



# 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)

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## 1 Functions

## 1.1 Mode of Operation

The function  $\mathbf{Q}(\mathbf{V})$  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

### **i** 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.

â	• My plant   Select Device		
Œ	CONFIGURATION	_	
Dashboard	My plant System	Grid management servio	e
Monitoring		Active power	Configuration & activation
		Reactive power	Configuration & activation
Configuration			
	Grid management service		

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 Con- troller")

Object name	Definition	Explanation
Inverter.VArModCfg.VArCtlVol- Cfg.Crv.YVal	Reactive power values of the charac- teristic curve in %	The reference value is WMaxOut / WMaxIn or Inverter.VArMaxQ1-Q4 (depending on the setting of In- verter.VArModCfg.VArNomRefMod).
Inverter.VArModCfg.VRefMod	Type of reference voltage	Adjustable: PhsAvg / mean value of phase volt- ages 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-	Operating mode of the reference	Adjustable:
Ctg.VolRet.AutnAdjMod	voltage adjustment	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 volt- age.
Inverter.VArModCfg.VArCtlVol- Cfg.VolRef.AutnAdjTms	Response time of the automatic refer- ence 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 parameter- ized 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-	Fallback behavior	Adjustable:
Com.CtlComMssMod		Values maintained (the values re- ceived 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 parameter- ized 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 volt- age setpoint in s	For this time, the reference voltage setpoint must be absent before the fallback procedure is activated.

### Setting the dynamics

	ActTms	U VArTmEna	🕛 VArGraEna	
P>	Characteristic curve	VArTms	VArGraPos VArGraNeg	≻ VArSpt
Object name		Definition	Explanation	
Inverter.VArModCfg.VA Cfg.Dyn.VArTmEna	vrCtIVol-	Setpoint filter	Activation / dea	ctivation
Inverter.VArModCfg.VA Cfg.Dyn.VArTms	vrCtlVol-	Response time for the setpoint s	filter in Response time co of a PT1 element	orresponds to 3 taus t.
Inverter.VArModCfg.VA Cfg.Dyn.VArGraEna	arCtlVol-	Limitation of change rate	Activation / dea	ctivation
Inverter.VArModCfg.VA Cfg.Dyn.VArGraPos	arCtlVol-	Ramp-up rate in %/s	The reference va MaxQ1.	lue is Inverter.VAr-
Inverter.VArModCfg.VA Cfg.Dyn.VArGraNeg	vrCtIVol-	Decrease rate in %/s	The reference va MaxQ1.	lue is Inverter.VAr-
Inverter.VArModCfg.VA Cfg.Dyn.ActTms	vrCtlVol-	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 ( <b>WMaxInOut</b> ) or maximum reactive power ( <b>VArMaxOx</b> ))	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	<ul><li>Mode of reference voltage:</li><li>Mean value of phase voltage</li><li>Maximum phase voltage</li></ul>	Mean value of phase voltage
Inverter.DGSModCfg.VArDy- nEna	Dynamic grid support, reactive power dynamic after er- ror end: • Off • On	Off

Further options for setting the Q(V) characteristic curve are available via the Modbus<sup>®</sup> 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:

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

Grid management service							
	1. STEP	2. STEP					
System config	uration						
Total system power*							
0							

2. **i** 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 Grid management service of 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**.

#### 2 Configuration

9. Set the Modification speed of the setpoint.

Grid management service •						
	1 6760	0.6750	0.0750	4.677		

	1. STEP	2. STEP	3. STEP	4. STEP	
Modification	speed of the	e setpoint			
Antino 🧰					
Active					
Setting time*					
1					
Reactive power gradient	*				
1					
Cancel					Previous Save

### 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:

SM	SMA DATA MANAG	ER L		<b>.</b> ~
<b>^</b>	♥ My plant ⊕ Select	Device		$\bigcirc$
~	CONFIGURATION			
•	My plant System			
*	System properties Device administration			👱 Download
	Parameter	e	Value	Channel
	Device parameter adjustmen Grid management service	t ry nominal capacity		Parameter.Bat.CapacRtg Wh
	Meter contiguration	ency monitoring upper max. threshold trip. time	2000 ms	Parameter.GridGuard.C ntry.FrqCtl.MaxTmms
	Grid Monitoring	Frequency monitoring, lower min. threshold trip. time	1000000 ms	Parameter.GridGuard.C ntry.FrqCtl.MinTmms
	Grid Monitoring	Maximum switching frequency	50.1 Hz	Parameter.GridGuard.C ntry.FrqCtl.ReconMax
	Grid Monitoring	Minimum switching frequency	49.9 Hz	Parameter.GridGuard.C ntry.FrqCtl.ReconMin
	Grid Monitoring	Reconnection time after grid fault	600 s	Parameter.GridGuard.C ntry.GriFltMonTms
	Grid Monitoring	Reconnection time upon short interruption	600 s	Parameter.GridGuard.C ntry.GriFltReConTms

Figure 3: Configuring the Parameters

1. Open the **Parameter** menu.

SM	A	SMA DATA MANA	AGER L		<u>.</u> ~
<b>^</b>	•	My plant 🗇 Se	lect Device		()
<ul><li></li><li></li><li></li><li></li><li></li><li></li><li></li><li></li><li></li><li></li><li></li><li></li><li></li><li></li><li></li><li></li><li></li><li></li><li></li><li></li><li></li><li></li><li></li><li></li><li></li><li></li><li></li><li></li><li></li><li></li><li></li><li></li></ul>		Parameter			
*		Filter VArCtlVol			👤 Download
		Group	Name	Value	Channel
		System and device control	Q(V), fallback behavior for absent reference voltage setting	Apply fallback 🔻	Parameter.Inverter.CtlCo mCfg. <b>VArCtlVol</b> Com.Ctl ComMssMod
		System and device control	Q(V), fallback of reference voltage	1 p.v.	Parameter.Inverter.CtlCo mCfg. <b>VArCtlVol</b> Com.Flb VolRefPu
		System and device control	Q(V), timeout for absent reference voltage setting	600 s	Parameter.Inverter.CtlCo mCfg. <b>VArCtlVol</b> Com.Tms Out
		System and device control	Presetting of Q(V) curve	Single Droop 🔻	Parameter.Inverter.VArM odCfg. <b>VArCtIVoI</b> Cfg.Crv. PreSet
		System and device control	Q(V), voltage value [1]	0.96 p.u.	Parameter.Inverter.VArM odCfg. <b>VArCtIVoI</b> Cfg.Crv. XVaI[0]
		System and device control	Q(V), voltage value [2]	1.04 p.u.	Parameter.Inverter.VArM odCfg. <b>VArCtIVoI</b> Cfg.Crv.

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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