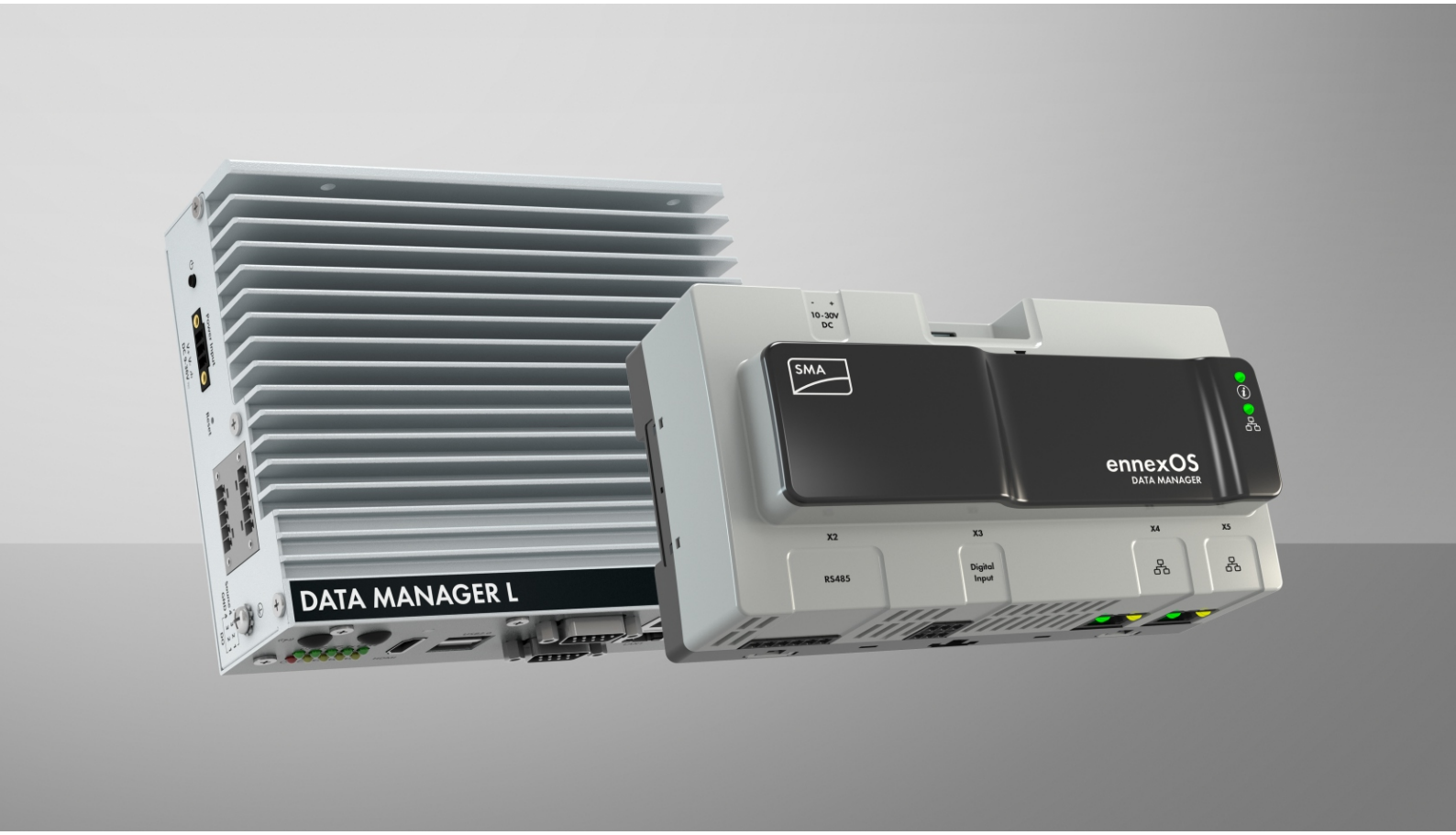
User Manual



SMA DATA MANAGER M / SMA DATA MANAGER L
Q(V) Characteristic Curve

Functional Description and Configuration

(valid for EDMM-10 from firmware version 1.10.06.R and for EDML-10 from firmware version 1.6.12.R)

Table of Contents

1 Functions

1.1 Mode of Operation

The function **Q(V)** controls the reactive power Q at the point of interconnection depending on the grid voltage. For this, a Q(V) characteristic curve is defined using up to eight interpolation points. In addition, a hysteresis and a deadband can be defined as a function of the nominal voltage.

The measuring device configured for the point of interconnection provides the measured value of the voltage V. As a function of the measured voltage V, the Q(V) function makes a setpoint available for the reactive power Q. According to this setpoint, the PI controller sends a control value to the inverter and with it adjusts the system in such a way that the actual value and the setpoint correspond to one another.

1.2 Control Principle

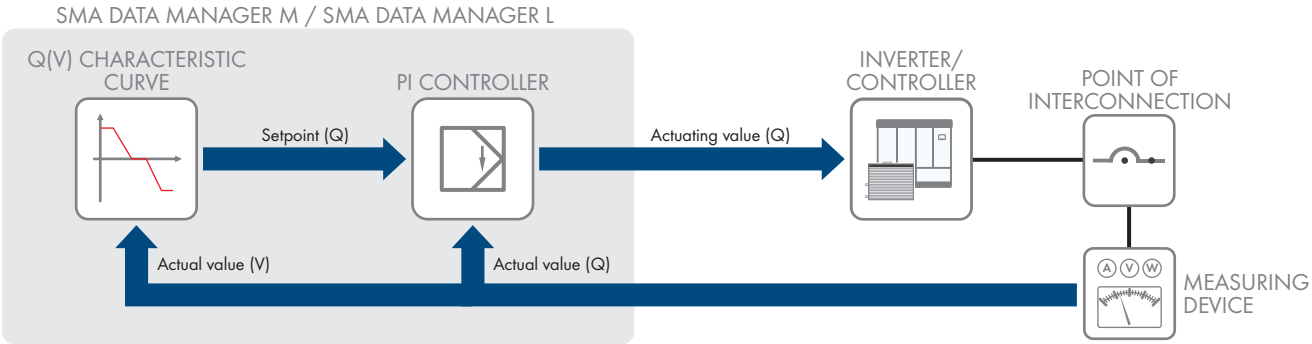


Figure 1: Control Principle

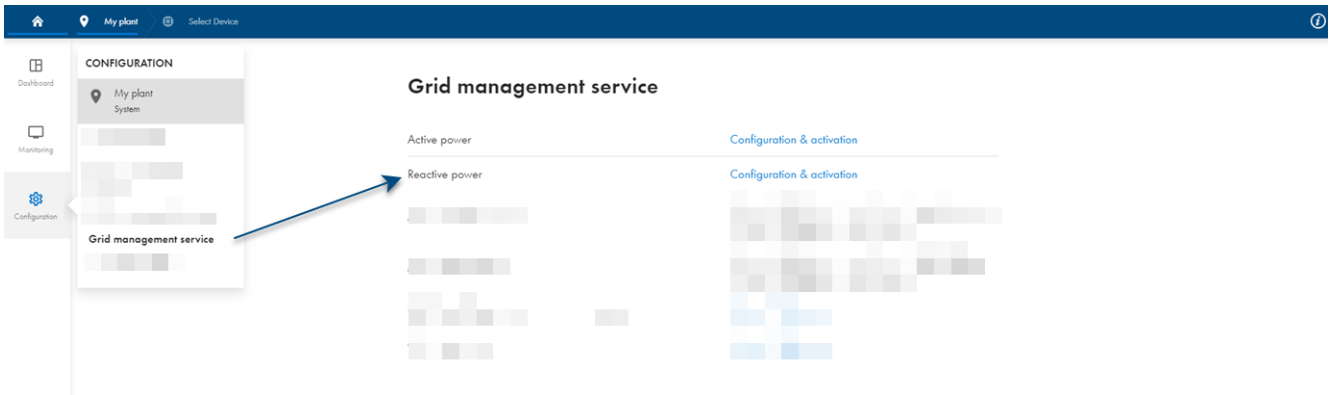
2 Configuration

2.1 Activation via the User Interface

Activation of Q(V) characteristic curve on inverter or system controller

The Q(V) characteristic curve can be activated and set on the inverter or on the system controller.

- If there is no system controller in the system, activate and set the Q(V) characteristic curve on the inverter.
- If there is a system controller in the system, activate and set the Q(V) characteristic curve on the system controller.



The activation and deactivation as well as the parameterization are carried out via the user interface under **Configuration > Grid management service**.

2.2 Parameter Description

2.2.1 Parameters for the Characteristic Curve

With this characteristic curve, the system is supposed to feed reactive power into the utility grid as a function of the grid voltage. The characteristic points are given as percentages based on the reference value.

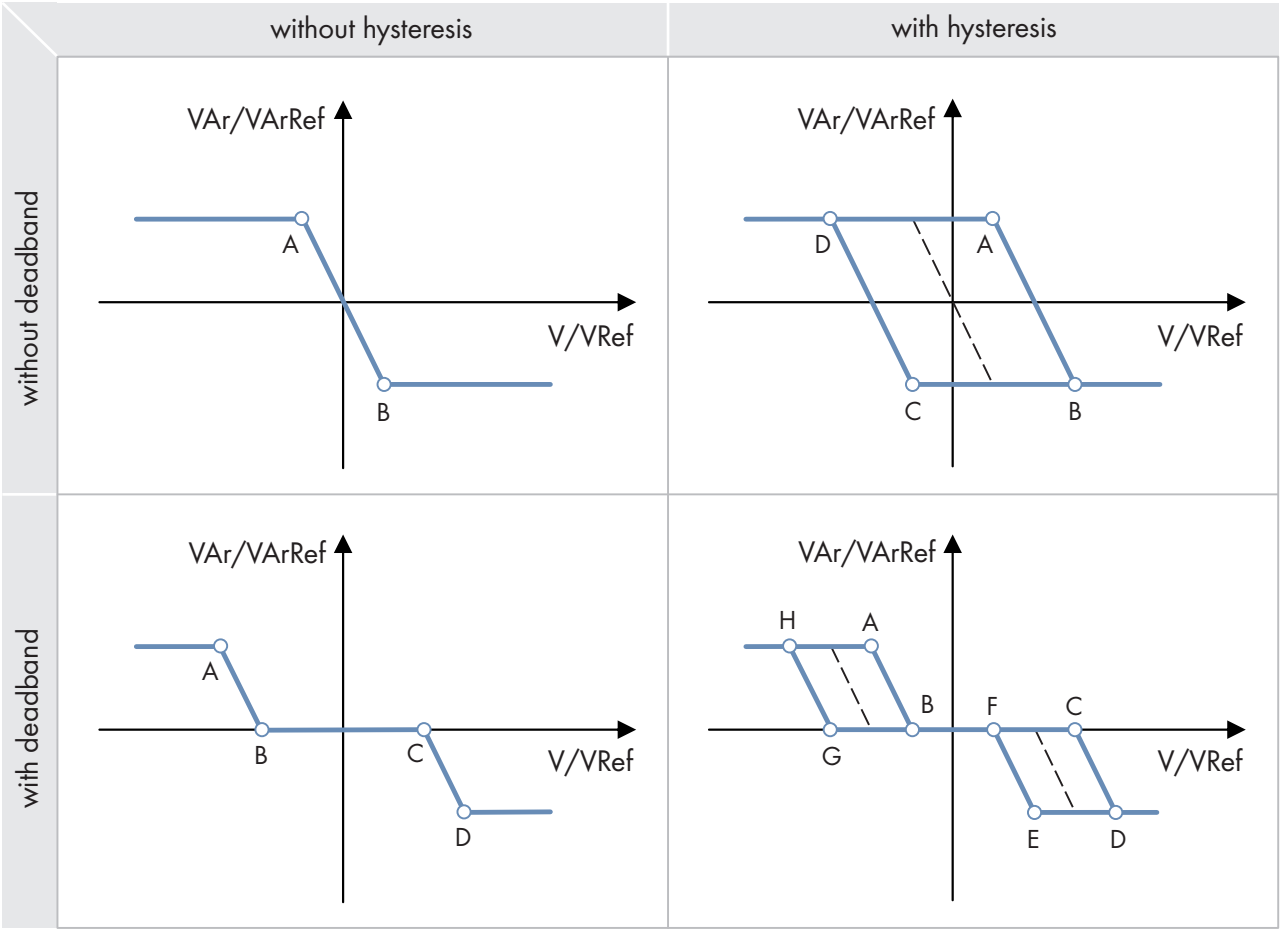


Figure 2: Q(V) characteristic curve (examples)

Setting the characteristic curve

Object name	Definition	Explanation
Inverter.VArModCfg.VArCtlVol-Cfg.Crv.NumPt	Number of used support points	-
Inverter.VArModCfg.VArCtlVol-Cfg.Crv.XVal	Voltage values of the characteristic curve in p.u.	Parameterized nominal voltage (see Technical Information "SMA GRID GUARD 10.0 - Grid Management Services via Inverter and System Controller")

Object name	Definition	Explanation
Inverter.VArModCfg.VArCtlVol-Cfg.Crv.YVal	Reactive power values of the characteristic curve in %	The reference value is WMaxOut / WMaxIn or Inverter.VArMaxQ1-Q4 (depending on the setting of Inverter.VArModCfg.VArNomRefMod).
Inverter.VArModCfg.VRefMod	Type of reference voltage	Adjustable: PhsAvg / mean value of phase voltages PhsMax / maximum phase voltage

Setting the reference voltage adjustment

Changing the reference voltage allows the Q(V) characteristic curve to be moved on the X axis. The reference voltage for Q(V) can be set by the following parameters.

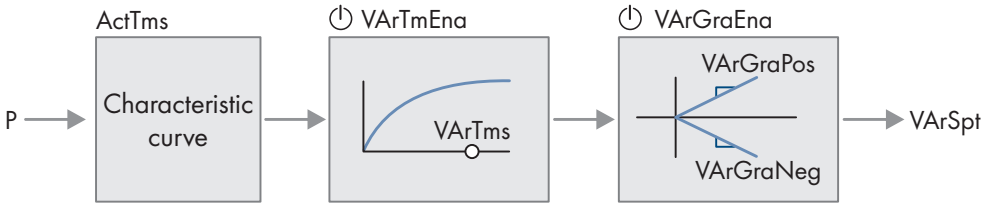
Object name	Definition	Explanation
Inverter.VArModCfg.VArCtlVol-Cfg.VolRef.AutnAdjMod	Operating mode of the reference voltage adjustment	Adjustable: Off (no adjustment) On: The reference voltage is taken from the external setpoint. Automatic (automatic adjustment): The reference voltage corresponds to the low-pass filtered measured voltage.
Inverter.VArModCfg.VArCtlVol-Cfg.VolRef.AutnAdjTms	Response time of the automatic reference voltage adjustment	Response time corresponds to 3 taus of a PT1 element.
Inverter.VArModCfg.VArCtlVol-Cfg.VolRef.VolRefPu	External reference voltage setting in p.u.	The reference value is the parameterized nominal voltage (see Technical Information "SMA GRID GUARD 10.0 - Grid Management Services via Inverter and System Controller").

Setting the behavior in case of absent reference voltage

Object name	Definition	Explanation
Inverter.CtlComCfg.VArCtlVol-Com.CtlComMssMod	Fallback behavior	Adjustable: Values maintained (the values received last are maintained) Apply fallback values

Object name	Definition	Explanation
Inverter.CtlComCfg.VArCtlVol-Com.FlbVolRefPu	Fallback of reference voltage in p.u.	The reference value is the parameterized nominal voltage (see Technical Information "SMA GRID GUARD 10.0 - Grid Management Services via Inverter and System Controller").
Inverter.CtlComCfg.VArCtlVol-Com.TmsOut	Timeout for the missing reference voltage setpoint in s	For this time, the reference voltage setpoint must be absent before the fallback procedure is activated.

Setting the dynamics



Object name	Definition	Explanation
Inverter.VArModCfg.VArCtlVol-Cfg.Dyn.VArTmEna	Setpoint filter	Activation / deactivation
Inverter.VArModCfg.VArCtlVol-Cfg.Dyn.VArTms	Response time for the setpoint filter in s	Response time corresponds to 3 taus of a PT1 element.
Inverter.VArModCfg.VArCtlVol-Cfg.Dyn.VArGraEna	Limitation of change rate	Activation / deactivation
Inverter.VArModCfg.VArCtlVol-Cfg.Dyn.VArGraPos	Ramp-up rate in %/s	The reference value is Inverter.VAr-MaxQ1.
Inverter.VArModCfg.VArCtlVol-Cfg.Dyn.VArGraNeg	Decrease rate in %/s	The reference value is Inverter.VAr-MaxQ1.
Inverter.VArModCfg.VArCtlVol-Cfg.Dyn.ActTms	Tripping delay in s	-

2.2.2 Device-Specific Parameters

Object name	Definition	Default value
Inverter.WMaxOut	Adjustable limiting value for the maximum active power for power output	-
Inverter.WMaxIn	Adjustable limiting value for the maximum active power for power consumption	-
Inverter.VArMaxQ1	Adjustable limiting value for the maximum reactive power quadrant 1	-
Inverter.VArMaxQ2	Adjustable limiting value for the maximum reactive power quadrant 2	-

Object name	Definition	Default value
Inverter.VArMaxQ3	Adjustable limiting value for the maximum reactive power quadrant 3	-
Inverter.VArMaxQ4	Adjustable limiting value for the maximum reactive power quadrant 4	-
Inverter.VArModCfg.VArNomRef-Mod	Mode reactive power reference (proportion of maximum active power (**WMaxInOut**) or maximum reactive power (**VArMaxOx**))	WMaxInOut (0)
Inverter.VArModCfg.VArCtlVol-Cfg.VolRef.pLim	Upper limit for the reference voltage	2
Inverter.VArModCfg.VArCtlVol-Cfg.VolRef.oLim	Lower limit for the reference voltage	0.01
Inverter.VArModCfg.VRefMod	Mode of reference voltage: • Mean value of phase voltage • Maximum phase voltage	Mean value of phase voltage
Inverter.DGSModCfg.VArDy-nEna	Dynamic grid support, reactive power dynamic after error end: • Off • On	Off

Further options for setting the Q(V) characteristic curve are available via the Modbus® interface (see Technical Information "SMA Modbus® Interface - SMA DATA MANAGER").

2.3 Interactions with other Functions

There are no known interactions with other functions.

2.4 Information on Commissioning

Requirement:

☐ A country data set must already be set for all inverters in the system.

Procedure:

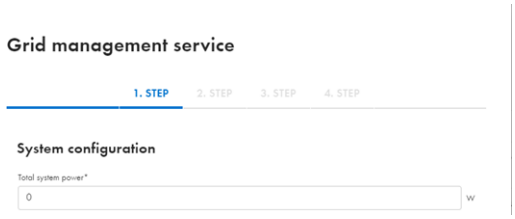
- Carry out default settings in installation assistant.
- Make detailed settings in the generic parameter list.

Carry out default settings in installation assistant

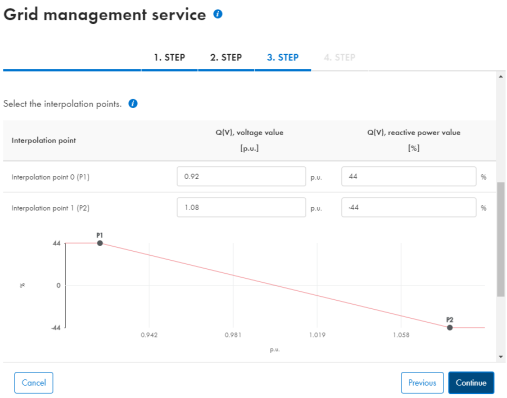
The Q(V) function is enabled and configured in the menu **Grid management service**.

Procedure:

1. Ensure that the **Total system power** under **System configuration** matches the sum of the nominal powers of all connected inverters.

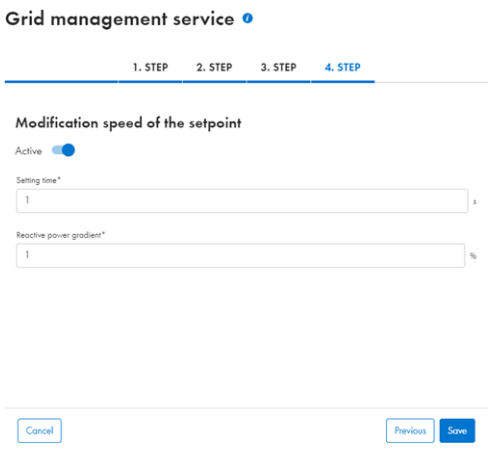


2. **Reactive power setpoint according to generator reference-arrow system necessary**
   The configuration of the Q(V) characteristic curve requires the specification of reactive power setpoints according to the generator reference-arrow system.
   - Check whether the reactive power setpoints have been specified by the grid operator according to the generator reference-arrow system or according to the consumer reference-arrow system.
   - If the reactive power setpoints were specified according to the consumer reference-arrow system, convert the reactive power setpoints according to the generator reference-arrow system (invert reactive power setpoints).
3. As the operating mode select **Open loop control** or **Closed-loop control** and as the signal source **Q(V) characteristic curve**.
4. Select the type of the Q(V) characteristic curve. The following options are available:
   - **Single droop**
   - **Droop with deadband**
   - **Single droop with hysteresis**
   - **Droop with 6 supporting points**
   - **Droop with 8 supporting points**
   - **Droop with 4 supporting points and hysteresis**
   - **Droop with deadband and hysteresis**
5. Set the **Phase reference of grid nominal voltage** to **Phase voltage** or **Outer conductor voltage**.
6. Set **Reactive power mode, reference value for reactive power setpoints** to **Maximum active power WMax** or **Maximum reactive power VArMax**.
7. Select the interpolation points of the characteristic curve as shown in the example of the linear characteristic curve.



8. Under **Reference voltage specification** set the **Parameter Q(V), operating mode of reference voltage** to **Off**, **On** or **Automatic**.

9. Set the **Modification speed of the setpoint**.



Make detailed settings in the generic parameter list

The menu **Parameters** on the user interface for the entire system serves for the configuration of the parameters (see Section 2.2, page 5).

Procedure:

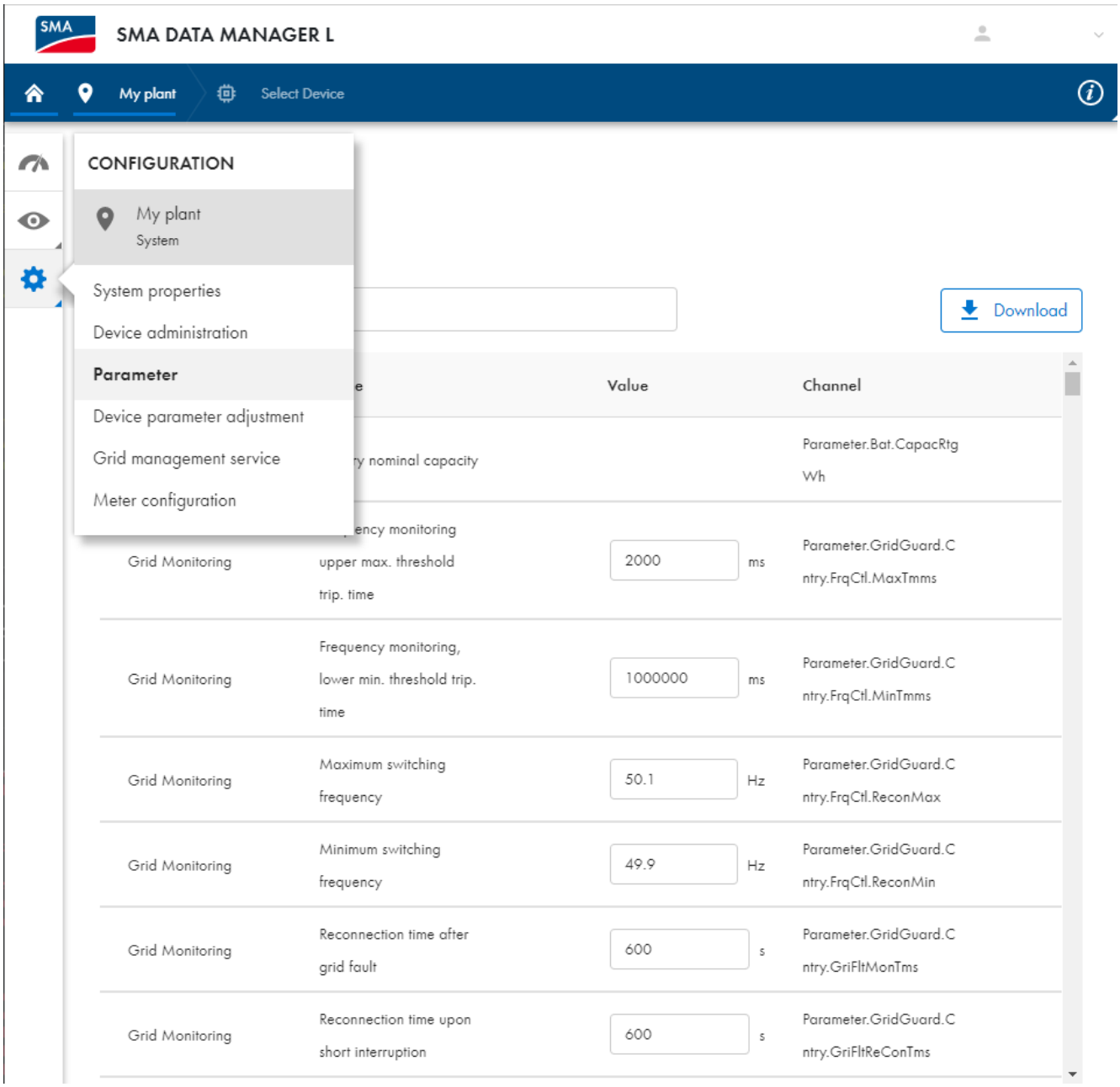


Figure 3: Configuring the Parameters

1. Open the **Parameter** menu.

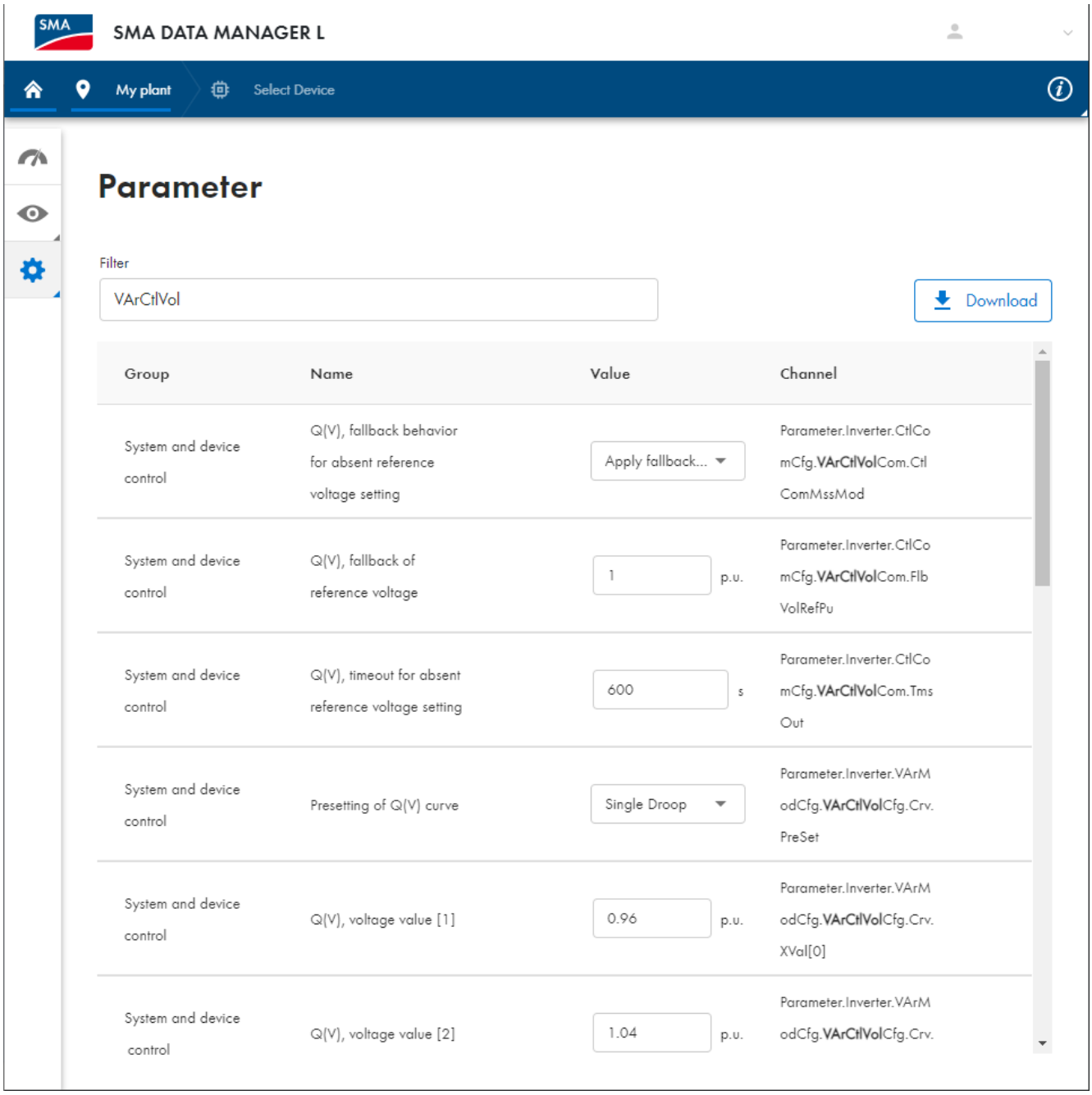


Figure 4: Configuration parameters **VArCtlVol** - example

2. Set the filtering, e.g. according to **VArCtlVol**.
3. Set the selected parameter for Q(V) function.

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