



SMA GRID GUARD 10.0

Grid Management Services via Inverter and System Controller

Table of Contents

1	Information on this Document.....	4
1.1	Validity.....	4
1.2	Target Group	6
1.3	Explanation of Used Terms	7
1.4	Content and Structure of this Document.....	7
1.5	Additional Information.....	8
2	General Information	9
3	General Operating Behavior	10
3.1	Electrical Connection Point.....	10
3.1.1	Setting the Reference Point for the PV System	10
3.1.2	Adjustable Parameters of the Nominal Voltage.....	11
3.2	P/Q Diagram in the Generator Reference-Arrow System.....	11
3.3	Connection Behavior of Inverters.....	13
3.3.1	Connection Gradients.....	13
3.3.2	Connection Times	14
3.3.3	Connection Limits.....	15
3.4	Operating States of the Inverter	15
3.4.1	Operating Status Control.....	17
3.4.2	Operating Status Indication.....	17
4	Behavior in Case of Undisturbed Utility Grid	19
4.1	Active Power Mode.....	19
4.1.1	Active Power Setpoint.....	20
4.1.1.1	Configuring the Active Power Mode.....	21
4.1.1.2	Manual Setting at Setpoint Input 1	21
4.1.1.3	External Setting at Setpoint Input 1	22
4.1.1.4	External Setting at Setpoint Input 2.....	23
4.1.1.5	Special Cases for System Controllers	25
4.1.2	Voltage-Dependent Active Power Adjustment P(V)	26
4.1.3	Active Power Increase in Case of Change in Irradiation	30
4.2	Reactive Power Mode	30
4.2.1	Reactive Power Mode Off.....	35
4.2.2	Reactive Power Setpoint	35
4.2.2.1	Manual Setting.....	35
4.2.2.2	External Setting.....	36
4.2.2.3	Dynamic Behavior for Implementing Manual and External Setpoints	37
4.2.2.4	Voltage Limitation Function.....	38
4.2.3	Cos phi Setpoint.....	39
4.2.3.1	Manual Setting	39
4.2.3.2	External Setting.....	40
4.2.3.3	Dynamic Behavior for Implementing Manual and External Setpoints	41
4.2.4	Reactive-Power / Active-Power Characteristic Curve Q(P)	42
4.2.5	React. power/volt. char. Q(V)	46
4.2.6	Cos phi/Active Power Characteristic Curve cos phi(P)	49
4.2.7	Cos phi/voltage characteristic curve Cos phi(V)	52
4.3	Limitation of the Maximum Apparent Power Unbalance	54
5	Behavior in Case of Disturbed Utility Grid.....	55
5.1	Behavior in Case of Voltage Errors	55
5.1.1	Voltage Monitoring.....	55
5.1.2	Dynamic Grid Support.....	58

5.2 Behavior in Case of Frequency Errors 69

5.2.1 Frequency Monitoring..... 69

5.2.2 P(f) Characteristic Curve 71

5.3 Islanding Detection 75

5.4 Monitoring the Maximum Frequency Change..... 76

1 Information on this Document

1.1 Validity

This document is valid for:

Devices		from firmware version	System Manager Functionality
PV inverter	SB1.5-1VL-40 (Sunny Boy 1.5) / SB2.0-1VL-40 (Sunny Boy 2.0) / SB2.5-1VL-40 (Sunny Boy 2.5)	3.10.xx.R	-
	SB3.0-1AV-41 (Sunny Boy 3.0) / SB3.6-1AV-41 (Sunny Boy 3.6) / SB4.0-1AV-41 (Sunny Boy 4.0) / SB5.0-1AV-41 (Sunny Boy 5.0) / SB6.0-1AV-41 (Sunny Boy 6.0)	3.10.xx.R	-
	STP 15000TL-30 (Sunny Tripower 15000TL) / STP 17000TL-30 (Sunny Tripower 17000TL) / STP 20000TL-30 (Sunny Tripower 20000TL) / STP 25000TL-30 (Sunny Tripower 25000TL)	3.10.xx.R	-
	STP8.0-3AV-40 (Sunny Tripower 8.0) / STP10.0-3AV-40 (Sunny Tripower 10.0)	3.10.xx.R	-
	STP3.0-3AV-40 (Sunny Tripower 3.0) / STP4.0-3AV-40 (Sunny Tripower 4.0) / STP5.0-3AV-40 (Sunny Tripower 5.0) / STP6.0-3AV-40 (Sunny Tripower 6.0)	3.10.xx.R	-
	STP 50-40 / STP 50-41 (Sunny Tripower CORE1)	3.10.xx.R	-
	STP 33-US-41 / STP 50-US-41 / STP 62-US-41 (Sunny Tripower CORE1-US)	4.xx.xx.R	-
	SHP 100-20 (Sunny Highpower PEAK3) / SHP 150-20 (Sunny Highpower PEAK3)	3.10.xx.R	-
	SHP 100-21 (Sunny Highpower PEAK3 100) / SHP 150-21 (Sunny Highpower PEAK3 150) / SHP 172-21 (Sunny Highpower PEAK3 172) / SHP 180-21 (Sunny Highpower PEAK3 180)	4.02.xx.R	-
	SHP 125-US-21 (Sunny Highpower PEAK3-US 125) / SHP 150-US-21 (Sunny Highpower PEAK3-US 150) / SHP 165-US-21 (Sunny Highpower PEAK3-US 165) / SHP 172-US-21 (Sunny Highpower PEAK3-US 172) / SHP FLEX-US-21 (Sunny Highpower FLEX-US)	4.02.xx.R	-
	STP 12-50 (Sunny Tripower X 12) / STP 15-50 (Sunny Tripower X 15) / STP 20-50 (Sunny Tripower X 20) / STP 25-50 (Sunny Tripower X 25)	02.06.04.R	✓

Devices		from firmware version	System Manager Functionality
PV inverter	STP 20-US-50 (Sunny Tripower X 20-US) / STP 25-US-50 (Sunny Tripower X 25-US) / STP 30-US-50 (Sunny Tripower X 30-US)	03.02.07.R	✓
	STP 50-80 (Sunny Tripower X 50) / STP 60-80 (Sunny Tripower X 60)	03.16.25.R	✓
	STP 27-US-80 (Sunny Tripower X 27-US) / STP 50-US-80 (Sunny Tripower X 50-US) / STP 62-US-80 (Sunny Tripower X 62-US) / STP 70-US-80 (Sunny Tripower X 70-US)	03.16.25.R	✓
	STP 125-70 (Sunny Tripower 125)	4.08.48.R	-
	PCU50-SO20-6400-U (Sunny Central FLEX PCU Solar 6400 UL) / PCU50-SO20-6720-U (Sunny Central FLEX PCU Solar 6720 UL) / PCU50-SO20-7040-U (Sunny Central FLEX PCU Solar 7040 UL)	3.5.0.R	-
Battery inverter	SBS2.5-1VL-10 (Sunny Boy Storage 2.5)	3.10.xx.R	-
	SBS3.7-10 (Sunny Boy Storage 3.7) / SBS5.0-10 (Sunny Boy Storage 5.0) / SBS6.0-10 (Sunny Boy Storage 6.0)	3.10.xx.R	-
	SI4.4M-13 (Sunny Island 4.4M) / SI6.0H-13 (Sunny Island 6.0H) / SI8.0H-13 (Sunny Island 8.0H)	3.20.xx.R	-
	STPS30-20 (Sunny Tripower Storage X 30) / STPS50-20 (Sunny Tripower Storage X 50)	3.00.62.R / 3.00.76.R	✓

Devices		from firmware version	System Manager Functionality
Hybrid inverter	STP5.0-3SE -40 (Sunny Tripower Smart Energy 5.0) / STP6.0-3SE -40 (Sunny Tripower Smart Energy 6.0) / STP8.0-3SE -40 (Sunny Tripower Smart Energy 8.0) / STP10.0-3SE -40 (Sunny Tripower Smart Energy 10.0)	3.2.20.R	-
	SBSE3.6-50 (Sunny Boy Smart Energy 3.6) / SBSE4.0-50 (Sunny Boy Smart Energy 4.0) / SBSE5.0-50 (Sunny Boy Smart Energy 5.0) / SBSE6.0-50 (Sunny Boy Smart Energy 6.0) / SBSE8.0-50 (Sunny Boy Smart Energy 8.0) / SBSE9.9-50 (Sunny Boy Smart Energy 9.9)	3.08.11.R	✓
	SBSE3.8-US-50 (Sunny Boy Smart Energy 3.8-US) / SBSE4.8-US-50 (Sunny Boy Smart Energy 4.8-US) / SBSE5.8-US-50 (Sunny Boy Smart Energy 5.8-US) / SBSE7.7-US-50 (Sunny Boy Smart Energy 7.7-US) / SBSE9.6-US-50 (Sunny Boy Smart Energy 9.6-US) / SBSE11.5-US-50 (Sunny Boy Smart Energy 11.5-US)	3.08.11.R	✓
	STPH5-60 (Sunny Tripower Hybrid X 5) / STPH6-60 (Sunny Tripower Hybrid X 6) / STPH8-60 (Sunny Tripower Hybrid X 8) / STPH10-60 (Sunny Tripower Hybrid X 10) / STPH12-60 (Sunny Tripower Hybrid X 12) / STPH15-60 (Sunny Tripower Hybrid X 15) / STPH20-70 (Sunny Tripower Hybrid X 20) / STPH25-70 (Sunny Tripower Hybrid X 25) / STPH30-70 (Sunny Tripower Hybrid X 30)	31.7.xx.R	✓
System controller	EDMM-10 (SMA Data Manager M)	1.11	✓
	EDMM-20 (SMA Data Manager M)	2.00.35.R	✓
	EDML-10 (SMA Data Manager L)	1.4	✓

1.2 Target Group

The functions described in this document are to be configured by qualified persons only. Qualified persons must have the following skills:

- Detailed knowledge of the grid management services
- Knowledge of how an inverter works and is operated
- Knowledge of how the product works and is operated
- Training in the installation and commissioning of electrical devices and installations
- Knowledge of all applicable laws, regulations, standards, and directives

1.3 Explanation of Used Terms

Term	Explanation
Operating mode	Method selected to perform a function or the type of application of a device
Operating state	Currently effective state of a device as a result of the active operating mode (e.g. in operation).
Fallback Behavior	If communication fails for an adjustable time, either the last communicated values are kept or predefined fallback values are taken.
Dynamic behavior	Abrupt changes in the setpoints can lead to undesirable system behavior. This system behavior can be avoided by the adjustable dynamic behavior. The dynamic behavior includes adjustable parameters and characteristic curves that allow a smooth transition from one setpoint to another.
System controller	Device for monitoring, controlling and grid-compliant power regulation at the grid connection point of larger PV systems with more than one inverter.
System Manager	A system controller or inverter with System Manager feature can take over the closed-loop control at the point of interconnection and provide open or closed-loop control of devices with a suitable measuring device. It also takes over system monitoring and communication to the Sunny Portal powered by ennexOS.

1.4 Content and Structure of this Document

This document provides an overview of the grid management service functions of inverters and system controllers. For this purpose, the document describes these functions and gives the object names of the parameters with which the functions can be set.

Not every system controller or inverter offers access to all parameters described in this document. The Technical Information "Parameters and Measured Values" provides an overview of the available parameters for the mentioned inverters.

Abbreviations Used

Frequently used abbreviations are listed and described in the following:

Designation in the document	Complete designation	Explanation
W	watt	Contained in object names of active power parameters
VAr	Volt-ampere reactive	Contained in object names of reactive power parameters
Pu	Per unit	Contained in object names of parameters that refer to another size (e.g. to the grid nominal voltage).
Ena	Enable	Contained in object names of activation/deactivation parameters
Mod	Mode	Contained in object names for which a setting can be selected from a list.
Q1	Quadrant 1	1st quadrant of the P/Q diagram
Q2	Quadrant 2	2nd quadrant of the P/Q diagram
Q3	Quadrant 3	3rd quadrant of the P/Q diagram

Designation in the document	Complete designation	Explanation
Q4	Quadrant 4	4th quadrant of the P/Q diagram
Rtg	Rating	Contained in object names of rating parameters
Stt	State	Contained in object names of state parameters
PF	Power Factor	Contained in object names of cos phi parameters

1.5 Additional Information

Additional information is available at www.SMA-Solar.com.

Title and information content	Type of information
"PUBLIC CYBER SECURITY - Guidelines for a Secure PV System Communication"	Technical Information
"Parameters and Measured Values"	Technical Information
Device-specific overview of all parameters and measured values and their setting options	
Information about the SMA Modbus registers	
"SMA and SunSpec Modbus® Interface"	Technical Information
Information on the Modbus interface	
"Modbus® parameters and measured values"	Technical Information
Device-specific list of the Modbus register	

2 General Information

Country Data Sets and Parameter Settings

The inverters are equipped with various country data sets that contain useful settings for the functions described in this document in order to comply with local standards and directives. These country data sets can be identified by the year ≥ 2018 . During commissioning of the system, the country data set must be set either via the installation assistant of the inverter or via a superordinate control unit (e.g. SMA Data Manager or Modbus control).

The parameters for setting the functions described in this document can either be set via the user interface of the inverter or via a superordinate control unit. An overview of all parameter settings of the inverter can be exported via the user interface of the inverter or, in the case of systems with SMA Data Manager, via the user interface of the SMA Data Manager. If a system is registered in the Sunny Portal powered by ennexOS, the parameter settings can also be exported via the Sunny Portal.

Communication Protocols

SMA Data

All parameters of the inverter are listed in the product-specific parameter list. The object name can be used to determine the parameter name for SMA Data as well as the path via which the parameter can be reached. You can also find additional information in the list (e.g. setting range, setting values, default value). The product-specific parameter list can be found in the download area at www.SMA-Solar.com. The list is assigned to the document type "Technical Information".

SMA Modbus

The product-specific Modbus list contains all parameters of the inverter with the associated SMA Modbus register address. The object name can be used to determine the register address for SMA Modbus. You can also find additional information in the list (e.g. format, type, access). The product-specific Modbus list can be found in the download area at www.SMA-Solar.com. The list is assigned to the document type "Technical Information".

SunSpec Modbus

The product-specific Modbus list contains all parameters of the inverter with the associated SunSpec Modbus register address. The object name can be used to determine the register address for SunSpec Modbus. You can also find additional information in the list (e.g. information model, access, scaling factor). The product-specific Modbus list can be found in the download area at www.SMA-Solar.com. The list is assigned to the document type "Technical Information".

SMA Grid Guard

No protection via SMA Grid Guard against cyber attacks

SMA Grid Guard is not an additional device or system password and does not provide protection against cyber attacks.

- During commissioning, assign secure device passwords and a secure system password (see Technical Information "PUBLIC CYBER SECURITY - Guidelines for a Secure PV System Communication").

All grid-relevant parameters for PV inverters are provided with SMA Grid Guard protection after the first ten feed-in hours have elapsed, and for battery inverters after the first ten operating hours have elapsed. When SMA Grid Guard protection is active, it is necessary to enter the SMA Grid Guard code in order to change grid-relevant parameters. You can request the SMA Grid Guard code via the Online Service Center.

In the "Grid Guard" column of the product-specific parameter and Modbus list you can see which parameters are given Grid Guard protection. The product-specific parameter and Modbus list can be found in the download area at www.SMA-Solar.com.

SMA Grid Guard protection is used to limit access to grid-relevant parameters to a group of persons qualified to do so and to log changes to these parameters.

3 General Operating Behavior

3.1 Electrical Connection Point

3.1.1 Setting the Reference Point for the PV System

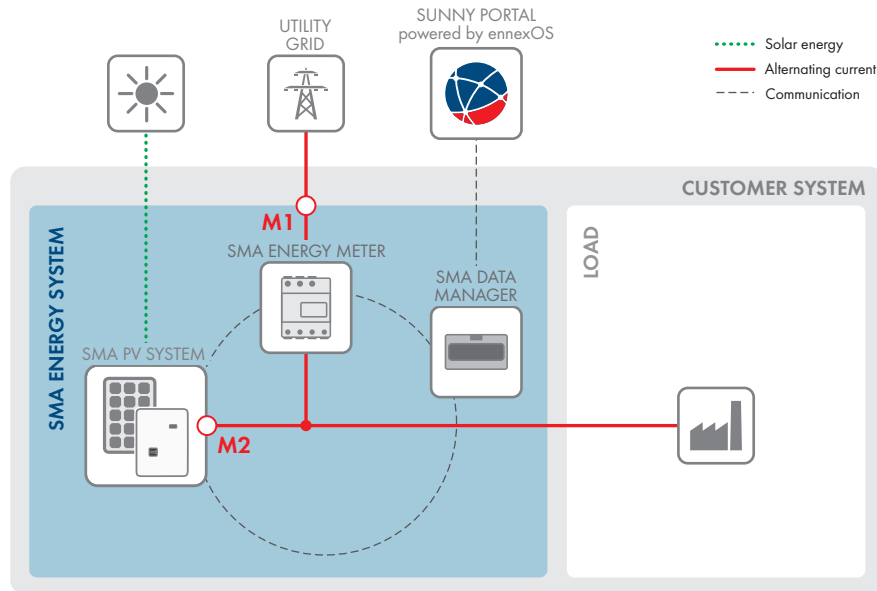


Figure 1: System overview with different electrical reference points

In the technical connection conditions, a distinction is typically made as to whether the requirements relate to the point of interconnection (M1) or to the inverter terminals (M2). The grid operator or the locally applicable regulations regarding the point of interconnection determine the reference point for your system.

Reference point	Explanation
M1	Reference point is the point of interconnection - Grid management services are generally implemented via a superordinate control unit (e.g. SMA Data Manager). - The measuring device at the grid-connection point must be selected. - The P/Q diagram must be set separately for the system. - Setpoints to the system refer to this P/Q diagram. - Disturbances between inverter and reference point M1 are adjusted for active and reactive power.
M2	The reference point is formed by the inverter terminals. All grid management services are implemented by the inverter and not by a superordinate control unit.

3.1.2 Adjustable Parameters of the Nominal Voltage

The grid nominal voltage for the reference point is indicated in the country data set. Normally, all voltage-related parameters (e.g. the shut-down limits of the voltage monitoring) refer to the grid nominal voltage. The nominal inverter voltage is a device-specific nominal value that must match the nominal grid voltage. Otherwise, a suitable transformer must be used and the nominal inverter voltage must be selected as the reference voltage for voltage-related values.

Object name	Definition (display group)	Explanation
Inverter.PlntCtl.VRef	Nominal grid voltage in V (AC Side > Inverter > PV system control)	The nominal grid voltage is specified as line-to-line voltage or line-to-neutral voltage, depending on the setting of Inverter.PlntCtl.VRef-Mod.
Inverter.PlntCtl.VRefMod	Phase reference of grid nominal voltage (AC Side > Inverter > PV system control)	Outer conductor / phase voltage
Inverter.PlntCtl.AppVol	Applicable voltages (AC Side > Inverter > PV system control)	Specifies whether the phase voltage, outer conductor voltage or both voltages are to be used for dynamic grid support and voltage monitoring.
Inverter.VRtg ¹⁾	Nominal inverter voltage in V (Device > Inverter)	The nominal inverter voltage is specified as line-to-line voltage.
Inverter.VRefIntMod ¹⁾	Reference voltage selection (Device > Inverter)	Specifies whether the nominal grid voltage (Inverter.PlntCtl.VRef) or the nominal inverter voltage (Inverter.VRtg) is used as the reference voltage for voltage-related values.

3.2 P/Q Diagram in the Generator Reference-Arrow System

At SMA Solar Technology AG all information always refers to the generator sign convention. The electricity and power flow from the generating plant into the utility grid always has a positive sign. The active power output is positive and the active power draw is negative. Positive reactive power corresponds to an overexcited operation and increases the voltage. Negative reactive power corresponds to an underexcited operation and lowers the voltage. The generator reference-arrow system is used internationally by IEC (International Electrotechnical Commission) and IEEE (Institute of Electrical and Electronics Engineers). In contrast, the VDE application guide, for example, refers to the consumer reference-arrow system. To translate the information into the generator reference-arrow system, the signs of the active and reactive power must be inverted. In the P/Q diagram, this corresponds to a mirroring at the origin.

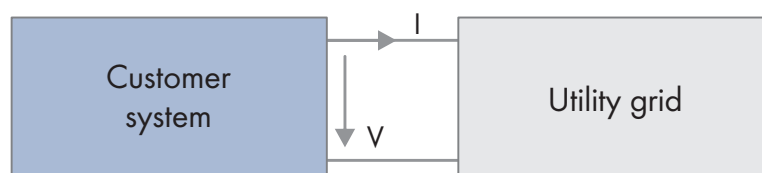


Figure 2: Generator Reference-Arrow System

¹⁾ Only three-phase inverters have this parameter.

The inverter or the system control is dimensioned for a certain P/Q power range. This limits the power range by multiple rating parameters for apparent power, active power, reactive power and cos phi. In case of an apparent power limitation, the reactive power is prioritized and the active power is reduced. The rating parameters cannot be set. In order to adjust the inverter or the system control to the local conditions, there are adjustable nominal sizes that limit the apparent power, active power, reactive power and cos phi. All nominal sizes typically have an associated rating parameter with the ending "Rtg". The following figure provides an overview of the nominal sizes.

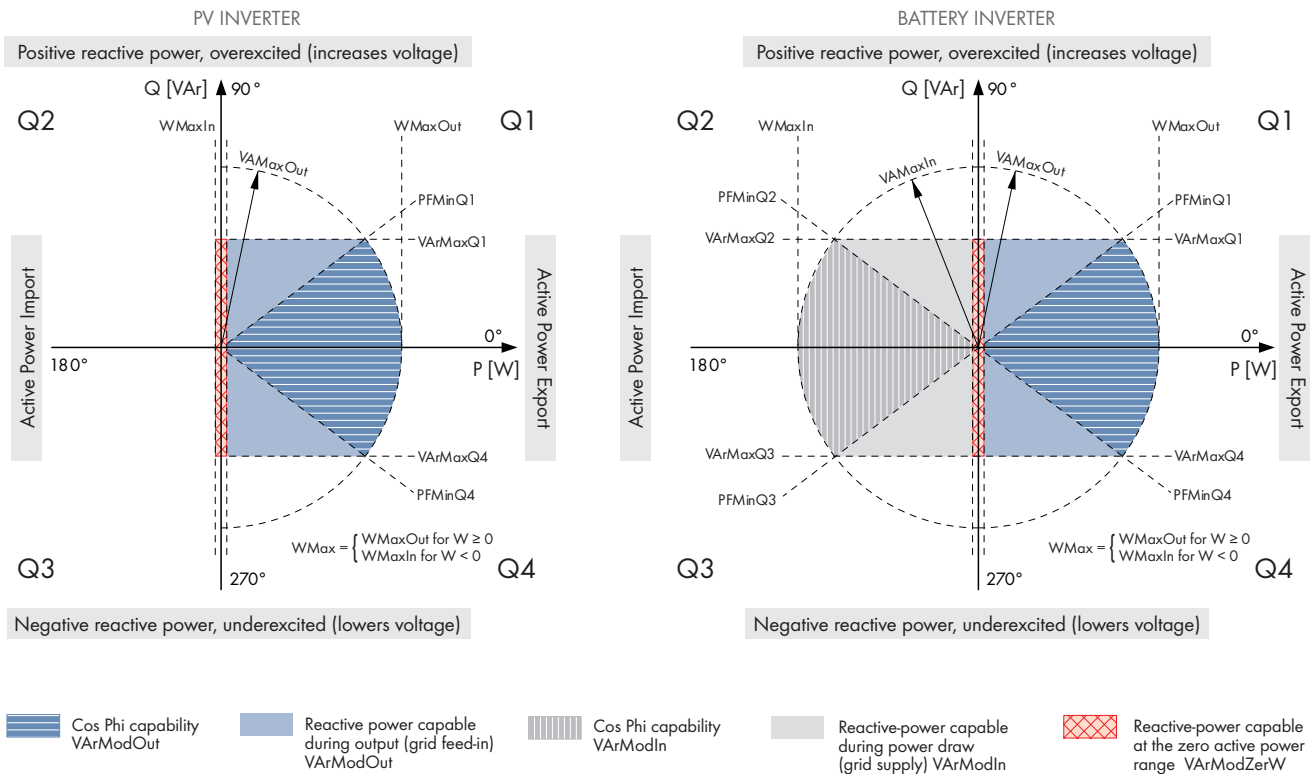


Figure 3: Nominal sizes and reactive power ranges in the P/Q diagram in the generator reference-arrow system for PV and battery inverters

Object name	Definition (display group)	Explanation
Inverter.VAMax	Nominal apparent power VAMaxOut in VA (AC Side > Inverter)	Maximum value limiting the apparent power at the active power output Rated value is Inverter.VALim (VAMaxOutRtg)
Inverter.VAMaxIn	Nominal apparent power VAMaxIn in VA (AC Side > Inverter)	Maximum value limiting the apparent power at the active power draw
Inverter.WMax	Nominal active power WMaxOut in W (AC Side > Inverter)	Maximum value limiting the active power at the active power output The rated active power is called Inverter.WLim (WMaxOutRtg)
Inverter.WMaxIn	Nominal active power WMaxIn in W (AC Side > Inverter)	Maximum value limiting the active power at the active power draw

Object name	Definition (display group)	Explanation
Inverter.VArMaxQ1 Inverter.VArMaxQ2 Inverter.VArMaxQ3 Inverter.VArMaxQ4	Nominal reactive power VArMaxQ1-Q4 in var (AC Side > Inverter)	Maximum value limiting the reactive power in each quadrant from Q1 to Q4
Inverter.PFMinQ1 Inverter.PFMinQ2 Inverter.PFMinQ3 Inverter.PFMinQ4	Nominal cos phi PFMinQ1-Q4 (AC Side > Inverter)	Limits the reactive power mode with cos phi setpoints or cos phi characteristic curves If Inverter.VArModCfg.PFMinEna is set to ON, then this limitation also applies to the other reactive power modes, but not at zero active power.
Inverter.VArMaxZerWQ1 Inverter.VArMaxZerWQ2 Inverter.VArMaxZerWQ3 Inverter.VArMaxZerWQ4	Nominal reactive power VArMaxZerWQ1-Q4 in var (AC Side > Inverter)	Limits the reactive power when there is zero active power
Inverter.VArModCfg.PFMinEna	Limit for all reactive power modes PFMinQ1-Q4 (System and device control > Inverter > Reactive power mode)	Activation / deactivation of cos phi limits PFMinQ1-Q4 also for reactive power modes that are not cos phi setpoints or cos phi characteristic curves (limits do not apply at zero active power)

3.3 Connection Behavior of Inverters

The inverter connects to the utility grid when the voltage and frequency are within the connection limits for a certain time. If the connection conditions are fulfilled, the inverter starts after a parameterizable connection time has elapsed. The connection time depends on whether the inverter connects after a grid fault, a short interruption or a normal restart. A grid fault is present when the voltage or frequency monitoring has triggered. A short interruption is present when the grid fault was shorter than the maximum duration of a short interruption.

Start-Up in Normal Operation

The inverter can use a ramp rate to control the set active and reactive power after a parameter change. This means that the inverter increases the power per second in steps according to the parameter settings.

Start-Up after Grid Fault

After a grid fault, the inverter can start feeding in active and reactive power immediately or control the specified active and reactive power at a ramp rate.

3.3.1 Connection Gradients

The connection gradients can limit the active and reactive power delivered or absorbed during a restart or when reconnecting after a grid fault. As a result, the connection gradients ensure a slow increase in the power output or power input from the zero point to the specified setpoint. The slow increase prevents abrupt changes in the power output or power input.

Parameters for the Increase in Active Power During a Restart

Object name	Definition (display group)	Explanation
Inverter.WGraConn	Soft start rate P in %/min (System and device control > Inverter)	Active power gradient for the connection during a restart The reference value is WMax-Out / WMaxIn.
Inverter.WGraConnEna	Soft start P (System and device control > Inverter)	Activates / deactivates the active power gradient for the connection during a restart

Parameters for the Increase in Active Power during Reconnection after a Grid Fault

Object name	Definition (display group)	Explanation
Inverter.WGraRecon	Soft start rate P after a grid fault in %/min (System and device control > Inverter)	Power gradient for reconnection after a grid fault The reference value is WMax-Out / WMaxIn.
Inverter.WGraReconEna	Soft start P after a grid fault (System and device control > Inverter)	Activates / deactivates the active power gradient for reconnection after a grid fault

Parameters for the Increase in Reactive Power after a Restart or Grid Fault

Object name	Definition (display group)	Explanation
Inverter.VArGraConn	Soft start rate Q in %/min (System and device control > Inverter)	Reactive power gradient for the connection after a restart or grid fault The reference value is Inverter.VArMaxQ1 / Inverter.VArMaxQ4.
Inverter.VArGraConnEna	Soft start Q after a grid fault (System and device control > Inverter)	Activates / deactivates the reactive power gradient for reconnection after a restart or grid fault

3.3.2 Connection Times**Restart**

Object name	Definition (display group)	Explanation
GridGuard.Cntry.GriStrTms	Connection time following a restart in s (Grid monitoring > Grid monitoring > Country standard)	-

Restarting after a Grid Fault

Object name	Definition (display group)	Explanation
GridGuard.Cntry.GriFlt-MonTms	Connection time after a grid fault in s (Grid monitoring > Grid monitoring > Country standard)	A grid fault is present when the voltage or frequency monitoring has triggered.
GridGuard.Cntry.GriFltRe-ConTms	Quick connection time after a short interruption in s (Grid monitoring > Grid monitoring > Country standard)	A short interruption is present when the grid fault was shorter than the maximum duration of a short interruption.
GridGuard.Cntry.GriFltTms	Maximum duration of a short interruption in s (Grid monitoring > Grid monitoring > Country standard)	If the grid fault is shorter than the set duration, then the quick reconnection time is used. Otherwise, the connection time after grid fault is used.

3.3.3 Connection Limits

Connection Limits for a Restart

The connection limits for an inverter restart are stored in the country data sets.

Setting the connection limits via	For information on parameters, see
Voltage monitoring	Section 5.1.1, page 55
Frequency monitoring	Section 5.2.1, page 69

Connection Limits for Restarting After a Grid Fault

The connection limits for an inverter restart after a grid fault are stored in the country data sets.

Setting the connection limits via	For information on parameters, see
Voltage monitoring	Section 5.1.1, page 55
Frequency monitoring	Section 5.2.1, page 69

3.4 Operating States of the Inverter

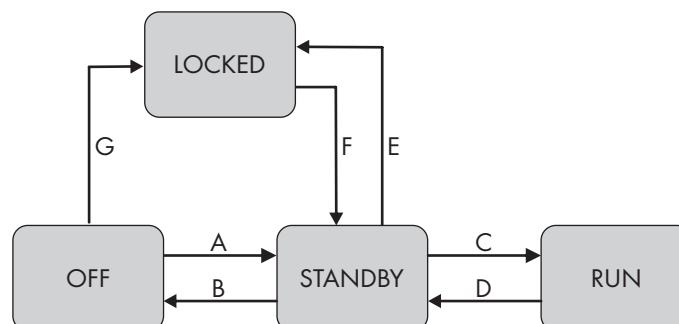


Figure 4: Overview of the operating states with state transitions

Operating States:

Operating state	Description
OFF	Off: The inverter is not in operation.
STANDBY	Ready for operation: The inverter is waiting for the operating conditions to be fulfilled.
RUN	In operation: The inverter is executing a function in accordance with the set operating mode (Operation.RunStt).
LOCKED	Blocked: The inverter is blocked due to a critical fault.

State Transitions:

Position	Change of operating state	Requirements
A	OFF > STANDBY:	The conditions for STANDBY are fulfilled (e.g. direct voltage is present) and the system operator has enabled operation (Operation.OpMod = Str).
B	STANDBY > OFF:	The conditions for STANDBY are not fulfilled (e.g. direct voltage is not present).
C	STANDBY > RUN:	The connection conditions are fulfilled: • The grid frequency is within the connection limits. • The grid voltage is within the connection limits. • The wait time after a grid fault or first grid connection without previous grid fault has elapsed: The wait time after the first grid connection without previous grid fault has elapsed (GridGuard.Cntry.GriStrTms). If there was a short-lived grid fault (less than GridGuard.Cntry.GriFltTms), the wait time after the grid fault has elapsed (GridGuard.Cntry.GriFltReConTms). If there was a prolonged grid fault (more than GridGuard.Cntry.GriFltTms), the wait time after the grid fault has elapsed (GridGuard.Cntry.GriFltMonTms). In case of a blocking event, in addition: The event message is acknowledged or the wait time has elapsed. The active power setpoint for the grid feed-in is not limited to 0% (see Section 4.1.1 "Active Power Setpoint", page 20). Only for battery inverters: energy management does not require STANDBY.
D	RUN > STANDBY:	Only 1 of the following conditions must be fulfilled: • A grid disconnecting event (relay opening event) occurs. • Only for battery inverters: energy management requires STANDBY. • The system operator has withdrawn the permission to operate (Operation.OpMod = Stop).
E	STANDBY > LOCKED:	The relay opening events is a manual restart or the system operator has withdrawn the permission to operate (Operation.OpMod = Stop)

Position	Change of operating state	Requirements
F	LOCKED > STANDBY:	The lock is released by the system operator enabling operation (Operation.OpMod = Str). When this occurs, there is no fast stop command for more than 10 s.
G	OFF > LOCKED	The conditions for STANDBY are fulfilled (e.g. direct voltage is present) and the system operator has withdrawn permission to operate (Operation.OpMod = Stop).

3.4.1 Operating Status Control

Object name	Definition (display group)	Explanation
Operation.OpMod	General operating mode: Determines the operating mode of the inverter. (Device > Operation)	Adjustable: Stop/Stop Str / Start
Operation.CtrlType	DC voltage control type: - The direct voltage is controlled in such a manner that the inverter operates at the maximum power point (MPP). - The direct voltage is kept constant. There is no MPP tracking. (Device > Operation)	Adjustable: Mpp / MPP VolDCCConst / constant voltage
Inverter.FstStop	Fast shutdown: The system must be separated from the utility grid. (System and device control > Inverter)	Adjustable: Stop/Stop Str / Start
Operation.EnSavMod	Energy saving mode: The inverter is switched on but does not feed in.	Adjustable: Off / Off On / On

3.4.2 Operating Status Indication

Object name	Definition (display group)	Explanation
Operation.OpStt	General operating state: The inverter shows its operating state. (Status > Operation)	Possible statuses: Off / Off Stdbby / Standby (Operation.StandbyStt) Run / Activated (Operation.RunStt) Lok / Bolted (Operation.RstrLokStt)
Operation.StandbyStt	Standby status: The inverter waits for an operating condition (e.g. for PV voltage). (Status > Operation)	Substatus for the operating status Standby Possible statuses: WaitPV / waiting for PV voltage WaitGri / waiting for valid AC grid EnSavMod / energy saving mode NaNStt / information not available

Object name	Definition (display group)	Explanation
Operation.RunStt	Operating status: The inverter is in operation. (Status > Operation)	Substatus for the operating status "Run" Possible statuses: Mpp / MPP tracking VolDCCConst / constant voltage Bck / Backup SocOp / Stand-Alone Operation Shtdwn / shutdown Drt / derating NaNStt / information not available
Operation.RstrLokStt	Locking status: The inverter is blocked by a critical fault. The lock is released by the system operator enabling operation (Operation.OpMod = Str) (Status > Operation)	Substatus for the operating status Lok Possible statuses: HzFlt / frequency not permitted EvtAfcI / electric arc detected FstStop / fast stop OvVol / overvoltage UnVol / undervoltage OvHz / overfrequency UnHz / underfrequency PID / passive islanding detection PLD / phase loss PLL / PLL error PLDLoVol / phase loss on low-voltage side ActIsldDet / active islanding detection ManRstrRCD / after fault current WaitStr / wait for enable operation NaNStt / information not available

4 Behavior in Case of Undisturbed Utility Grid

4.1 Active Power Mode

There are several active power modes that affect the active power flow of the customer system. For operation on the undisturbed utility grid, setpoint input 1 and, as an option, setpoint input 2 are implemented (e.g. for specifications from the market and grid). In addition, there is one P(V) characteristic curve and one P(f)-characteristic curve (see Section 5.2.2 "P(f) Characteristic Curve", page 71). The specifications resulting from these procedures are processed and prioritized in parallel as follows:

1. The minimum value is created from all the maximum specifications.
2. The maximum value is created from all the minimum specifications.
3. The minimum value of all maximum setpoints and the maximum value of all minimum setpoints result in a permitted range for the setpoint. If the minimum value of the maximum setpoints is smaller than the maximum value of the minimum setpoints, there is a conflict.

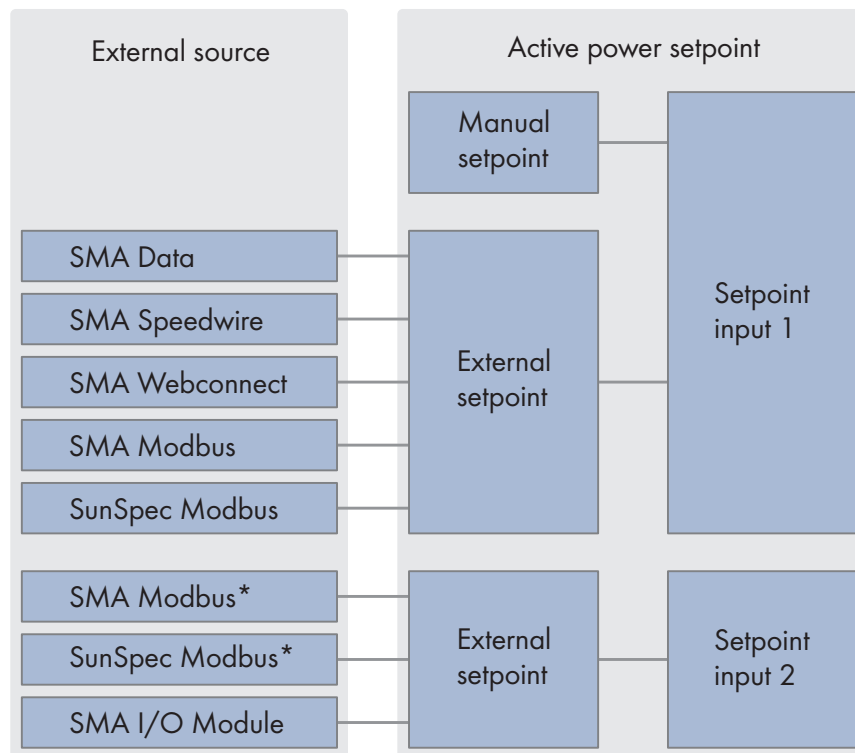
In case of a conflict, the specifications are taken into account in the following order:

- Manual setpoint input
- External setpoint input 2 with high priority
- External setpoint input 1 with high priority
- P(V) characteristic curve
- P(f) Characteristic Curve
- External setpoint input 2 with low priority
- External setpoint input 1 with low priority

Each setpoint input can only process 1 setpoint. The prioritization of the external setpoint inputs can be adjusted.

4.1.1 Active Power Setpoint

To avoid grid overloading, generating plants must reduce their active power at the grid-connection point if specified by the grid operator without disconnecting themselves from the utility grid. The setpoint for the active power setpoint can be specified manually via the user interface of the inverter or externally (e.g. through telecontrol or a system controller).



* In the case of external specification via the parameter Mb.ScdInEna, it is possible to set the input to be used for processing the setpoint.

Figure 5: Schematic diagram of the active power setpoint with two setpoint inputs

Manual Setpoint at Setpoint Input 1

In case of a manual setpoint, you must enter the setpoint specified by the grid operator as a value in watt or in percent via parameters. The dynamic behavior for converting the setpoint can be set by the same parameters as the dynamic behavior for converting the external setpoints at setpoint input 1 (see Section 4.1.1.3 "External Setting at Setpoint Input 1", page 22).

External Setpoint at Setpoint Input 1

In case of an external setpoint, the inverter receives the setpoint through a superordinate control unit. The dynamic behavior for the implementation of the setpoint and the fallback behavior for the absent active power setpoint can be adjusted via parameters. The setpoint is specified in the form of maximum and minimum value. As a result, both a one-sided limit and exact operating points can be specified.

External Setpoint at Setpoint Input 2

Products with a second input for external setpoints can process an additional setpoint from a second external source. This lets you process, for example, specifications of the direct seller with SMA Spot via SMA Webconnect at setpoint input 1 and, at the same time, the grid operator's specifications via the SMA I/O module at setpoint input 2. Just as with setpoint input 1, you can set the dynamic behavior for the implementation of the setpoint and the fallback behavior for absent setpoints.

Setting the Operating Mode for the Active Power Setpoint

Object name	Definition (display group)	Explanation
Inverter.WModCfg.WMod	Operating mode active power (System and device control > Inverter > Active power control)	Adjustable: Off Manual specification in W Manual specification in % External specification (setpoint input 1 and setpoint input 2) External specification setpoint input 1 External specification setpoint input 2

Setting the Inverter Behavior at an Active Power Setpoint of 0%

If the parameter Inverter.WModCfg.GriSwOpnZerW is activated and, at the same time, an active power of 0% is set, the system disconnects from the utility grid.

Object name	Definition (display group)	Explanation
Inverter.WModCfg.GriSwOpnZerW	Disconnection from the grid at an active power setpoint of 0% (System and device control > Inverter > Active power control)	Activates / deactivates disconnection from the grid at an active power setpoint of 0%

4.1.1.1 Configuring the Active Power Mode

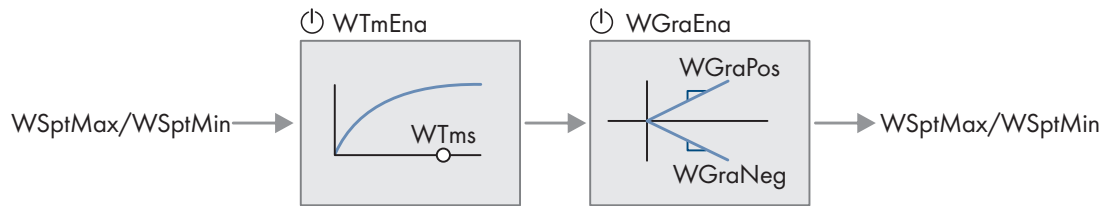
If **Off** is selected as the active power mode, the limitation of the manual and external active power setpoint is canceled. When there is a change to active power mode **Off**, the dynamic settings of the previously applicable manual or external active power setpoint apply for canceling the limitation.

4.1.1.2 Manual Setting at Setpoint Input 1

Object name	Definition (display group)	Explanation
Inverter.WModCfg.WCnstCfg.W	Active power limitation, in W (System and device control > Inverter > Active power control > Manual setting)	-
Inverter.WModCfg.WCnstCfg.WNom	Active power limitation in % (System and device control > Inverter > Active power control > Manual setting)	The reference value is WMax-Out / WMaxIn.

4.1.1.3 External Setting at Setpoint Input 1

Setting the Dynamic Behavior for Implementing the External Setpoint at Setpoint Input 1



Object name	Definition (display group)	Explanation
Inverter.WModCfg.WCtl-ComCfg.Dyn.WTmEna	Setpoint filter (System and device control > Inverter > Active power mode > External setting > Dynamics)	Activation / deactivation
Inverter.WModCfg.WCtl-ComCfg.Dyn.WTms	Response time for setpoint filter in s (System and device control > Inverter > Active power mode > External setting > Dynamics)	The response time corresponds to 3 taus (RC time constant) of a PT1 element
Inverter.WModCfg.WCtl-ComCfg.Dyn.WGraEna	Limitation of change rate (System and device control > Inverter > Active power mode > External setting > Dynamics)	Activation / deactivation
Inverter.WModCfg.WCtl-ComCfg.Dyn.WGraPos	Ramp-up rate in %/s (System and device control > Inverter > Active power mode > External setting > Dynamics)	The reference value is WMax-Out.
Inverter.WModCfg.WCtl-ComCfg.Dyn.WGraNeg	Ramp-down rate in %/s (System and device control > Inverter > Active power mode > External setting > Dynamics)	The reference value is WMax-Out.

Setting the Fallback Behavior for Absent External Setpoint at Setpoint Input 1

If communication fails for an adjustable time, either the last communicated values are kept or the fallback values are taken.

Object name	Definition (display group)	Explanation
Inverter.CtlComCfg.WCtl-Com.CtlComMssMod	Fallback Behavior (System and device control > Inverter > System control and fallback behavior > External setting)	Adjustable: Values maintained (maintain the values received last) Apply fallback values
Inverter.CtlComCfg.WCtl-Com.FlbWMin	Fallback value of minimum active power in W (System and device control > Inverter > System control and fallback behavior > External setting)	-
Inverter.CtlComCfg.WCtl-Com.FlbWMinNom	Fallback value as normalized minimum active power (System and device control > Inverter > System control and fallback behavior > External setting)	The reference value for positive values is WMaxOut The reference value for negative values is WMaxIn

Object name	Definition (display group)	Explanation
Inverter.CtlComCfg.WCtl-Com.FlbWMax	Fallback value of maximum active power in W (System and device control > Inverter > System control and fallback behavior > External setting)	-
Inverter.CtlComCfg.WCtl-Com.FlbWMaxNom	Fallback value as normalized maximum active power (System and device control > Inverter > System control and fallback behavior > External setting)	The reference value for positive values is WMaxOut The reference value for negative values is WMaxIn
Inverter.CtlComCfg.WCtl-Com.GraFlbMod	Activation of the ramp rate in fallback behavior	Adjustable: Ramp becomes active for the start of the fallback behavior: Flb-Str Ramp becomes active for the exit from the fallback behavior: FlbEnd Off
Inverter.CtlComCfg.WCtl-Com.WGraFlb	Ramp rate in fallback behavior in %/s in relation to WMaxOut	-
Inverter.CtlComCfg.WCtl-Com.TmsOut	Timeout in s	For this time, the external setpoint must remain off before the fallback mode is activated.
Inverter.CtlComCfg.WCtl-Com.TmsOutPrc	Timeout in s (2 decimal places) (System and device control > Inverter > System control and fallback behavior > External setting)	

4.1.1.4 External Setting at Setpoint Input 2

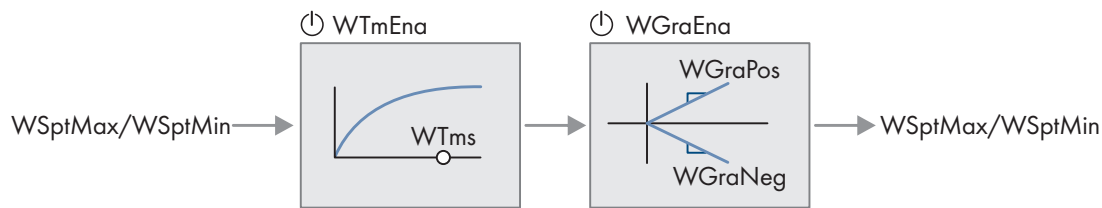
Object name	Definition (display group)	Explanation
Mb.ScdInEna	Modbus P specifications at inlet 2 (External communication > Modbus)	Active power setpoints via Modbus are processed at setpoint input 2. This enables parallel operation with SMA system control.

Setting the Priority of Setpoint Input 2

When the second setpoint input is activated with low priority, the maximum and minimum active power setpoint have lower priority than the P(V) characteristic curve and the P(f) characteristic curve. Otherwise, the maximum and the minimum active power setpoints have a higher priority.

Object name	Definition (display group)	Explanation
Inverter.WModCfg.WCtl-ComCfg2.LoPrioEna	Low priority (System and device control > Inverter > Active power mode > External setting 2)	Activation / deactivation

Setting the Dynamic Behavior for Implementing the External Setpoint at Setpoint Input 2



Object name	Definition (display group)	Explanation
Inverter.WModCfg.WCtl-ComCfg2.Dyn.WTmEna	Setpoint filter (System and device control > Inverter > Active power mode > External setting 2 > Dynamics)	Activation / deactivation
Inverter.WModCfg.WCtl-ComCfg2.Dyn.WTms	Response time for setpoint filter in s (System and device control > Inverter > Active power mode > External setting 2 > Dynamics)	The response time corresponds to 3 taus (RC time constant) of a PT1 element
Inverter.WModCfg.WCtl-ComCfg2.Dyn.WGraEna	Limitation of change rate (System and device control > Inverter > Active power mode > External setting 2 > Dynamics)	Activation / deactivation
Inverter.WModCfg.WCtl-ComCfg2.Dyn.WGraPos	Ramp-up rate in %/s (System and device control > Inverter > Active power mode > External setting 2 > Dynamics)	The reference value is WMax-Out.
Inverter.WModCfg.WCtl-ComCfg2.Dyn.WGraNeg	Ramp-down rate in %/s (System and device control > Inverter > Active power mode > External setting 2 > Dynamics)	The reference value is WMax-Out.

Setting the Fallback Behavior for Absent External Setpoint at Setpoint Input 2

If communication fails for an adjustable time, either the last communicated values are kept or the fallback values are taken.

Object name	Definition (display group)	Explanation
Inverter.CtlComCfg.WCtl-Com2.CtlComMssMod	Fallback Behavior (System and device control > Inverter > System control and fallback behavior > External active power setting 2)	Adjustable: Values maintained (maintain the values received last) Apply fallback values
Inverter.CtlComCfg.WCtl-Com2.FlbWMinNom	Fallback value as normalized minimum active power (System and device control > Inverter > System control and fallback behavior > External active power setting 2)	The reference value for positive values is WMaxOut The reference value for negative values is WMaxIn
Inverter.CtlComCfg.WCtl-Com2.FlbWMaxNom	Fallback value as normalized maximum active power (System and device control > Inverter > System control and fallback behavior > External active power setting 2)	The reference value for positive values is WMaxOut The reference value for negative values is WMaxIn

Object name	Definition (display group)	Explanation
Inverter.CtlComCfg.WCtl-Com2.GraFlbMod	Activation of the ramp rate in fallback behavior	Adjustable: Ramp becomes active for the start of the fallback behavior: Flb-Str Ramp becomes active for the exit from the fallback behavior: FlbEnd Off
Inverter.CtlComCfg.WCtl-Com2.WGraFlb	Ramp rate in fallback behavior in %/s in relation to WMaxOut	-
Inverter.CtlComCfg.WCtl-Com2.TmsOut	Timeout in s	For this time, the external setpoint must remain off before the fallback mode is activated
Inverter.CtlComCfg.WCtl-Com2.TmsOutPrc	Timeout in s (2 decimal places) (System and device control > Inverter > System control and fallback behavior > External active power setting 2)	

4.1.1.5 Special Cases for System Controllers

System controllers use setpoint input 1 for the direct seller's specifications and setpoint input 2 for the grid operator's specifications.

The lowest priority is always setpoint input 1 for market specifications. Manual specifications are counted as specifications of the grid operator. Thus, in contrast to the inverters, the dynamic behavior of the manual setpoint is set via the same parameters as the dynamic behavior of the external setpoints at setpoint input 2. For system controllers, the operating mode for active power setpoints is not set via the parameter Inverter.WModCfg.WMod, but via the parameters in the following table. By using multiple parameters, it is possible to have external specifications processed parallel to manual specifications.

Object name	Definition (display group)	Explanation
Inverter.WModCfg.WCnstCfg.WEna	Manual active power specification in W	-
Inverter.WModCfg.WCnstCfg.WNomEna	Manual active power specification in %	-
Inverter.WModCfg.WCtl-ComCfg.Ena	External active power specification	Activates / deactivates the operating mode WCtlCom (active power setpoint by communication) via channel 1.
Inverter.WModCfg.WCtl-ComCfg2.Ena	External active power setpoint 2	Activates / deactivates the operating mode WCtlCom (active power setpoint by communication) via channel 2.

Different reference values for external active power setpoints

For system controllers, a separate reference value can each be configured for the external active power setpoints at setpoint input 1 (direct seller) and at setpoint input 2 (grid operator).

By default, the external active power setpoints refer to the maximum active power of the system (W_{Max}). Alternatively, an individual reference value with a separate reference level can be parameterized for each setpoint input. This allows the specifications of different market participants to be standardized independently of each other. For example, the specification of the direct seller may be based on a different reference power than the specification of the grid operator.

Object name	Definition (display group)	Explanation
Inverter.WModCfg.WCtlCom-Cfg.WRefMod	External active power setpoint, selection of reference value	Selection of reference value for setpoint input 1 (direct seller) Adjustable: Maximum active power W_{Max} (default), reference value active power. When selecting the "Reference value Active power", the reference parameter W_{SpRef} is also used.
Inverter.WModCfg.WCtlCom-Cfg.WSpRef	External active power specification, reference value	Reference level for setpoint input 1
Inverter.WModCfg.WCtlCom-Cfg2.WRefMod	External active power setpoint 2, selection of reference value	Selection of reference value for setpoint input 2 (grid operator) Adjustable: Maximum active power W_{Max} (default), reference value active power. When selecting the "Reference value Active power", the reference parameter W_{SpRef} is also used.
Inverter.WModCfg.WCtlCom-Cfg2.WSpRef	External active power specification 2, reference value	Reference level for setpoint input 2

Information: The reference value and the associated reference level can be configured independently of each other for setpoint input 1 and setpoint input 2. This allows for different standardization bases for the specifications by the direct seller and the grid operator.

Example: A grid operator specifies an active power limitation at the point of interconnection (e.g. as part of PAV,E monitoring). The reference level configured for this purpose can be used as a reference value for the direct seller. Therefore, a setpoint of 100% from the direct seller refers to this reference level and not to the maximum system output (W_{Max}).

4.1.2 Voltage-Dependent Active Power Adjustment P(V)

The voltage-dependent active power adjustment reduces the feed-in power as a function of the measured grid voltage and, if necessary, can also lead to a power reversal and an active power draw (e.g. in the case of storage systems).

P(V) with Direction of Charging

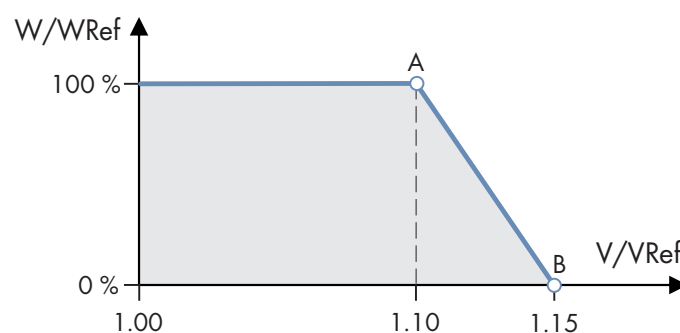


Figure 6: Example of a P(V) characteristic curve with two interpolation points

The reference value W_{Ref} is determined according to a procedure that is defined via the setting

Inverter.WModCfg.WCtIVolCfg.WRefMod (Display group: System and device control > Inverter > Active power mode > Voltage-dependent active power adjustment $P(V)$).

Reference value	Mode	Active power output	Active power draw
Inverter.WMod- Cfg.WCtIVol- Cfg.WRefMod	Maximum power (W_{MaxOut} / W_{MaxIn}): maximum active power of the inverter	$W_{Ref} = W_{MaxOut}$	$W_{Ref} = W_{MaxIn}$
	Instantaneous power (W_{Snpt}): measured active power at the time when the first buckling point of the characteristic curve is exceeded W_{Mom} is frozen if it is exceeded and from then on no longer corresponds to the actual instantaneous active power.	$W_{Ref} = W_{Mom}$	$W_{Ref} = 0$
	Potential power ($W_{SnptMax}$): difference between the maximum power and instantaneous power	$W_{Ref} = W_{Mom} - W_{MaxIn}$	

P(V) with Direction of Discharging and Charging

If A and B < 1.0 p.u., then the characteristic curve of the direction of discharging is used. If C and D > 1.0 p.u., then the characteristic curve of the direction of charging is used.

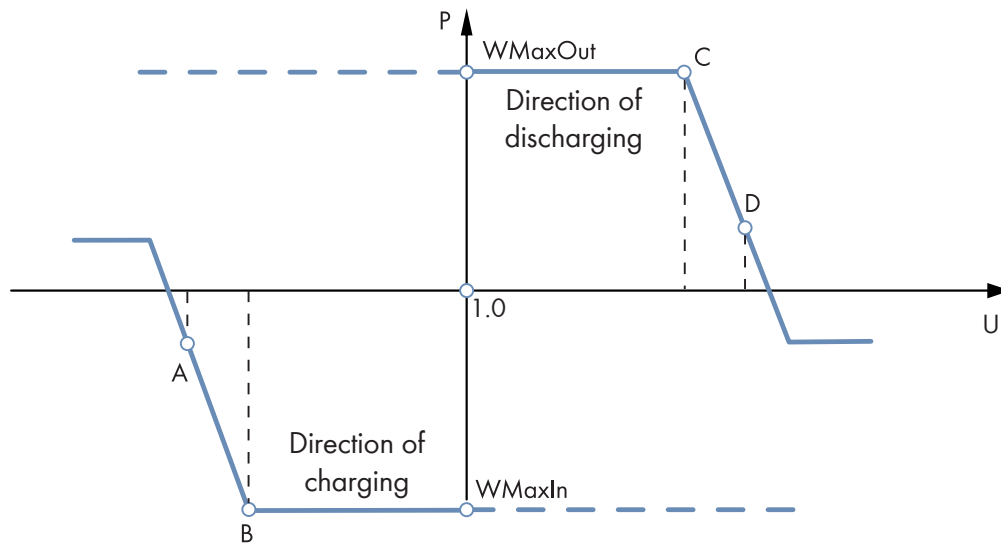


Figure 7: Example of a P(V) characteristic curve with two interpolation points, direction of charging added

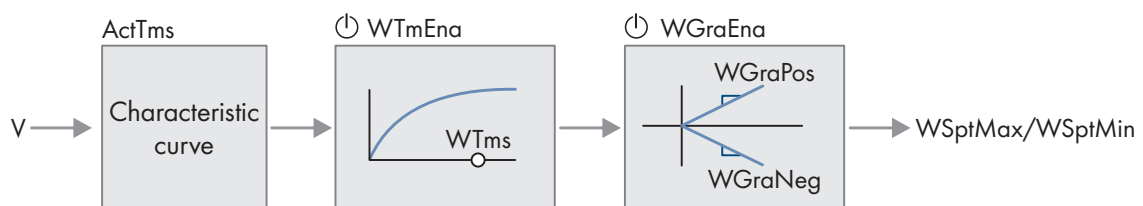
Reference value	Mode	Active power output	Active power draw
Inverter.WMod- Cfg.WCtlVol- Cfg.WRefMod	Maximum power (WMaxOut / WMaxIn): maximum active power of the inverter	$W_{Ref} = W_{MaxOut}$	$W_{Ref} = W_{MaxIn}$
	Instantaneous power (WSnpt): measured active power at the time when the first buckling point of the characteristic curve is exceeded WMom is frozen if it is exceeded and from then on no longer corresponds to the actual instantaneous active power.	$W_{Ref} = W_{Mom}$	$W_{Ref} = W_{Mom}$
	Potential power (WSnptMax): difference between the maximum power and instantaneous power	$W_{Ref} = W_{Mom} - W_{MaxIn}$	$W_{Ref} = W_{MaxOut} - W_{Mom}$

Setting the Characteristic Curve

Object name	Definition (display group)	Explanation
Inverter.WMod- Cfg.WCtlVolCfg.Ena	P(V) characteristic curve (System and device control > Inverter > Active power mode > Voltage-dependent active power adjustment P(V))	Activation / deactivation
Inverter.WMod- Cfg.WCtlVolCfg.LoPrioEna	When activated, P(V) has a lower priority compared to the P(f) characteristic curve	Activation/deactivation

Object name	Definition (display group)	Explanation
Inverter.WMod-Cfg.WCtIVolCfg.VRefMod	Type of reference voltage (System and device control > Inverter > Active power mode > Voltage-dependent active power adjustment P(V))	Adjustable: PhsAvg / mean value of phase voltages PhsMax / maximum phase voltage
Inverter.WMod-Cfg.WCtIVolCfg.WRefMod	Type of reference active power (System and device control > Inverter > Active power mode > Voltage-dependent active power adjustment P(V))	Adjustable: WMaxOut / WMaxIn / Maximum active power WSnpt / Current active power WSnptMax / Potential active power
Inverter.WMod-Cfg.WCtIVol-Cfg.Crv.NumPt	Number of used support points (System and device control > Inverter > Active power mode > Voltage-dependent active power adjustment P(V))	-
Inverter.WMod-Cfg.WCtIVolCfg.Crv.XVal	Voltage values of the P(V) characteristic curve in p.u. (System and device control > Inverter > Active power mode > Voltage-dependent active power adjustment P(V))	The reference value is the parameterized nominal voltage (see Section 3.1.2 "Adjustable Parameters of the Nominal Voltage", page 11).
Inverter.WMod-Cfg.WCtIVolCfg.Crv.YVal	Active power values of the P(V) characteristic curve (System and device control > Inverter > Active power mode > Voltage-dependent active power adjustment P(V))	Indicated in % of the maximum, current or potential active power (depending on the setting of Inverter.WModCfg.WCtIVol-Cfg.WRefMod).

Configuring Dynamic Response



Object name	Definition (display group)	Explanation
Inverter.WMod-Cfg.WCtIVolCfg.WTmEna	Setpoint filter (System and device control > Inverter > Active power mode > Voltage-dependent active power adjustment P(V))	Activation / deactivation
Inverter.WMod-Cfg.WCtIVolCfg.WTms	Response time for setpoint filter in s (System and device control > Inverter > Active power mode > Voltage-dependent active power adjustment P(V))	Response time corresponds to 3 taus (RC time constant) of a PT1 element

Object name	Definition (display group)	Explanation
Inverter.WMod-Cfg.WCtlVolCfg.WGraEna	Limitation of change rate (System and device control > Inverter > Active power mode > Voltage-dependent active power adjustment P(V))	Activation / deactivation
Inverter.WMod-Cfg.WCtlVolCfg.WGraPos	Ramp-up rate in %/s (System and device control > Inverter > Active power mode > Voltage-dependent active power adjustment P(V))	The reference value is WMax-Out.
Inverter.WMod-Cfg.WCtlVolCfg.WGraNeg	Decrease rate %/s (System and device control > Inverter > Active power mode > Voltage-dependent active power adjustment P(V))	The reference value is WMax-Out.
Inverter.WMod-Cfg.WCtlVolCfg.ActTms	Tripping delay in s (System and device control > Inverter > Active power mode > Voltage-dependent active power adjustment P(V))	Delay of the active power adjustment after exceeding the first buckling point

4.1.3 Active Power Increase in Case of Change in Irradiation

When there is a change in irradiation, the inverter can limit its active power by means of the increase rate.

Object name	Definition (display group)	Explanation
Inverter.WGraMppEna	Increase rate in case of change in irradiation (System and device control > Inverter)	Activation/deactivation
Inverter.WGraMpp	Ramp-up rate in case of a change in irradiation in %/min (System and device control > Inverter)	The reference value is WMax-Out.

4.2 Reactive Power Mode

Generating and electricity-drawing plants must provide reactive power to support the utility grid. By providing reactive power, voltage changes in the utility grid are kept within acceptable limits. The dimensioning of the generating plant with regard to the required reactive power provision at the grid-connection point is the responsibility of the PV system operator. The grid operator specifies the reactive power mode and the parameters to be set.

The grid operator typically has different demands for generating and electricity-drawing plants. Accordingly, the process can be activated and adjusted for active power consumption (consumption) regardless of the process for active power output (grid feed-in). Since the grid operator's requirements usually only apply from a certain minimum active power, a separate procedure can be activated and set for the range between zero active power and minimum active power. The cos phi procedure cannot be selected in this range due to technical reasons.

When the inverter is disconnected from the AC voltage or disconnects itself, a connection can only be made again if sufficient DC power is available at the inputs of the inverter.

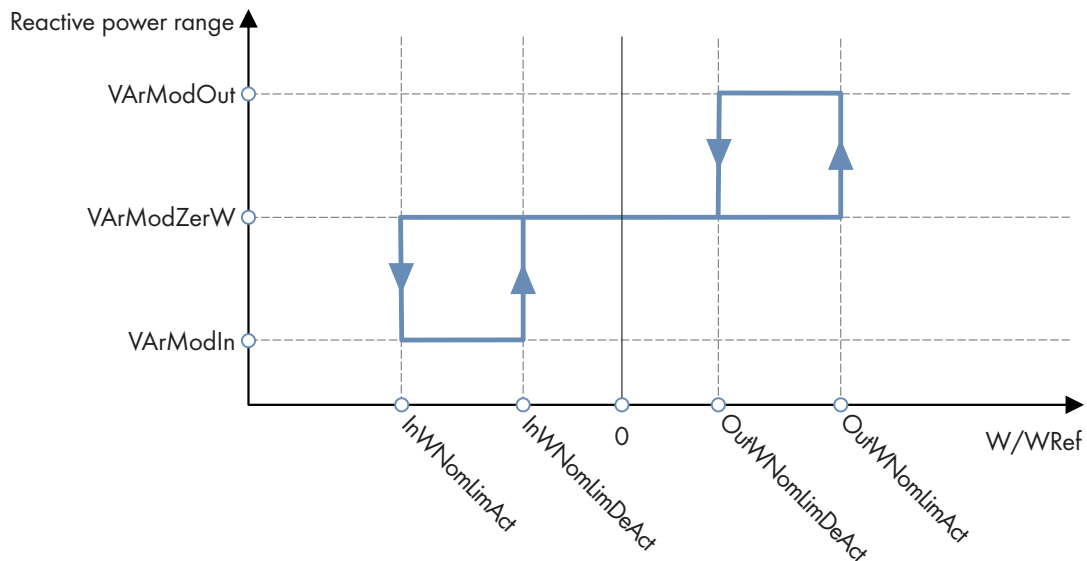


Figure 8: Activates / deactivates the reactive power ranges in relation to the active power

The parameters OutWNomLimAct and OutWNomLimDeAct describe the limits between the reactive power mode ranges VArModOut and VArModZerW. The parameters InWNomLimAct and InWNomLimDeAct describe the limits between the reactive power mode ranges VArModIn and VArModZerW. In these three reactive power ranges the reactive power mode required by the grid operator is set.

Reactive power range	Definition (display group)	Explanation
Inverter.VArModCfg.VArModOut	Reactive power mode in case of active power output (System and device control > Inverter > Reactive power mode)	Reactive power range in case of active power output
Inverter.VArModCfg.VArModIn	Reactive power mode in case of active power draw (System and device control > Inverter > Reactive power mode)	Reactive power range in case of active power draw
Inverter.VArModCfg.VArModZerW	Reactive power for zero active power (System and device control > Inverter > Reactive power mode)	Reactive power range for zero active power (e.g. for Q on Demand)

The following table gives an overview of which methods can be set for active power draw, active power output and zero active power.

Mode	Active power draw	Zero active power	Active power output
Off	✓	✓	✓
Q setting	✓	✓	✓
Cos phi setpoint	✓	-	✓
Q(P) characteristic curve	✓	✓	✓
Q(V) characteristic curve	✓	✓	✓

Mode	Active power draw	Zero active power	Active power output
Cos phi(P) characteristic curve	✓	-	✓
Cos phi(V) characteristic curve	✓	-	✓

Q on Demand

With the order option "Q on Demand", the inverter can provide reactive power in order to stabilize the utility grid during non-feed-in operation, e.g. at night, or to compensate for reactive power in the PV power plant.

To activate Q on Demand, the reactive power area at zero active power must be configured via parameter Inverter.VArModCfg.VArModZerW. In addition, parameter Inverter.VArModCfg.QoDEna must be set to ON. If parameter Inverter.VArModCfg.QoDEna is not present, Q on Demand is activated as soon as parameter Inverter.VArModCfg.VArModZerW is not OFF.

Setting the Activation and Deactivation Thresholds for Reactive Power Provision

The activation and deactivation thresholds are expressed in % and refer to the reference value selected in the parameter Inverter.VArModCfg.ActLimRefMod, which is typically defined via the country data set. In WMaxIn/WMaxOut mode, the values refer to either WMaxIn or WMaxOut, depending on the active power operating point. In VAMaxOut mode, all values refer to VAMaxOut.

Object name	Definition (display group)	Explanation
Inverter.VArModCfg.ActLimRefMod	Reference mode for switching the working ranges import, ZeroWatt, export	Selection of the reference value for converting the percentage activation and deactivation thresholds. If the parameter is not available, the WMaxIn/Out mode is used as default. VAMaxIn/Out: reference value switches between active power draw and active power output (WMaxIn/WMaxOut). VAMaxOut: reference value is constantly VAMaxOut for active power draw and active power output.
Inverter.VArModCfg.In-WNomLimAct	Activation threshold of the reactive power mode in case of active power draw in % (System and device control > Inverter > Reactive power mode)	The reference value is WMaxIn or WMaxOut (depending on the setting in Inverter.VArModCfg.ActLimRefMod). When the activation threshold is exceeded, the reactive power mode in case of active power draw is activated.

Object name	Definition (display group)	Explanation
Inverter.VArModCfg.In-WNomLimDeAct	Deactivation threshold of the reactive power mode in case of active power draw in % (System and device control > Inverter > Reactive power mode)	The reference value is WMaxIn or WMaxOut (depending on the setting in Inverter.VArModCfg.Act- LimRefMod). When the deactivation threshold is fallen short of, the reactive power mode in case of active power draw is deactivated and the reactive power mode in case of zero active power is activated.
Inverter.VArModCfg.Out-WNomLimAct	Activation threshold of the reactive power mode in case of active power output in % (System and device control > Inverter > Reactive power mode)	The reference value is WMaxOut or VAMaxOut (depending on the setting in Inverter.VArModCfg.Act- LimRefMod). When the activation threshold is exceeded, the reactive power mode in case of active power output is activated.
Inverter.VArModCfg.Out-WNomLimDeAct	Deactivation threshold of the reactive power mode in case of active power output in % (System and device control > Inverter > Reactive power mode)	The reference value is WMaxOut or VAMaxOut (depending on the setting in Inverter.VArModCfg.Act- LimRefMod). When the deactivation threshold is fallen short of, the reactive power mode in case of active power output is deactivated and the reactive power mode in case of zero active power is activated.
Inverter.VArModCfg.HystTms	Hysteresis time in s (System and device control > Inverter > Reactive power mode)	The hysteresis time is intended to prevent unnecessary changes between the reactive power ranges.

Setting the Reactive Power Mode for Absent Setpoints

If the setpoint is absent (e.g. due to communication failure between the inverter and the superordinate control unit), the grid operator can request switching to a specified reactive power mode.

Object name	Definition (display group)	Explanation
Inverter.VArModCfg.VArModOutFlb	Reactive power fallback process in case of active power output (System and device control > Inverter > Reactive power mode)	The permitted reactive power modes in case of active power output from the table in Section 4.2 can be set. Alternatively, selecting the "Maintain procedure" option uses the configured fallback value from the external specification (see Section 4.2.2.2).

Object name	Definition (display group)	Explanation
Inverter.VArModCfg.VArModInFlb	Reactive power fallback process in case of active power draw (System and device control > Inverter > Reactive power mode)	The permitted reactive power modes in case of active power draw from the table in Section 4.2 can be set. Alternatively, selecting the "Maintain procedure" option uses the configured fallback value from the external specification (see Section 4.2.2.2).
Inverter.VArModCfg.VArModZerWFlb	Reactive power fallback process in case of zero active power (System and device control > Inverter > Reactive power mode)	The permitted reactive power modes in case of zero active power from the table in Section 4.2 can be set. Alternatively, selecting the "Maintain procedure" option uses the configured fallback value from the external specification (see Section 4.2.2.2).

The parameters for setting the individual modes are listed in the following sections.

Setting the Reference Value for the Reactive Power Mode

Reactive power setpoints as a percentage can refer either to the configurable maximum value **WMaxOut** / **WMaxIn** / **VAMaxOut** / **VAMaxIn** or to the nominal reactive power **Inverter.VArMaxQ1-Q4**. The nominal active power depends on the current active power and corresponds to **WMaxOut** for active power output and **WMaxIn** for active power input. The nominal reactive power depends on the quadrant and corresponds to the respective nominal reactive power **Inverter.VArMaxQ1-Q4**. This setting then applies to all reactive power modes. In the zero active power range, the reference value is based on the active power range from which the zero active power range is approached. When the system is started, the reference value in the zero active power range corresponds to that of the active power output. Alternatively, only **WMaxOut** or **VAMaxOut** can be selected as a reference which then applies to the entire active power range (import, zero active power, export). This prevents switching based on the current active power.



Example

It is assumed that **Inverter.VArModCfg.VArNomRefMod** is parameterized to **WMaxOut/WMaxIn** and the system feeds in such a high power that it is in the active power output range. Thus, the reference value for the reactive power modes is **WMaxOut**. If the active power is reduced to the zero active power range, the reference value remains at **WMaxOut**. The reference value changes to **WMaxIn** only when the active power enters the active power draw range. However, if **VArNomRefMod** is set to **WMaxOut**, the reference remains constant at **WMaxOut** across all active power ranges and does not switch.

Object name	Definition (display group)	Explanation
Inverter.VArModCfg.VArNomRefMod	Reference size for reactive power setpoints (System and device control > Inverter > Reactive power mode)	The setting is specified by the grid operator and is typically already set by the country data set accordingly.

4.2.1 Reactive Power Mode Off

If Off is selected as the reactive power mode, the reactive power setpoint is set to 0%. When there is a switch to the reactive power mode Off, the dynamic settings of the reactive power setpoint apply (see Section 4.2.2 "Reactive Power Setpoint", page 35). The voltage limitation function is deactivated.

4.2.2 Reactive Power Setpoint

The reactive power setpoint can be specified manually via the user interface or externally via a superordinate control unit. The specification of the reactive power setpoint can also be deactivated.

Manual setpoint

In case of a manual setpoint, you must set the reactive power specified by the grid operator as a value in VAr or in percent of WMaxOut/WMaxIn, VAMaxOut, WMaxOut or Inverter.VArMaxQ1-Q4 (depending on the setting in Inverter.VArModCfg.VArNomRefMod) via parameters. You can make a different specification for each of the three reactive power ranges. In addition, depending on the specifications of the grid operator, the voltage-limiting function can be activated and set. The settings for dynamic behavior for the implementation of manual and external specifications of the reactive power apply.

Setting External Setpoints

In case of an external setpoint, the inverter receives the reactive power setpoint through a superordinate control unit. In case of an external setpoint, the dynamic behavior for the implementation of the setpoint and the specified fallback value for the absent setpoint must be entered. In addition, depending on the specifications of the grid operator, the voltage-limiting function can be activated and set.

4.2.2.1 Manual Setting

Manual Setting in VAr

Object name	Definition (display group)
Inverter.VArModCfg.VArCnstCfg.VAr	Manual reactive power setpoint for active power output in VAr (System and device control > Inverter > Reactive power mode)
Inverter.VArModCfg.VArCnstCfg.In.VAr	Manual reactive power setpoint in case of active power draw in VAr (System and device control > Inverter > Reactive power mode)
Inverter.VArModCfg.VArCnstCfg.Dmd.VAr	Manual reactive power setpoint at zero power output in VAr (System and device control > Inverter > Reactive power mode)

Manual Setting in %

Object name	Definition (display group)	Explanation
Inverter.VArModCfg.VArCnstCfg.VArNom	Manual reactive power setpoint for active power output in % (System and device control > Inverter > Reactive power mode)	The reference value is WMaxOut/WMaxIn, WMaxOut, VAMaxOut or Inverter.VArMaxQ1-Q4 (depending on the setting in Inverter.VArModCfg.VArNomRefMod).

Object name	Definition (display group)	Explanation
Inverter.VArModCfg.VArCnstCf- gln.VArNom	Manual reactive power setpoint in case of active power draw in % (System and device control > Inverter > Reactive power mode)	The reference value is WMaxOut/ WMaxIn, WMaxOut, VAMaxOut or Inverter.VArMaxQ1-Q4 (depending on the setting in Inverter.VArMod- Cfg.VArNomRefMod).
Inverter.VArModCfg.VArCn- stCfgDmd.VArNom	Manual reactive power setpoint at zero power output in % (System and device control > Inverter > Reactive power mode)	The reference value is WMaxOut/ WMaxIn, WMaxOut, VAMaxOut or Inverter.VArMaxQ1-Q4 (depending on the setting in Inverter.VArMod- Cfg.VArNomRefMod).

4.2.2.2 External Setting

Object name	Definition (display group)	Explanation
Inverter.VArMod- Cfg.VArCtlCom- Cfg.VArNomPrc	Reactive power setpoint Q in % (System and device control > Inverter > Reactive power mode > Extern. reactive power mode)	The reference value is WMax- Out/WMaxIn, WMaxOut, VA- MaxOut or Inverter.VArMaxQ1- Q4 (depending on the setting in Inverter.VArModCfg.VArNomRef- Mod).

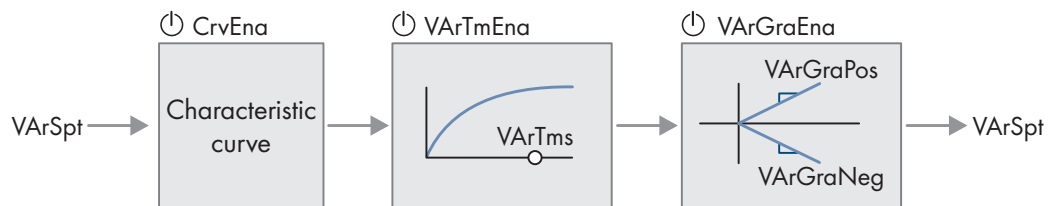
Setting Fallback Value for Absent External Setpoint

If communication fails for an adjustable time, either the last communicated values are kept or the fallback values are taken.

Object name	Definition (display group)	Explanation
Inverter.CtlComCfg.VArCtl- Com.CtlComMssMod	Fallback Behavior (System and device control > Inverter > System control and fallback behavior > Q, external setting)	Adjustable: Values maintained (maintain the values received last) Apply fallback values The fallback values configured here become active only if the fallback procedure in In- verter.VArModCfg.VArModOut- Flb, Inverter.VArModCfg.VAr- ModInFlb, and Inverter.VArMod- Cfg.VArModZerWFlb is set to "Maintain procedure."
Inverter.CtlComCfg.VArCtl- Com.FlbVArNom	Fallback value in % (System and device control > Inverter > System control and fallback behavior > Q, external setting)	The reference value is WMax- Out / WMaxIn or Inverter.VAr- MaxQ1-Q4 (depending on the setting in Inverter.VArMod- Cfg.VArNomRefMod).

Object name	Definition (display group)	Explanation
Inverter.CtlComCfg.VArCtl- Com.GraFlbMod	Activation of the ramp rate in fallback behavior	Adjustable: Ramp becomes active for the start of the fallback behavior: Flb-Str Ramp becomes active for the exit from the fallback behavior: FlbEnd Off
Inverter.CtlComCfg.VArCtl- Com.VArGraFlb	Ramp rate in fallback behavior in %/s in relation to VArMaxQ1	-
Inverter.CtlComCfg.VArCtl- Com.TmsOut	Timeout in s	For this time, the external setpoint must remain off before the fallback mode is activated.
Inverter.CtlComCfg.VArCtl- Com.TmsOutPrc	Timeout in s (2 decimal places) (System and device control > Inverter > System control and fallback behavior > Q, external setting)	

4.2.2.3 Dynamic Behavior for Implementing Manual and External Setpoints



Object name	Definition (display group)	Explanation
Inverter.VArModCfg.VAr- Cfg.Dyn.VArTmEna	Setpoint filter (System and device control > Inverter > Reactive power mode > Advanced settings for reactive power setpoint specifications > Dynamics)	Activation / deactivation
Inverter.VArModCfg.VAr- Cfg.Dyn.VArTms	Response time for setpoint filter in s (System and device control > Inverter > Reactive power mode > Advanced settings for reactive power setpoint specifications > Dynamics)	Response time corresponds to 3 taus of a PT1 element.
Inverter.VArModCfg.VAr- Cfg.Dyn.VArGraEna	Limitation of change rate (System and device control > Inverter > Reactive power mode > Advanced settings for reactive power setpoint specifications > Dynamics)	Activation / deactivation

Object name	Definition (display group)	Explanation
Inverter.VArModCfg.VAr-Cfg.Dyn.VArGraPos	Reactive power setpoint, ramp-up rate in %/s (System and device control > Inverter > Reactive power mode > Advanced settings for reactive power setpoint specifications > Dynamics)	The reference value is Inverter.VArMaxQ1.
Inverter.VArModCfg.VAr-Cfg.Dyn.VArGraNeg	Reactive power setpoint, decrease rate in %/s (System and device control > Inverter > Reactive power mode > Advanced settings for reactive power setpoint specifications > Dynamics)	The reference value is Inverter.VArMaxQ1.

4.2.2.4 Voltage Limitation Function

The voltage limit function can be set for both the external and the manual setpoint.

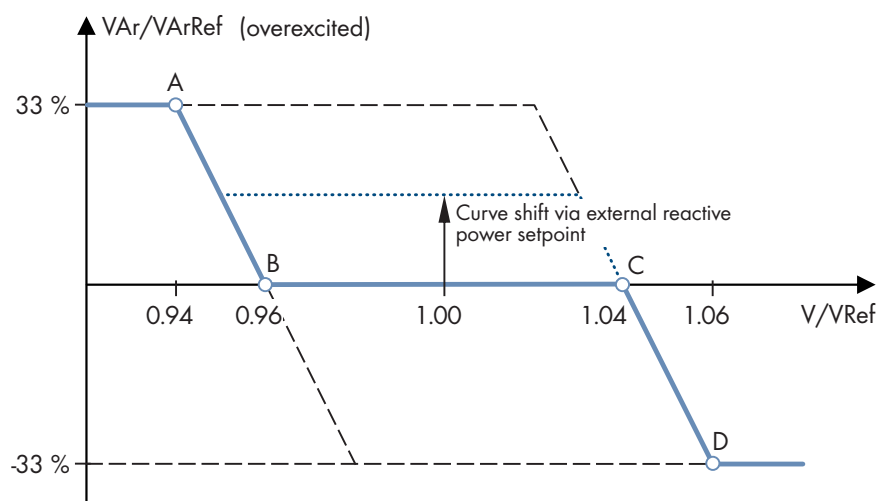


Figure 9: Characteristic curve for dynamic setpoint with activated voltage limitation function (example)

Object name	Definition (display group)	Explanation
Inverter.VArModCfg.VAr-Cfg.Crv.CrvEna	Reactive power setting with voltage limitation, voltage value (System and device control > Inverter > Reactive power mode > Advanced settings for reactive power setpoint specifications > Characteristic curve)	Activation / deactivation
Inverter.VArModCfg.VAr-Cfg.Crv.XVal	Voltage values of the characteristic curve in p.u. (System and device control > Inverter > Reactive power mode > Advanced settings for reactive power setpoint specifications > Characteristic curve)	The reference value is the parameterized nominal voltage (see Section 3.1.2 "Adjustable Parameters of the Nominal Voltage", page 11).

Object name	Definition (display group)	Explanation
Inverter.VArModCfg.VArCfv.YVal	Reactive power values of the characteristic curve in % (System and device control > Inverter > Reactive power mode > Advanced settings for reactive power setpoint specifications > Characteristic curve)	The reference value is WMax-Out / WMaxIn or Inverter.VArMaxQ1-Q4 (depending on the setting in Inverter.VArModCfg.VArNomRefMod).
Inverter.VArModCfg.VRefMod	Type of reference voltage (System and device control > Inverter > Reactive power mode)	Adjustable: PhsAvg / mean value of phase voltages PhsMax / maximum phase voltage

4.2.3 Cos phi Setpoint

The cos phi setpoint can be specified manually via the user interface or externally via a superordinate control unit.

Manual Setpoint

In case of a manual setpoint, you must enter the cos phi specified by the grid operator and the excitation type via parameters. There are separate parameters for active power output and active power input. The settings for dynamic behavior for the implementation of manual and external specifications of the reactive power of cos phi apply.

Setting external setpoints

In case of an external setpoint, the inverter receives the reactive power setpoint through a superordinate control unit. In case of an external setpoint, the dynamic behavior for the implementation of the setpoint and the specified fallback value for the absent setpoint must be entered.

4.2.3.1 Manual Setting

Object name	Definition (display group)	Explanation
Inverter.VArModCfg.PFCnstCfg.PFOut	Cos phi setpoint in case of active power output (System and device control > Inverter > Reactive power mode > Manual cos ϕ specification)	-
Inverter.VArModCfg.PFCnstCfg.PFExtOut	Excitation type for active power output (System and device control > Inverter > Reactive power mode > Manual cos ϕ specification)	overexcited / underexcited
Inverter.VArModCfg.PFCnstCfg.PFIn	Cos phi setpoint in case of active power draw (System and device control > Inverter > Reactive power mode > Manual cos ϕ specification)	-
Inverter.VArModCfg.PFCnstCfg.PFExtIn	Excitation type in case of active power draw (System and device control > Inverter > Reactive power mode > Manual cos ϕ specification)	overexcited / underexcited

4.2.3.2 External Setting

Setpoints

Object name	Definition (display group)	Explanation
Inverter.VArModCfg.PFCtl-ComCfg.PF	Cos phi setpoint in case of active power output (System and device control > Inverter > Reactive power mode > cos φ config. method of PV system control)	-
Inverter.VArModCfg.PFCtl-ComCfg.PFExt	Excitation type for active power output (System and device control > Inverter > Reactive power mode > cos φ config. method of PV system control)	underexcited/overexcited
Inverter.VArModCfg.PFCtl-ComCfg.PFIn	Cos phi setpoint in case of active power draw (System and device control > Inverter > Reactive power mode > cos φ config. method of PV system control)	-
Inverter.VArModCfg.PFCtl-ComCfg.PFExtIn	Excitation type in case of active power draw (System and device control > Inverter > Reactive power mode > cos φ config. method of PV system control)	underexcited/overexcited

Setting the Fallback Value When There is no External Setpoint for a Parameterizable Time

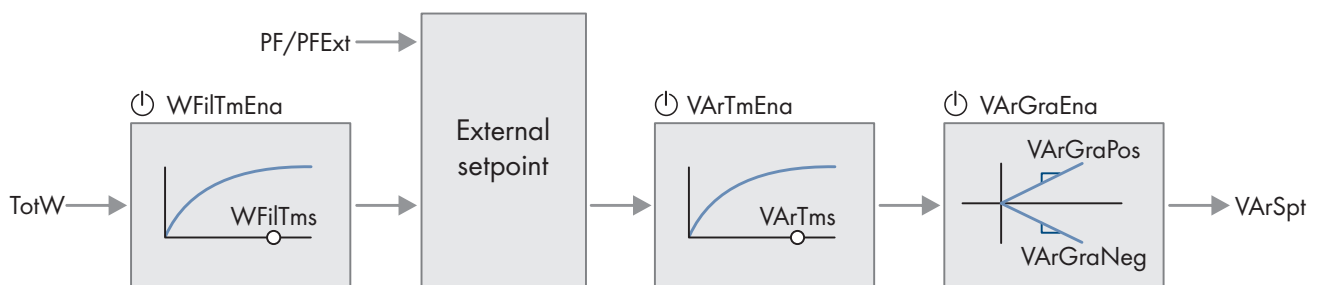
If communication fails for an adjustable time, either the last communicated values are kept or the fallback values are taken.

Object name	Definition (display group)	Explanation
Inverter.CtlComCfg.PFCtl-Com.CtlComMssMod	Fallback Behavior (System and device control > Inverter > Reactive power mode > cos φ config. method of PV system control)	Adjustable: Values maintained (maintain the values received last) Apply fallback values The fallback values configured here become active only if the fallback procedure in Inverter.VArModCfg.VArModOutFlb, Inverter.VArModCfg.VArModInFlb, and Inverter.VArModCfg.VArModZerWFlb is set to "Maintain procedure."
Inverter.CtlComCfg.PFCtl-Com.FlbfPF	Fallback value of Cos Phi in case of active power output (System and device control > Inverter > Reactive power mode > cos φ config. method of PV system control)	-

Object name	Definition (display group)	Explanation
Inverter.CtlComCfg.PFCtl-Com.FlbPFExt	Fallback value of excitation type in case of active power output (System and device control > Inverter > Reactive power mode > cos ϕ config. method of PV system control)	underexcited/overexcited
Inverter.CtlComCfg.PFCtl-Com.FlbPFIn	Fallback value of Cos Phi in case of active power draw (System and device control > Inverter > Reactive power mode > cos ϕ config. method of PV system control)	-
Inverter.CtlComCfg.PFCtl-Com.FlbPFExtIn	Fallback value of excitation type in case of active power draw (System and device control > Inverter > Reactive power mode > cos ϕ config. method of PV system control)	underexcited/overexcited
Inverter.CtlComCfg.PFCtl-Com.TmsOut	Timeout in s	For this time, the external setpoint must remain off before the fallback mode is activated.
Inverter.CtlComCfg.PFCtl-Com.TmsOutPrc	Timeout in s (2 decimal places) (System and device control > Inverter > Reactive power mode > cos ϕ config. method of PV system control)	

4.2.3.3 Dynamic Behavior for Implementing Manual and External Setpoints

The cos ϕ setpoint is converted internally into a setpoint for reactive power. The dynamic behavior of the resulting reactive power setpoint can be influenced as follows.



Object name	Definition (display group)	Explanation
Inverter.VArMod-Cfg.PFCfg.Dyn.WFilTmsEna	Actual value filter for active power value (System and device control > Inverter > Reactive power mode > Advanced settings for cos ϕ setpoint specifications > Dynamics)	Activation / deactivation
Inverter.VArMod-Cfg.PFCfg.Dyn.WFilTms	Response time of actual value filter in s (System and device control > Inverter > Reactive power mode > Advanced settings for cos ϕ setpoint specifications > Dynamics)	Response time corresponds to 3 taus (RC time constant) of a PT1 element

Object name	Definition (display group)	Explanation
Inverter.VArMod-Cfg.PFCfg.Dyn.VArTmEna	Setpoint filter (System and device control > Inverter > Reactive power mode > Advanced settings for cos φ setpoint specifications > Dynamics)	Activation / deactivation
Inverter.VArMod-Cfg.PFCfg.Dyn.VArTms	Response time for setpoint filter in s (System and device control > Inverter > Reactive power mode > Advanced settings for cos φ setpoint specifications > Dynamics)	Response time corresponds to 3 taus (RC time constant) of a PT1 element
Inverter.VArMod-Cfg.PFCfg.Dyn.VArGraEna	Limitation of change rate (System and device control > Inverter > Reactive power mode > Advanced settings for cos φ setpoint specifications > Dynamics)	Activation / deactivation
Inverter.VArMod-Cfg.PFCfg.Dyn.VArGraPos	Ramp-up rate for resulting reactive power setpoint in %/s (System and device control > Inverter > Reactive power mode > Advanced settings for cos φ setpoint specifications > Dynamics)	The reference value is Inverter.VArMaxQ1.
Inverter.VArMod-Cfg.PFCfg.Dyn.VArGraNeg	Decrease rate for resulting reactive power setpoint in %/s (System and device control > Inverter > Reactive power mode > Advanced settings for cos φ setpoint specifications > Dynamics)	The reference value is Inverter.VArMaxQ1.

4.2.4 Reactive-Power / Active-Power Characteristic Curve Q(P)

With this characteristic curve, the system is supposed to feed reactive power into the utility grid depending on the current active power output. The characteristic points are given as percentages based on the respective reference value.

The characteristic curve is defined from a maximum of eight support points.

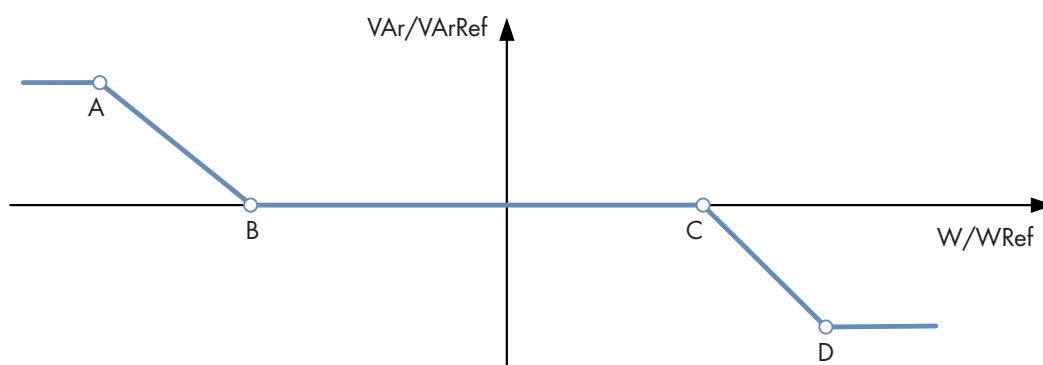


Figure 10: Example of a Q(P) characteristic curve for generators and loads with four support points

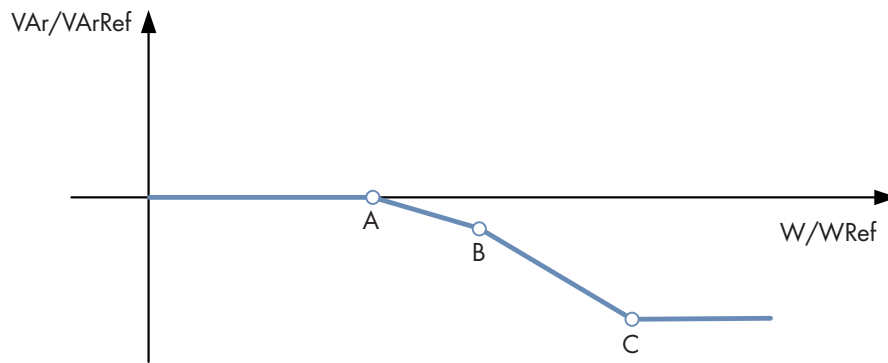


Figure 11: Example of a Q(P) characteristic curve for pure generators with 3 interpolation points

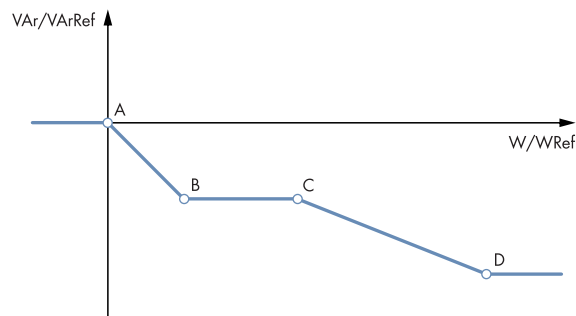
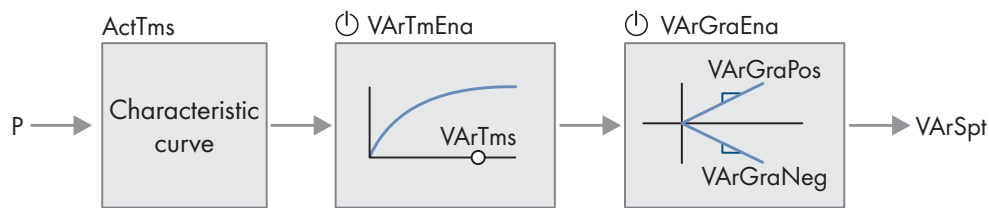


Figure 12: Example of a Q(P) characteristic curve with 4 interpolation points as per "IEEE1547.1 Charakteristik 2-B"

Setting the Characteristic Curve

Object name	Definition (display group)	Explanation
Inverter.VArMod-Cfg.VArCtlWCfg.Crv.NumPt	Number of used support points (System and device control > Inverter > Reactive power mode > Q(P) characteristic curve > Characteristic curve)	-
Inverter.VArMod-Cfg.VArCtlWCfg.Crv.XVal	Active power values of the characteristic curve in % (System and device control > Inverter > Reactive power mode > Q(P) characteristic curve > Characteristic curve)	The reference value is WMax-Out / WMaxIn.
Inverter.VArMod-Cfg.VArCtlWCfg.Crv.YVal	Reactive power values of the characteristic curve in % (System and device control > Inverter > Reactive power mode > Q(P) characteristic curve > Characteristic curve)	The reference value is WMax-Out / WMaxIn or Inverter.VArMod-Cfg.VArNomRefMod).

Configuring Dynamic Response



Object name	Definition (display group)	Explanation
Inverter.VArMod-Cfg.VArCtlWCfg.Dyn.VArTmEna	Setpoint filter (System and device control > Inverter > Reactive power mode > Q(P) characteristic curve > Dynamics)	Activation / deactivation
Inverter.VArMod-Cfg.VArCtlWCfg.Dyn.VArTms	Response time for setpoint filter in s (System and device control > Inverter > Reactive power mode > Q(P) characteristic curve > Dynamics)	Response time corresponds to 3 taus (RC time constant) of a PT1 element
Inverter.VArMod-Cfg.VArCtlWCfg.Dyn.VArGraEna	Limitation of change rate (System and device control > Inverter > Reactive power mode > Q(P) characteristic curve > Dynamics)	Activation / deactivation
Inverter.VArMod-Cfg.VArCtlWCfg.Dyn.VArGraPos	Ramp-up rate in %/s (System and device control > Inverter > Reactive power mode > Q(P) characteristic curve > Dynamics)	The reference value is Inverter.VArMaxQ1.
Inverter.VArMod-Cfg.VArCtlWCfg.Dyn.VArGraNeg	Ramp-down rate in %/s (System and device control > Inverter > Reactive power mode > Q(P) characteristic curve > Dynamics)	The reference value is Inverter.VArMaxQ1.
Inverter.VArMod-Cfg.VArCtlWCfg.Dyn.ActTms	Tripping delay in s (System and device control > Inverter > Reactive power mode > Q(P) characteristic curve > Dynamics)	-

Configuring Voltage-Sensitive Activation

In order to avoid that the system feeds reactive power permanently for static voltage stability, even though the grid voltage is OK, the reactive power/active power characteristic curve Q(P) can be activated and deactivated depending on the average value of the voltage.

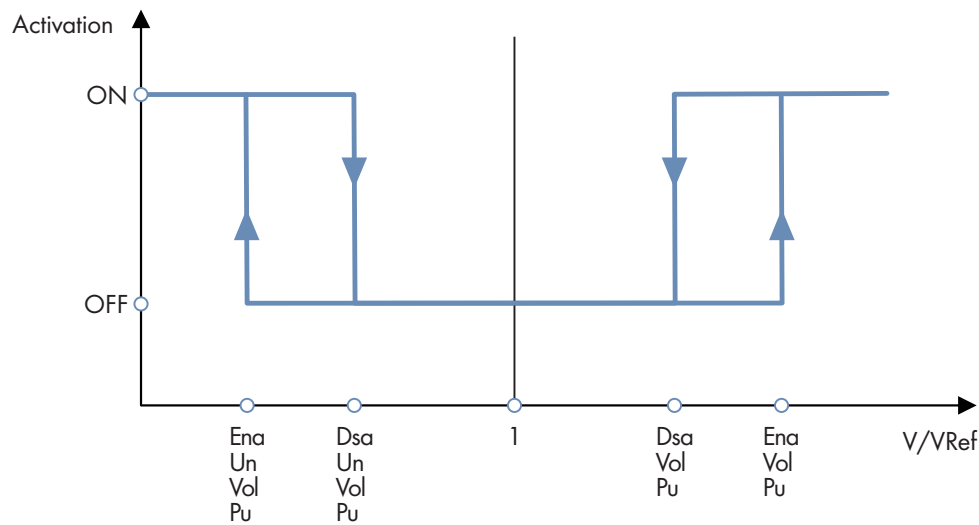


Figure 13: Principle of voltage-dependent activation

Object name	Definition (display group)	Explanation
Inverter.VArMod-Cfg.VArCtl-WCfgr.Trgr.EnaVolPu	Upper activation voltage in p.u. (System and device control > Inverter > Reactive power mode > Q(P) characteristic curve > Trigger)	The reference value is the parameterized nominal voltage (see Section 3.1.2 "Adjustable Parameters of the Nominal Voltage", page 11).
Inverter.VArMod-Cfg.VArCtl-WCfgr.Trgr.DsaVolPu	Upper deactivation voltage in p.u. (System and device control > Inverter > Reactive power mode > Q(P) characteristic curve > Trigger)	The reference value is the parameterized nominal voltage (see Section 3.1.2 "Adjustable Parameters of the Nominal Voltage", page 11).
Inverter.VArMod-Cfg.VArCtl-WCfgr.Trgr.EnaUnVolPu	Lower activation voltage in p.u. (System and device control > Inverter > Reactive power mode > Q(P) characteristic curve > Trigger)	The reference value is the parameterized nominal voltage (see Section 3.1.2 "Adjustable Parameters of the Nominal Voltage", page 11).
Inverter.VArMod-Cfg.VArCtl-WCfgr.Trgr.DsaUnVolPu	Lower deactivation voltage in p.u. (System and device control > Inverter > Reactive power mode > Q(P) characteristic curve > Trigger)	The reference value is the parameterized nominal voltage (see Section 3.1.2 "Adjustable Parameters of the Nominal Voltage", page 11).

4.2.5 React. power/volt. char. Q(V)

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.

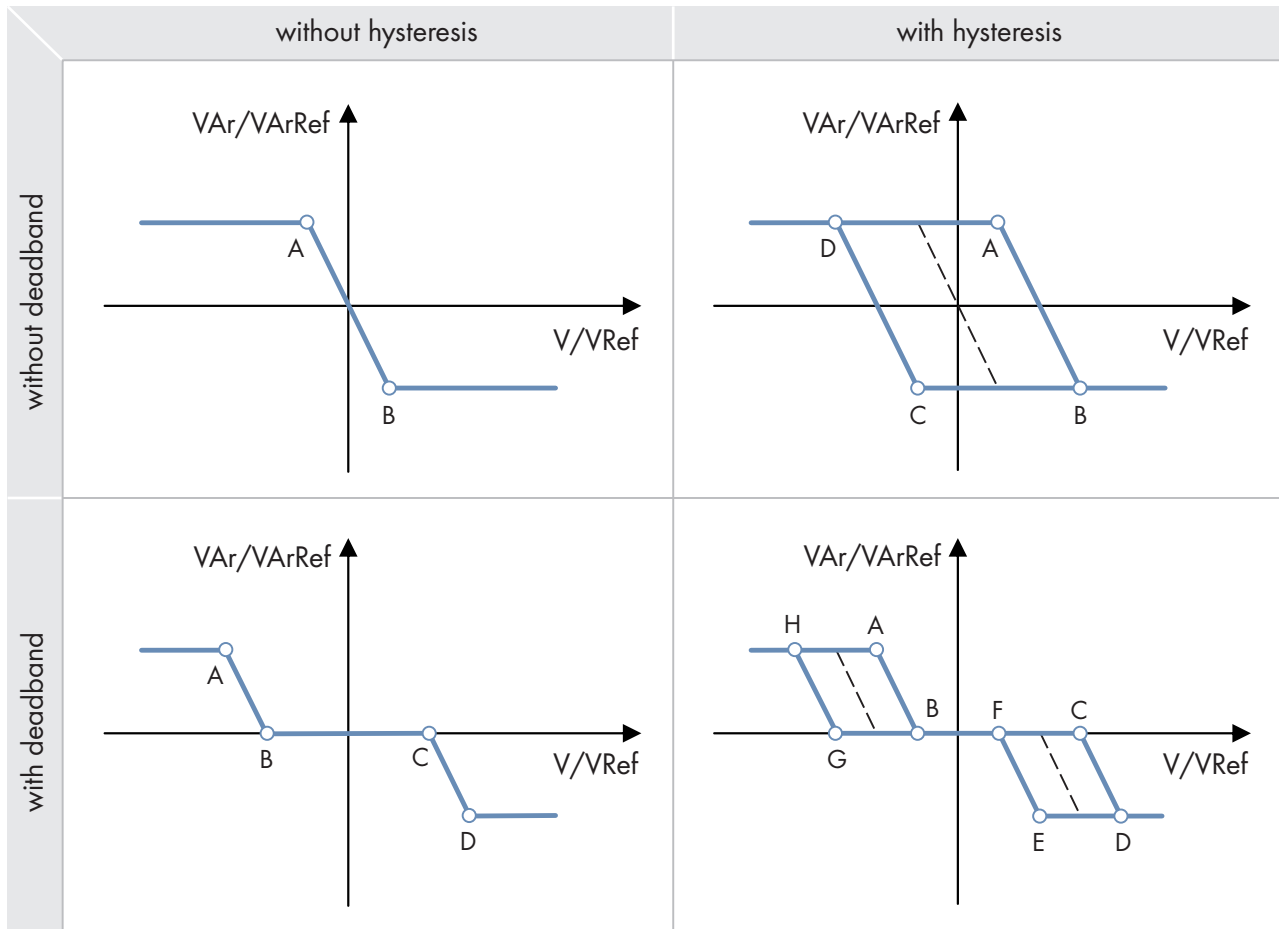


Figure 14: Q(V) characteristic curve (examples)

Setting the Characteristic Curve

Object name	Definition (display group)	Explanation
Inverter.VArMod- Cfg.VArCtlVol- Cfg.Crv.NumPt	Number of used support points (System and device control > Inverter > Reactive power mode > Q(V) characteristic curve > Characteristic curve)	-
Inverter.VArMod- Cfg.VArCtlVolCfg.Crv.XVal	Voltage values of the characteristic curve in p.u. (System and device control > Inverter > Reactive power mode > Q(V) characteristic curve > Characteristic curve)	Parameterized nominal voltage (see Section 3.1.2 "Adjustable Parameters of the Nominal Voltage", page 11)

Object name	Definition (display group)	Explanation
Inverter.VArMod-Cfg.VArCtlVolCfg.Crv.YVal	Reactive power values of the characteristic curve in % (System and device control > Inverter > Reactive power mode > Q(V) characteristic curve > Characteristic curve)	The reference value is WMax-Out / WMaxIn or Inverter.VArMaxQ1-Q4 (depending on the setting of Inverter.VArMod-Cfg.VArNomRefMod).
Inverter.VArModCfg.VRef-Mod	Type of reference voltage (System and device control > Inverter > Reactive power mode)	Adjustable: PhsAvg / mean value of phase voltages PhsMax / maximum phase voltage

Setting the Reference Voltage Adjustment

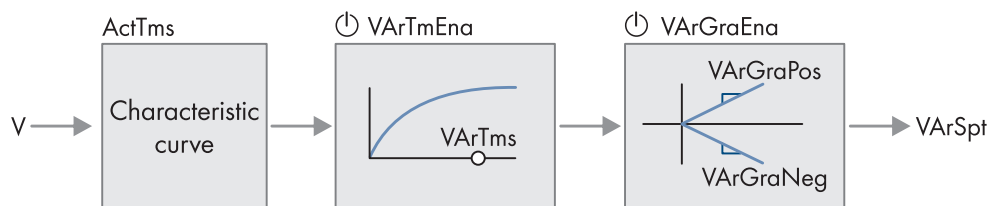
Changing the reference voltage allows the Q(V) characteristic curve to be moved on the X axis. The reference voltage for Q(V) can be set by the following parameters.

Object name	Definition (display group)	Explanation
Inverter.VArMod-Cfg.VArCtlVolCfg.Vol-Ref.AutnAdjMod	Operating mode of the reference voltage adjustment (System and device control > Inverter > Reactive power mode > Q(P) characteristic curve > 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.VArMod-Cfg.VArCtlVolCfg.Vol-Ref.AutnAdjTms	Response time of the automatic reference voltage adjustment (System and device control > Inverter > Reactive power mode > Q(P) characteristic curve > Reference voltage adjustment)	Response time corresponds to 3 taus of a PT1 element.
Inverter.VArMod-Cfg.VArCtlVolCfg.Vol-Ref.VolRefPu	External reference voltage setting in p.u. (System and device control > Inverter > Reactive power mode > Q(P) characteristic curve > Reference voltage adjustment)	The reference value is the parameterized nominal voltage (see Section 3.1.2 "Adjustable Parameters of the Nominal Voltage", page 11).

Setting the Behavior in Case of Absent Reference Voltage

Object name	Definition (display group)	Explanation
Inverter.CtlCom-Cfg.VArCtlVolCom.Ctl-ComMssMod	Fallback Behavior (System and device control > Inverter > System control and fallback behavior > External reference voltage setting)	Adjustable: Values maintained (the values received last are maintained) Apply fallback values The fallback values configured here become active only if the fallback procedure in Inverter.VArModCfg.VArModOut-Flb, Inverter.VArModCfg.VArModInFlb, and Inverter.VArModCfg.VArModZerWFlb is set to "Maintain procedure."
Inverter.CtlCom-Cfg.VArCtlVolCom.FlbVol-RefPu	Fallback of reference voltage in p.u. (System and device control > Inverter > System control and fallback behavior > External reference voltage setting)	The reference value is the parameterized nominal voltage (see Section 3.1.2 "Adjustable Parameters of the Nominal Voltage", page 11).
Inverter.CtlCom-Cfg.VArCtlVolCom.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.
Inverter.CtlCom-Cfg.VArCtlVolCom.TmsOut-Prc	Timeout for the missing reference voltage setpoint in s (2 digits after the decimal point) (System and device control > Inverter > System control and fallback behavior > External reference voltage setting)	

Configuring Dynamic Response



Object name	Definition	Explanation
Inverter.VArModCfg.VArCtlVol-Cfg.Dyn.VArTmEna	Setpoint filter	Activation / deactivation
Inverter.VArModCfg.VArCtlVol-Cfg.Dyn.VArTms	Response time for setpoint filter in s	Response time corresponds to 3 taus of a PT1 element.
Inverter.VArModCfg.VArCtlVol-Cfg.Dyn.VArTmsPrc		
Inverter.VArModCfg.VArCtlVol-Cfg.Dyn.VArGraEna	Limitation of change rate	Activation / deactivation

Object name	Definition	Explanation
Inverter.VArModCfg.VArCtlVol-Cfg.Dyn.VArGraPos	Ramp-up rate in %/s	The reference value is Inverter.VAr-MaxQ1.
Inverter.VArModCfg.VArCtlVol-Cfg.Dyn.VArGraNeg	Ramp-down rate in %/s	The reference value is Inverter.VAr-MaxQ1.
Inverter.VArModCfg.VArCtlVol-Cfg.Dyn.ActTms	Tripping delay in s	-

4.2.6 Cos phi/Active Power Characteristic Curve cos phi(P)

With this characteristic curve, the system is supposed to feed reactive power into the utility grid depending on the current active power output. Cos phi is specified based on the set reference value.

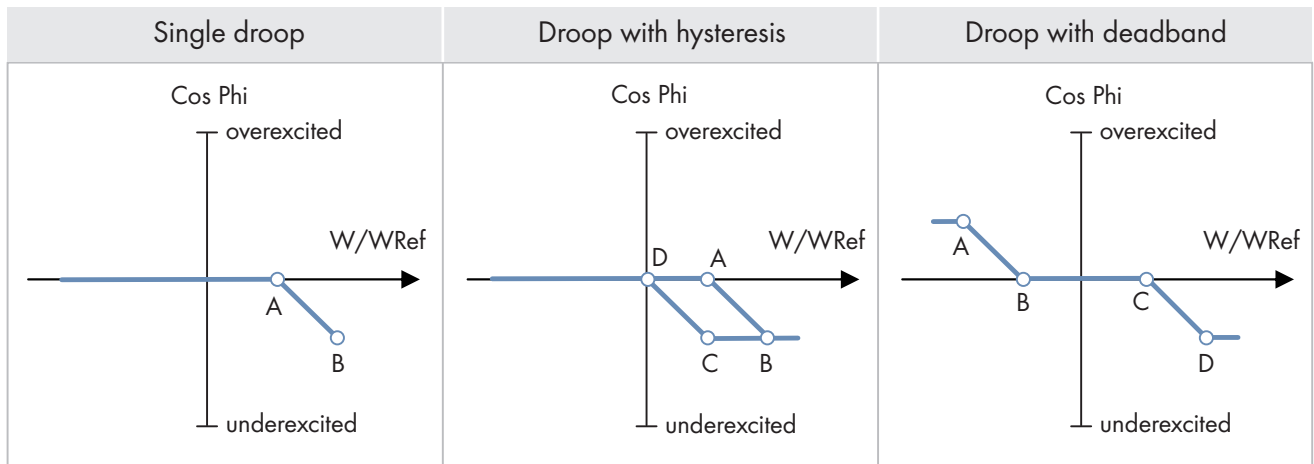
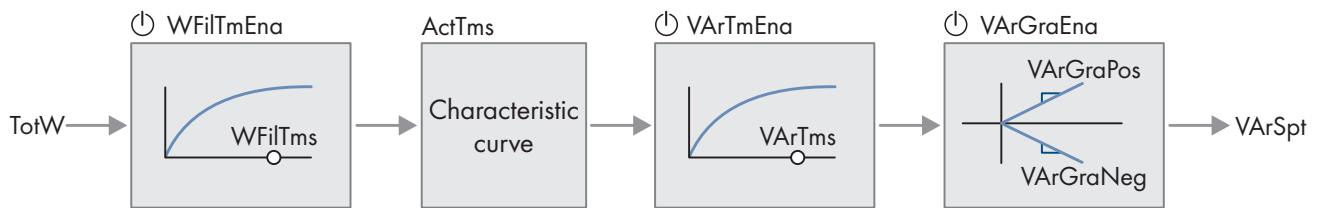


Figure 15: Cos phi/active power characteristic curve cos phi(P) (examples)

Setting the Characteristic Curve

Object name	Definition (display group)	Explanation
Inverter.VArModCfg.PFCtl-WCfg.Crv.NumPt	Number of used support points (System and device control > Inverter > Reactive power mode > cos ϕ (P) characteristic curve > Characteristic curve)	-
Inverter.VArModCfg.PFCtl-WCfg.Crv.WNom	Active power in % (System and device control > Inverter > Reactive power mode > cos ϕ (P) characteristic curve > Characteristic curve)	The reference value is WMax-Out / WMaxIn
Inverter.VArModCfg.PFCtl-WCfg.Crv.PF	Cos phi setpoint (System and device control > Inverter > Reactive power mode > cos ϕ (P) characteristic curve > Characteristic curve)	-
Inverter.VArModCfg.PFCtl-WCfg.Crv.PFExt	Excitation type (System and device control > Inverter > Reactive power mode > cos ϕ (P) characteristic curve > Characteristic curve)	For each cos phi setpoint, the excitation type must always be specified as well: underexcited / overexcited

Configuring Dynamic Response



Object name	Definition (display group)	Explanation
Inverter.VArModCfg.PFCtl-WCfg.Dyn.WFilTmsEna	Actual value filter for active power value (System and device control > Inverter > Reactive power mode > $\cos \varphi(P)$ characteristic curve > Dynamics)	Activation / deactivation
Inverter.VArModCfg.PFCtl-WCfg.Dyn.WFilTms	Response time of actual value filter in s (System and device control > Inverter > Reactive power mode > $\cos \varphi(P)$ characteristic curve > Dynamics)	Response time corresponds to 3 taus of a PT1 element.
Inverter.VArModCfg.PFCtl-WCfg.Dyn.VArTmsEna	Setpoint filter (System and device control > Inverter > Reactive power mode > $\cos \varphi(P)$ characteristic curve > Dynamics)	Activation / deactivation
Inverter.VArModCfg.PFCtl-WCfg.Dyn.VArTms	Response time for setpoint filter in s (System and device control > Inverter > Reactive power mode > $\cos \varphi(P)$ characteristic curve > Dynamics)	Response time corresponds to 3 taus of a PT1 element.
Inverter.VArModCfg.PFCtl-WCfg.Dyn.VArGraEna	Limitation of change rate (System and device control > Inverter > Reactive power mode > $\cos \varphi(P)$ characteristic curve > Dynamics)	Activation / deactivation
Inverter.VArModCfg.PFCtl-WCfg.Dyn.VArGraPos	Ramp-up rate in %/s (System and device control > Inverter > Reactive power mode > $\cos \varphi(P)$ characteristic curve > Dynamics)	The reference value is Inverter.VArMaxQ1.
Inverter.VArModCfg.PFCtl-WCfg.Dyn.VArGraNeg	Ramp-down rate in %/s (System and device control > Inverter > Reactive power mode > $\cos \varphi(P)$ characteristic curve > Dynamics)	The reference value is Inverter.VArMaxQ1.
Inverter.VArModCfg.PFCtl-WCfg.Dyn.ActTms	Tripping delay in s (System and device control > Inverter > Reactive power mode > $\cos \varphi(P)$ characteristic curve > Dynamics)	-

Configuring Voltage-Sensitive Activation

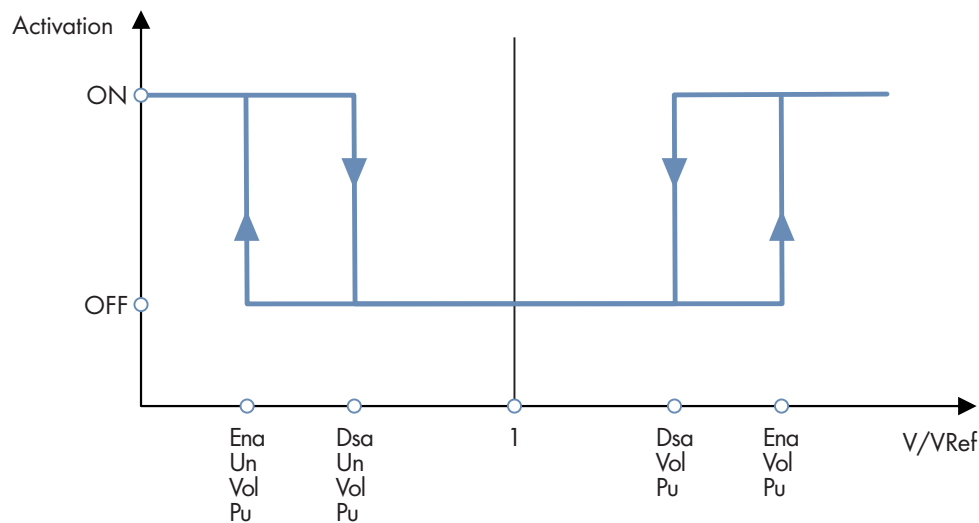


Figure 16: Principle of voltage-dependent activation

Object name	Definition (display group)	Explanation
Inverter.VArModCfg.PFCtl-WCfG.TrG.EnaVolPu	Upper activation voltage in p.u. (System and device control > Inverter > Reactive power mode > $\cos \varphi(P)$ characteristic curve > Trigger)	The reference value is the parameterized nominal voltage (see Section 3.1.2 "Adjustable Parameters of the Nominal Voltage", page 11).
Inverter.VArModCfg.PFCtl-WCfG.TrG.DsaVolPu	Upper deactivation voltage in p.u. (System and device control > Inverter > Reactive power mode > $\cos \varphi(P)$ characteristic curve > Trigger)	The reference value is the parameterized nominal voltage (see Section 3.1.2 "Adjustable Parameters of the Nominal Voltage", page 11).
Inverter.VArModCfg.PFCtl-WCfG.TrG.EnaUnVolPu	Lower activation voltage in p.u. (System and device control > Inverter > Reactive power mode > $\cos \varphi(P)$ characteristic curve > Trigger)	The reference value is the parameterized nominal voltage (see Section 3.1.2 "Adjustable Parameters of the Nominal Voltage", page 11).
Inverter.VArModCfg.PFCtl-WCfG.TrG.DsaUnVolPu	Lower deactivation voltage in p.u. (System and device control > Inverter > Reactive power mode > $\cos \varphi(P)$ characteristic curve > Trigger)	The reference value is the parameterized nominal voltage (see Section 3.1.2 "Adjustable Parameters of the Nominal Voltage", page 11).

4.2.7 Cos phi/voltage characteristic curve Cos phi(V)

With this characteristic curve, the system is supposed to feed into the utility grid in relation to the current grid voltage and the resulting cos phi reactive power. Cos phi is specified on the basis of the set reference voltage (see Section 3.1.2 "Adjustable Parameters of the Nominal Voltage", page 11). The characteristic curve must be configured in accordance with the locally applicable standards and directives. Please consult the grid operator.

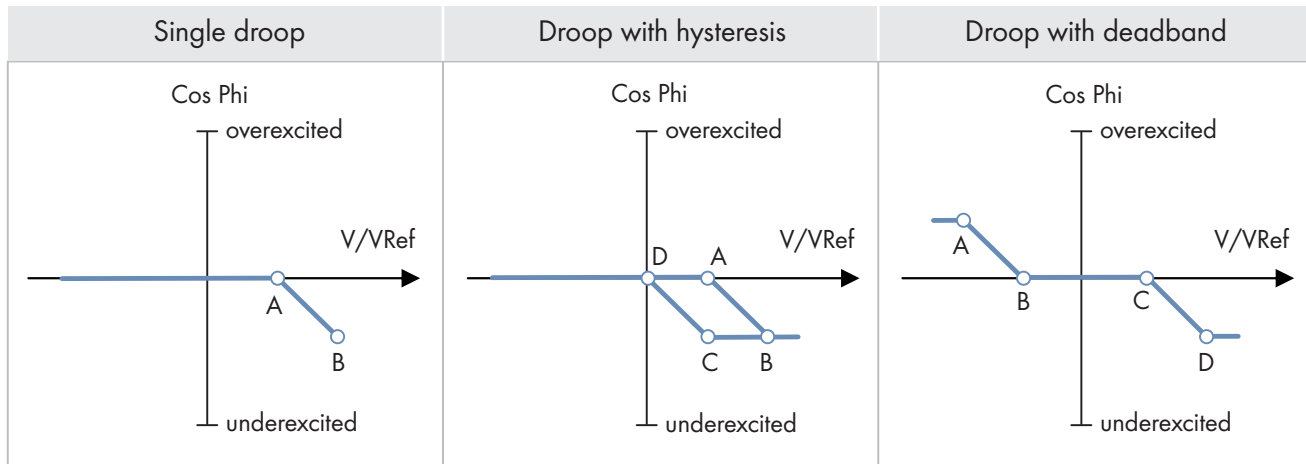


Figure 17: Cos phi/voltage characteristic curve Cos phi(V) (examples)

Setting the Characteristic Curve

Object name	Definition (display group)	Explanation
Inverter.VArMod-Cfg.PFCtlVol-Cfg.Dyn.ActTms	Cos phi(V), Tripping delay in s (System and device control > Inverter > Reactive power mode > cos φ(V) characteristic curve > Dynamics)	If the voltage exceeds the first buckling point, the resulting characteristic curve value is forwarded only after this time.
Inverter.VArMod-Cfg.PFCtlVol-Cfg.Dyn.VArTms	cos phi (V), response time for the setpoint filter in s (System and device control > Inverter > Reactive power mode > cos φ(V) characteristic curve > Dynamics)	Response time of the delay element for the reactive power setpoint Response time corresponds to 3 taus of a PT1 element.
Inverter.VArMod-Cfg.PFCtlVolCfg.Dyn.VArGraPos	Cos phi(V), ramp-up rate in %/s (System and device control > Inverter > Reactive power mode > cos φ(V) characteristic curve > Dynamics)	Gradient for limiting the reactive power change. The reference value is Inverter.VAMaxQ1.
Inverter.VArMod-Cfg.PFCtlVolCfg.Dyn.VArGraNeg	Cos phi(V), decrease rate in %/s (System and device control > Inverter > Reactive power mode > cos φ(V) characteristic curve > Dynamics)	Gradient for limiting the reactive power change. The reference value is Inverter.VAMaxQ1.
Inverter.VArMod-Cfg.PFCtlVol-Cfg.Dyn.WFilTms	Cos phi(V), Response time of the actual value filter (System and device control > Inverter > Reactive power mode > cos φ(V) characteristic curve > Dynamics)	Response time of the delay element for the measured value of the active power. Response time corresponds to 3 taus of a PT1 element.

Object name	Definition (display group)	Explanation
Inverter.VArMod-Cfg.PFCtlVolCfg.Dyn.VArT-mEna	Cos phi(V), setpoint filter (System and device control > Inverter > Reactive power mode > cos ϕ (V) characteristic curve > Dynamics)	Activation / deactivation of the delay element for the reactive power setpoint
Inverter.VArMod-Cfg.PFCtlVolCfg.Dyn.VAr-GraEna	Cos phi(V), limitation of the ramp rate (System and device control > Inverter > Reactive power mode > cos ϕ (V) characteristic curve > Dynamics)	Activation / deactivation of the gradient for limiting the reactive power change
Inverter.VArMod-Cfg.PFCtlVolCfg.Dyn.WFilT-mEna	Cos phi(V), actual value filter for active power value (System and device control > Inverter > Reactive power mode > cos ϕ (V) characteristic curve > Dynamics)	Activates / deactivates the delay element for the measured value of the active power
Inverter.VArMod-Cfg.PFCtlVolCfg.Crv.NumPt	Cos phi (V), number of used interpolation points (System and device control > Inverter > Reactive power mode > cos ϕ (V) characteristic curve > Characteristic curve)	-
Inverter.VArMod-Cfg.PFCtlVolCfg.Crv.VolPu	cos phi(V), voltage values in p.u. (System and device control > Inverter > Reactive power mode > cos ϕ (V) characteristic curve > Characteristic curve)	Voltage values of Cos phi(V) characteristic curve points The reference value is the parameterized nominal voltage (see Section 3.1.2 "Adjustable Parameters of the Nominal Voltage", page 11).
Inverter.VArMod-Cfg.PFCtlVolCfg.Crv.PF	Cos phi(V), cos phi setpoints (System and device control > Inverter > Reactive power mode > cos ϕ (V) characteristic curve > Characteristic curve)	Cos phi setpoints of the interpolation points of the Cos phi(V) characteristic curve
Inverter.VArMod-Cfg.PFCtlVolCfg.Crv.PFExt	Cos phi(V), excitation types (System and device control > Inverter > Reactive power mode > cos ϕ (V) characteristic curve > Characteristic curve)	Excitation types of the interpolation points of the Cos phi(V) characteristic curve: underexcited / overexcited
Inverter.VArModCfg.VRef-Mod	Type of reference voltage (System and device control > Inverter > Reactive power mode)	Adjustable: PhsAvg / mean value of phase voltages PhsMax / maximum phase voltage

4.3 Limitation of the Maximum Apparent Power Unbalance

The maximum apparent power unbalance that can be generated by the feed-in of a single-phase inverter can be limited by this function. This limits the maximum apparent power of a single-phase inverter, regardless of its nominal apparent power.

Object name	Definition (display group)	Explanation
Inverter.WModCfg.WCt- lAsym.Ena	Activation of the maximum apparent power unbalance	On/Off
Inverter.WModCfg.WCt- lAsym.VAMaxAsym	Maximum unbalanced apparent power	Threshold value

5 Behavior in Case of Disturbed Utility Grid

5.1 Behavior in Case of Voltage Errors

5.1.1 Voltage Monitoring

i Information

This function is currently only supported by inverters.

The inverter continuously checks the grid voltage. This enables the inverter to disconnect from the utility grid in case of overvoltage or undervoltage. If the grid voltage rises above or falls below the configured thresholds, the inverter waits for the time defined in the corresponding parameter and disconnects from the utility grid. For reconnection there are special limiting values GridGuard.Cntry.VolCtl.ReconMinPu and GridGuard.Cntry.VolCtl.ReconMaxPu (see Section 3.3 "Connection Behavior of Inverters", page 13).

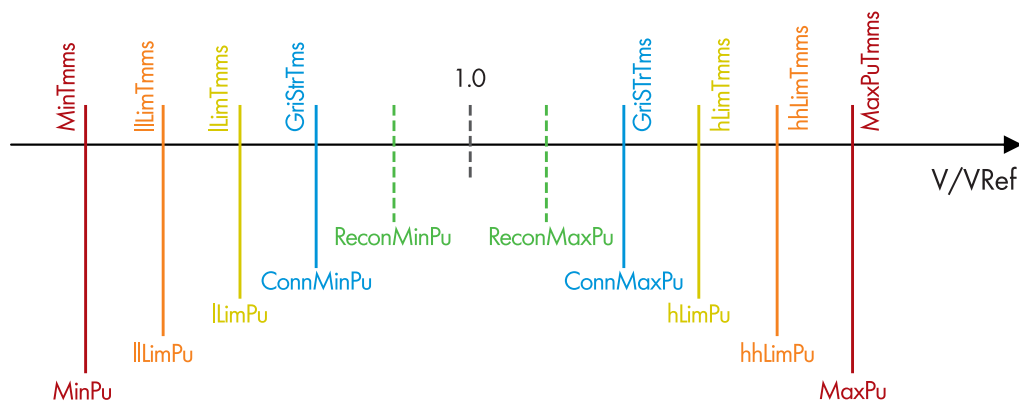


Figure 18: Voltage monitoring

Overvoltage Limits

Object name	Definition (display group)	Explanation
GridGuard.Cntry.VolCtl.MaxPu	Upper maximum threshold in p.u. (Grid monitoring > Grid monitoring > Country standard > Voltage monitoring)	Reference value: parameterized nominal voltage (see Section 3.1.2 "Adjustable Parameters of the Nominal Voltage", page 11)
GridGuard.Cntry.VolCtl.MaxPuTms	Tripping time of upper maximum threshold in ms (Grid monitoring > Grid monitoring > Country standard > Voltage monitoring)	-
GridGuard.Cntry.VolCtl.hhLimPu	Median maximum threshold in p.u. (Grid monitoring > Grid monitoring > Country standard > Voltage monitoring)	Reference value: parameterized nominal voltage (see Section 3.1.2 "Adjustable Parameters of the Nominal Voltage", page 11)
GridGuard.Cntry.VolCtl.hhLimTms	Tripping time of mean maximum threshold in ms (Grid monitoring > Grid monitoring > Country standard > Voltage monitoring)	-

Object name	Definition (display group)	Explanation
GridGuard.Cntry.VolCtl.hLimPu	Lower maximum threshold in p.u. (Grid monitoring > Grid monitoring > Country standard> Voltage monitoring)	Reference value: parameterized nominal voltage (see Section 3.1.2 "Adjustable Parameters of the Nominal Voltage", page 11)
GridGuard.Cntry.VolCtl.hLimTmms	Tripping time of lower maximum threshold in ms (Grid monitoring > Grid monitoring > Country standard> Voltage monitoring)	-
GridGuard.Cntry.VolCtl.ConnMaxPu	Maximum connection voltage after restart in P.u. (Grid monitoring > Grid monitoring > Country standard> Voltage monitoring > Upper limit of first connection)	Reference value: parameterized nominal voltage (see Section 3.1.2 "Adjustable Parameters of the Nominal Voltage", page 11)

Undervoltage Limits

Object name	Definition (display group)	Explanation
GridGuard.Cntry.VolCtl.MinPu	Lower minimum threshold in p.u. (Grid monitoring > Grid monitoring > Country standard> Voltage monitoring)	Reference value: parameterized nominal voltage (see Section 3.1.2 "Adjustable Parameters of the Nominal Voltage", page 11)
GridGuard.Cntry.VolCtl.MinTmms	Tripping time of lower minimum threshold in ms (Grid monitoring > Grid monitoring > Country standard> Voltage monitoring)	-
GridGuard.Cntry.VolCtl.lLimPu	Median minimum threshold in p.u. (Grid monitoring > Grid monitoring > Country standard> Voltage monitoring)	Reference value: parameterized nominal voltage (see Section 3.1.2 "Adjustable Parameters of the Nominal Voltage", page 11)
GridGuard.Cntry.VolCtl.lLimTmms	Median minimum threshold tripping time in ms (Grid monitoring > Grid monitoring > Country standard> Voltage monitoring)	-
GridGuard.Cntry.VolCtl.uLimPu	Upper minimum threshold in p.u. (Grid monitoring > Grid monitoring > Country standard> Voltage monitoring)	Reference value: parameterized nominal voltage (see Section 3.1.2 "Adjustable Parameters of the Nominal Voltage", page 11)

Object name	Definition (display group)	Explanation
GridGuard.Cn-try.VolCtl.lLimTmms	Tripping time of upper minimum threshold in ms (Grid monitoring > Grid monitoring > Country standard> Voltage monitoring)	-
GridGuard.Cn-try.VolCtl.ConnMinPu	Minimum connection voltage after restart in p.u. (Grid monitoring > Grid monitoring > Country standard> Voltage monitoring > Lower limit of first connection)	Reference value: parameterized nominal voltage (see Section 3.1.2 "Adjustable Parameters of the Nominal Voltage", page 11)

Rise-In-Voltage Protection

The rise-in-voltage protection function monitors the 10-minute average of the AC voltage.

Object name	Definition (display group)	Explanation
GridGuard.Cn-try.VolCtl.RproTmms	Tripping time of rise-in-voltage protection in ms (Grid monitoring > Grid monitoring > Country standard> Voltage monitoring)	-
GridGuard.Cn-try.VolCtl.RproPu	Rise-in-voltage protection in p.u. (Grid monitoring > Grid monitoring > Country standard> Voltage monitoring)	Reference value: parameterized nominal voltage (see Section 3.1.2 "Adjustable Parameters of the Nominal Voltage", page 11)

Monitoring of the Voltage Increase Protection

Object name	Definition (display group)	Explanation
GridGuard.Cn-try.VolCtl.MaxPeakTmms	Voltage monitoring, tripping time of voltage increase protection in ms (Grid monitoring > Grid monitoring > Country standard> Voltage monitoring)	-
GridGuard.Cn-try.VolCtl.MaxPeakPu	Voltage monitoring, peak voltage threshold in p.u. (Grid monitoring > Grid monitoring > Country standard> Voltage monitoring)	Reference value: parameterized nominal voltage (see Section 3.1.2 "Adjustable Parameters of the Nominal Voltage", page 11)

Connection Limits for Restarting After a Grid Fault

Object name	Definition (display group)	Explanation
GridGuard.Cntry.VolCtl.ReconMaxPu	Maximum connection voltage in p.u. (Grid monitoring > Grid monitoring > Country standard > Voltage monitoring)	The reference value is the parameterized nominal voltage (see Section 3.1.2 "Adjustable Parameters of the Nominal Voltage", page 11).
GridGuard.Cntry.VolCtl.ReconMinPu	Minimum connection voltage in p.u. (Grid monitoring > Grid monitoring > Country standard > Voltage monitoring)	The reference value is the parameterized nominal voltage (see Section 3.1.2 "Adjustable Parameters of the Nominal Voltage", page 11).

5.1.2 Dynamic Grid Support

Information

This function is currently only supported by inverters.

With dynamic grid support (fault ride-through – FRT), the inverter supports the utility grid during a brief grid voltage deviation (FRT event). This may involve either grid undervoltage (low-voltage ride-through – LVRT) or grid overvoltage (high-voltage ride-through – HVRT).

With full dynamic grid support, grid support is ensured by feeding in reactive current according to a defined droop (see figures reactive current droop). If the grid voltage is outside a defined range or optionally, exhibits a leap change exceeding a defined threshold, the inverter feeds in reactive current to counteract the voltage variation. The thresholds of the limited dynamic grid support are also active in this mode.

With limited dynamic grid support, the inverter interrupts grid feed-in during a grid voltage deviation without disconnecting from the utility grid.

The thresholds for the activation of the dynamic grid support are set by default according to the local grid codes by selecting the respective country data set.

Object name	Definition (display group)	Explanation
Inverter.DGSMo- Cfg.DGSMo	Dynamic grid support operating mode (System and device control > Inverter > Dynamic grid support)	Adjustable: Off Limited dynamic grid support Complete dynamic grid support

Limited Dynamic Grid Support

When exceeding voltage thresholds $ZerCurUnVolPu$ and $ZerCurOvVolPu$ of the dynamic grid support, the current feed-in is stopped (zero current feed-in). If these voltage thresholds are maintained again, the inverter feeds in again. Similar to full dynamic grid support, the voltage thresholds for limited dynamic grid support are also shifted by the hysteresis voltage $HystVolPu$. Parameters $ZerCurUnVolTmms$ and $ZerCurOvVolTmms$ can be used to delay the start of the limited dynamic grid support. The zero current feed-in is selected via $ZerCurMod$, between curtailment during active operation of the power semiconductor devices or a pulse block mode, in which the power semiconductor devices are switched into a high-impedance state.

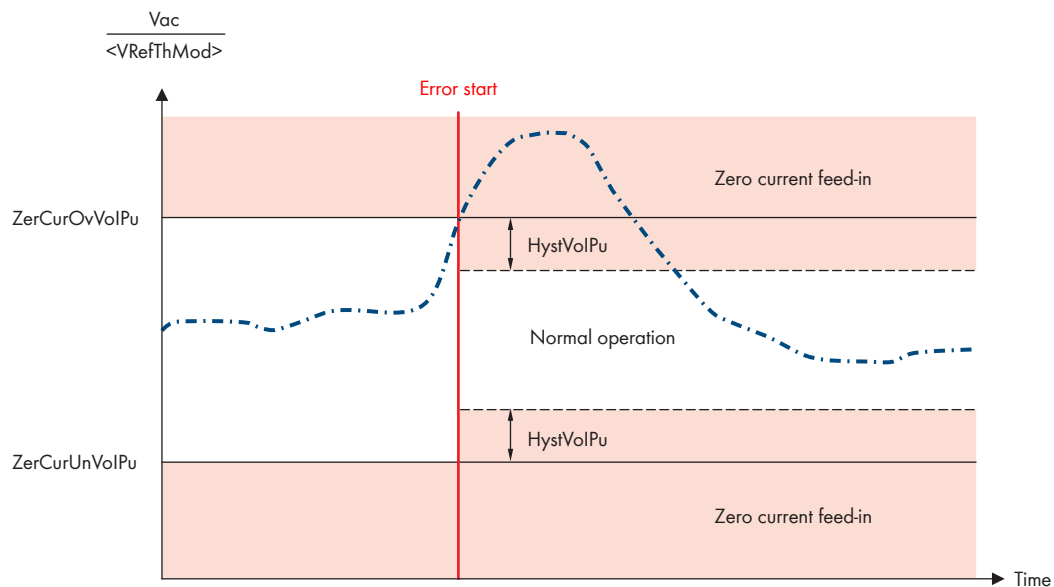


Figure 19: Limited dynamic grid support

Object name	Definition (display group)	Explanation
Inverter.DGSModCfg.Zer-CurOvVolPu	Dynamic grid support, overvoltage threshold for zero-sequence current in p.u. (System and device control > Inverter > Dynamic grid support)	Activation threshold for zero current feed-in in case of overvoltage. Reference value is specified through VRefThMod.
Inverter.DGSModCfg.Zer-CurUnVolPu	Dynamic grid support, undervoltage threshold for zero-sequence current in p.u. (System and device control > Inverter > Dynamic grid support)	Activation threshold for zero current feed-in in case of undervoltage. Reference value is specified through VRefThMod.
Inverter.DGSMod-Cfg.HystVolPu	Dynamic grid support, hysteresis voltage in p.u.	Hysteresis for activation thresholds of the dynamic grid support.
Inverter.DGSModCfg.Zer-CurUnVolTmms	Dynamic grid support, delay time for residual current at undervoltage in ms	Activation delay for the zero current feed-in in case of undervoltage.

Object name	Definition (display group)	Explanation
Inverter.DGSModCfg.Zer-CurOvVolTmms	Dynamic grid support, delay time for residual current at overvoltage in ms	Activation delay for the zero current feed-in in case of overvoltage.
Inverter.DGSModCfg.Zer-CurMod	Dynamic grid support, mode for zero current	Type of zero current feed-in Adjustable: Puls block for zero current (Blc) Controlled zero current (Ctrl)

Complete Dynamic Grid Support

Full dynamic grid support or reactive current droop is activated based on three different criteria:

- One or more phase voltages exceed the defined overvoltage and undervoltage thresholds Inverter.DGSModCfg.DGSFICfg.DbVMinPu and Inverter.DGSModCfg.DGSFICfg.DbVMaxPu.
- The negative-sequence voltage exceeds the activation threshold Inverter.DGSModCfg.DGSFICfg.DbVNegSeqPu.
- A voltage leap greater than Inverter.DGSModCfg.DGSFICfg.StepVolPu is detected.

Upon activation via the negative-sequence voltage limit, only the droop for the negative sequence is activated. The other two activation criteria each activate both droops.

To detect voltage deviations, there are three types of reference voltages available:

- The parameterized nominal voltage as static reference voltage.
- The average grid voltage (long-term average) calculated over the AvLtTms period.
- The average grid voltage (short-term average) calculated over the AvStTms period.

The deviations of the phase voltages and the negative-sequence voltage are, depending on the selection parameter VRefThMod, calculated either relative to the static reference voltage or relative to the long-term average of the grid voltage. A voltage leap is always detected based on the deviation from the short-term average of the grid voltage.

Deactivation of the droop occurs when the voltages fall below (HVRT) or exceed (LVRT) the deactivation thresholds. The deactivation thresholds are determined by shifting the activation thresholds by the hysteresis voltage HystVolPu. In case of a voltage leap, the subsequent activation time ArStrMaxTms is predefined.

Object name	Definition (display group)	Explanation
Inverter.DGSModCfg.DGSFICfg.DbVMinPu	Undervoltage threshold for reactive current in p.u. (System and device control > Inverter > Dynamic grid support)	Activation threshold of the reactive current droop, reference value is specified through VRefThMod
Inverter.DGSModCfg.DGSFICfg.DbVMaxPu	Overvoltage threshold for reactive current in p.u. (System and device control > Inverter > Dynamic grid support)	Activation threshold of the reactive current droop, reference value is specified through VRefThMod
Inverter.DGSModCfg.DGSFICfg.DbVNegSeqPu	Dynamic grid support, voltage threshold for reactive current in the negative sequence	Activation threshold of the negative-sequence reactive current droop, reference value is specified through VRefThMod
Inverter.DGSModCfg.HystVolPu	Dynamic grid support, hysteresis voltage in p.u.	Hysteresis for activation thresholds of the dynamic grid support

Object name	Definition (display group)	Explanation
Inverter.DGSMod-Cfg.VRefThMod	Dynamic grid support, averaging for threshold detection	Reference voltage for the detection of the dynamic grid support Adjustable: Off (nominal voltage Vref) On (averaged grid voltage VRefAv)
Inverter.DGSModCfg.DGS-FICfg.StepVolPu	Dynamic grid support, voltage leap height in p.u.	Threshold at which a voltage leap is detected.
Inverter.DGSModCfg.DGS-FICfg.FltEnd.ArMaxTms	Dynamic grid support, time for providing reactive power after voltage leap in s	Time for providing reactive power after voltage leap. At a value above 0, the voltage leap detection is deactivated.
Inverter.DGSMod-Cfg.AvLftTms	Dynamic grid support, long-term averaging time of the pre-fault voltage in s	Filter time constant for the long-term filtering of the grid voltage reference
Inverter.DGSMod-Cfg.AvStTms	Dynamic grid support, short-time average time of the pre-fault voltage	Filter time constant for the short-term filtering of the grid voltage reference. Only used for jump detection.

In addition to the activation conditions just described here, the activation conditions of the limited dynamic grid support remain active.

Reactive current droop

The reactive current droop determines the level of the reactive current provided during a grid voltage deviation. This reactive current is proportional to the deviation of the instantaneous voltage from a voltage reference value. The parameter VRefArMod can either be used to set the nominal voltage or the long-term average of the grid voltage as voltage reference value (see also paragraph Activation conditions). The calculations are performed separately for positive and negative sequence.

The droop for the positive sequence is defined via up to two voltage interpolation points and the associated gradients (k-factors). For voltage values between the nominal voltage and the first voltage interpolation point, the gain of the droop is zero. The reactive current determined from the droop can either be added to the pre-fault reactive current or assigned an arbitrary static offset. The additional reactive current from the droop is calculated from the voltage deviation in p.u., multiplied by the set gradients and the nominal current.

A separate gradient is available for the negative sequence. A buckling point can be set via the parameters ArGraMod and DbVNegSeqPu.

The reactive current resulting from the droop is less than the first interpolation point for voltage deviations or, if not activated, equal to zero. If no parameters of the voltage interpolation points $V_{StrArGraSagPu}$ and $V_{StrArGraSwellPu}$ are specified, the reactive current droop passes through the origin by default. The parameter $ArGraMod$ then also applies to the positive sequence.

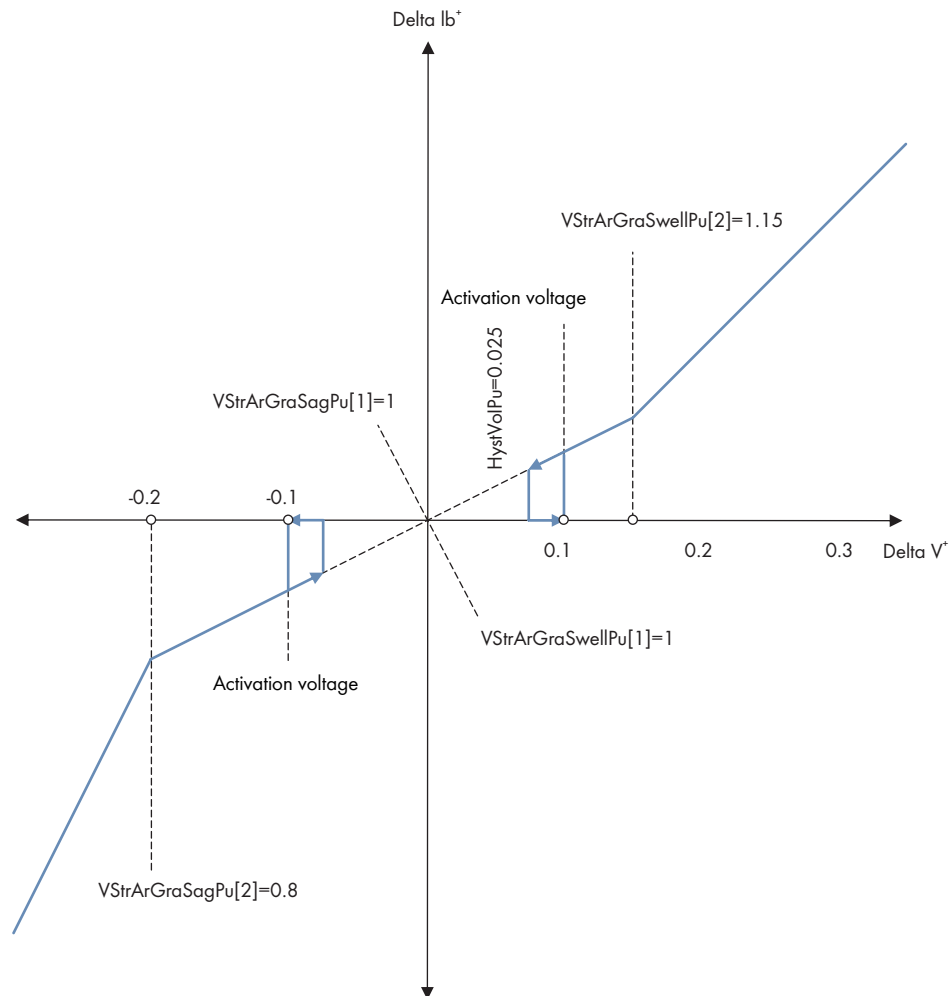


Figure 20: Reactive current droop positive sequence, droop through zero (example)

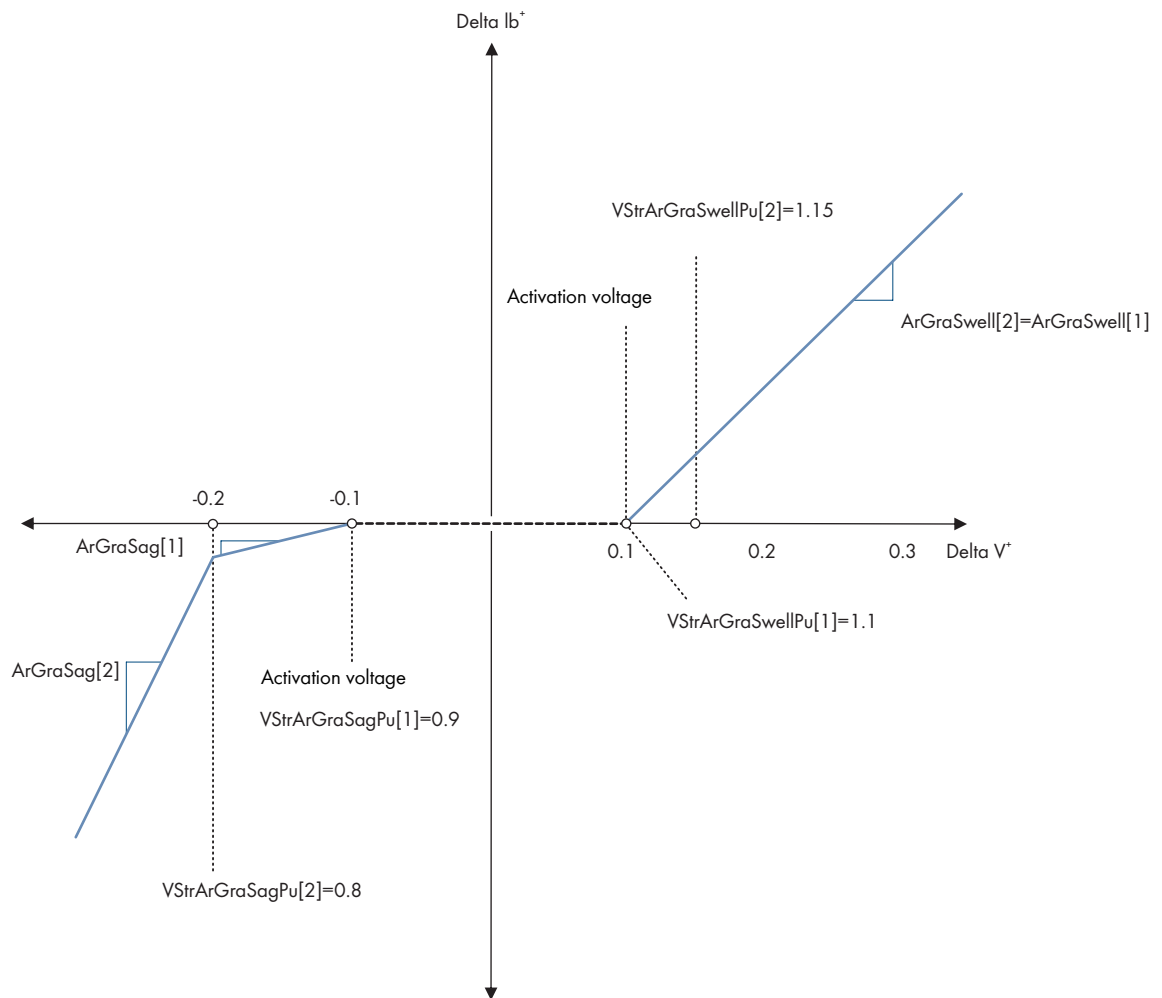


Figure 21: Reactive current droop positive sequence, droop starts at deadband (example)

Activation voltage positive sequence:

The activation voltage is not a constant positive-sequence voltage threshold. It becomes effective when one of the following conditions is met:

- Random phase voltage is less than DbV_{MaxPu}
- Random phase voltage is more than DbV_{MaxPu}
- A voltage leap was detected.

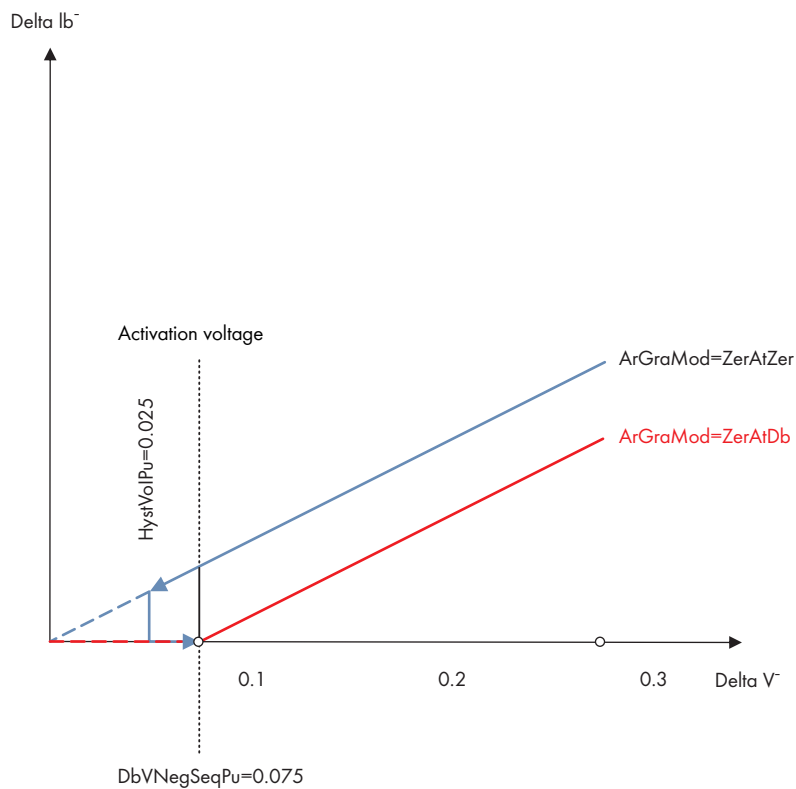


Figure 22: Reactive current droop in the negative sequence

Activation voltage negative sequence:

The activation voltage is not a constant negative-sequence voltage threshold. It becomes effective when one of the following conditions is met:

- Random phase voltage is less than DbVMaxPu
- Random phase voltage is more than DbVMaxPu
- The negative-sequence voltage exceeds DbVNegSeqPu
- A voltage leap was detected.

Object name	Definition (display group)	Explanation
Inverter.DGSModCfg.DGS- FLCfg.ArGraSag	Dynamic grid support, gradient K of the reactive current droop for undervoltage (System and device control > Inverter > Dynamic grid support > Full dynamic grid support)	The gradient K indicates the addi- tional reactive current per voltage deviation. Here, the additional re- active current relates to the nomi- nal current and the voltage devia- tion relates to the selected refer- ence voltage.

Object name	Definition (display group)	Explanation
Inverter.DGSModCfg.DGS- FlCfg.ArGraSwell	Dynamic grid support, gradient K of the reactive current droop for overvoltage (System and device control > Inverter > Dynamic grid support > Full dynamic grid support)	The gradient K indicates the additional reactive current per voltage deviation. Here, the additional reactive current relates to the nominal current and the voltage deviation relates to the selected reference voltage.
Inverter.DGSModCfg.DGS- FlCfg.ArGraNegSeq	Dynamic grid support, gradient K of the reactive current droop in the negative sequence (System and device control > Inverter > Dynamic grid support > Full dynamic grid support)	The gradient K indicates the additional reactive current per voltage deviation. Here, the additional reactive current relates to the nominal current and the voltage deviation relates to the selected reference voltage.
Inverter.DGSModCfg.DGS- FlCfg.VStrArGraSagPu	Dynamic grid support, start voltage for gradient K in case of undervoltage	Starting point of the positive sequence droop for LVRT. The second starting point is optional to be able to use another k-factor in case of greater voltage deviations.
Inverter.DGSModCfg.DGS- FlCfg.VStrArGraSwellPu	Dynamic grid support, start voltage for gradient K at overvoltage	Starting point of the positive sequence droop for HVRT. The second starting point is optional to be able to use another k-factor in case of greater voltage deviations.
Inverter.DGSModCfg.DGS- FlCfg.ArGraMod	Dynamic grid support, reactive current droop	Affects only the negative sequence droop Adjustable: Zero at dead band boundary Zero at origin
Inverter.DGSModCfg.DGS- FlCfg.ArOfsMod	Dynamic grid support, operating mode starting point reactive current static	Adjustable: Droop reactive current is added to the pre-fault reactive current (PreFltSpnt), droop reactive current has a fixed offset (CnstPu)
Inverter.DGSModCfg.DGS- FlCfg.ArOfsPu	Dynamic grid support, manual starting point reactive current droop	Offset for the droop reactive current
Inverter.DGSModCfg.DGS- FlCfg.VRefArMod	Dynamic grid support, averaging for reactive current droop	Adjustable: On Off

Time conditions

The following describes additional configurable time conditions that affect the deactivation of reactive current droop.

For the error types LVRT and HVRT, there are separate lag times of the reactive current droop beyond the fault end. If the grid voltage exceeds the deactivation thresholds after a voltage deviation, the reactive current droop continues to remain active from this moment for the duration $ArStopSagTmms$ or $ArStopSwellTmms$.

Furthermore, there is a general minimum and maximum time for which the reactive power droop must remain active or is allowed to remain active. Regardless of the fault duration, including the configured lag time, the inverter always activates reactive power droop for a minimum time of $ArStrMinTmms$ and a maximum time of $ArStrMaxTmms$.

The lag times as well as the minimum and maximum times do not apply when the reactive current droop was activated due to a voltage leap. In this case, the sole decisive factor is the activation time $ArStrMaxTms$, during which reactive current is to be fed in following a voltage leap. If a new voltage leap occurs during this time, the activation time is measured again from this leap.

During FRT events, voltage monitoring always runs in parallel with the disconnection times set there. This means that dynamic grid support itself never initiates a grid disconnection; however, it is possible that during an FRT event, voltage monitoring (according to Section 5.1.1) triggers and performs a grid disconnection.

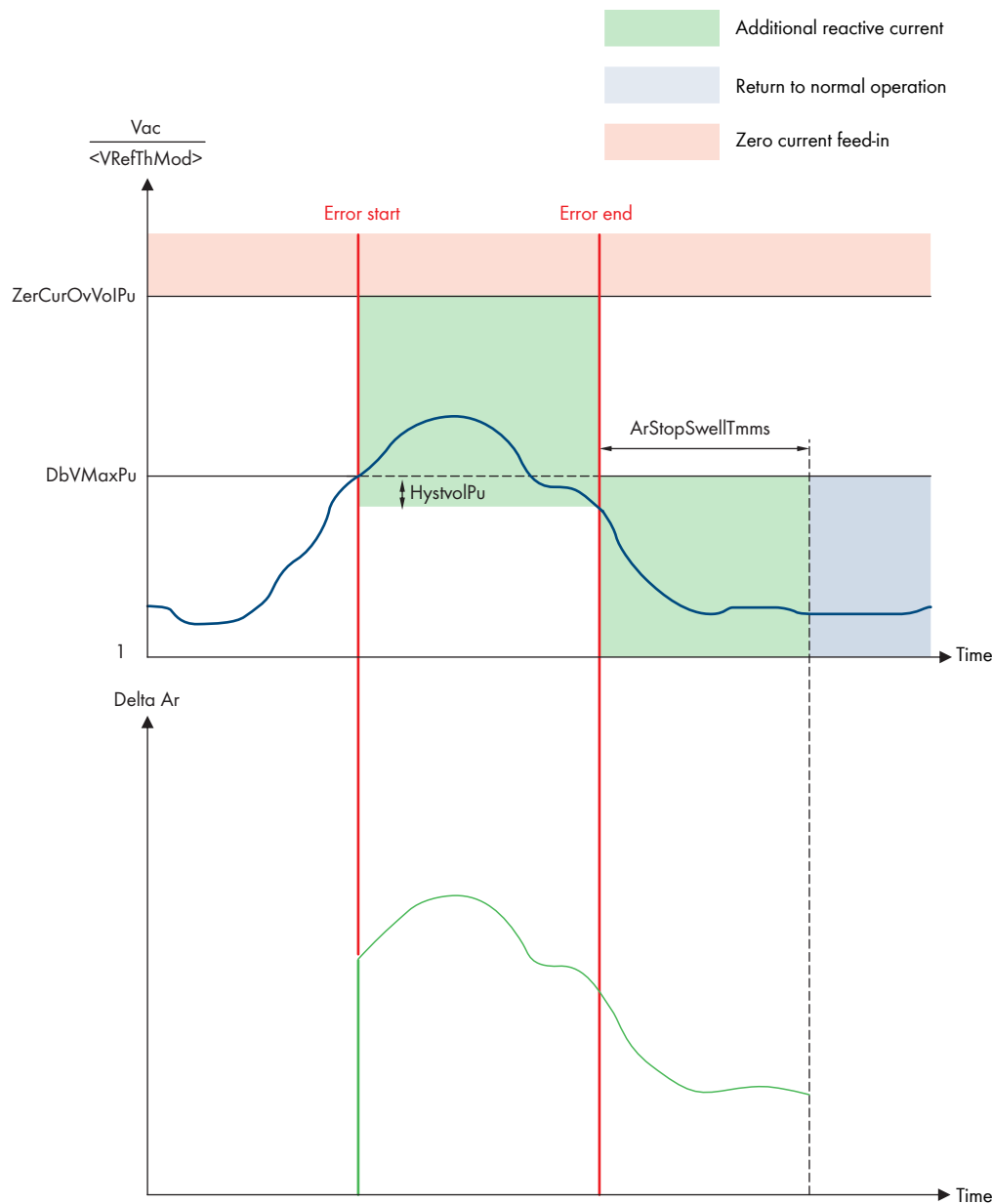


Figure 23: Time conditions, example for HVRT

Object name	Definition (display group)	Explanation
Inverter.DGSModCfg.DGS- FltCfg.FltEnd.ArStopSwellT- mms	Dynamic grid support, lag time in case of overvoltage in ms	Lag time for HVRT. After the voltage has returned to the normal range, reactive current continues to be supplied for this period according to the stored characteristic curve.

Object name	Definition (display group)	Explanation
Inverter.DGSModCfg.DGS- FLCfg.FltEnd.ArStopSagT- mms	Dynamic grid support, lag time in case of undervoltage in ms	Lag time for LVRT. After the voltage has returned to the normal range, reactive current continues to be supplied for this period according to the stored characteristic curve.
Inverter.DGSModCfg.DGS- FLCfg.ArStrMinTmms	Dynamic grid support, minimum duration of providing reactive current in ms	Minimum time for reactive power feed-in via droop.
Inverter.DGSModCfg.DGS- FLCfg.ArStrMaxTmms	Dynamic grid support, maximum duration of providing reactive current in ms	Maximum time for reactive power feed-in via droop.

Further limitations and boundary conditions of the complete dynamic grid support

ArMaxSwell and ArMaxSag define the maximum reactive current provided per line conductor in case of failure in the event of grid overvoltage or undervoltage. The maximum active current per line conductor in case of failure can be limited via AWattLimMod, AWattMin and AWattMax to the pre-fault value or fixed threshold.

Another setting option are the gradient limitations of the electric currents during and after an FRT event. The maximum ramp rate AWattGraMax of the active current can be set separately for the case of failure, i.e. while the voltage lies outside the permissible range and following an FRT event, i.e. during the return to the normal operating point. For reactive current, the adjustable current ramp applies only to the transition of reactive current setpoints between the values preceding and following the FRT event.

During full dynamic grid support, the priority between active and reactive current can also be switched via AWattPrioEna. It is recommended to use the reactive current priority to prioritize voltage support.

Object name	Definition (display group)	Explanation
Inverter.DGSModCfg.DGS- FLCfg.ArMaxSag	Dynamic grid support, maximum reactive current in case of undervoltage in %	Maximum provided reactive current during an LVRT.
Inverter.DGSModCfg.DGS- FLCfg.ArMaxSwell	Dynamic grid support, maximum reactive current at overvoltage in %	Maximum provided reactive current during an HVRT.
Inverter.DGSModCfg.DGS- FLCfg.AWattMax	Dynamic grid support, maximum active current	Maximum active current fed into the utility grid during an FRT event.
Inverter.DGSModCfg.DGS- FLCfg.AWattMin	Dynamic grid support, minimum active current	Maximum active current drawn from the utility grid during an FRT event.
Inverter.DGSModCfg.DGS- FLCfg.AWattLimMod	Dynamic grid support, operating mode active power limitation	Limit for the maximum active current fed into the utility grid during an FRT event. Adjustable: Limitation to the amount of the pre-fault active current (PreFltSpnt) Use of the fixed limits AWattMin/AWattMax (CnstPu)
Inverter.DGSModCfg.DGS- FLCfg.AWattGraMax	Dynamic grid support, active current change rate in case of failure	Maximum ramp rate of the active current in case of failure.

Object name	Definition (display group)	Explanation
Inverter.DGSMoCfG.DGS- FlCfG.FltEnd.AWattGra- Max	Dynamic grid support, active current change rate after fault end in %/s	Maximum ramp rate of the active current after a fault. Effective until the pre-fault operating point is reached.
Inverter.DGSMoCfG.DGS- FlCfG.FltEnd.ArGraMax	Dynamic grid support, reactive current change rate after fault end in %/s	Maximum ramp rate of the reac- tive power setpoint after an FRT event. Effective from the transition of the pre-fault setpoint to the re- quested setpoint after the FRT event.
Inverter.DGSMoCfG.DGS- FlCfG.AWattPrioEna	Dynamic grid support, active current priority at ap- parent current limit	Switching of the current priority during an FRT event Adjustable: Off (reactive power priority) On (active current priority)

Also see:

- [Adjustable Parameters of the Nominal Voltage](#) ⇒ page 11

5.2 Behavior in Case of Frequency Errors

5.2.1 Frequency Monitoring

i Information

This function is currently only supported by inverters.

The inverter continuously checks the power frequency. This enables the inverter to disconnect from the utility grid in case of overfrequency or underfrequency.

If the power frequency rises above or falls below the configured thresholds, the inverter waits for the time defined in the corresponding parameter and disconnects from the utility grid.

For reconnection there are special limiting values GridGuard.Cntry.FrqCtl.ReconMin and GridGuard.Cntry.FrqCtl.ReconMax (see Section 3.3 "Connection Behavior of Inverters", page 13).

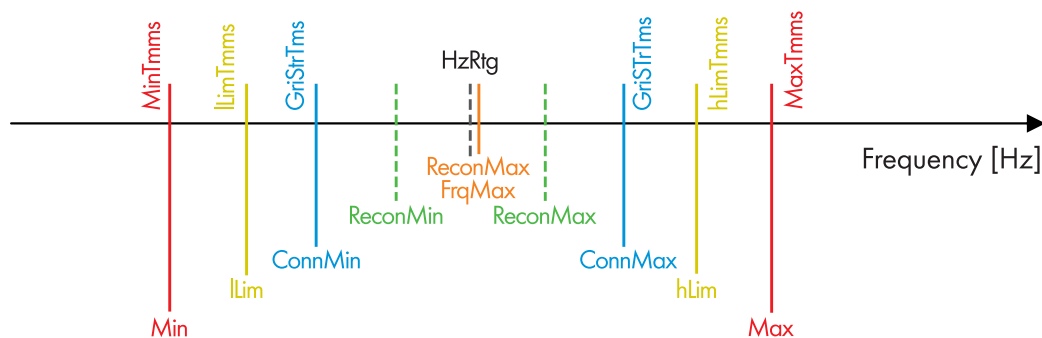


Figure 24: Frequency monitoring (HzRtg: nominal frequency of the utility grid)

Overfrequency Limits

Object name	Definition (display group)
GridGuard.Cntry.FrqCtl.Max	Upper maximum threshold in Hz (Grid monitoring > Grid monitoring > Country standard > Frequency monitoring)
GridGuard.Cntry.FrqCtl.MaxTmms	Tripping time of upper maximum threshold in ms (Grid monitoring > Grid monitoring > Country standard > Frequency monitoring)
GridGuard.Cntry.FrqCtl.hLim	Lower maximum threshold in Hz (Grid monitoring > Grid monitoring > Country standard > Frequency monitoring)
GridGuard.Cntry.FrqCtl.hLimTmms	Tripping time of lower maximum threshold in ms (Grid monitoring > Grid monitoring > Country standard > Frequency monitoring)
GridGuard.Cntry.FrqCtl.ConnMax	Maximum connection frequency after restart in Hz (Installer grid monitoring > Grid monitoring > Country standard > Frequency monitoring > Upper limit of first connection)

Underfrequency Limits

Object name	Definition (display group)
GridGuard.Cntry.FrqCtl.lLim	Upper minimum threshold in Hz (Grid monitoring > Grid monitoring > Country standard > Frequency monitoring)
GridGuard.Cntry.FrqCtl.lLimTmms	Tripping time of upper minimum threshold in ms (Grid monitoring > Grid monitoring > Country standard > Frequency monitoring)
GridGuard.Cntry.FrqCtl.Min	Lower minimum threshold in Hz (Grid monitoring > Grid monitoring > Country standard > Frequency monitoring)
GridGuard.Cntry.FrqCtl.MinTmms	Tripping time of lower minimum threshold in ms (Grid monitoring > Grid monitoring > Country standard > Frequency monitoring)
GridGuard.Cntry.FrqCtl.ConnMin	Minimum connection frequency after restart in Hz (Grid monitoring > Grid monitoring > Country standard > Frequency monitoring > Lower limit of first connection)

Connection Limits for Restarting After a Grid Fault

Object name	Definition (display group)
GridGuard.Cntry.FrqCtl.ReconMax	Maximum connection frequency in Hz (Grid monitoring > Grid monitoring > Country standard > Frequency monitoring)
GridGuard.Cntry.FrqCtl.ReconMin	Minimum connection frequency in Hz (Grid monitoring > Grid monitoring > Country standard > Frequency monitoring)
GridGuard.Cntry.FrqCtl.ReconMaxFrqMax	Maximum connection frequency after overfrequency disconnection (Grid monitoring > Grid monitoring > Country standard > Frequency monitoring > Upper limit of reconnection after overfrequency disconnection)

5.2.2 P(f) Characteristic Curve

With frequency-dependent active power control, the inverter continually checks the connected power frequency and changes the power in accordance with the frequency deviations. This function is activated via the parameter Inverter.WCtHzModCfg.Ena. To control the behavior of the inverter in the event of grid frequency deviations, the P(f) characteristic curve of the overfrequency with three sections each is configurable. A buckling frequency (HzUn / HzOv) and a gradient (HzUnGra / HzOvGra) are configurable for each section. When the grid frequency stabilizes again and passes the stop frequency (HzUnStop/HzOvStop), the inverter returns to normal operation. All parameters and interpolation points can be configured on the user interface.

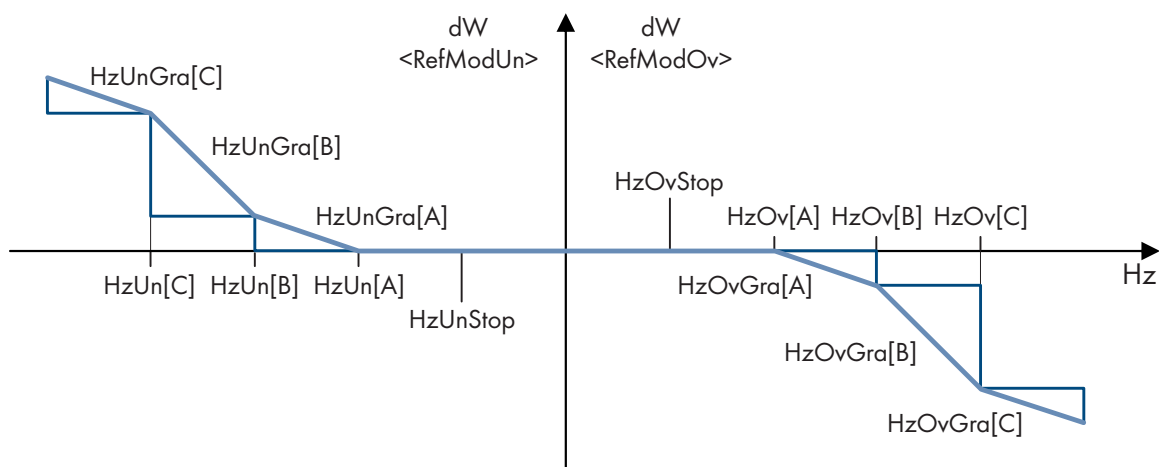


Figure 25: Example of a P(f) characteristic curve

Activating the Characteristic Curve

Object name	Definition (display group)	Explanation
Inverter.WCtHzModCfg.Ena	P(f) Characteristic Curve (System and device control > Inverter > Frequency-dependent active power adapt. P(f))	Activation / deactivation

Setting the Characteristic Curve

Object name	Definition (display group)	Explanation
Inverter.WCtHzMod-Cfg.RefModOv	Reference value for active power in case of overfrequency (System and device control > Inverter > Frequency-dependent active power adapt. $P(f)$)	Adjustable: Maximum active power ($W_{Max-Out}$) Instantaneous power (W_{Snpt}) Potential power ($W_{SnptMax}$) Potential power with characteristic curve break ($W_{SnptMaxStep}$)
Inverter.WCtHzMod-Cfg.RefModUn	Reference value for active power in case of underfrequency	Adjustable: Maximum active power ($W_{Max-Out}$) Instantaneous power (W_{Snpt}) Potential power ($W_{SnptMax}$) Potential power with characteristic curve break ($W_{SnptMaxStep}$)
Inverter.WCtHzMod-Cfg.WTms	Response time in s (System and device control > Inverter > Frequency-dependent active power adapt. $P(f)$)	Response time corresponds to 3 taus (RC time constant) of a PT1 element
Inverter.WCtHzMod-Cfg.WCtHzCfg.HystEnaOv	Hysteresis in case of overfrequency (System and device control > Inverter > Frequency-dependent active power adapt. $P(f) > P(f)$ characteristic curve)	When the hysteresis is activated in case of overfrequency, the characteristic value remains constant when the frequency drops again until falling below the reset overfrequency.
Inverter.WCtHzMod-Cfg.WCtHzCfg.HystEnaUn	Hysteresis in case of underfrequency (System and device control > Inverter > Frequency-dependent active power adapt. $P(f) > P(f)$ characteristic curve)	When the hysteresis is activated in case of underfrequency, the characteristic value remains constant when the frequency increases again until the reset underfrequency is exceeded.
Inverter.WCtHzMod-Cfg.WCtHzCfg.HzOv	Buckling overfrequencies in Hz (System and device control > Inverter > Frequency-dependent active power adapt. $P(f) > P(f)$ characteristic curve)	$HzOvStop$ must be less than or equal to $HzOv(A)$.
Inverter.WCtHzMod-Cfg.WCtHzCfg.HzOvGra	Changes in the active power in case of overfrequency %/Hz (System and device control > Inverter > Frequency-dependent active power adapt. $P(f) > P(f)$ characteristic curve)	The reference value is the active power set via Inverter.WCtHzModCfg.RefModOv in case of underfrequency.

Object name	Definition (display group)	Explanation
Inverter.WCtHzMod-Cfg.WCtHzCfg.HzOvStop	Reset overfrequency in Hz (System and device control > Inverter > Frequency-dependent active power adapt. P(f) > P(f) characteristic curve)	Upon falling below this frequency, the characteristic curve is deactivated and the transition to normal operation is started. During the switch to normal operation, a ramp rate is used to adjust the power to the maximum feed-in or reference power. HzOvStop must be less than or equal to HzOv(A).
Inverter.WCtHzMod-Cfg.WCtHzCfg.HzUn	Breaking underfrequencies in Hz (System and device control > Inverter > Frequency-dependent active power adapt. P(f) > P(f) characteristic curve)	HzUnStop must be greater than or equal to HzUn(A).
Inverter.WCtHzMod-Cfg.WCtHzCfg.HzUnGra	Changes in the active power in case of underfrequency %/Hz (System and device control > Inverter > Frequency-dependent active power adapt. P(f) > P(f) characteristic curve)	The reference value is the active power set via Inverter.WCtHzModCfg.RefModUn in case of underfrequency.
Inverter.WCtHzMod-Cfg.WCtHzCfg.HzUnStop	Reset underfrequency in Hz (System and device control > Inverter > Frequency-dependent active power adapt. P(f) > P(f) characteristic curve)	When this frequency is exceeded, the characteristic curve is deactivated and the transition to normal operation started. During the switch to normal operation, a ramp rate is used to adjust the power to the maximum feed-in or reference power. HzUnStop must be greater than or equal to HzUn(A).

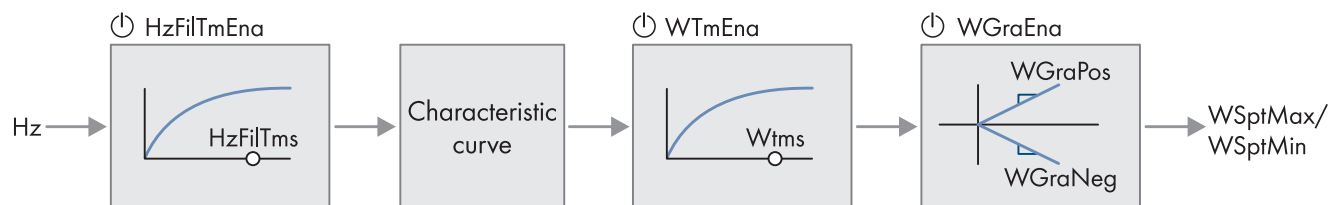
Behavior When Activating / Deactivating the Characteristic Curve

Object name	Definition	Explanation
Inverter.WCtHzMod-Cfg.WCtHzCfg.WCtTmms	Tripping delay (System and device control > Inverter > Frequency-dependent active power adapt. P(f) > P(f) characteristic curve)	Initial delay of the power change after exceeding the first buckling frequency or after falling short of the first buckling frequency in case of underfrequency

Object name	Definition	Explanation
Inverter.WCtHzMod-Cfg.WCtHzCfg.HzStopWGraTms	Waiting time in s (System and device control > Inverter > Frequency-dependent active power adapt. $P(f) > P(f)$ characteristic curve)	Waiting time until the transition to normal operation is started. The waiting time is started as soon as the frequency is within the two reset frequencies: $\text{HzUnStop} < f < \text{HzOvStop}$ After the waiting time has passed, a ramp rate is used to align the active power with the normal operation
Inverter.WCtHzMod-Cfg.WCtHzCfg.HzStopWGra	Active power ramp rate after the end of a fault in %/min (System and device control > Inverter > Frequency-dependent active power adapt. $P(f) > P(f)$ characteristic curve)	The reference value is $W_{\text{MaxOut}} / W_{\text{MaxIn}}$

Configuring Dynamic Response

The ramp and/or a PT1 element is only active outside the normal frequency range. The ramp Inverter.WCtHzModCfg.WCtHzCfg.HzStopWGra is activated for the return to the normal range.



Object name	Definition	Explanation
Inverter.WCtHzMod-Cfg.WTmEna	Setting time of the operating point of the $P(f)$ function	Activation / deactivation
Inverter.WCtHzMod-Cfg.WTms	Response time in s (System and device control > Inverter > Frequency-dependent active power adapt. $P(f)$)	Response time corresponds to 3 taus (RC time constant) of a PT1 element
Inverter.WCtHzMod-Cfg.WGraEna	Active power gradient of the operating point of the $P(f)$ function	Activation / deactivation
Inverter.WCtHzMod-Cfg.WGraPos	in % per second of W_{MaxOut}	Positive active power gradient of the operating point of the $P(f)$ function
Inverter.WCtHzMod-Cfg.WGraNeg	in % per second of W_{MaxOut}	Negative active power gradient of the operating point of the $P(f)$ function

Object name	Definition	Explanation
Inverter.WCtHzMod-Cfg.HzFilTmEna	Actual value filter for measured frequency value (System and device control > Inverter > Voltage-dependent active power adjustment P(f) > Actual value filter for measured frequency value)	Activation / deactivation
Inverter.WCtHzMod-Cfg.HzFilTms	Response time for actual value filter (System and device control > Inverter > Voltage-dependent active power adjustment P(f) > Response time for actual value filter)	Response time corresponds to 3 taus (RC time constant) of a PT1 element

5.3 Islanding Detection

Information

This function is currently only supported by inverters.

The islanding detection function detects the formation of unwanted electrical islands and disconnects the inverter from the utility grid. Unwanted islanding can occur when at the time of utility grid failure, the load in the shut-down sub-grid is roughly equivalent to the current feed-in power of the PV system or battery storage system. With active islanding detection, the inverter continuously checks the stability of the utility grid. There are 2 modes for this. One mode monitors the frequency and the other detects unbalanced loads between the line conductors. Detection of an unbalanced load is only supported by three-phase inverters. If the utility grid is intact, the modes for islanding detection have no impact on the utility grid and the inverter continues to feed in. Only if an unwanted electrical island has formed will the inverter disconnect from the utility grid.

By selecting the country data set, the islanding detection is deactivated or activated and adjusted according to the country standard.

Object name	Definition (display group)	Explanation
GridGuard.Cntry.Aid.HzMon.Stt	Islanding detection, status of frequency monitor (Grid monitoring > Grid monitoring > Country standard > Islanding detection)	Adjustable: On / On Off / Off
GridGuard.Cntry.Aid.AsymDet.Stt	Islanding detection, status of the unbalanced load detection (Grid monitoring > Grid monitoring > Country standard > Islanding detection)	Adjustable: On / On Off / Off
GridGuard.Cntry.Aid.HzMon.HzMonTmms	Islanding detection, tripping time of frequency monitoring in ms (Grid monitoring > Grid monitoring > Country standard > Islanding detection > Frequency monitoring)	-

5.4 Monitoring the Maximum Frequency Change

Monitoring the maximum frequency change supplements the islanding detection function (see Section 5.3 "Islanding Detection", page 75).

Object name	Definition (display group)
GridGuard.Cntry.FrqCtl.ChgMax	Frequency monitoring, maximum frequency change, per second in Hz (Grid monitoring > Grid monitoring > Country standard > Frequency monitoring)
GridGuard.Cntry.FrqCtl.Chg-MaxTmms	Frequency monitoring, tripping time of maximum frequency change in ms (Grid monitoring > Grid monitoring > Country standard > Frequency monitoring)

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