipment required	- Opto isolated	- USB-RS485	- Wifi

	USB-RS485 Converter - PC with USB port	Converter - PC with USB port	Enabled PC
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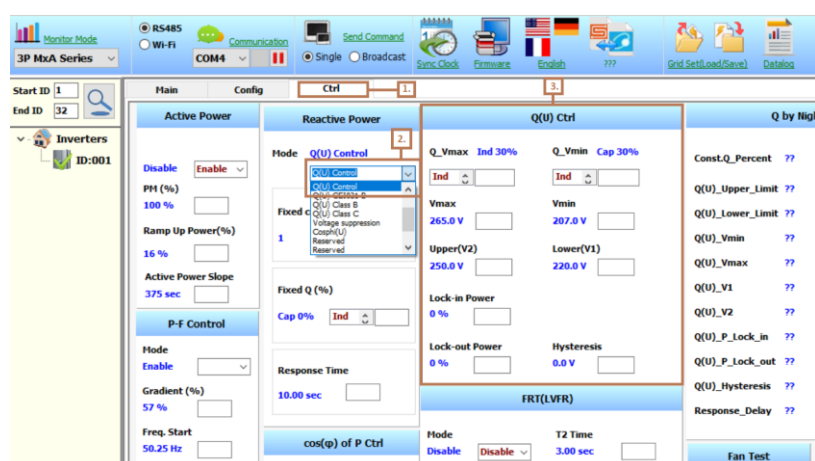
Note that this guide describes how to adjust the Volt Watt and volt Var response mode settings Using Delta Service software available for download at <http://support.delta-es.com.au/solar/>. For RPI M30A,M10A,M6A inverters, these modes can be adjusted by using the buttons on the LCD panel on the front of the inverter, refer to the user manual for further details.

Please install the latest version of Delta Service software and connect your inverter to your PC, for details on how to do this please refer to document.

- How to install DSS and connect inverter to PC.

## Adjusting Volt-VAr mode settings

1. Open CTRL (Control) tab in DSS software.
2. In the **Reactive Power** section, expand the **mode** drop down box and ensure that **Q(U)** is selected.
3. In the **Q(U) Ctrl** section, each field has the meaning below.



### Q\_Vmax

Ind/Cap- the inverter is either sinking (**ind**-inductor) or sourcing (**cap**-capacitor) at Vmax  
% - % of the VA rating of the inverter that will be sourced/sinked in VAR's at Vmax

### Q\_Vmin

Ind/Cap- the inverter is either sinking (**ind**-inductor) or sourcing (**cap**-capacitor) at Vmin  
% - % of the VA rating of the inverter that will be sourced/sinked in VAR's at Vmin

**Lock in power** – The output power must greater than this value before Q(U) mode is activated.

**Lock out Power** - The output power must greater than this value before Q(U) mode is activated.

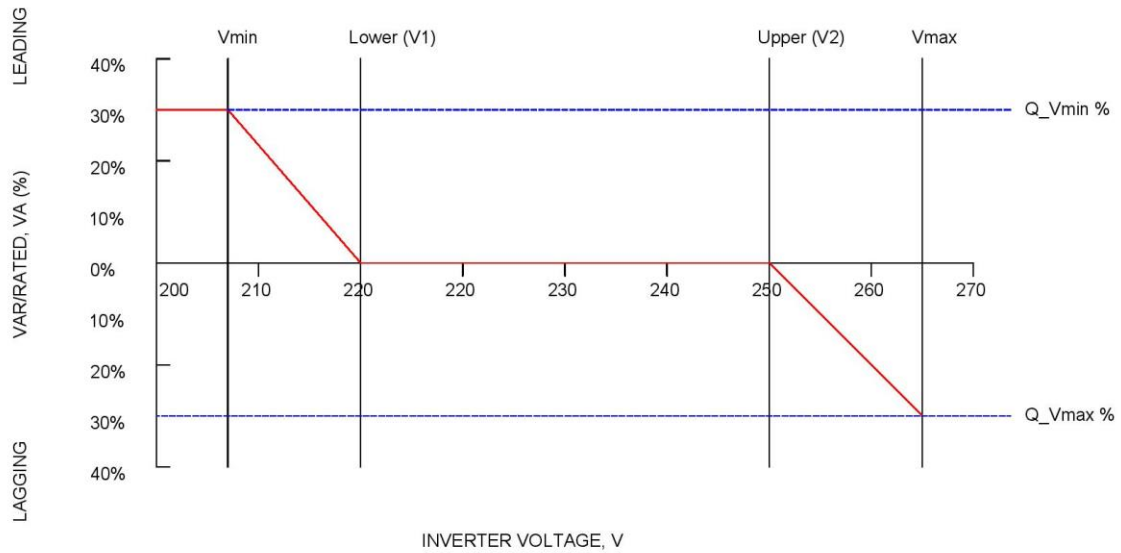


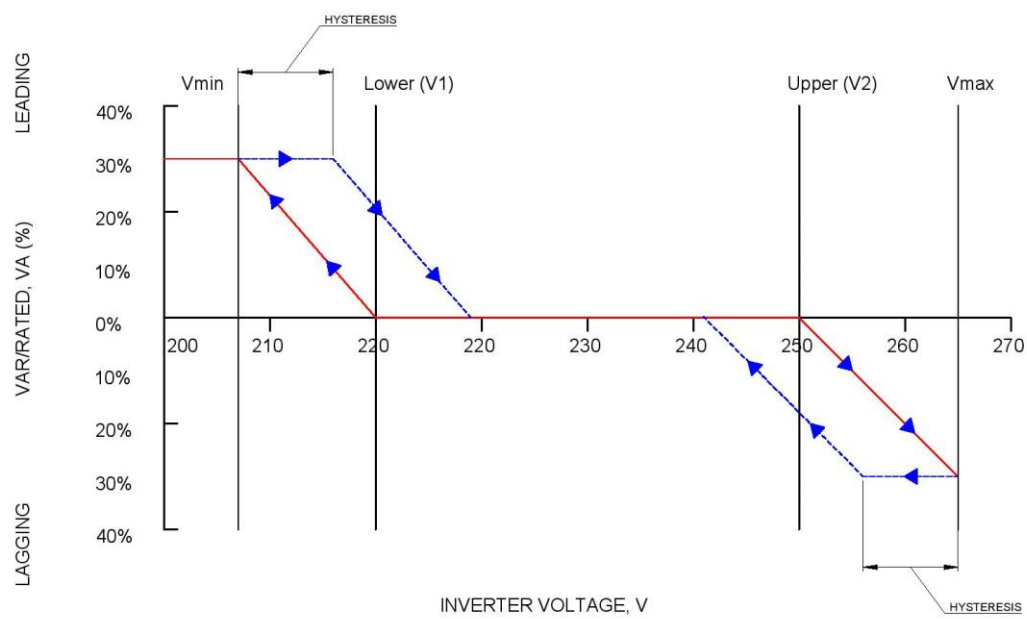
Figure 1 Explanation of  $Q_{v\_min}$  &  $Q_{v\_max}$  values

**Hysteresis** - The effect of Hysteresis value depends on the current AC voltage.

If the voltage is in the range;

**$V2(upper) < AC \text{ Voltage} < Vmax$**  – the AC Voltage would need to reduce by at least the **hysteresis** value before the reactive power value was to reduce.

**$V1(lower) > AC \text{ Voltage} > Vmin$**  – the AC Voltage would need to increase by at least the **hysteresis** value before the reactive power value was to reduce.





## Victoria Settings Quick Start Guide for Flex

To commission the Flex (H2.5,H3,H3A,H4A or H5A) inverter with the settings below, please follow the instructions as follows. You will need a laptop running windows versions XP or greater and with Wifi capability. It is recommended that you download and install DSS (Delta Service software) from the following link before going to site, the zip file password is 1234.

<http://support.delta-es.com.au/downloads-center/>

**Table 1: Mandatory: volt-var response mode settings**

Reference	Voltage in Volts	Var % Rated VA
V1	208	44% leading (exporting vars)
V2	220 (default)	0%
V3	241	0%
V4	253	44% lagging (sinking vars, 3.7% per volt, 0.9 power factor)

**Table 2: Mandatory volt-watt response mode settings**

Reference	Voltage in Volts	Power % rated Power
V1	207 (default)	100% (default)
V2	220 (default)	100% (default)
V3	253	100% (default)
V4	259	20% (default, 5.3%/volt)

**Table 3: Sustained operation for voltage variation**

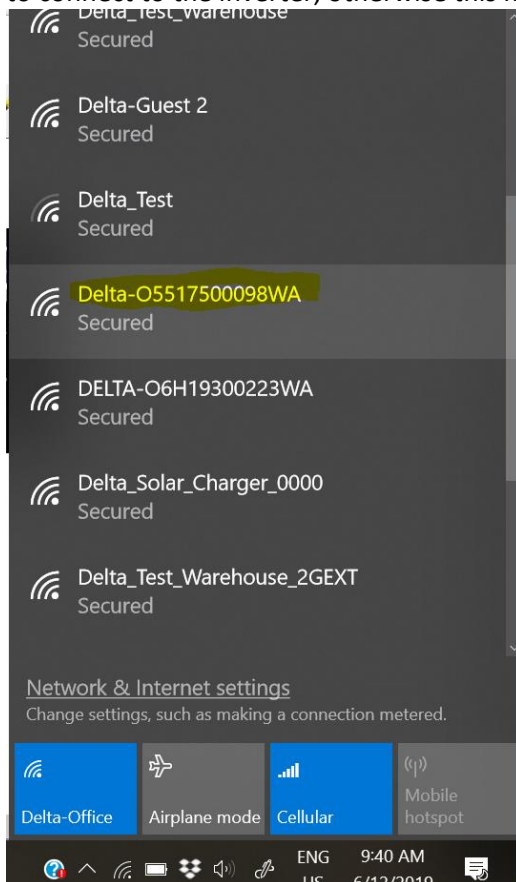
Reference	Voltage
V nom-max	258 volts

1. Commission the Flex inverter according to the quickstart guide provided with the inverter.  
<https://www.deltapvi.com.au/assets/Uploads/H-Series-WiFi-Quick-Start-Online-PDF.pdf>

2. If not done before attending site, download DSS from the link as described at the beginning of this section.
3. Extract DSS from the zip file and store on your desktop.



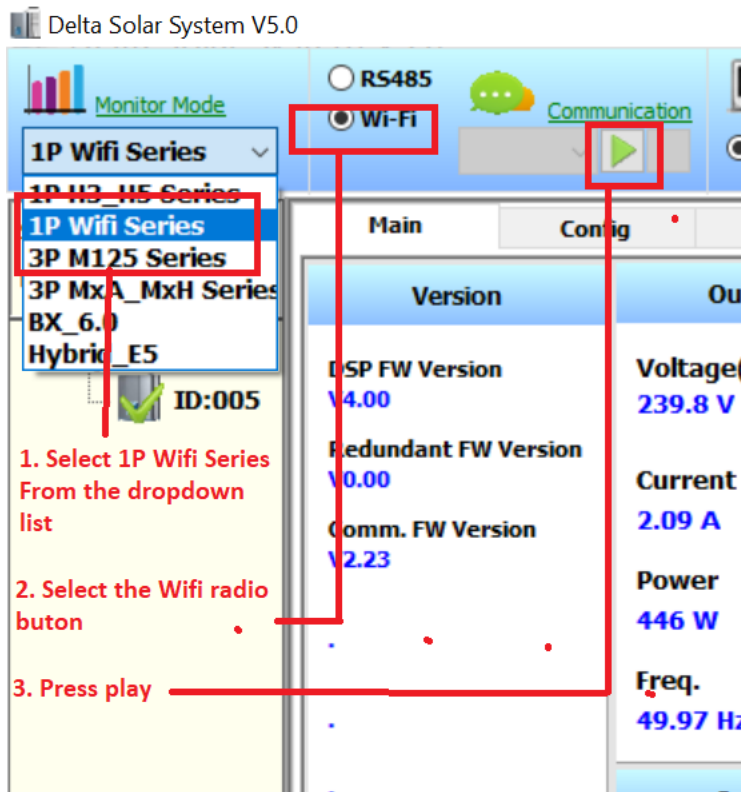
4. Go to your wifi networks and find the network name with the inverter serial number. The Default network password is DELTASOL. Ensure that no other devices (phones etc) are trying to connect to the inverter, otherwise this may not work.



5. Open "Delta\_Solar\_System V4.9.exe" file in the folder "Delta\_Solar\_System V4.9"

Clipboard	Organize	New	Open	Select	
↑ > Delta_Solar_System V4.9					
Name	Date modified	Type	Size		
1P H2.5_H5A flex Series	26/07/2019 6:40 PM	File folder			
1P H3_H5 Series	26/07/2019 6:40 PM	File folder			
3P MxA Series	22/08/2019 2:14 PM	File folder			
BX6.0	14/06/2019 3:30 PM	File folder			
Central INV	26/07/2019 6:40 PM	File folder			
ConfigLog	26/07/2019 6:40 PM	File folder			
DataLog	15/11/2018 6:06 PM	File folder			
Hybrid_E5	22/08/2019 4:32 PM	File folder			
M20A	22/08/2019 3:22 PM	File folder			
profile	26/07/2019 6:40 PM	File folder			
UpgradeLog	15/11/2018 6:06 PM	File folder			
Delta_Solar_System V4.9.exe	23/07/2019 6:51 PM	Application	5,719 KB		

6. Once DSS opens, follow the steps below



7. The section below should populate with numbers in blue

Version
DSP FW Version V4.00
Redundant FW Version V0.00
Comm. FW Version V2.23
ARC FW Version
SCM FW Version
Sub-1G FW Version V1.00
Serial Number 0551750098WA
Model Name H3_211

- Click on the "config" tab and enter password 4613

Config4613		Ctrl4613
<b>Uac Protection</b>		
U High Off:	265.0 V	<input type="text"/>
U High Off Time:	0.10 Sec	<input type="text"/>
U High On:	253.0 V	<input type="text"/>

- Enter 258 into the field for "U high off slow" and press enter. The value of 255.0V next to the field should briefly turn red and then become blue with the updated value of 258.0V

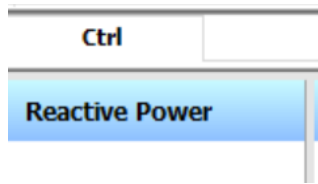
Uac Protection		Freq. Protection			
U High Off:	265.0 V	<input type="text"/>	F High Off:	52.00 Hz	<input type="text"/>
U High Off Time:	0.10 Sec	<input type="text"/>	F High Off Time:	0.10 Sec	<input type="text"/>
U High On:	253.0 V	<input type="text"/>	F High On:	50.15 Hz	<input type="text"/>
U High Off Slow:	255.0 V	<input type="text" value="258"/>	F High Off Slow:	70.00 Hz	<input type="text"/>
U High Off Slow Time:	601.00 Sec	<input type="text"/>	F High Off Slow Time:	655.35 Sec	<input type="text"/>
U High On Slow:	253.0 V	<input type="text"/>	F High On Slow:	70.00 Hz	<input type="text"/>
U Low Off:	180.0 V	<input type="text"/>	F Low Off:	47.00 Hz	<input type="text"/>
U Low Off Time:	1.00 Sec	<input type="text"/>	F Low Off Time:	1.00 Sec	<input type="text"/>
U Low On:	216.0 V	<input type="text"/>	F Low On:	47.50 Hz	<input type="text"/>
U Low Off Slow:	0.0 V	<input type="text"/>	F Low Off Slow:	0.00 Hz	<input type="text"/>
U Low Off Slow Time:	655.35 Sec	<input type="text"/>	F Low Off Slow Time:	655.35 Sec	<input type="text"/>
U Low On Slow:	0.0 V	<input type="text"/>	F Low On Slow:	0.00 Hz	<input type="text"/>

1. enter 258 and press enter

Number here should briefly turn red, then become blue.

U High Off Slow:	258.0 V	<input type="text" value="258"/>
U High Off Slow Time:	601.00 Sec	<input type="text"/>
U High On Slow:	253.0 V	<input type="text"/>

10. Click the “ctrl” tab












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11. Enter the following values in each field, press “enter” after entering, the value shown next to the field should briefly turn red and then turn blue with the correct value as in step 9. All other values can be left as the default settings.


Once this is completed the values shown in blue next to each field should match those shown in the screenshot on the next page.

Section	Setting	Value
Reactive power	Mode	Q(U) Control
Q(U) Ctrl	Q_Vmax	Cap 44
	Q_Vmin	Ind 44
	Vmax	253
	Vmin	208
	Lower(V1)	220
	Upper(V2)	241
P(U)	Lock in voltage	253
	Stop voltage	259

 Monitor Mode 1P Wifi Series		<input type="radio"/> RS485 <input checked="" type="radio"/> Wi-Fi		 Communication	 Send Command <input checked="" type="radio"/> Single <input type="radio"/> Broadcast	 Sync Clock	 Firmware	 English	 Delta	 Grid Set (Load/Save)	 Datalog
--	--	---	--	---	---	--	--	---	---	--	---

Start ID 1	End ID 5	Main	Config	Ctrl
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 Inverters  
ID:005

Active Power	Reactive Power	Q(U) Ctrl	P(U) Function	P-F Control	
Disable PM (%) 100 % Ramp Up Power(%) 17 %	Mode Q(U) Control Night Mode Q of Pac 24/7 Fixed cosφ 1 Ind Fixed Q (%) Ind 0% Ind Response Time 4.00 sec	Q_Vmax Cap 44% Ind 44 Vmax 253.0 V 253 Upper(V2) 241.0 V 241 Q2 0 Lock-in Power 20 % Hysteresis 0.0 V	Q_Vmin Ind 44% Ind 44 Vmin 208.0 V 208 Lower(V1) 220.0 V 220 Q3 0 Lock-out Power 5 %	Mode: Enable Recovery Time(s) 0 sec Lockin Power(%) 100 % Lockout Power(%) 100 % Lockin Voltage(Vac) 253.0 V 253 Lockout Voltage(Vac) 300.0 V Stop Voltage 259.0 V 259 Pend 20 % Response Time 4.00 sec	Over Frequency Mode Disable Gradient (%) 57 % Freq. Start 50.25 Hz Freq. Stop 52.00 Hz F Recovery 50.15 Hz Response Time 0.00 sec Under Frequency Mode Disable Gradient (%) 40 % Freq. Start 49.80 Hz F Recovery 49.80 Hz