Technical Information

SMA GRID GUARD 10.0

Grid Management Services via Inverter and System Controller

ENGLISH

NSM-GG10-TI-en-13 | Version 1.3

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1 Information on this Document

1.1 Validity

This document is valid for:

Machine		from firmware version
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
	SHP 100-20 (Sunny Highpower PEAK3) / SHP 150-20 (Sunny Highpower PEAK3)	3.10.xx.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
System controller	EDMM-10 (SMA Data Manager M)	1.11
	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, 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 point of interconnection of larger PV systems with more than 1 inverter

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.

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	2st quadrant of the P/Q diagram
Q3	Quadrant 3	3st quadrant of the P/Q diagram
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

For more information, please go to www.SMA-Solar.com.

Title and information content	Type of information
"Application for SMA Grid Guard Code"	Form
"PUBLIC CYBER SECURITY - Guidelines for a Secure PV System Communication"	Technical information
"Parameters and Measured Values" Overview of all inverter operating parameters and their configuration options	Technical Information
"SMA and SunSpec Modbus® Interface" Information on the Modbus interface	Technical Information
"Modbus® parameters and measured values" Device-specific list of the Modbus register	Technical Information

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 higher-level 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 higher-level 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

i 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. The order form for the SMA Grid Guard code is available in the download area at www.SMA-Solar.com.

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 is available 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

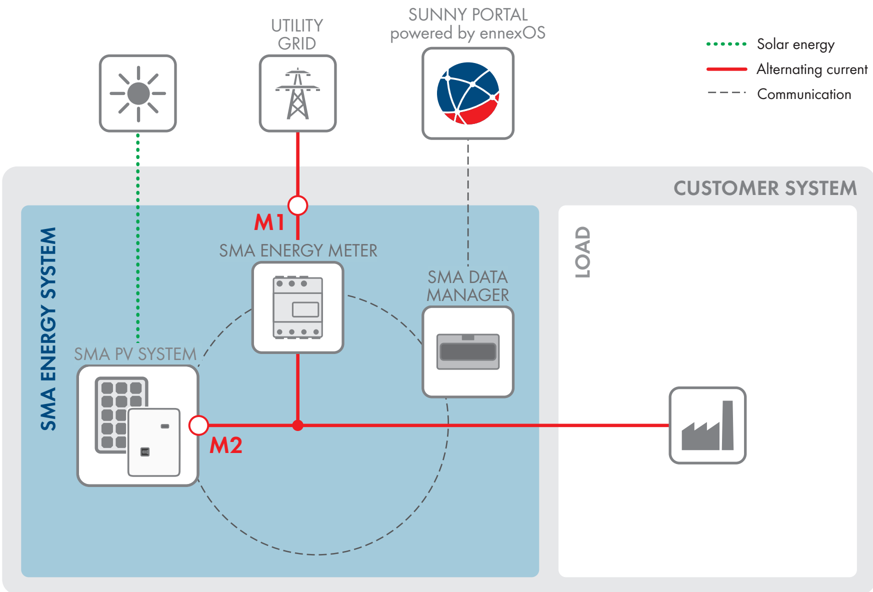


Figure 1: System overview with different electrical reference points

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 higher-level 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 higher-level 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	Explanation
Inverter.PlntCtl.VRef	Nominal grid voltage in V	The nominal grid voltage is specified as line-to-line voltage or line-to-neutral voltage, depending on the setting of Inverter.PlntCtl.VRefMod.
Inverter.PlntCtl.VRefMod	Phase reference of nominal grid voltage	Outer conductor / phase voltage
Inverter.VRtg*	Nominal inverter voltage in V	The nominal inverter voltage is specified as line-to-line voltage.
Inverter.VRefIntMod*	Reference voltage selection	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.
Inverter.PlntCtl.AppVol	Applicable voltages	Specifies whether the phase voltage, outer conductor voltage or both voltages are to be used for dynamic grid support and voltage monitoring.

* Only three-phase inverters have this parameter.

3.2 P/Q diagram in the generator reference-arrow system

At SMA Solar Technology AG all information always refers to the generator reference-arrow system. 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 input 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.

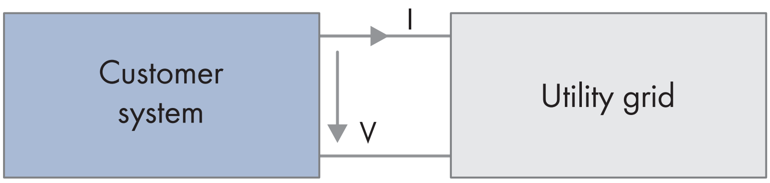


Figure 2: Generator reference-arrow system

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. 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 have an associated rating parameter with the ending "Rtg". The following figure provides an overview of the nominal sizes.

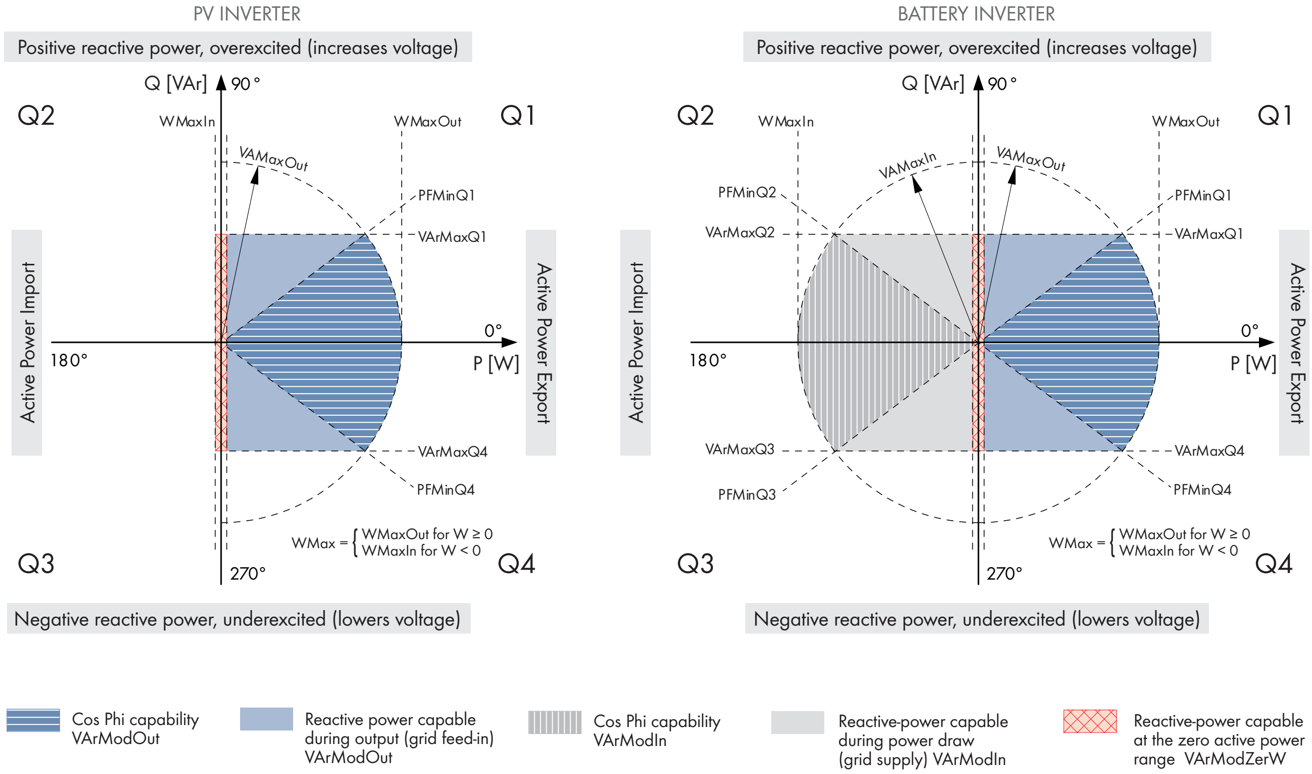


Figure 3: Nominal sizes and reactive power ranges in the P/Q diagram in the generator reference-arrow system for PV and battery inverters

Object name	Definition	Explanation
Inverter.VAMaxOut	Nominal apparent power VAMax-Out in VA	Maximum value limiting the apparent power at the active power output
Inverter.VAMaxIn	Nominal apparent power VAMaxIn in VA	Maximum value limiting the apparent power at the active power draw
Inverter.WMax	Nominal active power WMaxOut in W	Maximum value limiting the active power at the active power output
Inverter.WMaxIn	Nominal active power WMaxIn in W	Maximum value limiting the active power at the active power draw
Inverter.VArMaxQ1 Inverter.VArMaxQ2 Inverter.VArMaxQ3 Inverter.VArMaxQ4	Nominal reactive power VArMaxQ1-Q4 in var	Maximum value limiting the reactive power in each quadrant from Q1 to Q4

Object name	Definition	Explanation
Inverter.PFMinQ1 Inverter.PFMinQ2 Inverter.PFMinQ3 Inverter.PFMinQ4	Nominal cos phi PFMinQ1-Q4	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	Limits the reactive power when there is zero active power
Inverter.VArModCfg.PFMinEna	Limit for all reactive power modes PFMinQ1-Q4	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 during a restart or when reconnecting after a grid fault. As a result, the connection gradients ensure a slow increase in the power output from the zero point to the specified setpoint. The slow increase prevents abrupt changes in the power output.

Parameters for the Increase in Active Power During a Restart

Object name	Definition	Explanation
Inverter.WGraConn	Soft start rate P in %/min	Active power gradient for the connection during a restart The reference value is WMaxOut / WMaxIn.
Inverter.WGraConnEna	Soft start P	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	Explanation
Inverter.WGraRecon	Soft start rate P after a grid fault in %/min	Power gradient for reconnection after a grid fault The reference value is WMaxOut / WMaxIn.
Inverter.WGraReconEna	Soft start P after a grid fault	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	Explanation
Inverter.VArGraConn	Soft start rate Q in %/min	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	Activates / deactivates the reactive power gradient for reconnection after a restart or grid fault

3.3.2 Connection Times

Restart

Object name	Definition	Explanation
GridGuard.Cntry.GriStrTms	Connection time following a restart in s	-

Restarting after a grid fault

Object name	Definition	Explanation
GridGuard.Cntry.GriFltMonTms	Connection time after a grid fault in s	A grid fault is present when the voltage or frequency monitoring has triggered.

Object name	Definition	Explanation
GridGuard.Cntry.GriFltReConTms	Quick connection time after a short interruption in s	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	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 42
Frequency monitoring	Section 5.2.1, page 46

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 42
Frequency monitoring	Section 5.2.1, page 46

3.4 Operating States of the Inverter

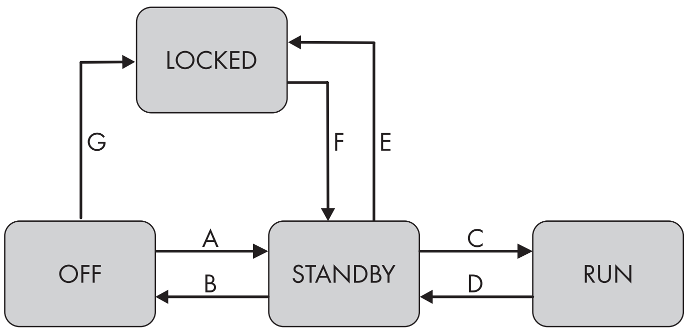


Figure 4: Overview of the operating states with state transitions

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.

Operating state	Description
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. • If there was a grid fault, the wait time after the grid fault has elapsed (GridGuard.Cntry.GriStrTms). 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, page 18). 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)
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	Explanation
Operation.OpMod	General operating mode: Determines the operating mode of the inverter.	Adjustable: Stop/Stop Str / Start

Object name	Definition	Explanation
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.	Adjustable: Mpp / MPP VolDCConst / constant voltage
Inverter.FstStop	Fast shutdown: The system must be separated from the utility grid.	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	Explanation
Operation.OpStt	General operating state: The inverter shows its operating state.	Possible statuses: Off / Off Stdby / standby (Operation.StandbyStt) Run / switched on (Operation.RunStt) Lok / blocked (Operation.RstrLokStt)
Operation.StandbyStt	Standby status: The inverter waits for an operating condition (e.g. for PV voltage).	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	Explanation
Operation.RunStt	Operating status: The inverter is in operation.	Substatus for the operating status "Run" Possible statuses: Mpp / MPP tracking VolDCConst / constant voltage Bck / Backup 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)	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, page 47). The specifications resulting from these procedures are processed and prioritized in parallel as follows:

1.	The minimum value is created from all the maximum setpoints.
2.	The maximum value is created from all the minimum setpoints.
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).

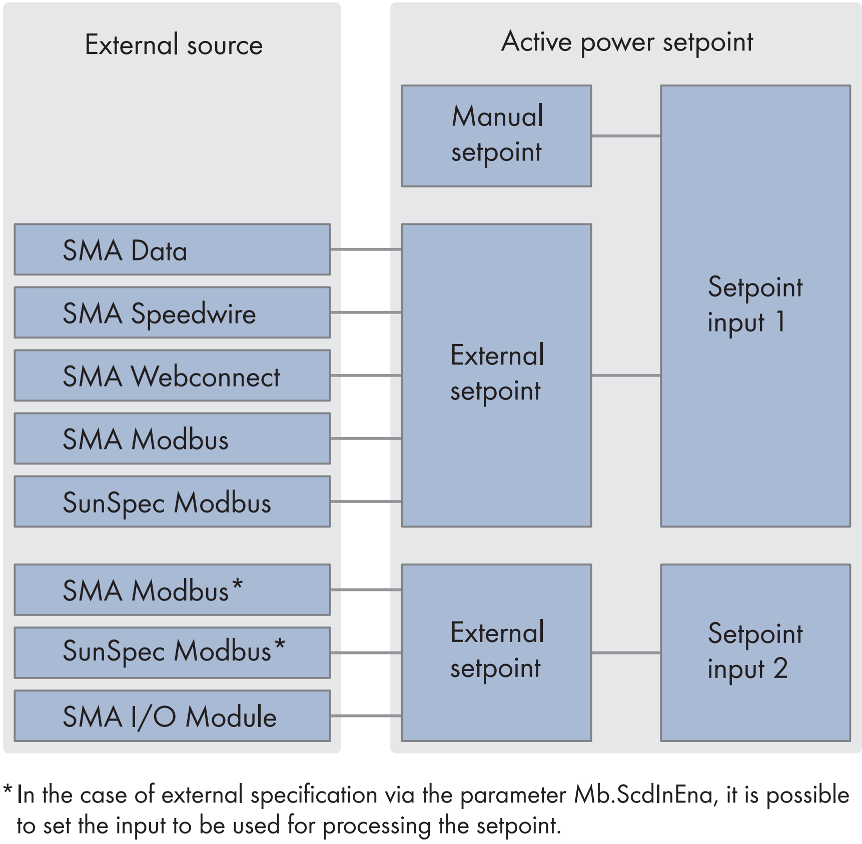


Figure 5: Schematic diagram of the active power setpoint with two setpoint inputs

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, page 19).

External setpoint at setpoint input 1

In case of an external setpoint, the inverter receives the setpoint through a higher-level 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

The setting of the operating mode is valid for setpoint input 1 and setpoint input 2.

Object name	Definition	Explanation
Inverter.WModCfg.WMod	Operating mode active power	Adjustable: Off Manual setting in W Manual setting in % External setting

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	Explanation
Inverter.WModCfg.GriSwOpnZerW	Disconnection from the grid at an active power setpoint of 0%	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	Explanation
Inverter.WModCfg.WCnstCfg.W	Active power limitation P, in W	-
Inverter.WModCfg.WCnstCfg.WNom	Active power limitation in %	The reference value is WMaxOut / WMaxIn.

4.1.1.3 External Setting at Setpoint Input 1

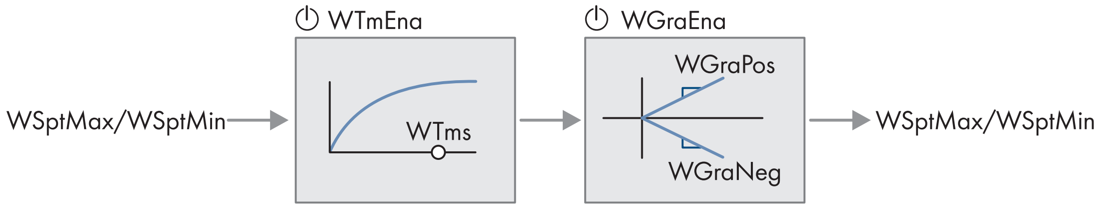
Object name	Definition	Explanation
Inverter.WModCfg.WCtlComCfg.WSptMaxNom	Maximum active power in % This parameter can also be set via setpoint input 2 (parameter Mb.ScdInEna (see Section 4.1.1.4, page 21)).	The reference value is WMaxOut / WMaxIn.
Inverter.WModCfg.WCtlComCfg.WSptMinNom	Minimum active power in % This parameter can also be set via setpoint input 2.	The reference value is WMaxOut / WMaxIn.

Setting the priority of setpoint input 1

For the first setpoint input, for each external setpoint you can specify whether it has a higher or lower priority than the P(V) characteristic curve and the P(f) characteristic curve.

Object name	Definition	Explanation
Inverter.WModCfg.WCtlComCfg.W	Low priority for maximum setpoint	Activation / deactivation
Inverter.WModCfg.WCtlCom-Cfg.WSptMinPrioCat	Low priority for minimum setpoint	Activation / deactivation

Setting the dynamic behavior for implementing the external setpoint at setpoint input 1



Object name	Definition	Explanation
Inverter.WModCfg.WCtlCom-Cfg.Dyn.WTmEna	Setpoint filter	Activation / deactivation
Inverter.WModCfg.WCtlCom-Cfg.Dyn.WTms	Response time for the setpoint filter in s	Response time corresponds to 3 taus (RC time constant) of a PT1 element
Inverter.WModCfg.WCtlCom-Cfg.Dyn.WGraEna	Limitation of change rate	Activation / deactivation
Inverter.WModCfg.WCtlCom-Cfg.Dyn.WGraPos	Ramp-up rate in %/s	The reference value is WMaxOut.
Inverter.WModCfg.WCtlCom-Cfg.Dyn.WGraNeg	Decrease rate in %/s	The reference value is WMaxOut.

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	Explanation
Inverter.CtlComCfg.WCtlCom.Ctl-ComMssMod	Fallback behavior	Adjustable: Values maintained (maintain the val-ues received last) Apply fallback values
Inverter.CtlComCfg.WCtlCom.Flb-WMin	Fallback value of minimum active power in W	-
Inverter.CtlComCfg.WCtlCom.FlbW-Max	Fallback value of maximum active power in W	-
Inverter.CtlComCfg.WCtlCom.Tm-sOut	Timeout in s	For this time, the external setpoint must remain off before the fallback mode is activated.

4.1.1.4 External Setting at Setpoint Input 2

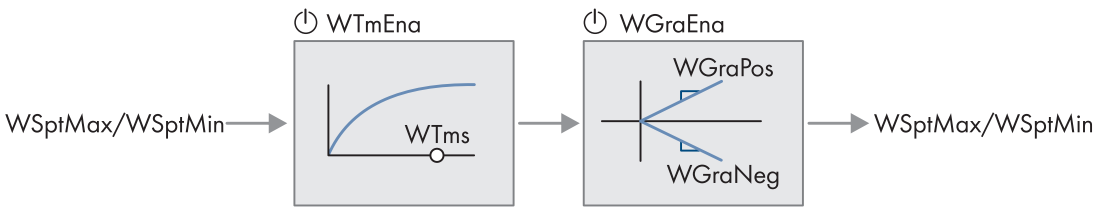
Object name	Definition	Explanation
Mb.ScdInEna	Modbus P-settings at input 2	Active power setpoints via Modbus are processed at setpoint input 2. This enables parallel operation with SMA system control.
Inverter.WModCfg.WCtlCom-Cfg.WSptMaxNom	Maximum active power in % This parameter can also be set via setpoint input 1 (parameter Mb.ScdI-nEna).	The reference value is WMaxOut / WMaxIn
Inverter.WModCfg.WCtlCom-Cfg.WSptMinNom	Minimum active power in % This parameter can also be set via setpoint input 1.	The reference value is WMaxOut / WMaxIn
Inverter.WModCfg.WCtlCom-Cfg.WSptMax	Maximum active power in W	-
Inverter.WModCfg.WCtlCom-Cfg.WSptMin	Minimum active power in W	-

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	Explanation
Inverter.WModCfg.WCtlCom-Cfg2.LoPrioEna	Low priority	Activation / deactivation

Setting the dynamic behavior for implementing the external setpoint at setpoint input 2



Object name	Definition	Explanation
Inverter.WModCfg.WCtlCom-Cfg2.Dyn.WTmEna	Setpoint filter	Activation / deactivation
Inverter.WModCfg.WCtlCom-Cfg2.Dyn.WTms	Response time for the setpoint filter in s	Response time corresponds to 3 taus (RC time constant) of a PT1 element
Inverter.WModCfg.WCtlCom-Cfg2.Dyn.WGraEna	Limitation of change rate	Activation / deactivation

Object name	Definition	Explanation
Inverter.WModCfg.WCtlCom-Cfg2.Dyn.WGraPos	Ramp-up rate in %/s	The reference value is WMaxOut.
Inverter.WModCfg.WCtlCom-Cfg2.Dyn.WGraNeg	Decrease rate in %/s	The reference value is WMaxOut.

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	Explanation
Inverter.CtlComCfg.WCtlCom2.Ctl-ComMssMod	Fallback behavior	Adjustable: Values maintained (maintain the values received last) Apply fallback values
Inverter.CtlComCfg.WCtlCom2.Flb-WMin	Fallback value of minimum active power in W	-
Inverter.CtlComCfg.WCtlCom2.Flb-WMax	Fallback value of maximum active power in W	-
Inverter.CtlComCfg.WCtlCom2.Tm-sOut	Timeout in s	For this time, the external setpoint must remain off before the fallback mode is activated.

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	Explanation
Inverter.WModCfg.WCnstCfg.WEna	Manual active power setpoint in W	-
Inverter.WModCfg.WCn-stCfg.WNomEna	Manual active power setpoint in %	-
Inverter.WModCfg.WCtlCom-Cfg.Ena	External active power setpoint	Activates / deactivates the operating mode WCtlCom (active power setpoint by communication) via channel 1.
Inverter.WModCfg.WCtlCom-Cfg2.Ena	External active power setpoint 2	Activates / deactivates the operating mode WCtlCom (active power setpoint by communication) via channel 2.

4.1.2 Voltage-Dependent Active Power Adjustment P(U)

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).

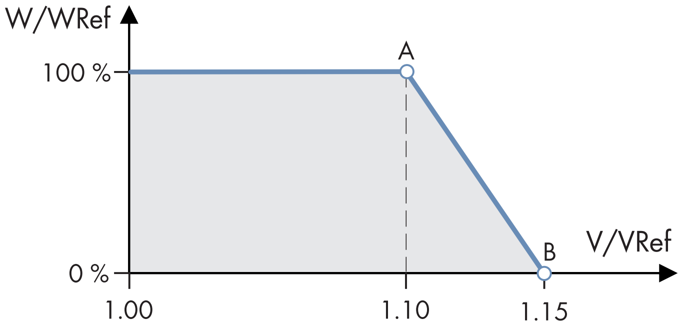


Figure 6: Example of a P(V) characteristic curve with 2 support points

The reference value WRef is determined according to a procedure that is defined via the setting **Inverter.WModCfg.WCtlVolCfg.WRefMod**.

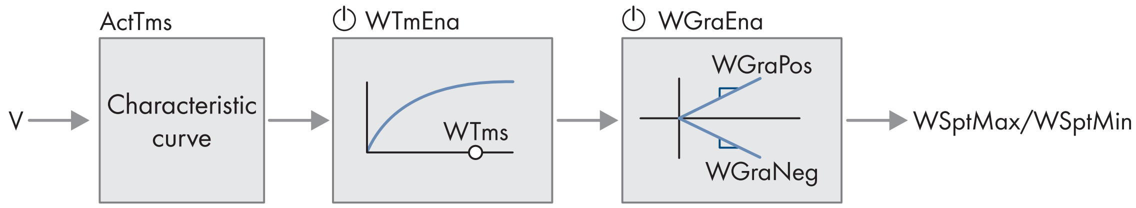
Reference value	Mode	Active power output	Active power input
Inverter.WMod-Cfg.WCtlVol-Cfg.WRefMod	Maximum power (WMaxOut / WMaxIn): maximum active power of the inverter	WRef = WMaxOut	WRef = WMaxIn
	Instantaneous power (WSnpt): measured active power at the time when the first buckling point of the characteristic curve is exceeded WMom is frozen if it is exceeded and from then on no longer corresponds to the actual instantaneous active power.	WRef = WMom	WRef = 0
	Potential power (WSnptMax): difference between the maximum power and instantaneous power	WRef = WMom - WMaxIn	

Setting the characteristic curve

Object name	Definition	Explanation
Inverter.WModCfg.WCtlVolCfg.Ena	P(V) Characteristic Curve	Activation / deactivation
Inverter.WModCfg.WCtlVolCfg.VRef-Mod	Type of reference voltage	Adjustable: PhsAvg / mean value of phase voltages PhsMax / maximum phase voltage
Inverter.WModCfg.WCtlVol-Cfg.WRefMod	Type of reference voltage	Adjustable: WMaxOut / WMaxIn / Maximum active power WSnpt / Current active power WSnptMax / Potential active power

Object name	Definition	Explanation
Inverter.WModCfg.WCtlVolCfg.Crv.NumPt	Number of used support points	-
Inverter.WModCfg.WCtlVolCfg.Crv.XVal	Voltage values of the P(V) characteristic curve in p.u.	The reference value is the parameterized nominal voltage (see Section 3.1.2, page 9).
Inverter.WModCfg.WCtlVolCfg.Crv.YVal	Active power values of the P(V) characteristic curve	Indicated in % of the maximum, current or potential active power (depending on the setting of Inverter.WModCfg.WCtlVolCfg.WRefMod).

Setting the dynamics



Object name	Definition	Explanation
Inverter.WModCfg.WCtlVolCfg.WTmEna	Setpoint filter	Activation / deactivation
Inverter.WModCfg.WCtlVolCfg.WTms	Response time for the setpoint filter in s	Response time corresponds to 3 taus (RC time constant) of a PT1 element
Inverter.WModCfg.WCtlVolCfg.WGraEna	Limitation of change rate	Activation / deactivation
Inverter.WModCfg.WCtlVolCfg.WGraPos	Ramp-up rate in %/s	The reference value is WMaxOut.
Inverter.WModCfg.WCtlVolCfg.WGraNeg	Decrease rate %/s	The reference value is WMaxOut.
Inverter.WModCfg.WCtlVolCfg.ActTms	Tripping delay in s	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	Explanation
Inverter.WGraMppEna	Increase rate in case of change in irradiation	Activation/deactivation
Inverter.WGraMpp	Ramp-up rate in case of a change in irradiation in %/min	The reference value is WMaxOut.

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.

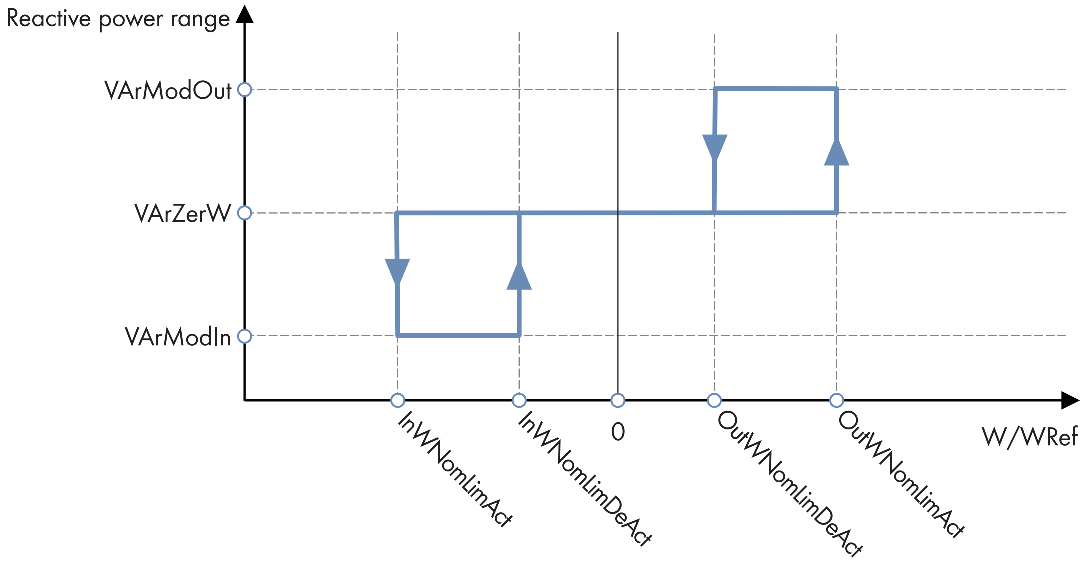


Figure 7: Activates / deactivates the reactive power ranges in relation to the active power

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	Explanation
Inverter.VArModCfg.VArModOut	Reactive power mode in case of active power output	Reactive power range in case of active power output
Inverter.VArModCfg.VArModIn	Reactive power mode in case of active power draw	Reactive power range in case of active power draw
Inverter.VArModCfg.VArModZerW	Reactive power for zero active power	Reactive power range for zero active power (e.g. for 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.

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

Mode	Active power input	Zero active power	Active power output
Off	x	x	x
Q setting	x	x	x
Cos phi setpoint	x	-	x
Q(P) characteristic curve	x	x	x
Q(V) Characteristic Curve	x	x	x
Cos phi(P) characteristic curve	x	-	x
Cos phi(V) characteristic curve	x	-	x

Setting the activation and deactivation thresholds for reactive power provision

Object name	Definition	Explanation
Inverter.VArModCfg.InWNomLimAct	Activation threshold of the reactive power mode in case of power draw in %	The reference value is WMaxIn. When the activation threshold is exceeded, the reactive power mode in case of active power draw is activated.
Inverter.VArModCfg.InWNomLimDeAct	Deactivation threshold of the reactive power mode in case of power draw in %	The reference value is WMaxIn. 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.OutWNomLimAct	Activation threshold of the reactive power mode in case of output in %	The reference value is WMaxOut. When the activation threshold is exceeded, the reactive power mode in case of active power output is activated.
Inverter.VArModCfg.OutWNomLimDeAct	Deactivation threshold of the reactive power mode in case of output in %	The reference value is WMaxOut. 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	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 higher-level control unit), the grid operator can request switching to a specified reactive power mode.

Object name	Definition	Explanation
Inverter.VArModCfg.VArModOutFlb	Reactive power fallback process in case of active power output	-
Inverter.VArModCfg.VArModInFlb	Reactive power fallback process in case of active power draw	-
Inverter.VArModCfg.VArModZer-WFlb	Reactive power fallback process in case of zero active power	-

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 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.

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.

Object name	Definition	Explanation
Inverter.VArModCfg.VArNomRef-Mod	Reference size for reactive power set-ting	The setting is specified by the grid op-erator 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, page 27). 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 higher-level 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 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.

External setpoint

In case of an external setpoint, the inverter receives the reactive power setpoint through a higher-level 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

Object name	Definition
Inverter.VArModCfg.VArCnstCfg.VAr	Manual reactive power setpoint for active power output in VAr
Inverter.VArModCfg.VArCnstCfgIn.VAr	Manual reactive power setpoint in case of active power draw in VAr
Inverter.VArModCfg.VArCnstCfgDmd.VAr	Manual reactive power setpoint at zero power output in VAr

Object name	Definition	Explanation
Inverter.VArModCfg.VArCnstCfg.VArNom	Manual reactive power setpoint for active power output in %	The reference value is WMaxOut / WMaxIn or Inverter.VArMaxQ1-Q4 (depending on the setting in Inverter.VArModCfg.VArNomRefMod).
Inverter.VArModCfg.VArCnstCfgIn.VArNom	Manual reactive power setpoint in case of active power draw in %	The reference value is WMaxOut / WMaxIn or Inverter.VArMaxQ1-Q4 (depending on the setting in Inverter.VArModCfg.VArNomRefMod).
Inverter.VArModCfg.VArCnstCfgDmd.VArNom	Manual reactive power setpoint at zero power output in %	The reference value is WMaxOut / WMaxIn or Inverter.VArMaxQ1-Q4 (depending on the setting in Inverter.VArModCfg.VArNomRefMod).

4.2.2.2 External Setting

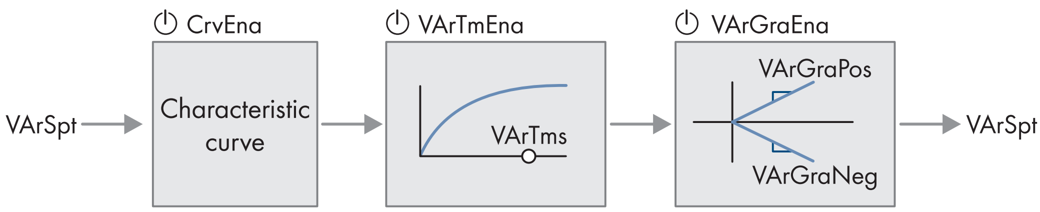
Object name	Definition	Explanation
Inverter.VArModCfg.VArCtlComCfg.VArNomPrc	Reactive power setpoint Q in %	The reference value is WMaxOut / WMaxIn or Inverter.VArMaxQ1-Q4 (depending on the setting in Inverter.VArModCfg.VArNomRefMod).

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	Explanation
Inverter.CtlComCfg.VArCtlCom.Ctl-ComMssMod	Fallback behavior	Adjustable: UsStp / values maintained (maintain the values received last) UsFlb / apply fallback values
Inverter.CtlComCfg.VArCtlCom.Flb-VArNom	Fallback value in %	The reference value is WMaxOut / WMaxIn or Inverter.VArMaxQ1-Q4 (depending on the setting in Inverter.VArModCfg.VArNomRefMod).
Inverter.CtlComCfg.VArCtlCom.Tm-sOut	Timeout in s	For this time, the external setpoint must remain off before the fallback mode is activated.

4.2.2.3 Dynamic behavior for implementing manual and external setpoints



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

4.2.2.4 Voltage limitation function

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

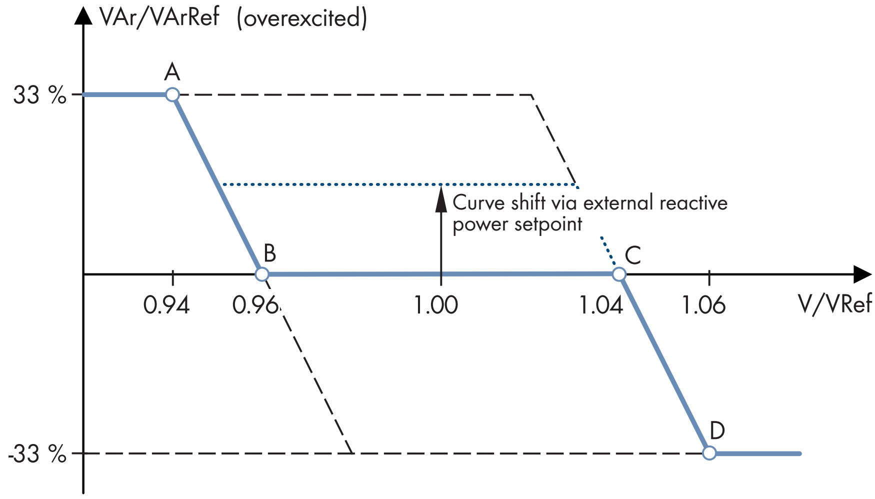


Figure 8: Characteristic curve for dynamic setpoint with activated voltage limitation function (example)

Object name	Definition	Explanation
Inverter.VArModCfg.VArCfg.Crv.CrvEna	Reactive power setting with voltage limitation, voltage value	Activation / deactivation
Inverter.VArModCfg.VArCfg.Crv.XVal	Voltage values of the characteristic curve in p.u.	The reference value is the parameterized nominal voltage (see Section 3.1.2, page 9).
Inverter.VArModCfg.VArCfg.Crv.YVal	Reactive power values of the characteristic curve in %	The reference value is WMaxOut / WMaxIn or Inverter.VArMaxQ1-Q4 (depending on the setting in Inverter.VArModCfg.VArNomRefMod).
Inverter.VArModCfg.VRefMod	Type of reference voltage	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 higher-level 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.

External setpoint

In case of an external setpoint, the inverter receives the reactive power setpoint through a higher-level 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	Explanation
Inverter.VArModCfg.PFCn-stCfg.PFOut	Cos phi setpoint in case of active power output	-
Inverter.VArModCfg.PFCn-stCfg.PFExtOut	Excitation type in case of active power output	overexcited / underexcited
Inverter.VArModCfg.PFCnstCfg.PFIn	Cos phi setpoint in case of active power draw	-
Inverter.VArModCfg.PFCnstCfg.PFEx-tIn	Excitation type in case of active power draw	overexcited / underexcited

4.2.3.2 External Setting

Setpoint

Object name	Definition	Explanation
Inverter.VArModCfg.PFCtlComCfg.PF	Cos phi setpoint in case of active power output	-
Inverter.VArModCfg.PFCtlCom-Cfg.PFExt	Excitation type in case of active power output	underexcited/overexcited
Inverter.VArModCfg.PFCtlCom-Cfg.PFIn	Cos phi setpoint in case of active power draw	-
Inverter.VArModCfg.PFCtlCom-Cfg.PFExtIn	Excitation type in case of active power draw	underexcited/overexcited

Setting the fallback value when there is no external setpoint for a parameterizable time

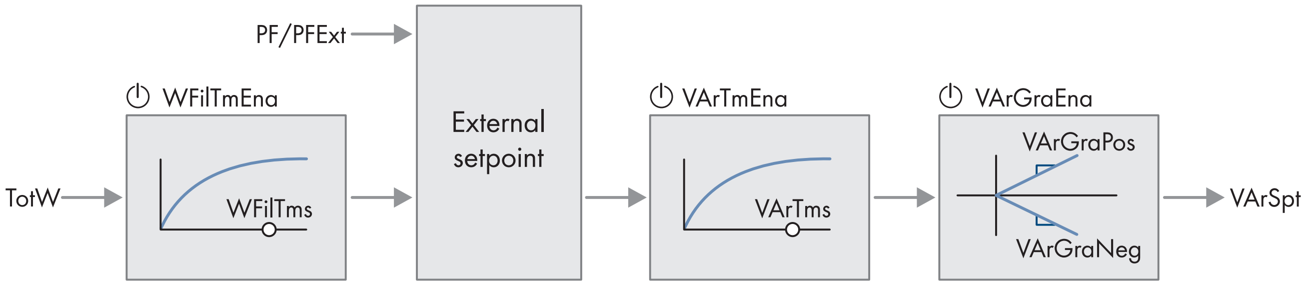
If communication fails for an adjustable time, either the last communicated values are kept or the fallback values are taken.

Object name	Definition	Explanation
Inverter.CtlComCfg.PFCtlCom.Ctl-ComMssMod	Fallback behavior	Adjustable: Values maintained (maintain the values received last) Apply fallback values
Inverter.CtlComCfg.PFCtlCom.FlbPF	Fallback value of Cos Phi in case of active power output	-
Inverter.CtlComCfg.PFCtl-Com.FlbPFExt	Fallback value of excitation type in case of active power output	underexcited/overexcited
Inverter.CtlComCfg.PFCtlCom.FlbPFIn	Fallback value of Cos Phi in case of active power draw	-

Object name	Definition	Explanation
Inverter.CtlComCfg.PFCtl-Com.FlbPFExtIn	Fallback value of excitation type in case of active power draw	underexcited/overexcited
Inverter.CtlComCfg.PFCtlCom.Tm-sOut	Timeout in s	For this time, the external setpoint must remain off before the fallback mode is activated.

4.2.3.3 Dynamic behavior for implementing manual and external setpoints

The cos phi 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	Explanation
Inverter.VArMod-Cfg.PFCfg.Dyn.WFilTmEna	Actual value filter for active power value	Activation / deactivation
Inverter.VArMod-Cfg.PFCfg.Dyn.WFilTms	Response time of actual value filter in s	Response time corresponds to 3 taus (RC time constant) of a PT1 element
Inverter.VArModCfg.PFCfg.Dyn.VArT-mEna	Setpoint filter	Activation / deactivation
Inverter.VArMod-Cfg.PFCfg.Dyn.VArTms	Response time for the setpoint filter in s	Response time corresponds to 3 taus (RC time constant) of a PT1 element
Inverter.VArModCfg.PFCfg.Dyn.VAr-GraEna	Limitation of change rate	Activation / deactivation
Inverter.VArModCfg.PFCfg.Dyn.VAr-GraPos	Ramp-up rate for resulting reactive power setpoint in %/s	The reference value is Inverter.VAr-MaxQ1.
Inverter.VArModCfg.PFCfg.Dyn.VAr-GraNeg	Decrease rate for resulting reactive power setpoint in %/s	The reference value is Inverter.VAr-MaxQ1.

4.2.4 Reactive power/active power char. 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 8 support points.

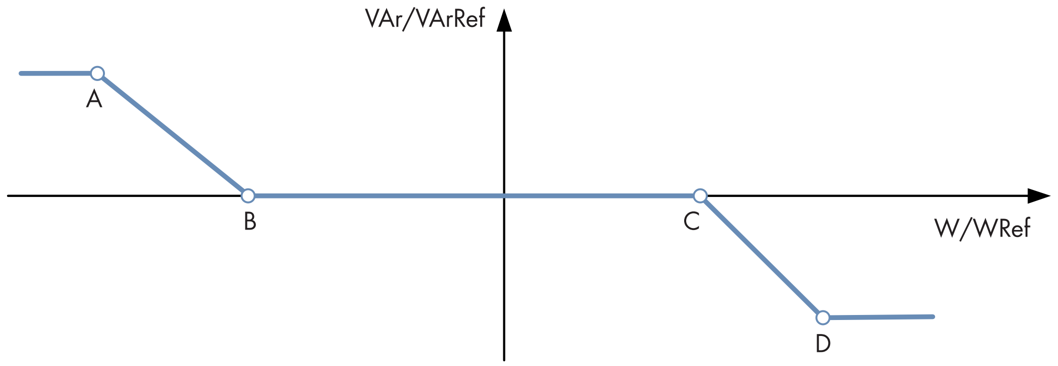


Figure 9: Example of a Q(P) characteristic curve for generators and loads with 4 support points

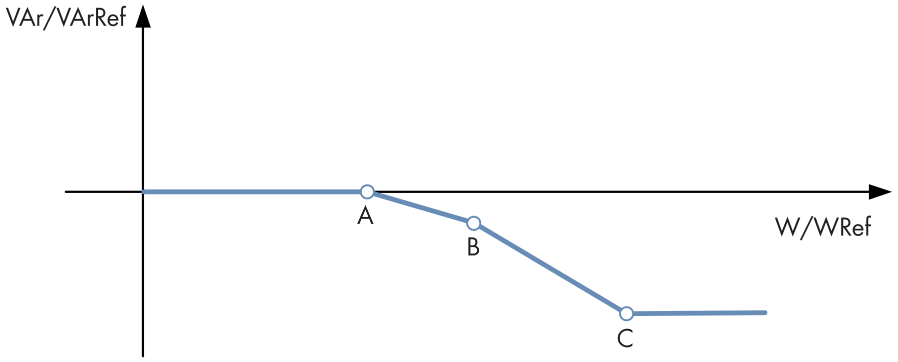
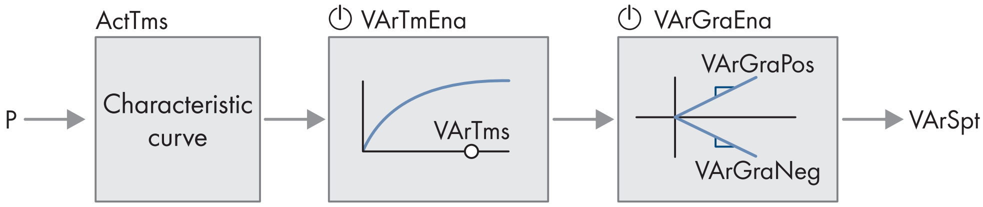


Figure 10: Example of a Q(P) characteristic curve for pure generators with 3 support points

Setting the characteristic curve

Object name	Definition	Explanation
Inverter.VArModCfg.VArCtl-WCfg.Crv.NumPt	Number of used support points	-
Inverter.VArModCfg.VArCtl-WCfg.Crv.XVal	Active power values of the characteristic curve in %	The reference value is WMaxOut / WMaxIn.
Inverter.VArModCfg.VArCtl-WCfg.Crv.YVal	Reactive power values of the characteristic curve in %	The reference value is WMaxOut / WMaxIn or Inverter.VArMaxQ1-Q4 (depending on the setting in Inverter.VArModCfg.VArNomRefMod).

Setting the dynamics



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

Setting the voltage-dependent 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.

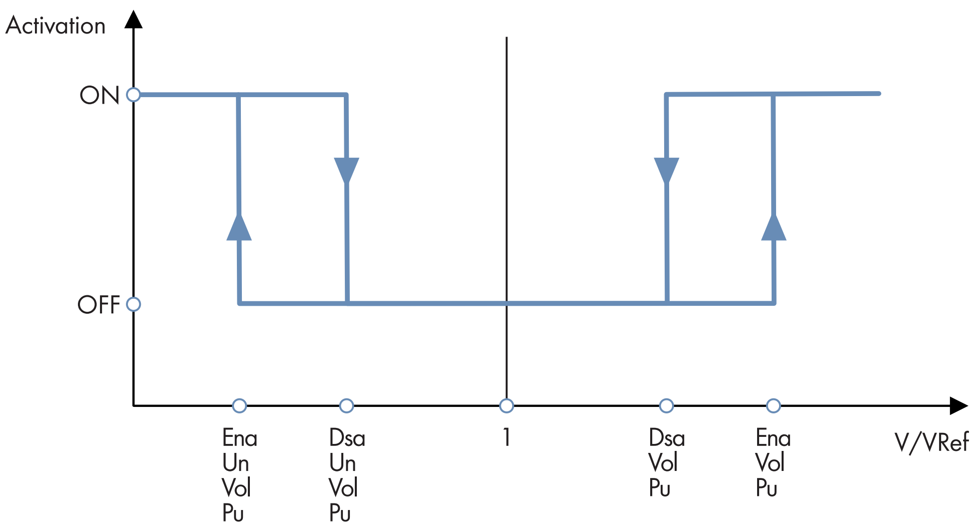


Figure 11: Principle of voltage-dependent activation

Object name	Definition	Explanation
Inverter.VArModCfg.VArCtl-WCfg.Trg.EnaVolPu	Upper activation voltage in p.u.	The reference value is the parameter-ized nominal voltage (see Sec-tion 3.1.2, page 9).

Object name	Definition	Explanation
Inverter.VArModCfg.VArCtl-WCfg.Trg.DsaVolPu	Upper deactivation voltage in p.u.	The reference value is the parameterized nominal voltage (see Section 3.1.2, page 9).
Inverter.VArModCfg.VArCtl-WCfg.Trg.EnaUnVolPu	Lower activation voltage in p.u.	The reference value is the parameterized nominal voltage (see Section 3.1.2, page 9).
Inverter.VArModCfg.VArCtl-WCfg.Trg.DsaUnVolPu	Lower deactivation voltage in p.u.	The reference value is the parameterized nominal voltage (see Section 3.1.2, page 9).

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

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.

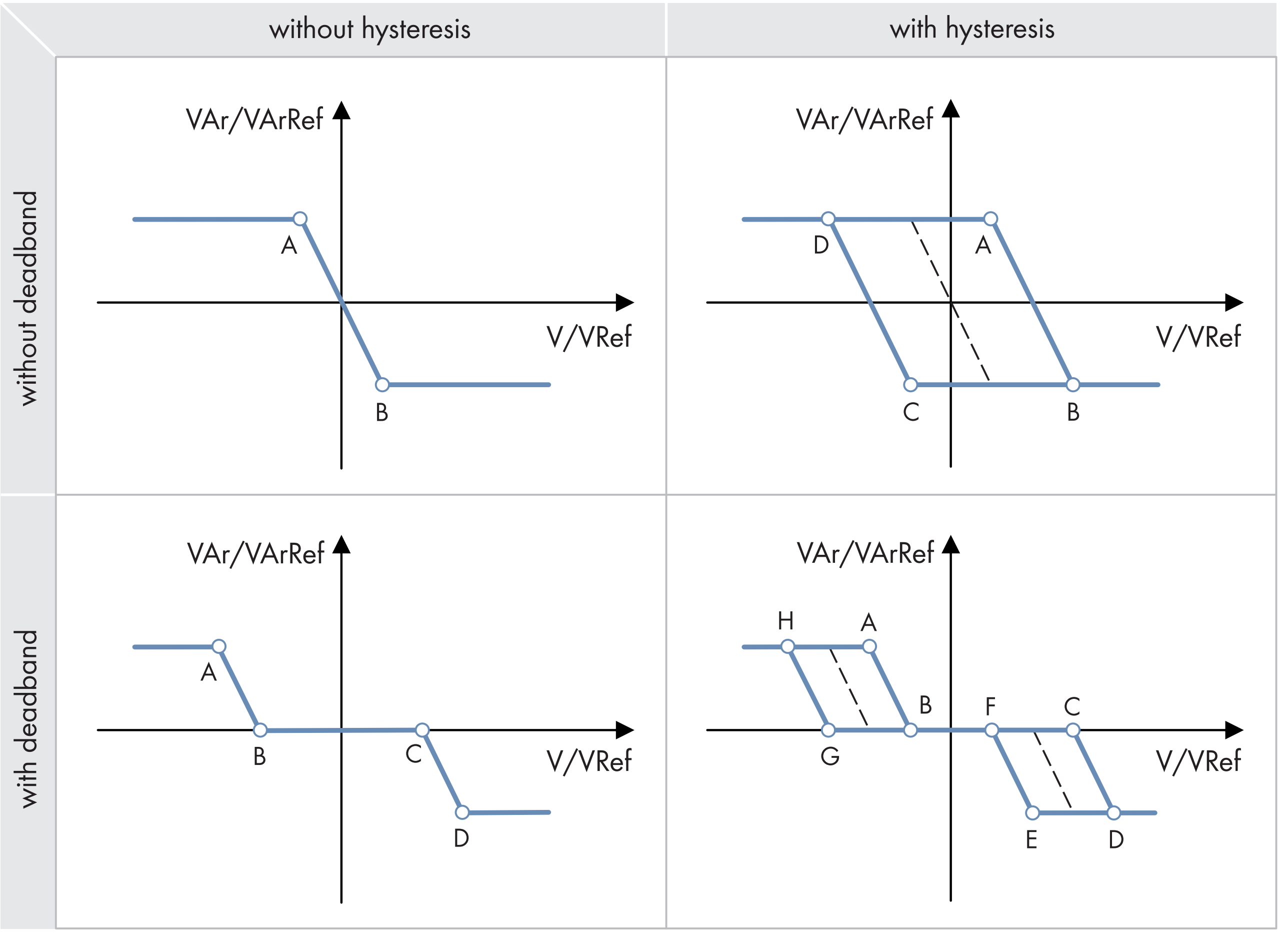


Figure 12: Q(U) characteristic curve (examples)

Setting the characteristic curve

Object name	Definition	Explanation
Inverter.VArModCfg.VArCtlVol-Cfg.Crv.NumPt	Number of used support points	-

Object name	Definition	Explanation
Inverter.VArModCfg.VArCtlVol-Cfg.Crv.XVal	Voltage values of the characteristic curve in p.u.	Parameterized nominal voltage(see Section 3.1.2, page 9)
Inverter.VArModCfg.VArCtlVol-Cfg.Crv.YVal	Reactive power values of the characteristic curve in %	The reference value is WMaxOut / WMaxIn or Inverter.VArMaxQ1-Q4 (depending on the setting of Inverter.VArModCfg.VArNomRefMod).
Inverter.VArModCfg.VRefMod	Type of reference voltage	Adjustable: PhsAvg / mean value of phase voltages PhsMax / maximum phase voltage

Setting the reference voltage adjustment

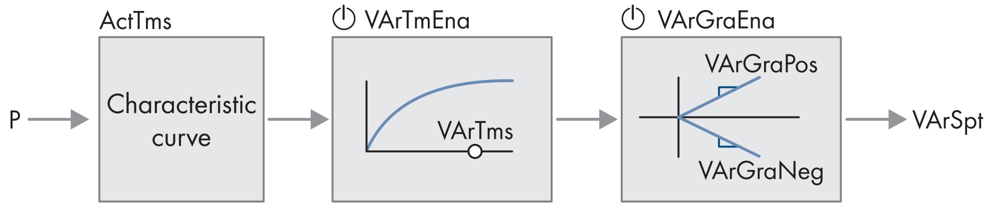
Changing the reference voltage allows the Q(V) characteristic curve to be moved on the X axis. The reference voltage for Q(V) can be set by the following parameters.

Object name	Definition	Explanation
Inverter.VArModCfg.VArCtlVol-Cfg.VolRef.AutnAdjMod	Operating mode of the reference voltage adjustment	Adjustable: Off (no adjustment) On: The reference voltage is taken from the external setpoint. Automatic (automatic adjustment): The reference voltage corresponds to the low-pass filtered measured voltage.
Inverter.VArModCfg.VArCtlVol-Cfg.VolRef.AutnAdjTms	Response time of the automatic reference voltage adjustment	Response time corresponds to 3 taus of a PT1 element.
Inverter.VArModCfg.VArCtlVol-Cfg.VolRef.VolRefPu	External reference voltage setting in p.u.	The reference value is the parameterized nominal voltage (see Section 3.1.2, page 9).

Setting the behavior in case of absent reference voltage

Object name	Definition	Explanation
Inverter.CtlComCfg.VArCtlVol-Com.CtlComMssMod	Fallback behavior	Adjustable: Values maintained (the values received last are maintained) Apply fallback values
Inverter.CtlComCfg.VArCtlVol-Com.FlbVolRefPu	Fallback of reference voltage in p.u.	The reference value is the parameterized nominal voltage (see Section 3.1.2, page 9).
Inverter.CtlComCfg.VArCtlVol-Com.TmsOut	Timeout for the missing reference voltage setpoint in s	For this time, the reference voltage setpoint must be absent before the fallback procedure is activated.

Setting the dynamics



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

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.

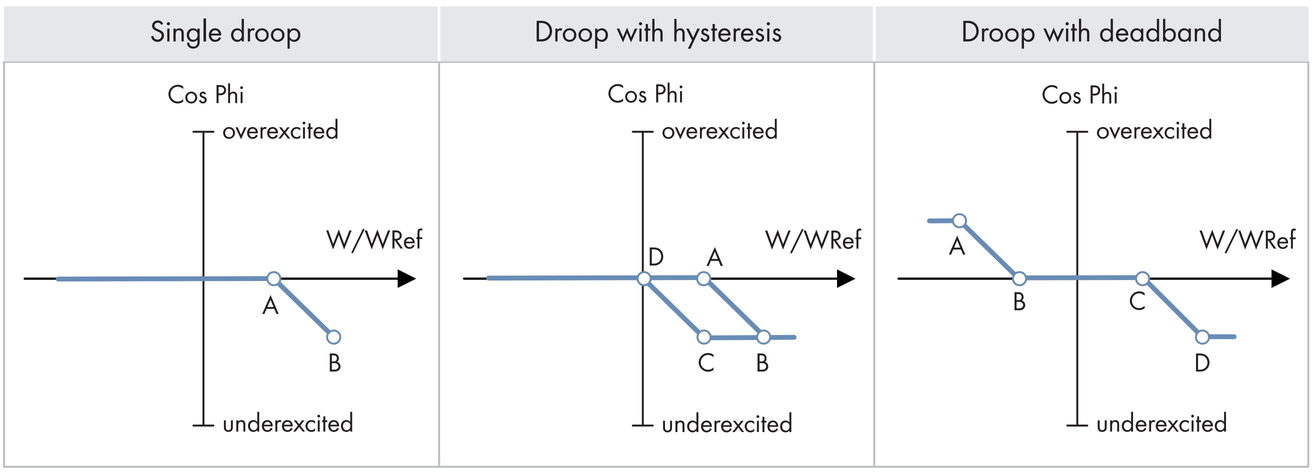


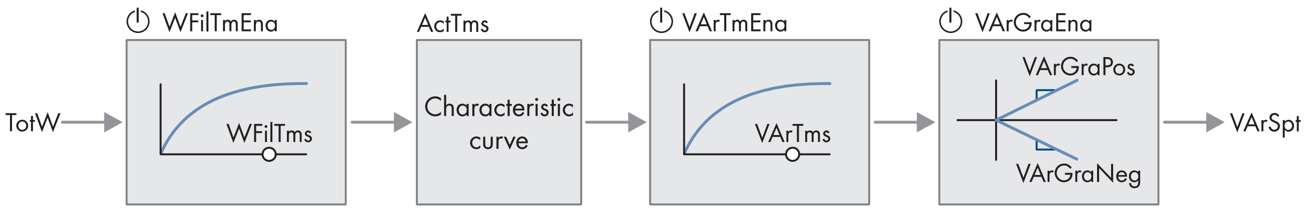
Figure 13: Cos phi/active power characteristic curve cos phi(P) (examples)

Setting the characteristic curve

Object name	Definition	Explanation
Inverter.VArModCfg.PFCtl-WCfg.Crv.NumPt	Number of used support points	-

Object name	Definition	Explanation
Inverter.VArModCfg.PFCtl-WCfg.Crv.WNom	Active power in %	The reference value is WMaxOut / WMaxIn
Inverter.VArModCfg.PFCtl-WCfg.Crv.PF	Cos phi setpoint	-
Inverter.VArModCfg.PFCtl-WCfg.Crv.PFExt	Excitation type	For each cos phi setpoint, the excitation type must always be specified as well: underexcited / overexcited

Setting the dynamics



Object name	Definition	Explanation
Inverter.VArModCfg.PFCtl-WCfg.Dyn.WFilTmEna	Actual value filter for active power value	Activation / deactivation
Inverter.VArModCfg.PFCtl-WCfg.Dyn.WFilTms	Response time of actual value filter in s	Response time corresponds to 3 taus of a PT1 element.
Inverter.VArModCfg.PFCtl-WCfg.Dyn.VArTmEna	Setpoint filter	Activation / deactivation
Inverter.VArModCfg.PFCtl-WCfg.Dyn.VArTms	Response time for the setpoint filter in s	Response time corresponds to 3 taus of a PT1 element.
Inverter.VArModCfg.PFCtl-WCfg.Dyn.VArGraEna	Limitation of change rate	Activation / deactivation
Inverter.VArModCfg.PFCtl-WCfg.Dyn.VArGraPos	Ramp-up rate in %/s	The reference value is Inverter.VArMaxQ1.
Inverter.VArModCfg.PFCtl-WCfg.Dyn.VArGraNeg	Decrease rate in %/s	The reference value is Inverter.VArMaxQ1.
Inverter.VArModCfg.PFCtlWCfg.Dyn.ActTms	Tripping delay in s	-

Setting the voltage-dependent activation

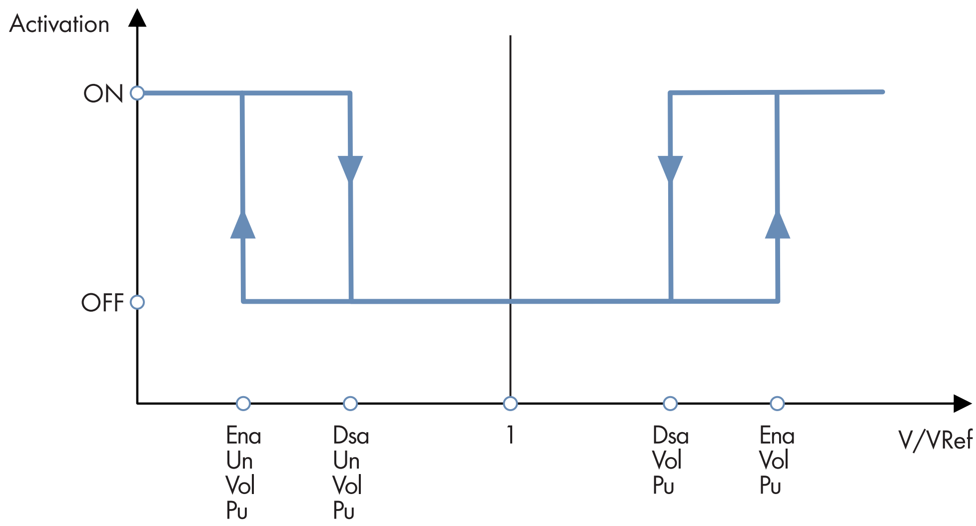


Figure 14: Principle of voltage-dependent activation

Object name	Definition	Explanation
Inverter.VArModCfg.PFCtl-WCfg.Trg.EnaVolPu	Upper activation voltage in p.u.	The reference value is the parameterized nominal voltage (see Section 3.1.2, page 9).
Inverter.VArModCfg.PFCtl-WCfg.Trg.DsaVolPu	Upper deactivation voltage in p.u.	The reference value is the parameterized nominal voltage (see Section 3.1.2, page 9).
Inverter.VArModCfg.PFCtl-WCfg.Trg.EnaUnVolPu	Lower activation voltage in p.u.	The reference value is the parameterized nominal voltage (see Section 3.1.2, page 9).
Inverter.VArModCfg.PFCtl-WCfg.Trg.DsaUnVolPu	Lower deactivation voltage in p.u.	The reference value is the parameterized nominal voltage (see Section 3.1.2, page 9).

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, page 9). The characteristic curve must be configured in accordance with the locally applicable standards and directives. Please consult the grid operator.

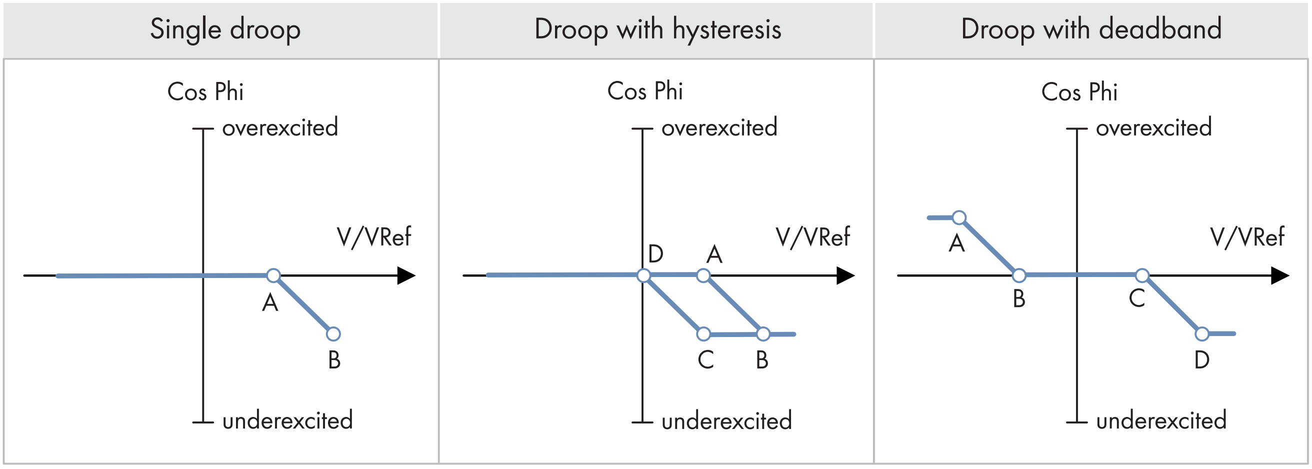


Figure 15: Cos phi/voltage characteristic curve Cos phi(V) (examples)

Setting the characteristic curve

Object name	Definition	Explanation
Inverter.VArModCfg.PFCtlVol-Cfg.Dyn.ActTms	Cos phi(V), Tripping delay in s	If the voltage exceeds the first buck-ling point, the resulting characteristic curve value is forwarded only after this time.
Inverter.VArModCfg.PFCtlVol-Cfg.Dyn.VArTms	cos phi (V), response time for the set-point filter in s	Response time of the delay element for the reactive power setpoint Response time corresponds to 3 taus of a PT1 element.
Inverter.VArModCfg.PFCtlVol-Cfg.Dyn.VArGraPos	Cos phi(V), ramp-up rate in %/s	Gradient for limiting the reactive power change. The reference value is Inverter.VA-MaxQ1.
Inverter.VArModCfg.PFCtlVol-Cfg.Dyn.VArGraNeg	Cos phi(V), decrease rate in %/s	Gradient for limiting the reactive power change. The reference value is Inverter.VA-MaxQ1.
Inverter.VArModCfg.PFCtlVol-Cfg.Dyn.WFilTms	Cos phi(V), Response time of the ac-tual value filter	Response time of the delay element for the measured value of the active power. Response time corresponds to 3 taus of a PT1 element.
Inverter.VArModCfg.PFCtlVol-Cfg.Crv.NumPt	Cos phi (v), number of used interpo-lation points	-

Object name	Definition	Explanation
Inverter.VArModCfg.PFCtlVolCfg.Crv.VolPu	cos phi(v), voltage values in p.u.	Voltage values of Cos phi(V) characteristic curve points The reference value is the parameterized nominal voltage (see Section 3.1.2, page 9).
Inverter.VArModCfg.PFCtlVolCfg.Crv.PF	Cos phi(V), cos phi setpoints	Cos phi setpoints of the interpolation points of the Cos phi(V) characteristic curve
Inverter.VArModCfg.PFCtlVolCfg.Crv.PFExt	Cos phi(V), excitation types	Excitation types of the interpolation points of the Cos phi(V) characteristic curve: underexcited / overexcited
Inverter.VArModCfg.VRefMod	Reactive power mode, type of reference voltage	Adjustable: Mean value of the phase voltage (PhsAvg) Highest phase voltage (PhsMax)
Inverter.VArModCfg.PFCtlVolCfg.Dyn.VArTmEna	Cos phi(V), setpoint filter	Activation / deactivation of the delay element for the reactive power setpoint
Inverter.VArModCfg.PFCtlVolCfg.Dyn.VArGraEna	Cos phi(V), limitation of the ramp rate	Activation / deactivation of the gradient for limiting the reactive power change
Inverter.VArModCfg.PFCtlVolCfg.Dyn.WFilTmEna	Cos phi(V), actual value filter for active power value	Activates / deactivates the delay element for the measured value of the active power
Inverter.VArModCfg.VRefMod	Type of reference voltage	Adjustable: PhsAvg / mean value of phase voltages PhsMax / maximum phase voltage

5 Behavior in case of disturbed utility grid

5.1 Behavior in case of voltage errors

5.1.1 Voltage Monitoring

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 or 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, page 11).

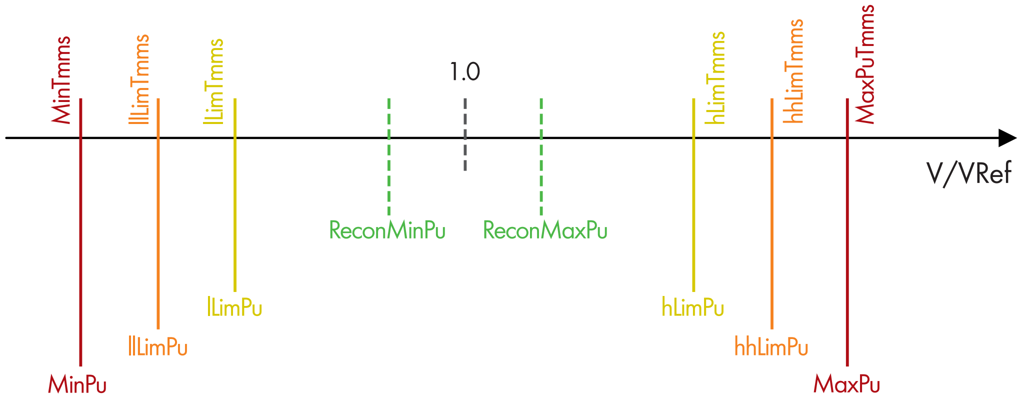


Figure 16: Voltage monitoring

Overvoltage limits

Object name	Definition	Explanation
GridGuard.Cntry.VolCtl.MaxPu	Upper maximum threshold in p.u.	Reference value: parameterized nominal voltage (see Section 3.1.2, page 9)
GridGuard.Cntry.VolCtl.MaxPuTmms	Tripping time of upper maximum threshold in ms	-
GridGuard.Cntry.VolCtl.hhLimPu	Median maximum threshold in p.u.	Reference value: parameterized nominal voltage (see Section 3.1.2, page 9)
GridGuard.Cntry.VolCtl.hhLimTmms	Tripping time of mean maximum threshold in ms	-
GridGuard.Cntry.VolCtl.hLimPu	Lower maximum threshold in p.u.	Reference value: parameterized nominal voltage (see Section 3.1.2, page 9)
GridGuard.Cntry.VolCtl.hLimTmms	Tripping time of lower maximum threshold in ms	-

Undervoltage limits

Object name	Definition	Explanation
GridGuard.Cntry.VolCtl.MinPu	Lower minimum threshold in p.u.	Reference value: parameterized nominal voltage (see Section 3.1.2, page 9)
GridGuard.Cntry.VolCtl.MinTmms	Tripping time of lower minimum threshold in ms	-
GridGuard.Cntry.VolCtl.llLimPu	Median minimum threshold in p.u.	Reference value: parameterized nominal voltage (see Section 3.1.2, page 9)
GridGuard.Cntry.VolCtl.llLimTmms	Median minimum threshold tripping time in ms	-
GridGuard.Cntry.VolCtl.lLimPu	Upper minimum threshold in p.u.	Reference value: parameterized nominal voltage (see Section 3.1.2, page 9)
GridGuard.Cntry.VolCtl.lLimTmms	Tripping time of upper minimum threshold in ms	-

Rise-in-voltage protection

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

Object name	Definition	Explanation
GridGuard.Cntry.VolCtl.RproTmms	Tripping time of rise-in-voltage protection in ms	-
GridGuard.Cntry.VolCtl.RproPu	Rise-in-voltage protection in p.u.	Reference value: parameterized nominal voltage (see Section 3.1.2, page 9)

Monitoring of the voltage increase protection

Object name	Definition	Explanation
GridGuard.Cntry.VolCtl.MaxPeakTmms	Voltage monitoring, tripping time of voltage increase protection in ms	-
GridGuard.Cntry.VolCtl.MaxPeakPu	Voltage monitoring, tripping time of voltage increase protection in .u.	Reference value: parameterized nominal voltage (see Section 3.1.2, page 9)

Connection limits for restarting after a grid fault

Object name	Definition	Explanation
GridGuard.Cntry.VolCtl.Recon-MaxPu	Maximum connection voltage in p.u.	The reference value is the parameterized nominal voltage (see Section 3.1.2, page 9).
GridGuard.Cntry.VolCtl.ReconMinPu	Minimum connection voltage in p.u.	The reference value is the parameterized nominal voltage (see Section 3.1.2, page 9).

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 dip (low-voltage ride-through – LVRT) or during a short period of overvoltage (high-voltage ride-through – HVRT).

With full dynamic grid support, grid support is ensured by feeding in reactive current. If the grid voltage is outside a defined range for a certain time, the inverter feeds in reactive current both in case of undervoltage and in case of overvoltage.

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

The grid limits and deactivation delays are set by default according to the local grid connection regulations when selecting the country data set. When the full dynamic grid support is activated, the islanding detection cannot be activated at the same time. Both functions cannot be used simultaneously.

Complete dynamic grid support

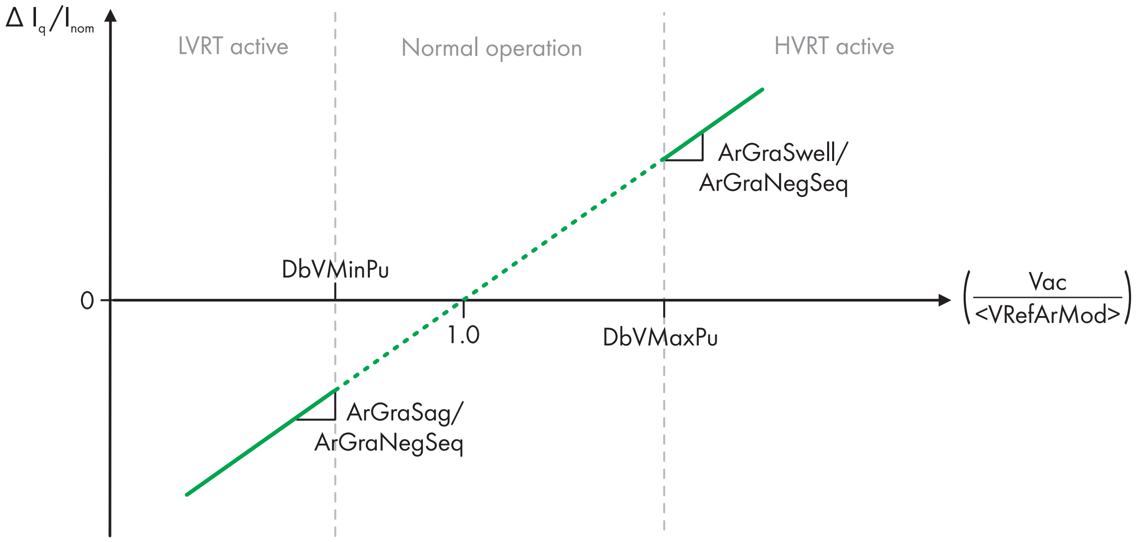


Figure 17: Characteristic curve of full dynamic grid monitoring

Object name	Definition	Explanation
Inverter.DGSModCfg.DGSMod	Dynamic grid support operating mode	Adjustable: Off Limited dynamic grid support Complete dynamic grid support

Object name	Definition	Explanation
Inverter.DGSModCfg.DGSFlCfg.DbVMinPu	Undervoltage threshold for reactive current in p.u.	The reference value is the parameterized nominal voltage (see Section 3.1.2, page 9).
Inverter.DGSModCfg.DGSFlCfg.DbVMaxPu	Overvoltage threshold for reactive current in p.u.	The reference value is the parameterized nominal voltage (see Section 3.1.2, page 9).
Inverter.DGSModCfg.DGSFlCfg.VRefArMod	Averaging for reactive current droop	Adjustable: Nominal grid voltage (VRef) Reference voltage, averaged (VRefAv)
Inverter.DGSModCfg.DGSFlCfg.ArGraSag	Gradient K of the reactive current droop for undervoltage in p.u.	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.DGSFlCfg.ArGraSwell	Gradient K of the reactive current droop for overvoltage in p.u.	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.DGSFlCfg.ArGraNegSeq	Gradient K of the reactive current droop in the negative sequence in p.u.	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.

Limited dynamic grid support

When exceeding parameterized voltage thresholds of the dynamic grid support the current feed-in is stopped (zero current feed-in). If these voltage thresholds are maintained again and the limits of the voltage monitoring are observed (see Section 5.1.1, page 42), the system feeds in again.

Object name	Definition	Explanation
Inverter.DGSModCfg.ZerCurOvVolPu	Dynamic grid support, overvoltage threshold for zero-sequence current in p.u.	The reference value is the parameterized nominal voltage (see Section 3.1.2, page 9).
Inverter.DGSModCfg.ZerCurUnVolPu	Dynamic grid support, undervoltage threshold for zero-sequence current in p.u.	The reference value is the parameterized nominal voltage (see Section 3.1.2, page 9).

5.2 Behavior in case of frequency errors

5.2.1 Frequency Monitoring

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 und GridGuard.Cntry.FrqCtl.ReconMax (see Section 3.3, page 11).

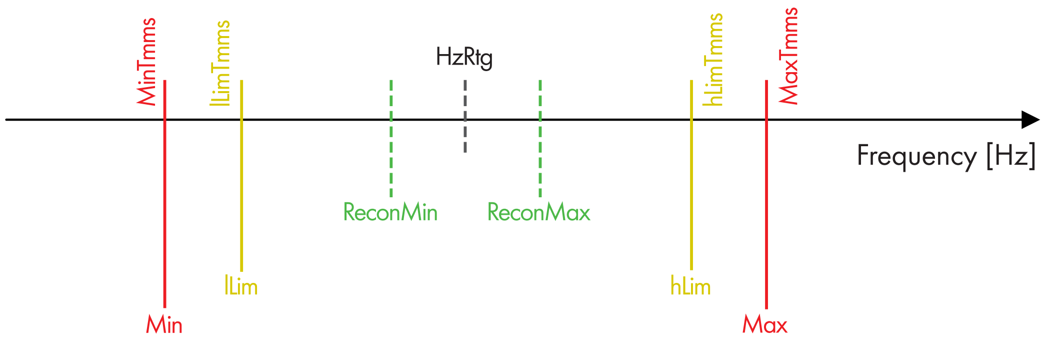


Figure 18: Frequency monitoring (HzRtg: nominal frequency of the utility grid)

Overfrequency limits

Object name	Definition
GridGuard.Cntry.FrqCtl.Max	Upper maximum threshold in Hz
GridGuard.Cntry.FrqCtl.MaxTmms	Tripping time of upper maximum threshold in ms
GridGuard.Cntry.FrqCtl.hLim	Lower maximum threshold in Hz
GridGuard.Cntry.FrqCtl.hLimTmms	Tripping time of lower maximum threshold in ms

Underfrequency limits

Object name	Definition
GridGuard.Cntry.FrqCtl.lLim	Upper minimum threshold in Hz
GridGuard.Cntry.FrqCtl.lLimTmms	Tripping time of upper minimum threshold in ms
GridGuard.Cntry.FrqCtl.Min	Lower minimum threshold in Hz
GridGuard.Cntry.FrqCtl.MinTmms	Tripping time of lower minimum threshold in ms

Connection limits for restarting after a grid fault

Object name	Definition
GridGuard.Cntry.FrqCtl.ReconMax	Maximum connection frequency in Hz
GridGuard.Cntry.FrqCtl.ReconMin	Minimum connection frequency in Hz

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.WCtlHzModCfg.Ena. To control the behavior of the inverter in the event of grid frequency deviations, a characteristic curve with 8 interpolation points can be configured. These interpolation points can be configured on the user interface.

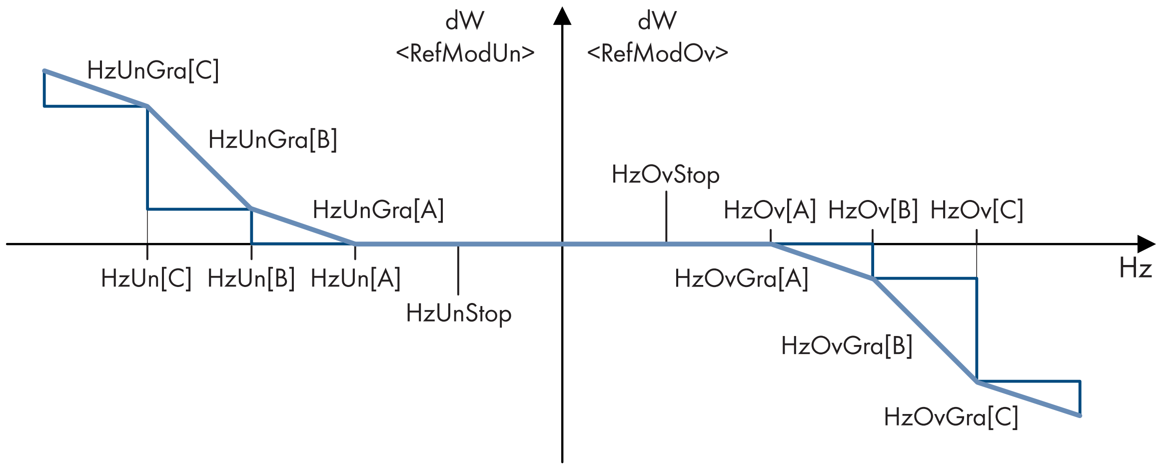


Figure 19: Example of a P(f) characteristic curve

Activating the characteristic curve

Object name	Definition	Explanation
Inverter.WCtlHzModCfg.Ena	P(f) Characteristic Curve	Activation / deactivation

Setting the characteristic curve

Object name	Definition	Explanation
Inverter.WCtlHzModCfg.RefModOv	Reference value for active power in case of overfrequency	Adjustable: Maximum active power (WMaxOut) Instantaneous power (WSnpt) Distance of the instantaneous power to the maximum reference power WMaxIn (WSnptMax)
Inverter.WCtlHzModCfg.RefModUn	Reference value for active power in case of underfrequency	Adjustable: Maximum active power (WMaxOut) Instantaneous power (WSnpt) Distance of the instantaneous power to the maximum reference power WMaxIn (WSnptMax)
Inverter.WCtlHzModCfg.WTms	Response time in s	Response time corresponds to 3 taus (RC time constant) of a PT1 element

Object name	Definition	Explanation
Inverter.WCtlHzModCfg.WCtlHzCfg.HystEnaOv	Hysteresis in case of overfrequency	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.WCtlHzModCfg.WCtlHzCfg.HystEnaUn	Hysteresis in case of underfrequency	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.WCtlHzModCfg.WCtlHzCfg.HzOv	Buckling overfrequencies in Hz	-
Inverter.WCtlHzModCfg.WCtlHzCfg.HzOvGra	Changes in the active power in case of overfrequency %/Hz	The reference value is the active power set via Inverter.WCtlHzModCfg.RefModOv in case of underfrequency.
Inverter.WCtlHzModCfg.WCtlHzCfg.HzOvStop	Reset overfrequency in Hz	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.
Inverter.WCtlHzModCfg.WCtlHzCfg.HzUn	Buckling underfrequency in Hz	-
Inverter.WCtlHzModCfg.WCtlHzCfg.HzUnGra	Changes in the active power in case of underfrequency %/Hz	The reference value is the active power set via Inverter.WCtlHzModCfg.RefModUn in case of underfrequency.
Inverter.WCtlHzModCfg.WCtlHzCfg.HzUnStop	Reset underfrequency in Hz	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.

Behavior when activating / deactivating the characteristic curve

Object name	Definition	Explanation
Inverter.WCtlHzModCfg.WCtlHzCfg.WCtlTmms	Tripping delay	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.WCtlHzModCfg.WCtlHzCfg.HzStopWGraTms	Power-down time in s	Waiting time until the transition to normal operation is started. The power-down time is started, namely as soon as the frequency is within the 2 reset frequencies: Inverter.WCtlHzModCfg.WCtlHzCfg.HzUnStop < f < Inverter.WCtlHzModCfg.WCtlHz- Cfg.HzOvStop During the power-down time, a ramp rate is used to align the active power with the normal operation.
Inverter.WCtlHzModCfg.WCtlHzCfg.HzStopWGra	Active power ramp rate after the end of a fault in %/min	The reference value is WMaxOut / WMaxIn.

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. When the islanding detection is activated, the complete dynamic grid support cannot be activated at the same time. Both functions cannot be used simultaneously.

Object name	Definition	Explanation
GridGuard.Cntry.Aid.HzMon.Stt	Islanding detection, status of frequency monitor	Adjustable: On / On Off / Off
GridGuard.Cntry.Aid.AsymDet.Stt	Islanding detection, status of the unbalanced load detection	Adjustable: On / On Off / Off
GridGuard.Cntry.Aid.HzMon.HzMonTmms	Islanding detection, tripping time of frequency monitoring in ms	-

5.4 Only Japan: Monitoring the maximum frequency change

Monitoring the maximum frequency change supplements the islanding detection function (see Section 5.3, page 49).

Object name	Definition
GridGuard.Cntry.FrqCtl.ChgMax	Frequency monitoring, maximum frequency change, per second in Hz
GridGuard.Cntry.FrqCtl.Chg-MaxTmms	Frequency monitoring, tripping time of maximum frequency change in ms

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