ABB solar inverters

Service menu guide
PRO-33.0-TL string inverters

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List of related manuals

PRO-33.0-TL manuals	Code (English)
PRO-33.0-TL quick installation and start-up guide	*3AUA0000123263*
PRO-33.0-TL product manual	*3AUA0000123261*
PRO-33.0-TL service menu guide	*3AXD50000015823*

Option manuals and guides	
FIO-01 Digital I/O Extension user manual	*3AFE68784921*
VSN700 Data Logger	*9AKK106103A7625*

You can find manuals and other product documents in PDF format on the Internet. For manuals not available in the Document library, contact your local ABB representative.

Service menu guide

PRO-33.0-TL string inverters

3AXD50000015823 Rev A
EN
EFFECTIVE: 2014-12-18

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3. Parameters

4. Fieldbus interfaces

1

Service menu

Contents of this chapter

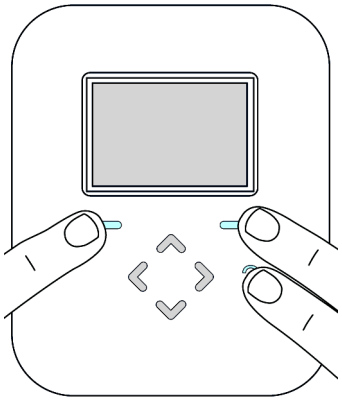
This chapter describes the Service menu, when to use it and how to access it.

Service menu overview

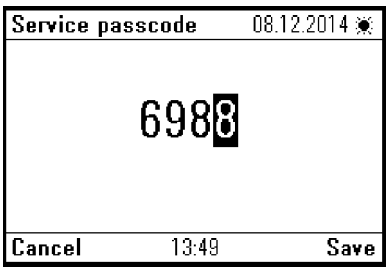
In the basic use of the inverter you do not need the Service menu. However, some of the inverter features are accessible only from the Service menu. For example, you can make custom settings for countries that are not defined in the inverter software or adjust the inverter's operating parameters to better meet the local requirements.

Accessing Service menu

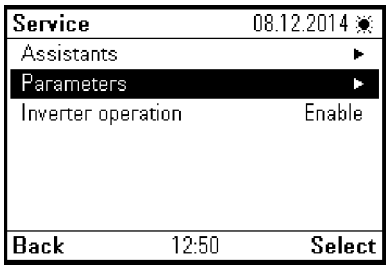
1. From the screen saver display or output view screen, simultaneously push the left soft key, right soft key and **Help** button. If you push one button before the others, you need to try again.



2. Enter the PIN 6988. Use the up, left and right arrows to enter the digits. Press the right soft key to save.



3. Scroll down the menu and enter the **Service** submenu. The heading **Parameters** is now shown on the list.



Exiting Service menu

If you do not press any buttons on the inverter for a preset period of time, the screen saver turns on and you exit the Service menu. For instructions on changing the screen saver delay, see chapter *Setting screen saver delay* on page *11*.

To exit the Service menu before the preset period expires, for example, to prevent anyone from altering parameters in your absence:

1. From the screen saver display or output view screen, simultaneously push the left soft key, right soft key and help button.
2. Push **Cancel** without entering the PIN.

Setting screen saver delay

If you do not press any buttons on the inverter for a preset period of time, the screen saver turns on and you exit the Service menu. To return to the Service menu, see *Accessing Service menu* on page 9. If an assistant is active or waiting for a response from the user, the screen saver does not turn on.

Before using the Service menu, increase the preset screen saver delay so you do not need to repeatedly access the menu. This is useful especially when the delay is short. You can change the screen saver delay from the Screen menu and set the value from 30 seconds to 10 minutes. Remember to reset the delay back to the original value after you have finished working with the Service menu.

Parameters you are allowed to change

It is possible to change the parameters and their values from the Service menu almost without any restrictions. Note that you are allowed to change the parameters and select the values only to match the relevant local requirements and regulations set by the local authority.

2

Program features

Contents of this chapter

This chapter describes the software features of PRO-33.0-TL inverter. Each feature is described in detail with a list of parameters and related faults and warnings, if applicable.

Control and monitoring interfaces

In basic setup the operation of PRO-33.0-TL inverter does not require any user actions. Once the inverter has been properly commissioned, automatic functions start and stop the inverter based on measurements.

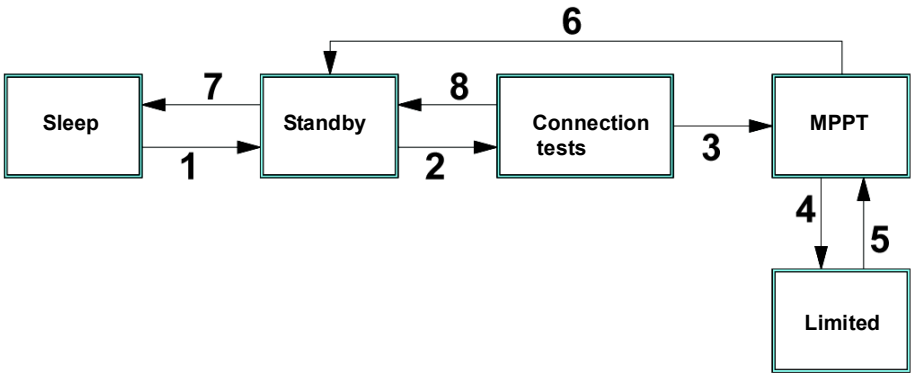
In some cases the inverter requires monitoring and additional control. You can control and monitor the inverter locally from the control unit and remotely through the fieldbus interface.

The control unit operation and menu structure are described in the *PRO-33.0-TL Product manual* (3AUA0000123261 [English]).

Operational description

PRO-33.0.-TL inverter operation follows the state machine described below.

- *MPPT* is the normal operational state during power generation.
- If a power limitation is active, the inverter is in the *Limited* state while the inverter produces energy to the grid.
- When the DC power level from panels is low, the inverter is in the *Sleep* or *Standby* state depending on the night mode settings (parameter *189.07 Night mode*).
- *Connection tests* is a state the inverter goes through every time it connects to the grid and performs tests for DC voltage and internal protection devices.
- If a fault occurs, the inverter moves to the *Standby* state and waits to be reset.

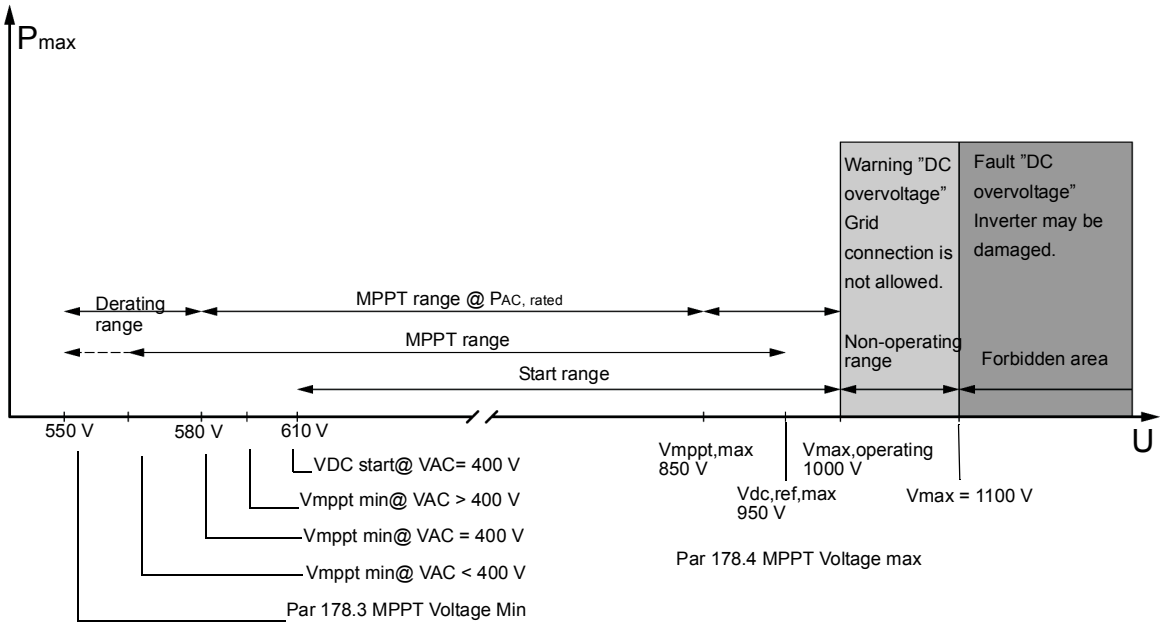


The conditions for state transitions are as follows:

1	VDC > ~300 V
2	Inverter enabled (parameter *189.01 Inverter operation*) **AND** country code set **AND** grid stable **AND** VDC > VDC_{start} **AND** VDC < VDC_{max} **AND** no faults
3	VDC > VDC_{start} **AND** ground impedance ok **AND** grid relay ok
4	Available power is greater than the inverter's power limit (parameter *130.01 Limit word 1*) $P_{lim} < P_{act}$
5	Available power is less than the inverter's power limit $P_{act} < P_{lim}$
6	Inverter disabled (parameter *189.01 Inverter operation*) **OR** fault **OR** grid unstable **OR** VDC low **OR** VDC > VDC_{max} **OR** FRT overshoot
7	No monitoring mode (parameter *189.07 Night mode*) **AND** VDC < VDC_{sleep} **AND** Control unit screensaver active **AND** No events active
8	Inverter disabled (parameter *189.01 Inverter operation*) **OR** fault **OR** grid unstable **OR** VDC < VDC_{start}

DC voltages and maximum power point tracking

The following picture visualizes the operational voltage ranges of the PRO-33.0.-TL inverter. The input operation voltage range depends on the AC voltage and it is between 580 and 950 volts when the AC voltage is nominal 400 V_{AC}.



- MPPT range @ $P_{AC, rated}$ = maximum power available with tracking, no derating
- MPPT range = maximum power tracking range, power may be derated.
- Start range = Input voltage range where inverter may start

Start range

The inverter starting range is between 610 V and 1000 V. The minimum startup voltage depends linearly on AC voltage. 610 V is valid at nominal AC voltage 400 V_{AC}. If the voltage at start is greater than 950 V, it is regulated down to 950 V where tracking is started.

DC overvoltage monitoring

If the DC voltage is over 1000 V, the inverter gives a DC overvoltage warning and grid connection is not allowed. The inverter may be damaged if the input voltage is higher than 1100 V_{DC}. If the DC voltage is over 1100 V_{DC}, the inverter gives the DC overvoltage fault.

Maximum power point tracking range

Maximum power point tracking (MPPT) range with rated Power $P_{AC,rated}$ is available between 580 V and 850 V in nominal conditions and at nominal AC voltage. See the figure for MPPT range @ $P_{AC,rated}$. Maximum power point tracking operates up to 950 V, but the available inverter maximum power between 850 V and 950 V depends on the temperature inside the inverter.

The MPPT range operates between V_{MPPT_min} and 950 V. The V_{MPPT_min} is the higher value of either parameter *178.03 Minimum voltage ref* or voltage level that depends on the AC voltage. The default value for the parameter *178.03 Minimum voltage ref* is 550 V and nominal value for the V_{MPPT_min} is 580 V @ 400 VAC.

The inverter topology is single stage inverter which means that the inverter does not have a DC / DC booster. Thus the inverter startup voltage and minimum maximum power point voltage depend linearly on the AC output voltage.

If the available PV power is greater than inverter's derated power, MPP tracking is disabled and DC voltage is determined by PV curve. The inverter limits output power and voltage rises but the inverter stays connected to the grid unless the voltage exceeds 1000 V.

If the available PV power is smaller than inverter's derated power, MPP is tracked within the operating voltage range. If V_{mpp} > 950 V, tracker does not reach V_{mpp}, instead the voltage is limited to 950 V.

DC current limiting

The inverter limits its output power with the smaller DC voltages to the 58 A maximum operating input current. The smallest DC input voltage that provides the maximum output power is 580 V in nominal conditions.

Settings

178.03 Minimum voltage ref

178.04 Maximum voltage ref

Diagnostics

101.10 DC voltage

Country settings

Preset country codes

The PRO-33.0-TL inverter has preset country code settings for numerous installation countries. The installation country is initially set with the First start assistant or with the parameter *188.01 Country code*.

The First Start assistant activates automatically when the inverter is turned on for the very first time. See more details in the *PRO-33.0-TL Product manual*. The country code may also have separate options for low voltage and medium voltage settings when there are separate requirements for MV connection in the same country, such as Germany LV and Germany MV. If the country code is not set, the inverter does not operate.

When a country code is selected, all the necessary parameter settings are set to match the country requirements. The country code settings affects the parameters in the groups *124 Q ref*, *125 FRT support curve*, *126 FRT tripping curve*, *130 Limits, 178 MPPT settings*, *188 Grid monitoring*, *189 Inverter control* and *209 Misc*. The parameters include, for example, nominal output values, tripping limits for under- and overvoltage and under- and overfrequency, initial connection delays, variety of reconnection delays, anti-islanding settings, reactive power settings, fault ride-through settings, power limitation settings and MPPT recovery settings. Usually the country code is not changed during the lifetime of the inverter.

If the country code has to be changed, note that changing the parameter *188.01 Country code* always overrides the changes done to the above-mentioned parameter groups.

The ready-made parameter settings made by the selected country code can be modified according to the local requirements after the country code has been set. See more details in chapter *Customizing country code settings* on page *17*.

Settings

188.01 Country code

Diagnostics

172.01 Connection status

Customizing country code settings

If the country code-related parameter settings (parameters in groups *124 Q ref*, *125 FRT support curve*, *126 FRT tripping curve*, *130 Limits, 178 MPPT settings*, *188 Grid monitoring*, *189 Inverter control* and *209 Misc*) need to be changed, follow this procedure:

Disable the inverter

1. Enter the **Service** menu.
2. Select **Inverter operation** and press **Edit**.
3. Change the value from **Enable** to **Disable** and press **Save**. After a short period, the inverter stops running and it is possible to change the parameter values.

Customize settings

1. Enter the parameter list: **Service menu** - **Parameters** - **Complete list**.
2. Check that you have a country code set with parameter *188.01 Country code*.
3. Make required changes to the parameters.

Enable the inverter and save the parameter changes to permanent memory

1. Set parameter *189.01 Inverter operation* to **Enable**.
2. Refresh the settings by setting the parameter *188.05 Refresh*.
3. Save parameter values by setting the parameter *196.07 Param save*.

Grid monitoring

The PRO-33.0-TL inverter monitors the grid conditions with internal measurements. The measured values are compared against the limits set in the parameter group *188 Grid monitoring*. If the measured value does not stay within the limit for a certain minimum period of time, the inverter declares the grid as unstable. All grid monitoring settings are reset when the country code is changed.

Note: If the grid monitoring settings are changed, do a parameter refresh with the parameter *188.05 Refresh*.

Note: Depending on the installation country, an external third party-certified grid monitoring relay may be needed.

Nominal values

Note: The fault ride-through settings must be taken into account when defining grid monitoring.

The inverter monitors either line-to-line voltages or line-to-neutral voltages. This is selected with the parameter *188.06 Voltage source* that can be set to **Main** or **Phase**, respectively. The settings for grid monitoring are set in relation to the nominal value.

Settings

188.02 Nominal LL voltage

188.03 Nominal phase voltage

188.04 Nominal frequency

188.06 Voltage source

Connection delays

Typically, it is required that the grid must be stable for some time before grid connection is allowed. For this purpose there is a set of delays.

- *188.10 Initial connection delay* must expire before the first grid connection after a power-up can be made.
- *188.11 Reconnection delay* defines the delay that must expire after a disconnection before the following reconnection.
- *188.13 Quick reconnection delay* is used if the grid has been unstable for less than defined in the parameter *188.12 Quick disturbance limit*. Thus a short unstable grid allows a faster reconnection. If the parameter *188.12 Quick disturbance limit* is set to **0**, quick reconnection is not used.

Settings

188.10 Initial connection delay

188.11 Reconnection delay

188.12 Quick disturbance limit

188.13 Quick reconnection delay

Connection limits

The inverters grid monitoring function includes a connection condition checking that is used only in a grid connection. Typically the connection limits are stricter than the disconnection limits. The connection limits may be referred also as "cut-in" conditions.

There are connection limits for underfrequency, overfrequency, overvoltage and undervoltage. Each phase/main voltage is independently monitored.

Settings

188.20 Connect underfrequency type

188.21 Connect underfrequency limit

188.22 Connect overfrequency type

188.23 Connect overfrequency limit

188.24 Connect undervoltage type

188.25 Connect undervoltage limit

188.26 Connect overvoltage type

188.27 Connect overvoltage limit

Voltage monitoring

There are two limits for undervoltage monitoring and three limits for overvoltage monitoring. Each limit has an enable parameter, a limit parameter and a time parameter.

When the limit is enabled and the measured value exceeds the limit for the time, the grid is declared as unstable. All limits are logically connected in parallel. Each phase/main voltage is independently monitored.

Settings

188.50 Undervoltage enable 1 -- *188.71 Overvoltage time 3*

Sliding overvoltage

Sliding overvoltage implements monitoring for the slowly rising AC voltage. 10-minute average value is calculated and compared against the limit. Each phase/main voltage is independently monitored.

Settings

188.72 Sliding overvoltage enable

188.73 Sliding overvoltage limit

188.74 Sliding overvoltage time

Frequency monitoring

There are two limits for underfrequency and overfrequency monitoring. Both limits have an enable parameter, limit parameter and time parameter.

When the limit is enabled and the measured value exceeds the limit for the time, the grid is declared as unstable. All limits are logically connected in parallel.

Settings

188.30 Underfrequency enable 1 -- *188.45 Overfrequency time 2*

Combinatory limit

Combinatory limit monitors grid voltage and frequency simultaneously. There are limits for the positive sequence and the negative sequence of grid voltage, and limits for underfrequency and overfrequency.

The grid is declared as unstable, if

- the negative sequence voltage and the frequency are outside their limits, or
- the positive sequence voltage and the frequency are outside their limits.

If either of the conditions is true for the time defined in *188.81 Combinatory trip time*, the grid is declared as unstable and the inverter disconnects from the grid.

Settings

188.80 Combinatory trip

188.81 Combinatory trip time

188.84 Comb pos seq voltage limit

188.85 Comb neg seq voltage limit

188.86 Comb underfrequency limit

188.87 Comb overfrequency limit

Rate of change of frequency

The grid frequency rate of change (RoCoF) has enable and limit parameters. If it is enabled and the limit is exceeded, the inverter disconnects from the grid.

Active anti-islanding

The anti-islanding function is used to prevent an island situation in an electrical grid. Island in a grid is a situation in which a generator powers part of the grid even though the power

from the utility grid has been cut off. Islanding can be dangerous to people working with the grid and not realizing that the circuit is still powered. For that reason, distributed power generators such as solar inverters must detect an island situation and immediately stop feeding power to the grid.

The anti-island function injects reactive current into the grid and thus it is so-called active method. The actual detection of the island condition is based on the grid voltage measurements. The function can configured with parameters. The parameters are preset to such values that ensure that the relevant country-dependent requirements are fulfilled.

The operation of the anti-islanding function can be tuned with several parameters:

- The frequency of the injection can be adjusted from 5 Hz to 20 Hz.
- The minimum amplitude of the injection is adjusted with the parameter *188.122 AI injection offset*.
- Amplitude is increased relative to active power by the amount specified with the parameter *188.123 AI injection gain*.
- Sensitivity can be adjusted with the parameter *188.124 AI trip limit*.
- Injection is ramped with the ramp defined in the parameter *188.125 AI injection ramp* to smooth operation.

Settings

188.120 1-phase AI

188.121 AI injection frequency

188.122 AI injection offset

188.123 AI injection gain

188.124 AI trip limit

188.125 AI injection ramp

External grid monitoring relay

Depending on the installation country, an external third party-certified grid monitoring relay may be needed. If an external relay is used, loose limits for grid monitoring should be set. The recommended setting for overvoltage monitoring limit is 130 %. The limit for undervoltage monitoring should be set below the external relay setting.

The inverter can use external grid monitoring via the parameter *188.16 External trip* that can be written, for example, by the fieldbus. If this parameter has the value **1**, external grid monitoring indicates an unstable grid.

Settings

188.16 External trip

Reactive power control

The inverter is capable of generating a selectable amount of reactive power to the grid (positive = capacitive, negative = inductive). A reference value for the reactive power can be given via the control unit or fieldbus interface. The inverter also supports reactive power generating according to defined curves such as Q(U) and Q(P).

A reference type for the reactive power can be selected from many different formats; see the parameter *124.06 Q power ref type*. A reference value must be finally written to the parameter *124.01 User Qref* according to the selected reference format.

When the parameter *124.06 Q power ref type* is set to **Q(x) regulation curve**, the parameter *124.30 Q(x) input signal* is used to select the curve type. Examples of different curve types are shown below. Lock-in and lock-out conditions define when the selected curve is active. The curve is defined with six points that map the input signal to the output signal.

Reactive power control curve activates when lock-in conditions are fulfilled and deactivates when lock-out conditions are fulfilled. Lock-in condition can be set so that the curves are always active (set to zero (power>0)).

Settings

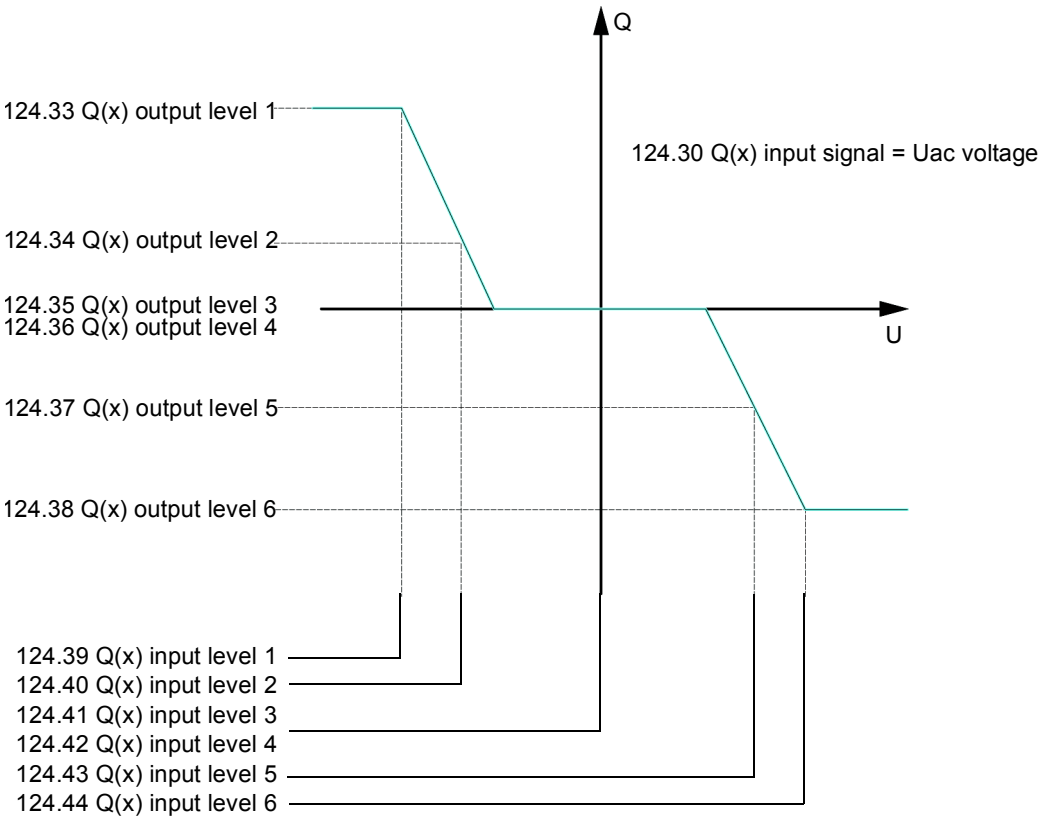
124.01 User Qref

124.06 Q power ref type

124.30 Q(x) input signal

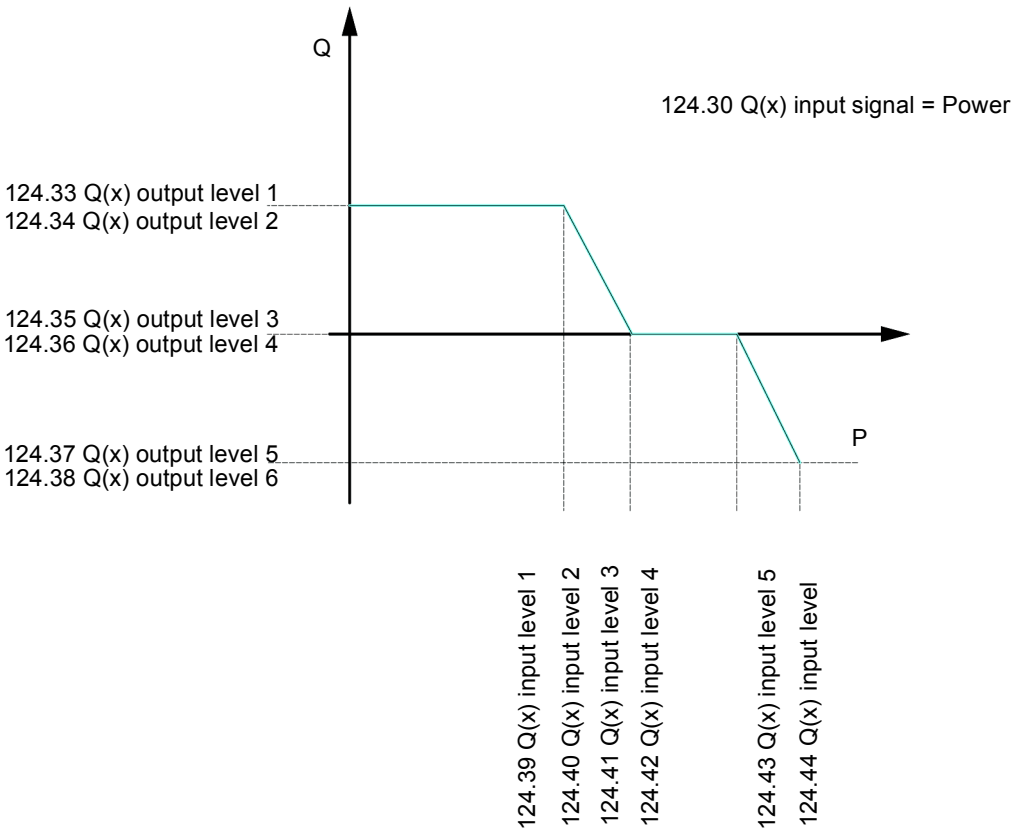
Q(U) control curve

In Q(U) control curve mode reactive power generated by inverter depends on the grid voltage as described in the example picture. Active power in percent is used as a lock-in condition.



Q(P) control curve

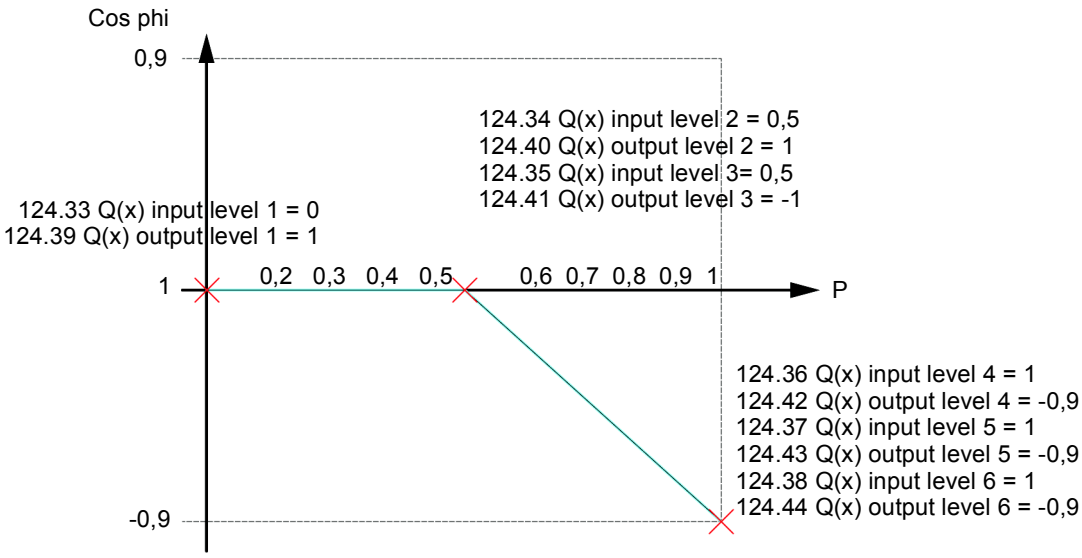
In the Q(P) control curve mode the reactive power generated by inverter depends on the active power as described in the example picture. Grid voltage in percent is used as a lock-in condition.



cos phi(P) control curve

In the cos phi(P) control curve mode the reactive power generated by inverter depends on the active power. Grid voltage is used as a lock-in condition. When setting this curve, crossing cos phi level one must be defined with two different points in the same point. For

example, input level 2 = 0,5; output level 2 = 1,0 and input level 3 = 0,5; output level 3 = -1,0.



Power prioritization

Prioritization of the active and reactive power is set with the parameter *209.11 Limit priority*.

Note: The inverter can generate reactive power according to the given reference if the current limit of the inverter is not exceeded. If the inverter is already feeding maximum allowed current to the grid, the parameter *209.11 Limit priority* defines whether active or reactive power is limited. In this case the actual reactive power and the reactive power reference may not be the same.

Settings

124.01 User Qref

124.06 Q power ref type

124.30 Q(x) input signal

124.31 Lock-in level

124.32 Lock-out level

124.33 Q(x) input level 1 -- *124.44 Q(x) output level 6* curve points

209.11 Limit priority

Active power limitations

External active power limit

Inverter output power can be limited by writing the required maximum output power value to parameter *130.75 External power limit*. The external power limit has ramps *130.98 External limit ramp up* and *130.99 External limit ramp down*.

Settings

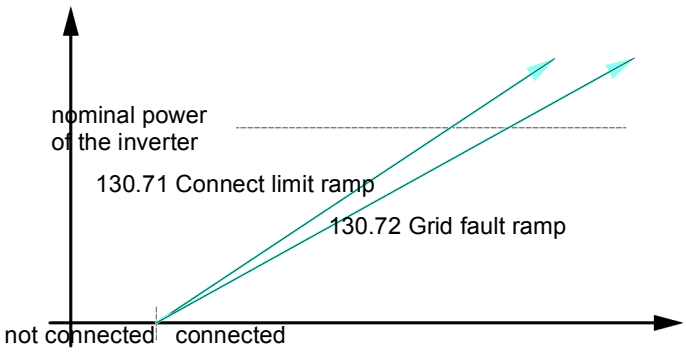
130.75 External power limit

130.98 External limit ramp up

130.99 External limit ramp down

Limitation after grid connection and after grid fault

Active power can limited after grid connection and after grid fault. The limitation type is selected with the parameter *130.70 Connect limit type*. The limitation can be set to be active always, only after grid fault or never. There are different ramp rates for grid connections and re-connections after grid faults. Limitation ramp starts from 0 %. Ramp is defined as % / min.



Settings

130.70 Connect limit type

130.71 Connect limit ramp

130.72 Grid fault ramp

Limitation based on grid frequency

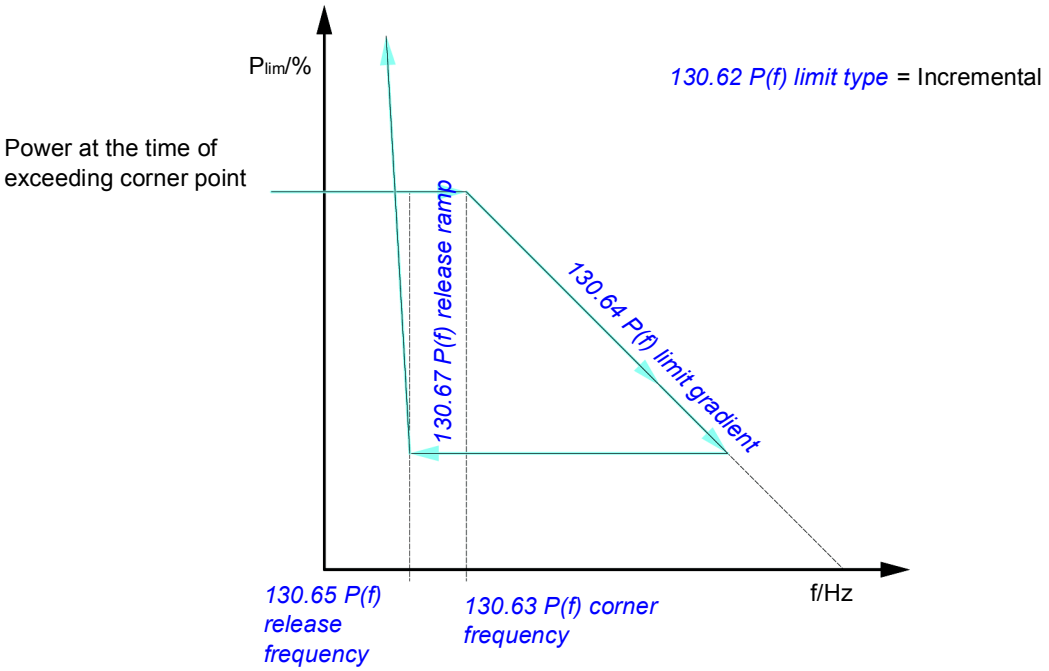
Power limitation based on grid frequency can be set to operate in different ways. This chapter describes some of the most common ways. P(f) limitation type is selected with the parameter *130.62 P(f) limit type*.

P(f) limitation curve based on Germany MV grid code

This is an example of an *incremental* P(f) limitation.

Frequency is defined with the parameter *130.63 P(f) corner frequency*. When the frequency is crossed, the power value is saved and the power limit is calculated in relation to that power. The limit may only decrease until the frequency drops below the value in

defined by the parameter *130.65 P(f) release frequency*. Then the power limit is ramped up with the parameter *130.67 P(f) release ramp* in relation to the nominal power.



Settings

130.62 P(f) limit type

130.63 P(f) corner frequency

130.64 P(f) limit gradient

130.65 P(f) release frequency

130.67 P(f) release ramp

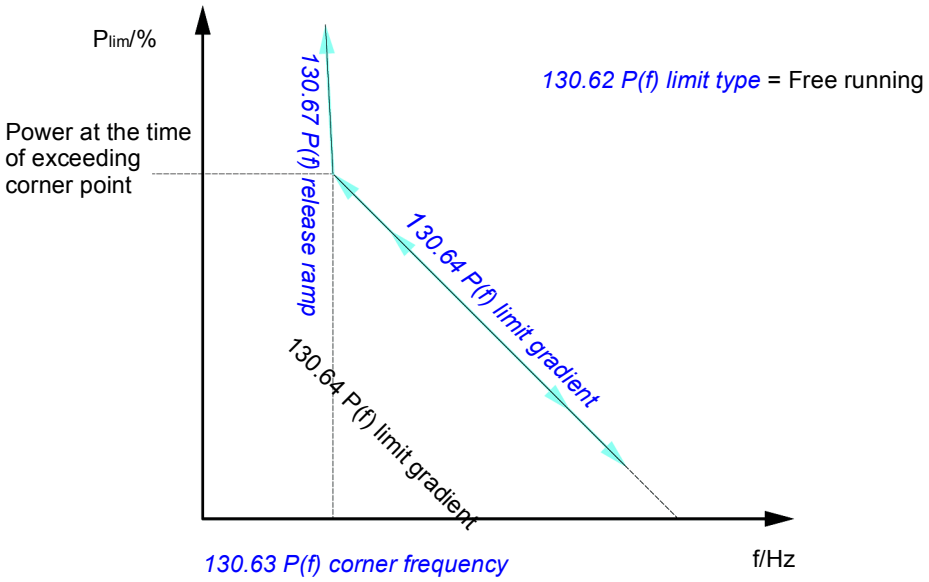
130.68 P(f) release ramp ref

P(f) limitation curve based on Germany LV grid code

This is an example of a *free running* P(f) limitation.

When *130.63 P(f) corner frequency* is crossed, power is saved and the power limit is calculated in relation to that power. The limit may change freely at the frequencies above the corner frequency. When the frequency drops below *130.63 P(f) corner frequency*,

power limit is ramped up with the parameter *130.67 P(f) release ramp* in relation to nominal power.



Settings

130.62 P(f) limit type

130.63 P(f) corner frequency

130.64 P(f) limit gradient

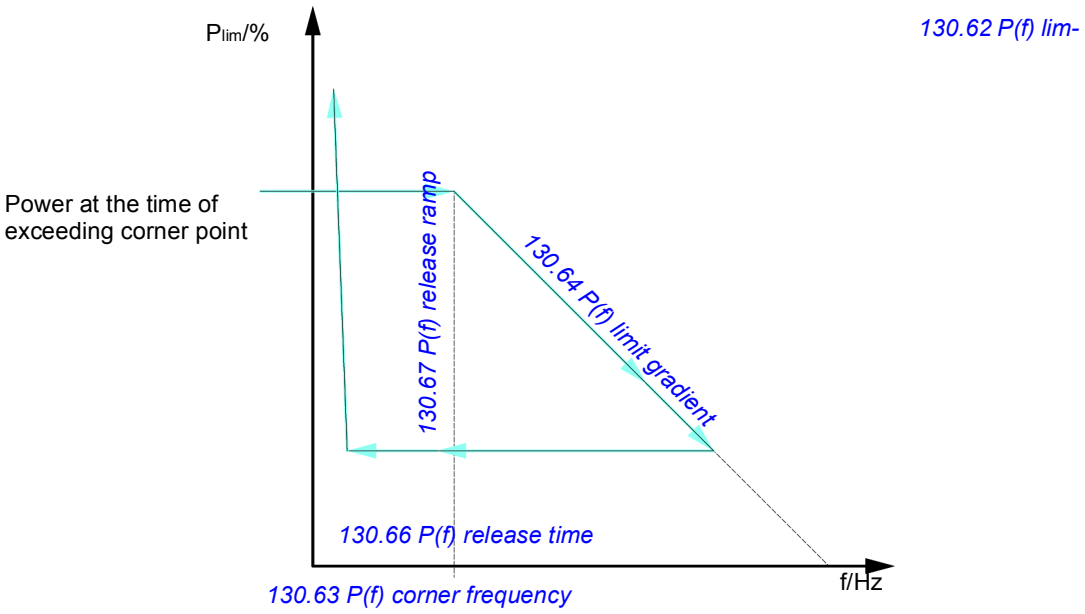
130.67 P(f) release ramp

P(f) limitation curve based on Italy MV grid code

This is an example of an *incremental* P(f) limitation.

When *130.63 P(f) corner frequency* is crossed, power is saved and the power limit is calculated in relation to that power. The limit may only decrease until the frequency drops

below *130.63 P(f) corner frequency*. Then *130.66 P(f) release time* must expire before the power limit is ramped up with *130.67 P(f) release ramp* in relation to nominal power.



Settings

130.62 P(f) limit type

130.63 P(f) corner frequency

130.64 P(f) limit gradient

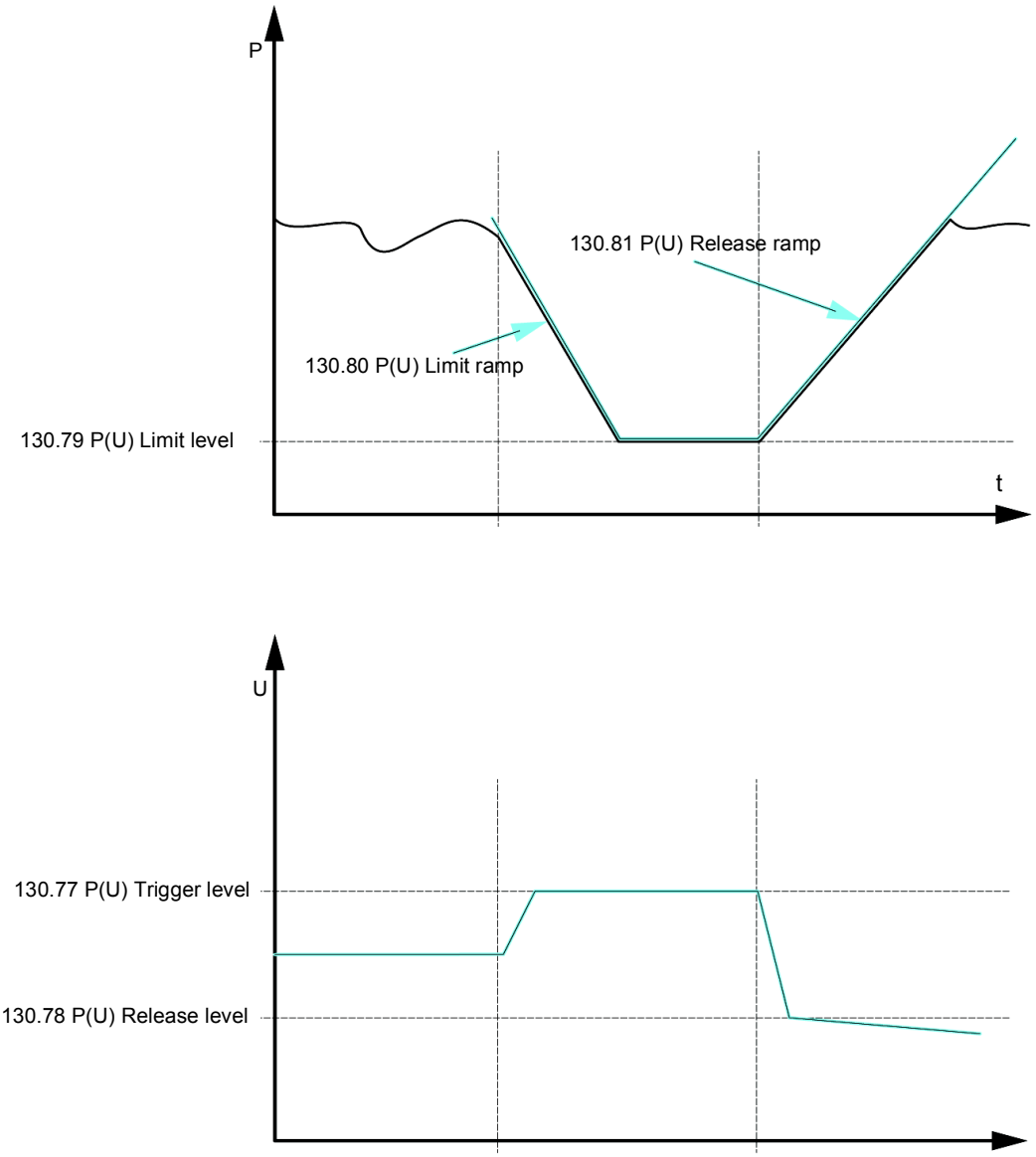
130.66 P(f) release time

130.67 P(f) release ramp

Limitation based on grid voltage

Active power limit as a function of grid voltage is meant to reduce grid voltage rise because of active power. When average grid voltage exceeds the *130.77 P(U) trigger level*, power limit is ramped down to *130.79 P(U) limit level*. *130.80 P(U) limit ramp* is used to when ramping power limit down.

When the average grid voltage goes below the *130.78 P(U) release level*, power limit is released and ramped up with *130.81 P(U) release ramp*. Blue color in the figure below marks the active power limit.



Settings

130.77 P(U) trigger level

130.78 P(U) release level

130.79 P(U) limit level

130.80 P(U) limit ramp

130.81 P(U) release ramp

Flat-top limit

Flat-top limit permanently limits the inverter's active power capacity to a value lower than nominal. Normally the inverter has semi-circular power capacity as the inverter can produce as much active power as it can produce reactive power. However, with the flat-top limit, this capacity can be cut by reducing the amount of active power. As the AC current limit stays intact, this increases the full active power range where the full power is the

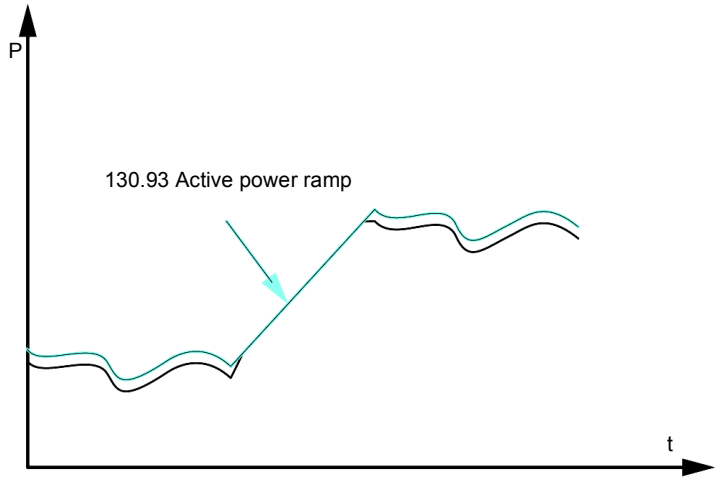
setpoint value of the flat-top limit. Note that in the end flat-top is only one constant active power limit.

Settings

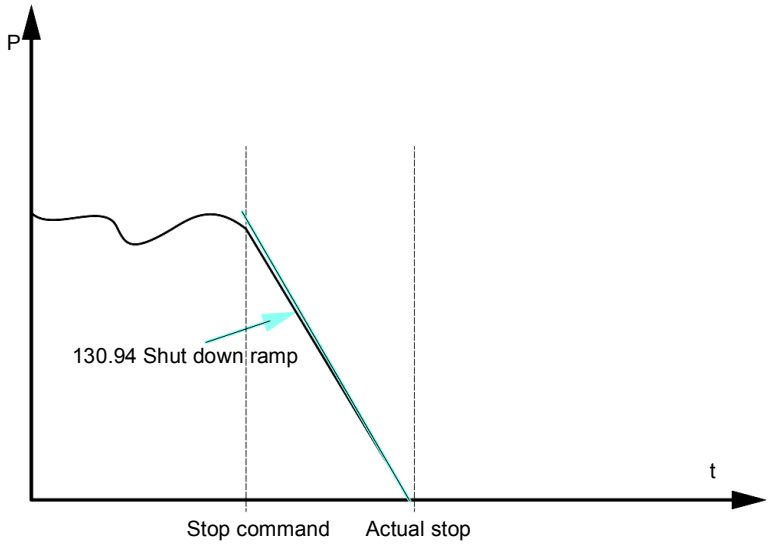
130.90 Flat-top limit

Power gradient

The power gradient functionality limits the rise rate of active power to a predefined value. This stabilizes the grid as the power does not change too rapidly. The power gradient functionality is enabled with the parameter *130.92 Active power ramping* and the rise rate is set with the parameter *130.93 Active power ramp*. If the power does not change much, the rise rate limit follows the actual power closely. When the active power starts to increase rapidly, the limit is ramped up slowly as long as the power has stabilized again.



For controlled stopping, a shut down ramp is implemented. This way power is first reduced slowly to zero and then the grid relays are opened. The ramp is defined with the parameter *130.94 Shut down ramp*. The internal limit value follows the actual power and once the inverter operation is deactivated, the power limit is ramped to zero with a ramp defined with the parameter *130.94 Shut down ramp*. This does not affect the grid disconnection time in case of faults or grid disturbance.



Settings

130.92 Active power ramping

130.93 Active power ramp

130.94 Shut down ramp

189.01 Inverter operation

Fault ride-through

The fault ride-through (FRT) function manages the voltage peaks and dips in the grid. The function is programmable: the user can define when the inverter must stay connected to the grid (that is, the depth and length of the grid voltage transient) and when the inverter is required to disconnect. The user may also define when the inverter supports the grid by feeding capacitive or inductive reactive current to the grid. The inverter behavior during a grid fault is defined in grid codes. Typically they specify the following:

- how long a dip can last
- how long a swell can last
- how to behave with symmetrical voltage dips and peaks
- how to behave with asymmetrical voltage dips and peaks.

FRT can be divided to two different cases: low-voltage ride-through (LVRT) and high-voltage ride-through (HVRT). The cases are described below. The grid support function supports the grid voltage during a voltage dip or peak by injecting capacitive or inductive reactive current to the grid. This is also described in more detail below.

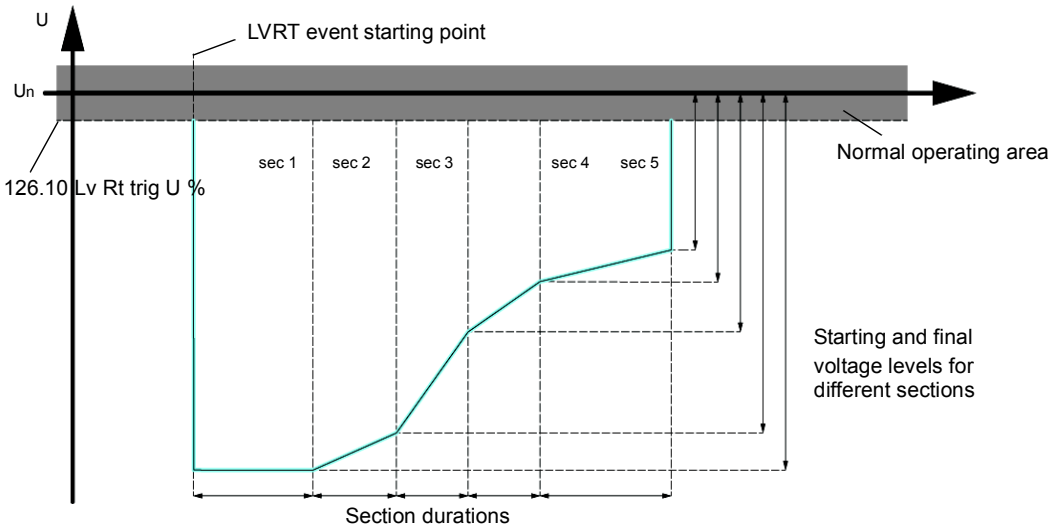
The FRT function is enabled with the parameter *126.01 FRT enable*.

Low-voltage ride-through (LVRT)

If the grid voltage falls below the low-voltage ride-through triggering level defined with the parameter *126.10 Lv Rt trig U %*, a grid warning is indicated. If the grid transient lasts longer than the defined time, the inverter trips, otherwise the inverter operates normally without interruptions after the LVRT event has ended. After the LVRT event, the inverter's MPPT starts generating power according to the voltage level present. If a faster power recovery is required after the LVRT event, a separate fast recovery function must be enabled with parameter *178.40 Fast recovery*. The ramp for the function must also be set with the parameter *178.41 Recovery ramp*. These parameters are set by the country code.

The LVRT tripping curve is defined with five sections. Each section is defined with the duration, starting and final voltage level parameters. These parameters are in the parameter group *126 FRT tripping curve*. The picture below describes an example of the LVRT tripping curve. When the voltage remains inside the area outlined with all five sections, the inverter stays connected to the grid, otherwise the inverter trips to fault.

The compared voltage is defined with the parameters *126.02 Lv Rt symm sig* -*126.03 Lv Rt asymm sig*. The asymmetric limit can be set with parameter *126.06 Asymm/symm limit*.



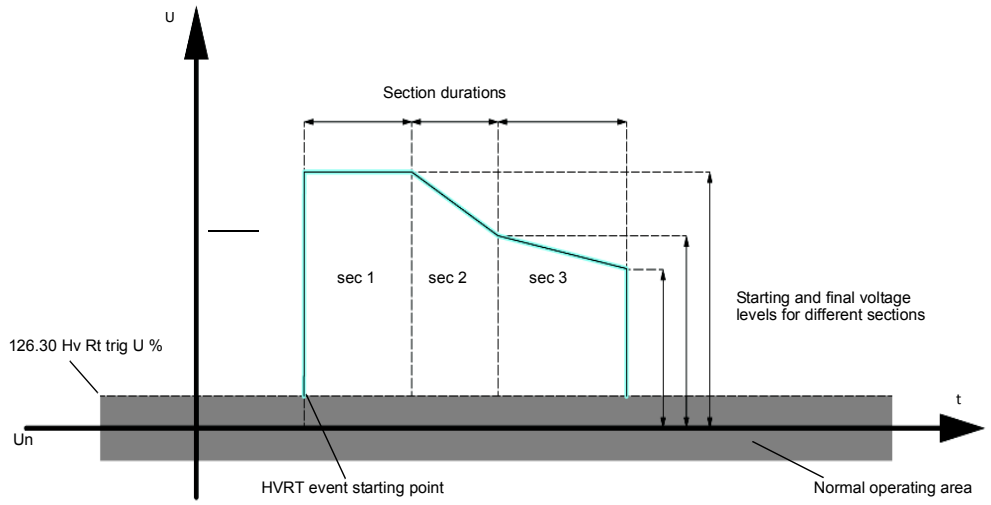
Note: Grid monitoring settings must be taken into account when defining LVRT settings.

High-voltage ride-through (HVRT)

If the grid voltage rises above the high-voltage ride-through (HVRT) triggering level defined with the parameter *126.30 Hv Rt trig U %*, a grid warning is indicated. If the grid transient lasts longer than the defined time, the inverter trips, otherwise the operation continues normally without interruptions after the HVRT event has ended.

The HVRT tripping curve is defined with three sections. Each section is defined with the duration, starting and final voltage level parameters. The parameters are in the parameter group *126 FRT tripping curve*. The picture below describes an example of the HVRT tripping curve. When the voltage remains inside the area outlined with all three sections, the inverter stays connected to the grid, otherwise the inverter trips to fault.

The compared voltage is defined with the parameters *126.04 Hv Rt symm sig* and *126.05 Hv Rt asymm sig*. The asymmetric limit can be set with the parameter *126.06 Asymm/symm limit*.



Grid support

Grid support means the injection of capacitive or inductive reactive current to the grid. This supports grid voltage during a voltage dip or peak. Typically, the amount of reactive current depends on the grid voltage level. Different grid codes demand different grid support functionalities, which are defined with parameter settings. The fault ride-through function must be enabled with the parameter *126.01 FRT enable* to have grid support.

Note! Settings are preset according to the country code.

Triggering grid support

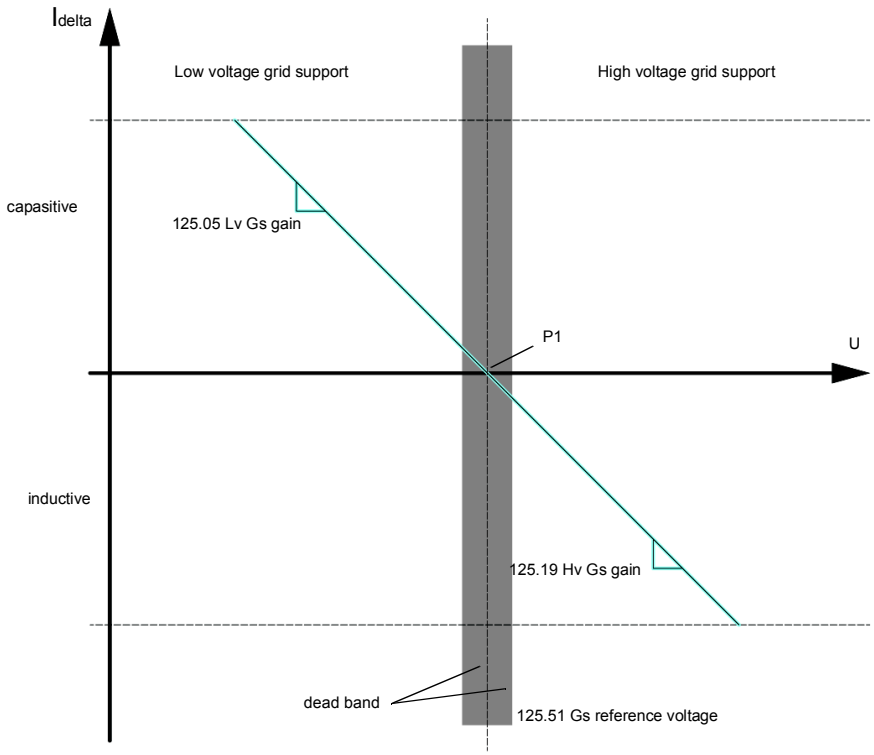
In general, grid support is activated when the voltage drops below the lower trigger level *125.04 Lv Gs trig U %* or rises above the higher trigger level *125.18 Hv Gs trig U %*. The actual voltage that is compared against the trigger level can be selected separately for symmetric and asymmetric faults with the parameters *125.02 Gs symm sig* and *125.03 Gs asymm sig*, respectively. The asymmetry limit is set with the parameter *126.06 Asymm/symm limit* as a ratio of negative and positive sequence grid voltage.

Trigger voltages are relative to a reference voltage which is set to either the nominal voltage or to a 60 second average (that is, pre-fault) voltage. Reference voltage is selected with the parameter *125.51 Gs reference voltage*. If **Nominal voltage** is selected, then the selected actual voltage is compared against the nominal value. However, a typical no-fault voltage can vary from a connection point to another. This can be taken into account by setting the reference voltage to **60 s average**. The averaged voltage is selected with the parameter *125.52 Gs average voltage* and that value is used as a reference voltage. In practice this means that if the pre-fault voltage is 110 % and the trigger is set to 90 %, grid support is triggered at 100 % of nominal.

Grid support current

During a grid fault, the injected reactive current comprises of a base part, I-base, and an additional grid support part, I-delta. The base part can either be zero or equal to a pre-dip value that is calculated as a 60 second average of the actual reactive current. The base part can be configured with the parameter *125.50 Gs base current*. Grid support current I-delta depends on the difference between the above-mentioned reference voltage and the selected actual voltage.

In the figure below, the reference voltage is shown as a dotted vertical line. The actual voltage is compared against this reference line. The mapping of voltage difference depends on the selected support mode. Grid support is active as long as the selected voltage stays outside the dead band and additionally after a dip for a time defined with the parameter *125.36 Gs after dip time*. Total current during grid fault can be limited with the parameter *125.32 Frt Imax %*. There are also ramp times for active current and reactive current that are used during grid fault, for example, the parameter *125.28 Frt Ireact ref ramp up* defines how fast reactive current is ramped up when the voltage drops.



Support modes

Grid support mode is selected with the parameter *125.01 Gs mode*. It defines how the measured voltage value is converted into a reactive current reference. Four conversion modes can be defined/selected.

- If the selected mode is **Disabled**, FRT grid support is not active. Instead, the inverter follows the reactive power settings defined with the parameter group *124 Q ref*. For example, the CosPhi(P) can be active.
- In **Mode 0**, the I-delta is set to zero and the base current I-base is defined with the parameter *125.50 Gs base current*. In this case, the same base current value is used during the whole FRT event.
- **Mode 1** is the "k-factor" mode. The amount of grid support is defined with the starting point P1 and the grid support gains as described in the figure above. There are separate gains for low voltage and high voltage ride-through grid support. These are set in *125.05 Lv Gs gain* and *125.19 Hv Gs gain*, respectively. Point P1 is defined with voltage and current settings with the parameters *125.06 Lv Gs P1 volt %*,*125.07 Lv Gs P1 cur %*, *125.20 Hv Gs P1 volt %* and *125.21 Hv Gs P1 cur %*. Note that point P1 can be different for low voltage and high voltage grid support. With P1, an offset can be added to the grid support current.
- **Mode 2** should be used when piecewise linear grid support current is needed. The mode uses five points on the low voltage side and three points on the high voltage side to map the voltage into the grid support current references. The areas between the points are interpolated.

Active power reserve

To have limited control over the DC input voltage also during the grid faults when reactive power has higher priority, a small amount of current can be reserved for active power. This reserve power is defined with the parameter *125.53 Gs active power reserve* and the maximum reserve current with the parameter *125.54 Gs max reserve current*.

Settings

Parameter groups: *125 FRT support curve*, *126 FRT tripping curve*

Diagnostics

Parameter groups: *130 Limits*, *188 Grid monitoring*

String monitoring

In -SX inverter model each individual string current is measured. This information is used to detect reverse string current, blown fuses and it can also be used to detect current deviation in the measured strings. Reverse total input current is detected also in the standard and -S models.

Reverse input current detection

If reverse current is detected in the total input current, a fault is activated after a short delay. The threshold value is initially set with the parameter *174.31 Reverse input current limit* so that the inverter recognizes the reverse current. Reverse input current detection is enabled with the parameter *174.30 Reverse input current detection*. By default it is enabled.

Settings

174.30 Reverse input current detection

174.31 Reverse input current limit

174.32 Reverse input current delay

101.30 Input current

Reverse string current detection (-SX model)

If reverse current is detected in one of the connected strings, a warning is activated. Threshold value is initially set so that it recognizes the reverse current direction with the parameter *174.13 Reverse string current limit*. Reverse current detection is enabled with the parameter *174.12 Reverse string current detection*.

Settings

174.12 Reverse string current detection

174.13 Reverse string current limit

174.35 Reverse string current threshold

174.36 Reverse string current delay

174.50 Current: [1] -- *174.57 Current: [8]*

Blown fuse detection (-SX model)

In the -SX model a warning is shown to the user in case of blown fuse. Blown fuse detection is enabled with the parameter *174.22 Blown fuse detection*. Blown fuse is detected if the string current is around 0.0 A in an activated string and the average string current is over *174.22 Blown fuse detection*.

Settings

174.11 Input connection status

174.22 Blown fuse detection

174.23 Blown fuse tolerance

174.24 Blown fuse active boundary

174.50 Current: [1] -- *174.57 Current: [8]*

String current deviation detection (-SX model)

A faulty string, for example, due to high amount of shadowing or obstacles can be detected if the current in one string deviates significantly from other strings. The feature can be enabled with the parameter *174.14 String current detection* and it has several configuration parameters.

Inverter can be configured to use either relative or absolute comparison between string currents with the parameter *174.16 Comparison mode*. If there is major difference, a warning is activated after a delay which is set in the parameter *174.15 String monitor delay*. The value that the individual currents are compared against is the reference value of which type is defined in the parameter *174.17 Reference type*. The reference value can be selected to be either the maximum or the mean value of the connected strings.

In absolute mode, individual string currents are compared against the reference value in amperes. If the difference is greater than the value set in the parameter *174.19 Absolute current limit* in amperes, warning is triggered after the delay.

In relative comparison mode, individual string currents are compared against the reference value in percent. The limit is defined in the parameter *174.18 Relative current limit*. If a string current is that much more or less than the reference value, a warning is triggered after the delay. In addition, the reference value must be more than defined in the parameter *174.20 Relative threshold* to void nuisance warnings at very low currents.

Settings

174.11 Input connection status

174.14 String current detection

174.15 String monitor delay

174.16 Comparison mode

174.17 Reference type

174.18 Relative current limit

174.19 Absolute current limit

174.20 Relative threshold

174.50 Current: [1] -- *174.57 Current: [8]*

Autoreset

The autoreset function automatically resets the following faults the inverter generates due to special ambient conditions:

- Overcurrent fault, fault code 11776
- DC protection fault, fault code 37190
- Isolation fault, fault code 37191

The autoreset function can be configured to perform a number of fault reset trials. Also the time delay between the trials can be configured. During the time delay an autoreset warning is shown to inform the user about the coming automatic fault reset.

There are separate settings for each autoresettable fault. With the settings, the inverter can be configured to perform a reasonable amount of automatic fault resets. For example, if the isolation fault is caused by significant moisture in the solar panels in the morning, there is no point trying to restart the inverter every minute, but wait until the solar panels have been dried up. The internal counter of automatic fault resets is cleared when the inverter has been connected to the grid for at least 10 seconds. If the number of trials has been used up and the root cause still exists, the fault remains active.

Settings

132.03 Overcurrent trials

132.04 Overcurrent reset delay

132.05 DC protection trials

132.06 DC protection reset delay

132.07 Ground impedance trials

132.08 Ground impedance reset delay

Diagnostics

132.01 Autoreset counter

Autoreset warning, warning code 57652

Fault history

The inverter fault history can be accessed from the **Events** menu or from the parameters in the group *104 Warnings and faults*. In the **Events** menu, the active faults and warnings are shown in their own submenus. All faults are shown in one submenu. Warnings and other events are shown in the other submenu. Other events include, for example, all fault resets.

Fault and warning codes can be read through the fieldbus interface. For more information, see chapter *Fieldbus interfaces*.

Clearing of the fault history is done with the parameter *196.51 Clear fault and event logger*. This empties the event and fault logs.

Temperature control

The thermal model of the inverter controls the cooling of the inverter as well as protects it. The thermal model controls the operation and speed of the cooling fans and limits the output current, if needed. Overtemperature warning is issued if the inverter temperature has exceeded the limit and current limitation has been activated. If the temperature of the inverter continues to increase, a fault is triggered and the inverter disconnects. The fault has to be reset manually.

Diagnostics

130.04 Limit word 4: bit3 CB temperature, bit4 inverter temperature, bit5 filter temperature

173.06 Internal fan speed

173.07 External fan 1 speed

173.08 External fan 2 speed

173.23 Control board temperature

173.24 Inverter temperature A

Fan service

The inverter has three fans that run on a need basis depending on the temperature inside the inverter. The fan speed is variable and controlled by the software. The lifetime of the fans depends on the installation and the inverter internal temperature. The typical replacement time for the fans is eight years.

The inverter shows a warning to the user when the fan run time counter is near the calculated life time. After the run time counter warning, the inverter and fans continue their normal operation, but the fans must be replaced with new ones to guarantee the optimal operation of the inverter.

The inverter shows a warning to the user if the fans are not running when they should be. In that case the inverter continues operation but it might limit the output power or suffer overtemperature trips.

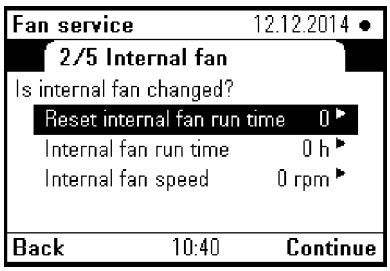
Resetting fan run time counters

PRO-33.0-TL Product manual (3AUA0000123261 [English]) describes how to replace the fans. Note that the inverter has to be stopped and disconnected from the grid when the fans are being replaced.

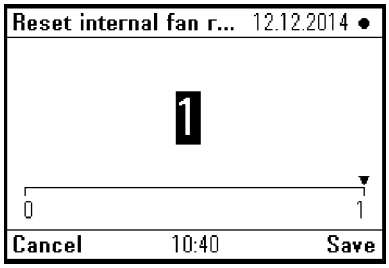
After replacing the fans, reset the fan run time counters according to procedure described below. Do not reset the counters after only cleaning the fans.

1. Enter the **Service** menu, select **Assistants** and **Fan Service**.
2. Fan service assistant info is shown. Press **Continue** to proceed.

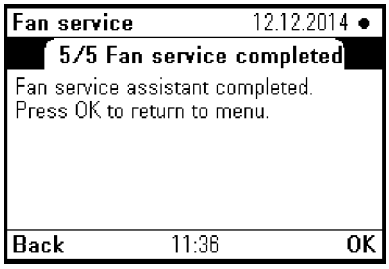
3. Change between different fans (Internal fan, External fan 1, External fan 2) menus with **Back** and **Continue**.



4. Reset the counters for the fans that have been changed by pressing the right arrow key and setting the value to **1**. Save the selection.



5. Press the right soft key to confirm that you have completed the Fan service assistant and return to the menu.



Diagnostics

173.03 Internal fan run time

173.04 External fan 1 run time

173.05 External fan 2 run time

173.06 Internal fan speed

173.07 External fan 1 speed

173.07 External fan 2 speed

3

Parameters

Contents of this chapter

The chapter describes the inverter parameters. The parameters are either editable or read-only. The editable parameters can be used to change the inverter settings and they are saved periodically to the permanent memory.

The read-only parameters (actual values) can be used to view the inverter status. An actual value is the result of a measurement or calculation by the inverter, or it contains status information.

Terms and abbreviations

Term	Definition
Default	Default value for an editable parameter.
FbEq16b	(In the following table, shown on the same row as the parameter range, or for each selection) 16-bit fieldbus equivalent: The scaling between the value shown on the control unit and the integer used in fieldbus communication when a 16-bit value is selected. A dash (-) indicates that the parameter is not accessible in 16-bit format.
FbEq32b	(In the following table, shown on the same row as the parameter range, or for each selection) 32-bit fieldbus equivalent: The scaling between the value shown on the control unit and the integer used in fieldbus communication when a 32-bit value is selected.
Other	The value is taken from another parameter. Choosing “Other” displays a parameter list in which the user can specify the source parameter.
Other [bit]	The value is taken from a specific bit in another parameter. The source is selected from a parameter list.

Parameter listing

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
101 Actual values			
101.01	DC voltage	Measured DC link voltage.	-
	0 … 2 000 V		10 = 1 V / 100 = 1 V
101.02	Line current	Calculated line current.	-/R
	0 … 100 A		10 = 1 A / 100 = 1 A
101.03	Line current %	Calculated line current in percent of the nominal current.	-
	0 … 200 %		1 = 1 % / 10 = 1 %
101.04	Active current	Calculated active current.	-
	0 … 100		10 = 1 A / 100 = 1 A
101.05	Active current %	Active current in percent of the nominal current.	-
	0 … 200 %		1 = 1 % / 10 = 1 %
101.06	Reactive current	Calculated reactive current.	-
	-100 … 100		10 = 1 A / 100 = 1 A
101.07	Reactive current %	Reactive current in percent of the nominal current.	-
	-200 … 200 %		1 = 1 % / 10 = 1 %
101.08	Frequency	Measured grid frequency.	-
	0 … 100 Hz		100 = 1 Hz
101.09	Grid voltage	Calculated average line-to-line grid voltage based on voltage measurements.	-
	0 … 2 000 V		1 = 1 V / 100 = 1 V
101.10	Apparent power	Apparent output power of the inverter.	-
	0 … 50		10 = 1 kVA
101.11	Apparent power %	Apparent output power of the inverter in percent of the nominal output power.	-
	0 … 200 %		1 = 1 % / 10 = 1 %
101.12	Power	Calculated output power.	-
	0 … 50		10 = 1 kW
101.13	Power %	Output power in percent of the nominal power.	-
	0 … 200 %		1 = 1 % / 10 = 1 %
101.14	Reactive power	Calculated reactive output power.	-
	-100 … 100		10 = 1

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
101.15	Reactive power %	Calculated reactive output power in percent of the nominal power.	-
	-200 … 200 %		1 = 1 % 10 = 1 %
101.16	CosPhi	Power factor.	-
	-1 … 1		100 = 1
101.20	Converter current	Measured converter current.	-
	0 … 100		10 = 1 A 100 = 1 A
101.21	Converter current %	Measured converter current in percent of the nominal current.	-
	0 … 200 %		1 = 1 % 10 = 1 %
101.30	Input current	Measured input current	-
	0 … 100 A		10 = 1 A 100 = 1 A

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
104 Warnings and faults			
104.01	Tripping fault	Fault which actually caused the inverter to trip, as it arrived at the trip register.	- 1 = 1
104.02	Active fault 2	2nd active fault in the trip register.	- 1 = 1
104.03	Active fault 3	3rd active fault in the trip register.	- 1 = 1
104.04	Active fault 4	4th active fault in the trip register.	- 1 = 1
104.05	Active fault 5	5th active fault in the trip register.	- 1 = 1
104.06	Active warning 1	1st active warning in the warning register.	- 1 = 1
104.07	Active warning 2	2nd active warning in the warning register.	- 1 = 1
104.08	Active warning 3	3rd active warning in the warning register.	- 1 = 1
104.09	Active warning 4	4th active warning in the warning register.	- 1 = 1
104.10	Active warning 5	5th active warning in the warning register.	- 1 = 1
104.11	Latest fault	Latest fault in the trip log store. The trip log store is loaded with the active faults in the order they occur.	- 1 = 1
104.12	2nd latest fault	2nd fault in the trip log store.	- 1 = 1
104.13	3rd latest fault	3rd fault in the trip log store.	- 1 = 1
104.14	4th latest fault	4th fault in the trip log store.	- 1 = 1
104.15	5th latest fault	5th fault in the trip log store.	- 1 = 1
104.16	Latest warning	Latest warning in the warning log store. The warning log store is loaded with the active warnings in the order they occur.	- 1 = 1
104.17	2nd latest warning	2nd warning in the trip log store.	- 1 = 1
104.18	3rd latest warning	3rd warning in the trip log store.	- 1 = 1

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
104.19	4th latest warning	4th warning in the trip log store.	- 1 = 1
104.20	5th latest warning	5th warning in the trip log store.	- 1 = 1

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
107 System info			
107.03	Rating id	Drive rating ID	-
	0 … 65535		1 = 1
107.04	Firmware name	Shows the inverter firmware name.	- / 1 = 1
107.05	Firmware ver	Shows the inverter firmware version.	- / 1 = 1
107.06	Loading package name	Shows the inverter loading package name.	- / 1 = 1
107.07	Loading package version	Shows the inverter loading package version.	- / 1 = 1
107.11	Cpu usage	Shows the CPU usage.	-
	0 … 100 %		1 = 1 %
107.20	LCON HW version	Shows the HW version of the LCON board.	-
	0 … 255		1 = 1
107.21	LUAC HW version	Shows the HW version of the LUAC board.	-
	0 … 255		1 = 1
107.22	LUFU HW version	Shows the HW version of the LUFU board.	-
	0 … 255		1 = 1
107.23	LUPU HW version	Shows the HW version of the LUPU board.	-
	0 … 255		1 = 1
107.30	Product name1	Holds part of the Product Name of the inverter. The Product Name is obtained by concatenating parameters "Product name1" ... "Product name6" into a string. Each parameter contains 4 ASCII characters represented as a 32 decimal number.	0
	-		- / 1 = 1
...	**...**	**...**	**...**
107.36	Product name7	See parameter *107.30 Product name1*	- / 1 = 1
107.40	Product serial number1	Holds part of the serial number of the inverter. The serial number is obtained by concatenating parameters "Product serial number1" ... "Product serial number6" into a string. Each parameter contains 4 ASCII characters represented as a 32 decimal number.	0
	-		- / 1 = 1
...	**...**	**...**	**...**
107.46	Product serial number7	See parameter *107.40 Product serial number1*	0
	-		- / 1 = 1
107.50	CB serial number1	Holds part of the control board serial number of the inverter. The complete serial number is obtained by concatenating all the "CB serial number" parameters into a string. Each parameter contains 4 ASCII characters represented as a 32 decimal number. Characters are arranged from left to right in the 32 bit integer.	0
	-		- / 1 = 1
...	...	...	...
107.56	CB serial number7	See parameter *107.50 CB serial number1*	- / 1 = 1

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
114 Extension I/O module 1			
114.01	Option module 1 type		None
	None		0
	FIO-01		1
	FIO-11		2
114.03	Option module 1 status		No option
	No option	No module detected in the specified slot.	0
	No communication	A module has been detected but cannot be communicated with.	1
	Unknown	The module type is unknown.	2
	FIO-01	An FIO-01 module has been detected and is active.	15
	FIO-11	An FIO-11 module has been detected and is active.	20
114.05	DIO status	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-01 or FIO-11.) Displays the status of the digital input/outputs on the extension module. The activation/ deactivation delays (if any are specified) are ignored. Bit 0 indicates the status of DIO1. **Note**: The number of active bits in this parameter depends on the number of digital input/outputs on the extension module. **Example**: 00001001b = DIO1 and DIO4 are on, remainder are off. This parameter is read-only.	- 1 = 1
114.09	DIO1 configuration	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-01 or FIO-11.) Selects whether DIO1 of the extension module is used as a digital input or output.	Input
	Output	DIO1 is used as a digital output.	0
	Input	DIO1 is used as a digital input.	1
114.11	DIO1 output source	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-01 or FIO-11.) Selects an inverter signal to be connected to digital input/output DIO1 of the extension module when parameter *114.09 DIO1 configuration* is set to Output.	Off
	Off		0
	Always On		1
	Fault	Relay output activation when fault.	2
	No fault	Relay output activation when no fault.	3
	Grid connected	Relay output activation when grid connected.	4
	Grid not connected	Relay output activation when grid not connected.	5
	Power level 20%	Relay output activation when output power level over 20 % of rated power.	6
	Power level 40%	Relay output activation when output power level over 40 % of rated power.	7

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
	Power level 70%	Relay output activation when output power level over 70 % of rated power.	8
114.14	DIO2 configuration	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-01 or FIO-11.) Selects whether DIO2 of the extension module is used as a digital input or output.	Input
	Output	DIO2 is used as a digital output.	0
	Input	DIO2 is used as a digital input.	1
114.16	DIO2 output source	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-01 or FIO-11.) Selects an inverter signal to be connected to digital input/output DIO2 of the extension module when parameter *114.14 DIO2 configuration* is set to Output. For the available selections, see parameter *114.11 DIO1 output source*.	Off
114.19	DIO3 configuration	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-01.) Selects whether DIO3 of the extension module is used as a digital input or output.	No action
	Output	DIO3 is used as a digital output.	0
	Input	DIO3 is used as a digital input.	1
114.21	DIO3 output source	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-01.) Selects an inverter signal to be connected to digital input/output DIO3 of the extension module when parameter *114.19 DIO3 configuration* is set to Output. For the available selections, see parameter *114.11 DIO1 output source*.	Off
114.24	DIO4 configuration	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-01.) Selects whether DIO4 of the extension module is used as a digital input or output.	Input
	Output	DIO4 is used as a digital output.	0
	Input	DIO4 is used as a digital input.	1
114.26	DIO4 output source	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-01.) Selects an inverter signal to be connected to digital input/output DIO4 of the extension module when parameter *114.24 DIO4 configuration* is set to Output. For the available selections, see parameter *114.11 DIO1 output source*.	Off
114.26	AI1 actual value	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-11.) Displays the value of analog input AI1 in mA or V (depending on whether the input is set to current or voltage). This parameter is read-only.	-

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
114.27	AI1 scaled value	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-11.) Displays the value of analog input AI1 after scaling. See parameter *114.35 AI1 scaled at AI1 min*. This parameter is read-only.	-
114.29	AI1 HW switch position	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-11.) Shows the position of the hardware current/voltage selector on the I/O extension module. **Note**: The setting of the current/voltage selector must match the unit selection made in parameter *114.30 AI1 unit selection*.	mA
114.30	AI1 unit selection	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-11.) Selects the unit for readings and settings related to analog input AI1. **Note**: This setting must match the corresponding hardware setting on the I/O extension module (see the manual of the I/O extension module). The hardware setting is shown by parameter *114.29 AI1 HW switch position*.	mA
	mA	milliamperes	0
	V	voltage	1
114.31	RO status	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-01.) Status of relay outputs on the I/O extension module. Example: 00000001b = RO1 is energized, RO2 is de-energized.	-
		Status of relay outputs	1 = 1
114.33	AI1 min	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-11.) Defines the minimum value for analog input AI1.	0.000 mA or V
	-22.000 … 22.000 mA or V	Minimum value of AI1.	1000 = 1 mA or V
114.34	RO1 source	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-01.) Selects an inverter signal to be connected to relay output RO1. For the available selections, see parameter *114.11 DIO1 output source*.	Off
114.34	AI1 max	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-01 or FIO-11.) Defines the maximum value for analog input AI1.	10.000 mA or V
	-22.000 … 22.000 mA or V	Maximum value of AI1.	1000 = 1 mA or V

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
114.35	AI1 scaled at AI1 min	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-11.) Defines the real value that corresponds to the minimum analog input AI1 value defined by parameter *114.33 AI1 min*.	0.0000
	-32768.000 … 32767.000	Real value corresponding to minimum AI1 value.	1 = 1
114.36	AI1 scaled at AI1 max	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-11.) Defines the real value that corresponds to the maximum analog input AI1 value defined by parameter *114.34 AI1 max*. See the drawing at parameter *114.35 AI1 scaled at AI1 min*.	100.000
	-32768.000 … 32767.000	Real value corresponding to maximum AI1 value.	1 = 1
114.37	RO2 source	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-01.) Selects an inverter signal to be connected to relay output RO2. For the available selections, see parameter *114.11 DIO1 output source*.	Off
114.41	AI2 actual value	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-11.) Displays the value of analog input AI2 in mA or V (depending on whether the input is set to current or voltage). This parameter is read-only.	-
	-22.000 … 22.000 mA or V	Value of analog input AI2.	1000 = 1 mA or V
114.42	AI2 scaled value	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-11.) Displays the value of analog input AI2 after scaling. See parameter *114.50 AI2 scaled at AI2 min*. This parameter is read-only.	-
	-32768.000 … 32767.000	Scaled value of analog input AI2.	1 = 1
114.44	AI2 HW switch pos	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-11.) Shows the position of the hardware current/voltage selector on the I/O extension module. **Note**: The setting of the current/voltage selector must match the unit selection made in parameter *114.45 AI2 unit selection*.	-
	V	Volts	2
	mA	Milliamperes	10
114.45	AI2 unit selection	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-11.) Selects the unit for readings and settings related to analog input AI2. **Note**: This setting must match the corresponding hardware setting on the I/O extension module (see the manual of the I/O extension module). The hardware setting is shown by parameter *114.44 AI2 HW switch pos*.	mA

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
	V	Volts	2
	mA	Milliamperes	10
114.48	AI2 min	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-11.) Defines the minimum value for analog input AI2.	0.000 mA or V
	-22.000 .. 22.000 mA or V	Minimum value of AI2.	1000 = 1 mA or V
114.49	AI2 max	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-11.) Defines the maximum value for analog input AI2	10.000 mA or V
	-22.000 … 22.000 mA or V	Maximum value of AI2.	1000 = 1 mA or V
114.50	AI2 scaled at AI2 min	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-11.) Defines the real value that corresponds to the minimum analog input AI2 value defined by parameter *114.48 AI2 min*.	0.000
	-32768.000 … 32767.000	Real value corresponding to minimum AI2 value.	1 = 1
114.51	AI2 scaled at AI2 max	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-11.) Defines the real value that corresponds to the maximum analog input AI2 value defined by parameter *114.49 AI2 max*. See the drawing at parameter *114.50 AI2 scaled at AI2 min*.	100.000
	-32768.000 … 32767.000	Real value corresponding to maximum AI2 value.	1 = 1
114.56	AI3 actual value	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-11.) Displays the value of analog input AI3 in mA or V (depending on whether the input is set to current or voltage). This parameter is read-only.	-
	-22.000 … 22.000 mA or V	Value of analog input AI3.	1000 = 1 mA or V
114.57	AI3 scaled value	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-11.) Displays the value of analog input AI3 after scaling. See parameter *114.65 AI3 scaled at AI3 min*. This parameter is read-only.	-
	-32768.000 … 32767.000	Scaled value of analog input AI3.	1 = 1
114.59	AI3 HW switch position	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-11.) Shows the position of the hardware current/voltage selector on the I/O extension module. **Note**: The setting of the current/voltage selector must match the unit selection made in parameter *114.60 AI3 unit selection*.	-
	V	Volts	2
	mA	Milliamperes	10

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
114.60	AI3 unit selection	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-11.) Selects the unit for readings and settings related to analog input AI3. **Note**: This setting must match the corresponding hardware setting on the I/O extension module (see the manual of the I/O extension module). The hardware setting is shown by parameter *114.59 AI3 HW switch position*.	mA
	V	Volts	2
	mA	Milliamperes	10
114.63	AI3 min	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-11.) Defines the minimum value for analog input AI3.	0.000 mA or V
	-22.000 … 22.000 mA or V	Minimum value of AI3.	1000 = 1 mA or V
114.64	AI3 max	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-11.) Defines the maximum value for analog input AI3.	10
	-22.000 … 22.000 mA or V	Maximum value of AI3.	1000 = 1 mA or V
114.65	AI3 scaled at AI3 min	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-11.) Defines the real value that corresponds to the minimum analog input AI3 value defined by parameter *114.63 AI3 min*.	0.000
	-32768.000 … 32767.000	Real value corresponding to minimum AI3 value.	1 = 1
114.66	AI3 scaled at AI3 max	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-11.) Defines the real value that corresponds to the maximum analog input AI3 value defined by parameter *114.64 AI3 max*. See the drawing at parameter *114.65 AI3 scaled at AI3 min*.	100.000
	-32768.000 … 32767.000	Real value corresponding to maximum AI3 value.	1 = 1
114.76	AO1 actual	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-11.) Displays the value of AO1 in mA. This parameter is read-only.	-
	0.000 ... 22.000 mA	Value of AO1.	1000 = 1 mA
114.77	AO1 source	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-11.) Selects a signal to be connected to analog output AO1.	Zero
	Zero		0
	DC voltage	*101.01 DC voltage*	1
	Line current	*101.02 Line current*	2
	Power	*101.12 Power*	3
	Frequency	*101.08 Frequency*	4

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
	Inverter temperature A	*173.24 Inverter temperature A*	5
	Inverter temperature B	*173.25 Inverter temperature B*	6
	Inverter temperature C	*173.26 Inverter temperature C*	7
114.80	AO1 source min	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-11.) Defines the real value of the signal (selected by parameter *114.77 AO1 source*) that corresponds to the minimum AO1 output value (defined by parameter *114.82 AO1 out at AO1 src min*).	0.0
	-32768.0 … 32767.0	Real signal value corresponding to minimum AO1 output value.	1 = 1
114.81	AO1 source max	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-11.) Defines the real value of the signal (selected by parameter 114.77 AO1 source) that corresponds to the maximum AO1 output value (defined by parameter *114.83 AO1 out at AO1 src max*). See parameter *114.80 AO1 source min*.	100.0
	-32768.0 … 32767.0	Real signal value corresponding to maximum AO1 output value.	1 = 1
114.82	AO1 out at AO1 src min	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-11.) Defines the minimum output value for analog output AO1. See also drawing at parameter *114.80 AO1 source min*.	0.000 mA
	0.000 … 22.000 mA	Minimum AO1 output value.	1000 = 1 mA
114.83	AO1 out at AO1 src max	(Visible when the value of the parameter *114.01 Option module 1 type* is FIO-11.) Defines the maximum output value for analog output AO1. See also drawing at parameter *114.80 AO1 source min*.	10.000 mA
	0.000 … 22.000 mA		1000 = 1 mA

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
124 Q ref			
124.01	User Qref	Writes the reactive reference value. The value unit depends on *124.06 Q power ref type*.	-
	-		1 = 1 / 100 = 1
124.03	Qref 1	Reactive power reference from *124.01 User Qref*.	-
	-		1 = 1/ 100 = 1
124.04	Q ref scale	The scaling value for *124.03 Qref 1*.	1
	-1000 … 1000		1 = 1 / 100 = 1
124.05	Qref 2	The scaled value of *124.03 Qref 1*	-
	-		1 = 1 / 100 = 1
124.06	Q power ref type	Reactive power reference type.	Qref [%]
	Ireact ref [A]		0
	Ireact ref [%]		1
	Qref [kVAr]		2
	Qref [%]		3
	Phi		4
	CosPhi		5
	Q(x) regulation curve		6
124.07	Ireact ref %	Reactive current reference in percent.	-
	-1000 … 1000 %		1 = 1 % / 10 = 1 %
124.08	Ireact ref	Reactive current reference	-
	-		1 = 1 A / 100 = 1 A
124.09	Q pow ref %	Reactive power reference in percents of nominal power.	-
	-1000 … 1000 %		1 = 1 % / 10 = 1 %
124.10	Q pow ref	Reactive power reference in kVArs.	-
	-		1 = 1 / 10 = 1
124.11	Ireact ref max %	Maximum value of reactive current reference in percent.	105 %
	0 … 200 %		1 = 1 % / 10 = 1 %
124.12	Ireact ref min %	Minimum value of reactive current reference in percent.	-105 %
	-200 … 0 %		1 = 1 % / 10 = 1 %
124.13	Ireact ref lim %	Output value of reactive power reference limitation. Limitation based on *124.11 Ireact ref max %* and *124.12 Ireact ref min %* values.	-

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
	-200 … 200 %		1 = 1 % / 10 = 1 %
124.14	Ireact ref ramp up	Reactive current ramp up time in ms.	1000 ms
	0 … 30000 ms		1 = 1 ms
124.15	Ireact ref ramp down	Reactive current ramp down time in ms.	1000 ms
	0 … 30000 ms		1 = 1 ms
124.16	Ireact ref out %	Output value of reactive current reference in percent.	-
	-200 … 200 %		1 = 1 % / 10 = 1 %
124.17	Ireact ref out	Output value of reactive current in amperes.	-
	-		1 = 1 A / 100 = 1 A
124.18	Q pow ref out %	Output value of reactive power reference in percents of nominal power.	-
	-200 … 200 %		1 = 1 % / 10 = 1 %
124.19	Q pow ref out	Output value of reactive power reference in kVArs.	-
	-		1 = 1 / 10 = 1
124.30	Q(x) input signal	Selection of the input signal used in Q(x) regulation curve.	Uac voltage
	Uac voltage	Input: Measured grid voltage Output: Reactive power reference	0
	Power	Input: Actual active power Output: Reactive power reference	1
	Power to cos phi	Input: Actual active power Output: CosPhi	2
124.31	Lock-in level	Must be over lock-in level before Q(x) regulation curve is activated.	20 %
	0 … 200 %		1 = 1 %
124.32	Lock-out level	Must be over lock-out level or reactive power reference is reset to zero until lock-in level is exceeded.	5 %
	0 … 200 %		1 = 1 %
124.33	Q(x) input level 1	Defines the first input value for the Q(x) regulation curve. When the selected input signal reaches this value, reactive power reference is set to the value defined by parameter *124.39 Q(x) output level 1*.	0 %
	-		1 = 1 % / 100 = 1 %
124.34	Q(x) input level 2	2. input value for the Q(x) regulation curve	0 %
	-		1 = 1 % / 100 = 1 %
124.35	Q(x) input level 3	3. input value for the Q(x) regulation curve	0 %

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
	-		1 = 1 % / 100 = 1 %
124.36	Q(x) input level 4	4. input value for the Q(x) regulation curve.	0 %
	-		1 = 1 % / 100 = 1 %
124.37	Q(x) input level 5	5. input value for the Q(x) regulation curve	0 %
	-		1 = 1 % / 100 = 1 %
124.38	Q(x) input level 6	6. input value for the Q(x) regulation curve	0 %
	-		1 = 1 % / 100 = 1 %
124.39	Q(x) output level 1	Defines the first reference output value for the Q(x) regulation curve. When the selected input signal reaches *124.33 Q(x) input level 1*, the reactive power reference is set to the value defined by this parameter.	0
	-		1 = 1 / 100 = 1
124.40	Q(x) output level 2	2. reference value for the Q(x) regulation curve	0
	-		1 = 1 / 100 = 1
124.41	Q(x) output level 3	3. reference value for the Q(x) regulation curve	0
	-		1 = 1 / 100 = 1
124.42	Q(x) output level 4	4. reference value for the Q(x) regulation curve	0
	-		1 = 1 / 100 = 1
124.43	Q(x) output level 5	5. reference value for the Q(x) regulation curve	0
	-		1 = 1 / 100 = 1
124.44	Q(x) output level 6	6. reference value for the Q(x) regulation curve	0
	-		1 = 1 / 100 = 1

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
125 FRT support curve			
125.01	Gs mode	Grid support mode selection.	Disable
	Disable	Grid support is disabled.	0
	Mode 0	Grid support current is set to zero.	1
	Mode 1	Grid support current is defined by starting point (P1) and grid support gains.	2
	Mode 2	Grid support current is defined by curve points.	3
125.02	Gs symm sig	Grid support voltage signal selection of symmetric dip.	Max phase rms voltage
	Max LL rms voltage	Maximum RMS value of line-to-line voltage.	0
	Min LL rms voltage	Minimum RMS value of line-to-line voltage.	1
	Max phase rms voltage	Maximum RMS value of phase voltage.	2
	Min phase rms voltage	Minimum RMS value of phase voltage.	3
	Pos seq voltage	Positive sequence component of voltage.	4
125.03	Gs asymm sig	Grid support voltage signal selection of asymmetric dip.	Max phase rms voltage
	Max LL rms voltage	Maximum RMS value of line-to-line voltage.	0
	Min LL rms voltage	Minimum RMS value of line-to-line voltage.	1
	Max phase rms voltage	Maximum RMS value of phase voltage.	2
	Min phase rms voltage	Minimum RMS value of phase voltage.	3
	Pos seq voltage	Positive sequence component of voltage.	4
125.04	Lv Gs trig U %	Low voltage grid support trigger level.	90 %
	0 … 100 %		1 = 1 %
125.05	Lv Gs gain	Low voltage grid support gain of capacitive reactive current.	1
	0 … 10		100 = 1
125.06	Lv Gs P1 volt %	Low voltage grid support level 1. When the voltage falls below the given level, the grid is supported by feeding capacitive reactive current.	90 %
	0 … 100 %		1 = 1 %
125.07	Lv Gs P1 cur %	Capacitive reactive current for low voltage grid support level 1.	25 %
	0 … 100 %		1 = 1 %
125.08	Lv Gs P2 volt %	Low voltage grid support level 2. When the voltage falls below the given level, the grid is supported by feeding capacitive reactive current.	80 %
	0 … 100 %		1 = 1 %
125.09	Lv Gs P2 cur %	Capacitive reactive current for low voltage grid support level 2.	50 %
	0 … 100 %		1 = 1 %
125.10	Lv Gs P3 volt %	Low voltage grid support level 3. When the voltage falls below the given level, the grid is supported by feeding capacitive reactive current.	60 %
	0 … 100 %		1 = 1 %
125.11	Lv Gs P3 cur %	Capacitive reactive current for low voltage grid support level 3.	80 %

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
	0 … 100 %		1 = 1 %
125.12	Lv Gs P4 volt %	Low voltage grid support level 4. When the voltage falls below the given level, the grid is supported by feeding capacitive reactive current.	25 %
	0 … 100 %		1 = 1 %
125.13	Lv Gs P4 cur %	Capacitive reactive current for low voltage grid support level 4.	100 %
	0 … 100 %		1 = 1 %
125.14	Lv Gs P5 volt %	Low voltage grid support level 5. When the voltage falls below the given level, the grid is supported by feeding capacitive reactive current.	0 %
	0 … 100 %		1 = 1 %
125.15	Lv Gs P5 cur %	Capacitive reactive current for low voltage grid support level 5.	100 %
	0 … 100 %		1 = 1 %
125.18	Hv Gs trig U %	High voltage grid support trigger level.	110 %
	100 … 150 %		1 = 1 %
125.19	Hv Gs gain	High voltage grid support gain of inductive reactive current.	1
	0 … 10		100 = 1
125.20	Hv Gs P1 volt %	High voltage grid support level 1. When the voltage rises above the given level, the grid is supported by feeding inductive reactive current.	110 %
	90 … 150 %		1 = 1 %
125.21	Hv Gs P1 cur %	Inductive reactive current for high voltage grid support level 1.	-10 %
	-100 … 0 %		1 = 1 %
125.22	Hv Gs P2 volt %	High voltage grid support level 2. When the voltage rises above the given level, the grid is supported by feeding inductive reactive current.	125 %
	90 … 150 %		1 = 1 %
125.23	Hv Gs P2 cur %	Inductive reactive current for high voltage grid support level 2.	-30 %
	-100 … 0 %		1 = 1 %
125.24	Hv Gs P3 volt %	High voltage grid support level 3. When the voltage rises above the given level, the grid is supported by feeding inductive reactive current.	150 %
	90 … 150 %		1 = 1 %
125.25	Hv Gs P3 cur %	Inductive reactive current for high voltage grid support level 3.	-50 %
	-100 … 0 %		1 = 1 %
125.28	Frt Ireact ref ramp up	FRT reactive current ramp up time.	10 ms
	0 … 1000 ms		1 = 1 ms
125.29	Frt Ireact ref ramp down	FRT reactive current ramp down time.	10 ms
	0 … 1000 ms		1 = 1 ms

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
125.30	Frt Ipow ref ramp up	FRT active current ramp up time.	10 ms
	0 … 1000 ms		1 = 1 ms
125.31	Frt Ipow ref ramp down	FRT active current ramp down time.	10 ms
	0 … 1000 ms		1 = 1 ms
125.32	Frt Ireact ref %	FRT reactive current reference.	-
	-200 … 200 %		1 = 1 %
125.33	Frt Ireact ref out %	Ramped FRT reactive current reference.	-
	-200 … 200 %		1 = 1 %
125.34	Frt Ipow ref %	FRT active current reference.	-
	-200 … 200 %		1 = 1 %
125.35	Frt Ipow ref out %	Ramped FRT active current reference.	-
	-200 … 200 %		1 = 1 %
125.36	Gs after dip time	Duration after LVRT/HVRT function.	500 ms
	0 … 300000 ms		- / 1 = 1 ms
125.37	Frt Imax %	Total current limit in percentage of nominal current at FRT function.	100 %
	0 … 200 %		1 = 1 %
125.50	Gs base current	Defines the base level for the reactive current calculated by the grid support function.	Zero
	Zero	Base current is zero.	0
	60 s average	Base current is 60 s average of the reactive current	1
125.51	Gs reference voltage	Defines the reference level for the AC voltage for the grid support function.	60 s average
	Nominal voltage	Nominal voltage is used to calculate FRT grid support current.	0
	60 s average	60 s average voltage is used to calculate FRT grid support current. The 60 s average is calculated from voltage defined in Gs average voltage	1
125.52	Gs average voltage	Grid support averaging voltage selection. When the reference voltage is set to 60 s average, this parameter defines which voltage is used to calculate the average voltage.	Pos seq voltage
	Max LL rms voltage	Maximum RMS value of line-to-line voltage.	0
	Min LL rms voltage	Minimum RMS value of line-to-line voltage.	1
	Max phase rms voltage	Maximum RMS value of phase voltage.	2
	Min phase rms voltage	Minimum RMS value of phase voltage.	3
	Pos seq voltage	Positive sequence component of voltage.	4
125.53	Gs active power reserve	Active power reserve in fault ride-through.	5 %
	0 … 100 %		1 = 1 %
125.54	Gs max reserve current	Maximum active current reserve in fault ride-through. Limits the reserve current because scaling between power and current may be complicated when the grid voltage is very low.	10 %
	0 … 100 %		1 = 1 %

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
126 FRT tripping curve			
126.01	FRT enable	Enables the FRT function.	No
	No		0
	Yes		1
126.02	Lv Rt symm sig	Voltage signal selection of low voltage symmetric dip.	Pos seq voltage
	Max LL rms voltage	Maximum RMS value of line-to-line voltage.	0
	Min LL rms voltage	Minimum RMS value of line-to-line voltage.	1
	Max phase rms voltage	Maximum RMS value of phase voltage.	2
	Min phase rms voltage	Minimum RMS value of phase voltage.	3
	Pos seq voltage	Positive sequence component of voltage.	4
126.03	Lv Rt asymm sig	Voltage signal selection of low voltage asymmetric dip.	Pos seq voltage
	Max LL rms voltage	Maximum RMS value of line-to-line voltage.	0
	Min LL rms voltage	Minimum RMS value of line-to-line voltage.	1
	Max phase rms voltage	Maximum RMS value of phase voltage.	2
	Min phase rms voltage	Minimum RMS value of phase voltage.	3
	Pos seq voltage	Positive sequence component of voltage.	4
126.04	Hv Rt symm sig	Voltage signal selection of high voltage symmetric dip.	Max phase rms voltage
	Max LL rms voltage	Maximum RMS value of line-to-line voltage.	0
	Min LL rms voltage	Minimum RMS value of line-to-line voltage.	1
	Max phase rms voltage	Maximum RMS value of phase voltage.	2
	Min phase rms voltage	Minimum RMS value of phase voltage.	3
	Pos seq voltage	Positive sequence component of voltage.	4
126.05	Hv Rt asymm sig	Voltage signal selection of high voltage asymmetric dip.	Max phase rms voltage
	Max LL rms voltage	Maximum RMS value of line-to-line voltage.	0
	Min LL rms voltage	Minimum RMS value of line-to-line voltage.	1
	Max phase rms voltage	Maximum RMS value of phase voltage.	2
	Min phase rms voltage	Minimum RMS value of phase voltage.	3
	Pos seq voltage	Positive sequence component of voltage.	4
126.06	Asymm/symm limit	Asymmetric dip limit. (Uneg_seq/Upos_seq) > limit.	3 %
	0 … 100 %		1 = 1 %
126.10	Lv Rt trig U %	If mains voltage is below trig level, the LVRT function is enabled.	85 %
	0 … 100 %		1 = 1 %
126.11	Lv Rt recover hyst U %	LVRT function recover hysteresis. If mains voltage is above the limit (Lv Rt trig U % + Lv Rt recover hyst U %), LVRT function is disabled.	5 %
	0 … 20 %		1 = 1 %
126.12	Lv Rt sec 1 time	LVRT section 1 duration.	600 ms
	0 … 300000 ms		1 = 1 ms
126.13	Lv Rt sec 2 time	LVRT section 2 duration.	600 ms

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
	0 … 300000 ms		1 = 1 ms
126.14	Lv Rt sec 3 time	LVRT section 3 duration.	600 ms
	0 … 300000 ms		1 = 1 ms
126.15	Lv Rt sec 4 time	LVRT section 4 duration.	600 ms
	0 … 300000 ms		1 = 1 ms
126.16	Lv Rt sec 5 time	LVRT section 5 duration.	600 ms
	0 … 300000 ms		1 = 1 ms
126.18	Lv Rt S1 start U %	Defines the starting voltage level of the section 1.	0 %
	0 … 100 %		1 = 1 %
126.19	Lv Rt S1 end U %	Defines the final voltage level of the section 1.	0 %
	0 … 100 %		1 = 1 %
126.20	Lv Rt S2 start U %	Defines the starting voltage level of the section 2.	0 %
	0 … 100 %		1 = 1 %
126.21	Lv Rt S2 end U %	Defines the final voltage level of the section 2.	20 %
	0 … 100 %		1 = 1 %
126.22	Lv Rt S3 start U %	Defines the starting voltage level of the section 3.	20 %
	0 … 100 %		1 = 1 %
126.23	Lv Rt S3 end U %	Defines the final voltage level of the section 3.	40 %
	0 … 100 %		1 = 1 %
126.24	Lv Rt S4 start U %	Defines the starting voltage level of the section 4.	40 %
	0 … 100 %		1 = 1 %
126.25	Lv Rt S4 end U %	Defines the final voltage level of the section 4.	60 %
	0 … 100 %		1 = 1 %
126.26	Lv Rt S5 start U %	Defines the starting voltage level of the section 5.	60 %
	0 … 100 %		1 = 1 %
126.27	Lv Rt S5 end U %	Defines the final voltage level of the section 5.	80 %
	0 … 100 %		1 = 1 %
126.30	Hv Rt trig U %	If mains voltage is above trig level, HVRT function is enabled.	115 %
	0 … 150 %		1 = 1 %
126.31	Hv Rt recover hyst U %	HVRT function recover hysteresis. If mains voltage is below limit (Hv Rt trig U % - Hv Rt recover hyst U %) HVRT function is disabled.	5 %
	0 … 20 %		1 = 1 %
126.32	Hv Rt sec 1 time	HVRT section 1 duration.	100 ms
	0 … 5000 ms		1 = 1 ms
126.33	Hv Rt sec 2 time	HVRT section 2 duration.	400 ms
	0 … 5000 ms		1 = 1 ms
126.34	Hv Rt sec 3 time	HVRT section 3 duration.	2 000 ms
	0 … 5000 ms		1 = 1 ms
126.37	Hv Rt S1 start U %	Defines the starting voltage level of the section 1.	130 %

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
	0 … 150 %		1 = 1 %
126.38	Hv Rt S1 end U %	Defines the final voltage level of the section 1.	130 %
	0 … 150 %		1 = 1 %
126.39	Hv Rt S2 start U %	Defines the starting voltage level of the section 2.	120 %
	0 … 150 %		1 = 1 %
126.40	Hv Rt S2 end U %	Defines the final voltage level of the section 2.	120 %
	0 … 150 %		1 = 1 %
126.41	Hv Rt S3 start U %	Defines the starting voltage level of the section 3.	115 %
	0 … 150 %		1 = 1 %
126.42	Hv Rt S3 end U %	Defines the final voltage level of the section 3.	115 %
	0 … 150 %		1 = 1 %

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
130 Limits			
130.01	Limit word 1	Shows active power limitation status.	
	Reserved	Reserved	0
	Reserved	Reserved	1
	P max	Maximum power level	2
	P min	Minimum power level	3
	Stop ramp	Stop ramp	4
	Power gradient	Power gradient	5
	Reserved	Reserved	6
	P(f)	P(f) limitation	7
	Grid fault	Power is limited after grid fault.	8
	Connect	Power is limited after connection to grid.	9
	External	External limit is active, *130.75 External power limit*.	10
	FRT recovery	Power is limited after FRT event.	11
	P(U)	P(U) limitation	12
	Flat-top	Flat-top	13
	Reserved	Reserved	14
	Current	Grid current is limiting active power.	15
130.02	Limit word 2	Shows reactive power limitation status.	
	Q ref max	Reactive power reference is being limited by *124.11 Ireact ref max %*.	0
	Q ref min	Reactive power reference is being limited by *124.12 Ireact ref min %*.	1
	Reserved	Reserved	2
	Reserved	Reserved	3
	Reserved	Reserved	4
	Reserved	Reserved	5
	Reserved	Reserved	6
	Reserved	Reserved	7
	Reserved	Reserved	8
	Reserved	Reserved	9
	Reserved	Reserved	10
	Reserved	Reserved	11
	Reserved	Reserved	12
	Reserved	Reserved	13
	Reserved	Reserved	14
	Current	Grid current is limiting reactive power.	15
130.04	Limit word 4	Shows current based limitation status.	
	Reserved	Reserved	0
	Reserved	Reserved	1
	I max	Maximum current	2
	CB temperature	Control board temperature	3
	Inverter temperature	IGBT temperature	4
	Filter temperature	Line filter temperature	5
	Nominal power	Nominal apparent power	6
	Reserved	Reserved	7 ... 15

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
130.62	P(f) limit type	Selects the P(f) limiter type.	Disabled
	Disabled	P(f) limiter is disabled.	0
	Free running	Limit moves both ways along the gradient.	1
	Incremental	Limit only decreases along the gradient until the frequency drops below the corner point	2
130.63	P(f) corner frequency	Sets the starting point for limitation.	50.2 Hz
	40 … 70 Hz		100 = 1 Hz
130.64	P(f) limit gradient	Sets the limit gradient.	40 %/Hz
	0 … 200 %/Hz		10 = 1 %/Hz
130.65	P(f) release frequency	Sets the frequency where the power limit is released and ramping the limit up starts.	50.2 Hz
	40 … 70 Hz		100 = 1 Hz
130.66	P(f) release time	Sets the waiting time before releasing the power limit. The timer is started after the frequency drops below the release frequency.	0 s
	0 … 600 s		1 = 1 s
130.67	P(f) release ramp	Sets the ramp that is used after releasing the power limit.	10 %/min
	0 … 600 %/min		1 = 1 %/min
130.68	P(f) release ramp ref	Sets the P(f) limiter's release ramp reference.	Nominal
	Nominal	Ramp reference is relative to nominal power.	0
	Corner power	Ramp reference is relative to corner power.	1
	Pdelta	Ramp reference is relative to corner power minus release power.	2
130.70	Connect limit type	Sets the active power ramping type after connecting to grid.	Off
	Off	No active power ramping after grid connection.	0
	After grid fault	Power ramping is active only after grid fault.	1
	Always	Power ramping is active always when connecting to grid.	2
130.71	Connect limit ramp	Sets the active power ramp that is used after connecting to grid.	10 %/min
	0 … 600 %/min		1 = 1 %/min
130.72	Grid fault ramp	Sets the ramp that is used in reconnection after grid fault.	10 %/min
	0 … 600 %/min		1 = 1 %/min
130.75	External power limit	Sets the active power limit. Parameter for externally controlled power limit.	200 %
	0 … 200 %		1 = 1 %
130.76	P(U) limiter	Activates P(U) limitation function.	Disable
	Disable		0
	Enable		1
130.77	P(U) trigger level	Sets the voltage level where power limitation is triggered.	110 %
	0 … 200 %		1 = 1 %

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
130.78	P(U) release level	Sets the voltage level where power limitation is released.	110 %
	0 … 200 %		1 = 1 %
130.79	P(U) limit level	Sets the limited power level.	20 %
	0 … 100 %		1 = 1 %
130.80	P(U) limit ramp	Sets the ramp down after power limit triggering.	50 %/min
	0 … 100 %/min		1 = 1 %/min
130.81	P(U) release ramp	Sets the ramp up after power limit release.	20 %/min
	0 … 100 %/min		1 = 1 %/min
130.90	Flat-top limit	Sets the active power limit which cuts the semi-circular operating range to a flat-top range.	200 %
	0 … 200 %		1 = 1 %
130.91	Input current limit	Sets the total input current limit.	58 A
	0 … 100 A		1 = 1 A
130.92	Active power ramping	Enables the active power ramping function.	Disable
	Disable		0
	Enable		1
130.93	Active power ramp	Sets the active power ramp rate.	100 %/min
	0 … 1000 %/min		1 = 1 %/min
130.94	Shut down ramp	Sets the active power ramp that is applied in a controlled shut down.	100 %/s
	0 … 1000 %/s		1 = 1 %/s
130.98	External limit ramp up	Sets the ramp up time for *130.75 External power limit*.	0 ms
	0 … 60 000 ms		1 = 1 ms
130.99	External limit ramp down	Sets the ramp down time for *130.75 External power limit*.	0 ms
	0 … 60 000 ms		1 = 1 ms

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
132 Autoreset			
132.01	Autoreset counter	Shows the number of autoresets. Can be cleared to allow better monitoring.	0
	-		1 = 1
132.03	Overcurrent trials	Sets the number of overcurrent autoreset trials.	5
	0 … 20		1 = 1
132.04	Overcurrent reset delay	Sets the delay for overcurrent autoreset.	10 s
	1 … 3000 s		1 = 1 s
132.05	DC protection trials	Number of DC protection autoreset trials.	3
	0 … 20		1 = 1
132.06	DC protection reset delay	Sets the delay for DC protection autoreset.	10 s
	1 … 3000 s		1 = 1 s
132.07	Ground impedance trials	Sets the number of ground impedance autoreset trials.	50
	0 … 100		1 = 1
132.08	Ground impedance reset delay	Sets the delay for ground impedance autoreset.	900 s
	1 … 7200 s		1 = 1 s

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
149 Control unit communication			
149.01	Node ID	Unique node identification in the communication network. The default value is 1.	2
	1 … 32		1 = 1
149.03	Baud rate	Maximum communication baud rate for the drive. Reliability of the communication may require lower setting, depending of the electrical characteristics of the wiring.	115.2 kbps
	9.6 kbps		0
	38.4 kbps		1
	57.6 kbps		2
	86.4 kbps		3
	115.2 kbps		4
	230.4 kbps		5
	460.8 kbps		6
	921.6 kbps		7
149.06	Refresh settings	Applies the settings from parameters *149.01* and *149.03*. **Note**: May cause a communication break, thus reconnection is required.	Done
	Done		0
	Configure		1

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
150 FBA			
150.01	FBA A Enable	Enables communication between the inverter and fieldbus adapter.	Disable
	Disable		0
	Option slot 2		1

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
151 FBA A settings			
151.01	FBA type	Displays the type of the connected fieldbus adapter.	None
	None		0
	Ethernet	Shown when FENA-11/21 is connected.	4
	RS-485 comm	Shown when FSCA-01 is connected.	8
151.32	FBA comm SW ver	Displays the patch and build versions of the adapter module firmware.	-

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
152 FBA A data in			
152.01	FBA data in1	Selects data to be transferred from inverter to fieldbus controller through fieldbus adapter A.	None
	None		0
	CW 16bit	Currently not in use.	1
	Ref1 16bit	Currently not in use.	2
	Ref2 16bit	Currently not in use.	3
	SW 16bit	Currently not in use.	4
	Act1 16bit	Currently not in use.	5
	Act2 16bit	Currently not in use.	6
	CW 32bit	Currently not in use.	7
	Ref1 32bit	Currently not in use.	8
	Ref2 32bit	Currently not in use.	9
	SW 32bit	Currently not in use.	10
	Act1 32bit	Currently not in use.	11
	Act2 32bit	Currently not in use.	12
	CW2 16bit	Currently not in use.	13
	SW2 16bit	Currently not in use.	14
	Other	Source selection (see *Terms and abbreviations* on page *39*.)	
...	...	...	...
152.12	FBA data in12	See parameter *152.01 FBA data in1*	None

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
153 FBA A data out			
153.01	FBA data out1	Selects data to be transferred from the fieldbus controller to the inverter through fieldbus adapter A.	None
	None		0
	CW 16bit	Currently not in use.	1
	Ref1 16bit	Currently not in use.	2
	Ref2 16bit	Currently not in use.	3
	CW 32bit	Currently not in use.	4
	Ref1 32bit	Currently not in use.	5
	Ref2 32bit	Currently not in use.	6
	CW2 16bit	Currently not in use.	7
	Other	Source selection (see *Terms and abbreviations* on page *39*.)	
...	...	...	...
153.12	FBA data out12	See parameter *153.01 FBA data out1*	None

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
158 Embedded fieldbus			
158.01	Protocol enable	Enables / disables the EFB communication protocol.	Modbus RTU
	None		0
	Modbus RTU		1
158.02	Protocol ID	Contains the protocol ID and revision. First 4 bits specify the protocol ID, last 12 bits specify the revision.	-
158.03	Node address	Defines the address for the device on the RS485 bus. Also called Station ID, MAC Address, or Device Address. Changes to this parameter take effect when settings are refreshed or power is cycled on the device.	0
	0 ... 255		1 = 1
158.04	Baud rate	Defines the communication speed of the RS485 bus. Changes to this parameter take effect when settings are refreshed or power is cycled on the device.	19.2 kbps
	Autodetect	Automatic baud rate detection.	0
	9.6 kbps	Force baud rate to 9 600 bps.	1
	19.2 kbps	Force baud rate to 19 200 bps.	2
	38.4 kbps	Force baud rate to 38 400 bps.	3
	57.6 kbps	Force baud rate to 57 600 bps.	4
	76.8 kbps	Force baud rate to 76 800 bps.	5
	115.2 kbps	Force baud rate to 115 200 bps.	6
158.05	Parity	Defines the character framing (bits per character, start/stop bits, parity) for the RS485 bus. Changes to this parameter take effect when settings are refreshed or power is cycled on the device.	8 EVEN 1
	8 NONE 1	No parity. One stop bit.	0
	8 NONE 2	No parity. Two stop bits.	1
	8 EVEN 1	Even parity. One stop bit.	2
	8 ODD 1	Odd parity. One stop bit.	3
158.06	Comm control	Restarts the EFB to activate changes in configuration parameters or forces the EFB to silent mode.	Enabled
	Enabled		0
	Refresh Settings	Restart the EFB to active changes in configuration parameters.	1
	Silent Mode	Force the EFB to Silent Mode.	2
158.07	Comm diagnostics	This parameter contains a bit-field of statuses for diagnostics. They can be mapped for control purposes if needed by the application (for example: Comm Loss Timeout).	-
	Init failed	"1 = ""Init failed"" EFB initialization failed 0 = ""-"" No error"	0
	Addr config err	"1 = ""Addr Config Err"" The device address is out of range for the protocol 0 = ""-"" No error"	1

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
	Silent mode	"1 = ""Silent mode"" EFB is in Listen-Only mode. 0 = ""-"" EFB is not restricted from transmitting."	2
	Autobauding	"1 = ""Autobauding"" EFB is trying to determine the baud rate 0 = ""-"" Baud rate is fixed"	3
	Wiring error	"1 = ""Wiring error"" EFB is detecting errors. The B and A comm wires might be swapped. 0 = ""-"" No error"	4
	Parity error	"1 = ""Parity error"" EFB is detecting errors. The Parity or Baud Rate setting might be incorrect. 0 = ""-"" No error"	5
	Baud rate error	"1 = ""Baud rate error"" EFB is detecting errors. The Baud Rate or Parity setting might be incorrect. 0 = ""-"" No error"	6
	No bus activity	"1 = ""No bus activity"" Zero bytes have been received during the last 5 seconds. 0 = ""-"" No error"	7
	No packets	"1 = ""No packets"" Zero packets to any device have been received during the last 5 seconds. 0 = ""-"" No error"	8
	Noise or addressing error	"1 = ""Noise or Addr Err"" EFB is detecting errors. Noise or a duplicate address might be present on the bus. 0 = ""-"" No error"	9
	Comm loss	"1 = ""Comm loss"" Zero packets (of any type) have been addressed to the device during the configured timeout period. [Equals to ""58.08 Comm loss mode (1) Any message""] 0 = ""-"" No comm loss"	10
	CW/Ref loss	"1 = ""CW/Ref loss"" Zero writes to the control or reference points have occurred during the configured timeout period. [Equals to ""58.08 Comm loss mode (2) Cw / Ref1 / Ref2""] 0 = ""-"" No CW or Ref loss"	11
	Not active	"1 = ""Not active"" EFB is not the active channel. Only used in redundant comms control (see Group 57). 0 = ""-"" Writes are not restricted. EFB is the active channel or the product does not support redundant comms control."	12
	Protocol 1	"1 = ""Refer to protocol documentation"" This bit is used for protocol-dependent statuses. 0 = ""-"" No error"	13
	Protocol 2	"1 = ""Refer to protocol documentation"" This bit is used for protocol-dependent statuses. 0 = ""-"" No error"	14
	Internal error	"1 = ""Internal Err"" There was a problem with the calls to the drive software. 0 = ""-"" No error"	15
158.08	Received packets	Contains a count of valid packets addressed to the drive. During normal operation this number increases constantly.	0
	0 … 4 294 967 295		- / 1 = 1

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
158.09	Transmitted packets	Contains a count of packets transmitted by the drive. During normal operation this number increases constantly.	0
	0 … 4 294 967 295		- / 1 = 1
158.10	All packets	Contains a count of all valid packets to any device on the bus. During normal operation, this number increases constantly. Only writable to zero.	0
	0 … 4 294 967 295		- / 1 = 1
158.11	UART errors	Contains a count of the character errors received by the drive. This is an indicator of a configuration problem on the RS485 bus.	0
	0 … 4 294 967 295		- / 1 = 1
158.12	CRC errors	Contains a count of the messages with a CRC error received by the device. This is an indicator of noise on the RS485 bus.	0
	0 … 4 294 967 295		- / 1 = 1
158.17	Transmit delay	Defines a minimum response delay in addition to any fixed delay imposed by the protocol. Changes to this parameter take effect when settings are refreshed or power is cycled on the device.	0
158.33	Addressing mode	Defines the mapping between parameters and holding registers in the upper Modbus register range (101..65536). Changes to this parameter take effect when settings are refreshed or power is cycled on the device.	7
	Mode 1	(16-bit values, groups 1..255, indexes 1..255) RegisterAddress = 256*ParamGroup + ParamIndex Used when 16-bit parameter access is acceptable. No access to 32-bit parameter values.	1
	Mode 6	(16-bit values, groups 101..199, indexes 1..99) RegisterAddress = 100*(ParamGroup – 100) + ParamIndex Similar to Mode 0, but it is intended to be used in ISU-only devices where the parameter list starts with parameter 101.01. 32-bit parameters can be accessed using the following equation: RegisterAddress = 20000 + 200*(ParamGroup – 100) + 2*ParamIndex (32-bit values, groups 1..99, indexes 101..199)	6
	Mode 7	(32-bit values, groups 128..227, indexes 1..255) RegisterAddress = 512*(ParamGroup – 100) + 2*ParamIndex This mode is similar to Mode 2 and Mode 4, but it is intended for ISU-only devices where the parameter list starts with parameter *101.01*.	7
158.34	Word order	Selects in which order 16-bit registers of 32-bit parameters are transferred. Changes to this parameter take effect when settings are refreshed or power is cycled on the device.	LO-HI
	HI-LO	The first register contains the high order word and the second register contains the low order word.	0
	LO-HI	The first register contains the low order word and the second register contains the high order word.	1

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
158.35	Return app error	Specifies whether or not to return exceptions when writes fail at the applications. For example a register is out of range. Changes to this parameter take effect when settings are refreshed or power is cycled on the device.	No
	No	Do not return an error to application-layer errors. Conforms to the modbus protocol spec.	0
	Yes	Return an exception code (03) if an application error occurs, e.g. if the written register is out of range (ACx550 behavior).	1
158.101	Data I/O 1	Selects a parameter that is mapped to a protocol register/point/object. Set by the user for their application.	None
	None	Not used	0
	DC voltage	DC voltage	1
	Line current	Line current	2
	Frequency	Frequency	3
	Apparent power	Apparent power	4
	Power	Power	5
	Reactive power	Reactive power	6
	CosPhi	CosPhi	7
	Input current	Input current	8
	Tripping fault	Tripping fault	9
	Active warning 1	Active warning 1	10
	Active warning 2	Active warning 2	11
	Active warning 3	Active warning 3	12
	Active warning 4	Active warning 4	13
	Active warning 5	Active warning 5	14
	Latest warning	Latest warning	15
	Main status word	Main status word	16
	Cpu usage	Cpu usage	17
	Connection Diagnostic	Connection Diagnostic	18
	Disconnect Diagnostic	Disconnect Diagnostic	19
	Output Power Diagnostic	Output Power Diagnostic	20
	Uptime	Uptime	21
	Operation time	Operation time	22
	Internal fan speed	Internal fan speed	23
	External fan 1 speed	External fan 1 speed	24
	External fan 2 speed	External fan 2 speed	25
	Grid connections	Grid connections	26
	Control board temperature	Control board temperature	27
	Inverter temperature A	Inverter temperature A	28
	Inverter temperature B	Inverter temperature B	29
	Inverter temperature C	Inverter temperature C	30
	Current: [1]	Current: [1]	31
	Current: [2]	Current: [2]	32
	Current: [3]	Current: [3]	33
	Current: [4]	Current: [4]	34
	Current: [5]	Current: [5]	35

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
	Current: [6]	Current: [6]	36
	Current: [7]	Current: [7]	37
	Current: [8]	Current: [8]	38
	Total Energy	Total Energy	39
	Phase voltage U1	Phase voltage U1	40
	Phase voltage V1	Phase voltage V1	41
	Phase voltage W1	Phase voltage W1	42
	Main voltage U1-V1	Main voltage U1-V1	43
	Main voltage V1-W1	Main voltage V1-W1	44
	Main voltage W1-U1	Main voltage W1-U1	45
...	...	...	...
158.169	Data I/O 69	See parameter *158.101 Data I/O 1*	None

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
172 Connection diagnostics			
172.01	Connection status	Shows the connection status of the inverter.	- 1 = 1
	0 Connected	Connected to the grid.	
	1400 Regulatory delay	Waiting for a regulatory delay to expire.	
	1300 Grid synchronization	Synchronizing to the grid.	
	1200 Connection tests	Performing connection tests.	
	1100 Grid unstable	Grid is not within country code dependent limits.	
	1000 Power-up tests	Performing power-up tests.	
	800 DC undervoltage	DC voltage is too low.	
	500 Active fault	A fault is active.	
	300 Start inhibit active	Start inhibit has been requested by firmware upgrade process.	
	200 Country code not set	Country code has not been set.	
	100 Inverter disabled	Inverter operation is disabled. See parameter *189.01 Inverter operation*.	
	1500 Other	If none of the other reasons is valid, this value is shown.	
	1150 External trip signal	External signal tripped. See parameter *188.16 External trip*.	
	820 DC overvoltage	DC voltage is too high.	
172.02	Disconnect diagnostic	Shows the reason for last disconnection. Reverts to value No disconnection when inverter connects back to grid.	- 1=1
	100 Inverter disabled	Inverter operation disabled.	
	300 DC undervoltage	DC voltage too low.	
	600 Faulted	Fault activated.	
	700 No disconnection	Inverter is connected to the grid or has not performed disconnection.	
	410 Grid overvoltage	Grid voltage too high.	
	420 Grid undervoltage	Grid voltage too low.	
	430 Grid overfrequency	Grid frequency too high.	
	440 Grid underfrequency	Grid frequency too low.	
	444 Anti-islanding	Anti-islanding.	
	445 Rate of change of freq	Rate of change of frequency has tripped.	
	460 External signal	External signal tripped. See parameter *188.16 External trip*.	
	470 No grid	No zero crossings in grid voltage.	
	450 Combinatory limit	Combinatory limit has tripped.	
	480 Low voltage ride through	Low voltage ride-through trip.	
	490 High voltage ride through	High voltage ride-through trip.	

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
	320 DC overvoltage	DC voltage too high.	
172.03	Output power diagnostic	Shows the status of energy generation.	- 1 = 1
	50 MPPT tracking	System delivers power based upon MPPT.	
	100 DC voltage ref	Inverter uses constant DC voltage reference. Inverter's MPPT is not used.	
	200 Min DC voltage	MPPT has reached the minimum DC voltage level. System delivers power at the rate necessary to maintain DC input voltage within the operating range.	
	300 At power	System delivers power according to the selected power reference.	
	800 Disconnected	Inverter is disconnected.	
	0 Other	If none of the other reasons is valid, this value is shown.	
	220 Max DC Voltage	MPPT has reached the maximum DC voltage level. System delivers power at the rate necessary to maintain DC input voltage within the operating range.	
	500 Active power limited	Inverter limits active power. See parameter *130.01 Limit word 1*.	
172.04	Connection 1 date	Latest connection date.	-
172.05	Connection 1 time	Latest connection time.	-
172.06	Connection 2 date	2nd latest connection date.	-
172.07	Connection 2 time	2nd latest connection time.	-
172.08	Connection 3 date	3rd latest connection date.	-
172.09	Connection 3 time	3rd latest connection time.	-
172.10	Connection 4 date	4th latest connection date.	-
172.11	Connection 4 time	4th latest connection time.	-
172.12	Connection 5 date	5th latest connection date.	-
172.13	Connection 5 time	5th latest connection time.	-
172.20	Grid monitoring SW1	Status word 1 of the grid monitoring.	-
172.21	Grid monitoring SW2	Status word 2 of the grid monitoring.	-
172.22	Grid monitoring SW3	Status word 3 of the grid monitoring.	-

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
173 Inverter diagnostics			
173.01	Uptime	Shows inverter uptime counter.	-
	0 … 4294967295 h		- / 1 = 1 h
173.02	Operation time	Shows inverter operation time.	-
	0 … 4294967295 h		1 = 1 h
173.03	Internal fan run time	Shows the run time of internal fan.	0 h
	0 … 4294967295 h		- / 1 = 1 h
173.04	External fan 1 run time	Shows the run time of external fan 1.	0 h
	0 … 4294967295 h		- / 1 = 1 h
173.05	External fan 2 run time	Shows the run time of external fan 2.	0 h
	0 … 4294967295 h		- / 1 = 1 h
173.06	Internal fan speed	The RPM the stirring fan is running at the moment.	0 rpm
	0 … 10 000 rpm		1 = 1 rpm
173.07	External fan 1 speed	The RPM the cooling fan is running at the moment.	0 rpm
	0 … 10 000 rpm		1 = 1 rpm
173.08	External fan 2 speed	The RPM the cooling fan is running at the moment.	0 rpm
	0 … 10 000 rpm		1 = 1 rpm
173.18	Power-up tests	Shows the number of power-ups.	0
	0 … 4294967295		- / 1 = 1
173.19	Connection tests	Shows the number of grid connection tests.	0
	0 … 4294967295		- / 1 = 1
173.20	Grid connections	Shows amount of grid connections.	0
	0 … 4294967295		- / 1 = 1
173.21	Ground impedance Zn	Shows the measured impedance from negative pole to ground.	0 MOhm
	-1000 … 1000 MOhm		- / 1000 = 1 MOhm
173.22	Ground impedance Zp	Shows the measured impedance from positive pole to ground.	0 MOhm
	-1000 … 1000 MOhm		- / 1000 = 1 MOhm
173.23	Control board temperature	Control board temperature.	0 °C
	-80 … 150 °C		1 = 1 °C
173.24	Inverter temperature A	Inverter phase A module temperature.	0 °C
	-80 … 150 °C		1 = 1 °C
173.25	Inverter temperature B	Inverter phase B module temperature.	0 °C
	-80 … 150 °C		1 = 1 °C
173.26	Inverter temperature C	Inverter phase C module temperature.	0 °C
	-80 … 150 °C		1 = 1 °C

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
173.27	Line filter temperature	Line filter temperature.	0 °C
	-80 … 150 °C		1 = 1 °C
173.30	SPD installed	This parameter is automatically set **ON** when a Surge Protection Device has been detected in the system. If SPD is permanently removed from system, this parameter has to be manually set **OFF** to avoid warnings being issued.	No
	No	Do not return an error to application-layer errors. Conforms to Modbus protocol spec.	0
	Yes	Return an exception code (03) if an application error occurs, for example, if the written register is out of range (ACx550 behavior).	1
173.31	Ground impedance parallel	Shows the measured ground impedance.	0 MOhm
	-1000 … 1000 MOhm		- / 1000 = 1 MOhm

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
174 String monitor			
174.02	String monitor action	Selects how the inverter reacts when a deviation is detected in the string currents.	Warning
	No		0
	Warning		1
	Fault		2
174.11	Input connection status	Sets the connection status of each string.	0b00000000
	String 1		0
	String 2		1
	String 3		2
	String 4		3
	String 5		4
	String 6		5
	String 7		6
	String 8		7
	Reserved		8...15
174.12	Reverse string current detection	Enables reverse current detection.	Disable
	Disable		0
	Enable		1
174.13	Reverse string current limit	Sets the reverse current detection limit.	0.3 A
	0 … 0.34 A		100 = 1 A
174.14	String current detection	Enables the string current deviation detection. Requires a fuse board to be installed.	Disable
	Disable		0
	Enable		1
174.15	String monitor delay	Sets the duration how long the current deviation must be above limit before defined action of the string monitor is triggered.	1 min
	0 … 1440 min		1 = 1 min
174.16	Comparison mode	Selects the comparison mode of the string current deviation detection.	Relative
	Absolute	The string current deviation is detected by comparing the difference in amperes.	0
	Relative	The string current deviation is detected by comparing the difference in percents of reference value.	1
174.17	Reference type	Selects the current reference type of the string monitor.	Mean
	Max	The reference is the maximum value.	0
	Mean	The reference is the mean value.	1
174.18	Relative current limit	Sets the relative string current limit: maximum allowed difference in percent between each string and the reference value.	30 %
	0 … 100 %		1 = 1 %

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
174.19	Absolute current limit	Sets the absolute string current limit: maximum allowed difference in amperes between each string and the reference value.	1 A
	0 … 100 A		1 = 1 A / 10 = 1 A
174.20	Relative threshold	Sets the relative string current threshold value. Below this value the relative difference detection is disabled.	1 A
	0 … 100 A		1 = 1 A / 10 = 1 A
174.22	Blown fuse detection	Enables the blown fuse detection. Requires a fuse board to be installed.	Disable
	Disable		0
	Enable		1
174.23	Blown fuse tolerance	Sets blown fuse detection tolerance.	0.5 A
	0 … 100 A		1 = 1 A / 10 = 1 A
174.24	Blown fuse active boundary	Sets the blown fuse detection boundary. If mean current of the corresponding input is below this value, blown fuse detection is not enabled.	1 A
	0 … 100 A		1 = 1 A / 10 = 1 A
174.30	Reverse input current detection	Enables reverse input current detection.	Enable
	Disable		0
	Enable		1
174.31	Reverse input current limit	Sets the reverse input current detection limit.	1 A
	0 … 1.5 A		100 = 1 A
174.32	Reverse input current delay	Sets the duration for how long the reverse input current must be above the limit before indicating a fault.	10 s
	0 … 600 s		1 = 1 s
174.35	Reverse string current threshold	Sets the activation power level in percent of the nominal power for reverse string current detection.	10 %
	0 … 100 %		1 = 1 %
174.36	Reverse string current delay	Sets the duration for how long the reverse string current must be above the limit before indicating a warning. Reverse string current detection is available only in -SX model.	60 s
	0 … 600 s		1 = 1 s
174.50	Current: [1]	Measured current of string 1.	-
	-15 … 15 A		100 = 1 A
174.51	Current: [2]	Measured current of string 2.	-
	-15 … 15 A		100 = 1 A
174.52	Current: [3]	Measured current of string 3.	-
	-15 … 15 A		100 = 1 A

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
174.53	Current: [4]	Measured current of string 4.	-
	-15 … 15 A		100 = 1 A
174.54	Current: [5]	Measured current of string 5.	-
	-15 … 15 A		100 = 1 A
174.55	Current: [6]	Measured current of string 6.	-
	-15 … 15 A		100 = 1 A
174.56	Current: [7]	Measured current of string 7.	-
	-15 … 15 A		100 = 1 A
174.57	Current: [8]	Measured current of string 8.	-
	-15 … 15 A		100 = 1 A

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
178 MPPT settings			
178.01	Tracking method	Sets the inverter MPP tracking method.	Modified P&O
	P&O	Basic P&O	0
	Modified P&O	Modified P&O	1
178.03	Minimum voltage ref	Sets the minimum MPPT voltage reference.	550 V
	0 … 1000 V		1 = 1 V
178.04	Maximum voltage ref	Sets the maximum MPPT voltage reference.	950 V
	0 … 1000 V		1 = 1 V
178.05	Start voltage	Sets the initial voltage for MPPT in percents of measured input voltage before grid connection.	85 %
	0 … 100 %		1 = 1 %
178.06	Step size	Sets the nominal step size.	3 V
	1 … 10 V		10 = 1 V
178.07	Sample time	Sets the sampling time for MPPT in normal operation.	0.5 s
	0.1 … 10 s		10 = 1 s
178.08	Relative ramp time	Sets the relative ramp time for MPPT voltage reference. Relative ramp time defines the time in which new reference is achieved in percents of sample time.	30 %
	0 … 100 %		1 = 1 %
178.09	Low power mode limit	Sets the power level in which the tracking method is changed to basic perturb and observe.	10 %
	0 … 100 %		1 = 1 %
178.12	Zero power level	Sets the power level in percents of nominal output power where MPPT considers power to be 0 % and brings the voltage down. This avoids MPPT from drifting at voltages above the panel open circuit voltage.	1 %
	0 … 10 %		1 = 1 %
178.40	Fast recovery	Sets the inverter to recover power by restoring MPPT operating point after FRT event.	Off
	Off		0
	On		1
178.41	Recovery ramp	Sets the fast recovery ramp. After FRT event voltage reference is ramped down with this rate to the value that was measured before the event.	1000 V/s
	0 … 2 000 V/s		1 = 1 V/s
178.50	MPPT status word	Shows the MPPT status word.	
	MPPT	MPPT is on	0
	Limited mode	Tracking is not active because active power is limited.	1
	Minimum voltage	MPPT reference is at the minimum voltage.	2
	Maximum voltage	MPPT reference is at the maximum voltage.	3
	Reserved	Reserved	4...15

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
178.51	Input power	Shows the input power from all strings that MPPT uses for tracking.	-
	-		100 = 1 kW

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
179 Energy saving			
179.01	CO2 reduction	Shows the reduction in CO2 emissions. This value is calculated by multiplying produced energy by conversion factor.	-
	0 … 2147483 t		1 = 1 t / 1000 = 1 t
179.02	CO2 reduction factor	Sets the conversion factor to calculate CO2 reduction from produced energy.	0.7
	0 … 65500		1 = 1 t / 1000 = 1 t

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
180 Day production			
180.01	Hour 0 energy	Shows the energy produced in one hour during current day.	-
	0 … 655 kWh		1 = 1 kWh / 100 = 1 kWh
...	...	...	...
180.24	Hour 23 energy	See parameter *180.01 Hour 0 energy*	

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
181 Month production			
181.01	Day 1 energy	Shows the energy produced in one day during current month.	-
	0 … 279000 kWh		1 = 1 kWh / 10 = 1 kWh
...	...	...	...
181.31	Day 31 energy	See parameter *181.01 Day 1 energy*	

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
182 Year production			
182.01	Month 1 energy	Shows the energy produced in month during current year.	-
	0 … 279000 kWh		1 = 1 kWh
...	...	...	...
182.12	Month 12 energy	See parameter *182.01 Month 1 energy*	

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
183 24 years production			
183.01	Year 0 energy	Shows the energy produced in one year of all of product lifetime after first start-up.	-
	0 … 279000 kWh		1 = 1 kWh
...	...	...	...
183.24	Year 23 energy	See parameter *183.01 Year 0 energy*	
183.25	Energy counter, resettable	Shows the total produced energy since last reset. Writing 0 resets the counter.	0 kWh
	-		- / 100 = 1 kWh
183.26	Total Energy	Shows the total produced energy.	-
	-		- / 1 = 1 kWh

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
184 Logger setup			
184.01	Startup date	Sets the start-up date. The date needs to be defined as the starting year of Energy logging. Days since 1.1.1980.	0 days
	0 … 43440 days		1 = 1 days
184.02	Last Boot Time, Days	Shows the date saved in power failure to update loggers accordingly in the next power-up. This is the date when the device was shut down.	0 days
	0 … 65500 days		1 = 1 days
184.03	Last Boot Time, Ticks	Shows the time saved in power failure to update energy loggers accordingly in the next power-up.	0
	0 … 864000000		- / 1 = 1

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
185 Calibration measurement			
185.20	Phase A calibration	Used in factory calibration.	230 V
	0 … 500 V		1 = 1 V / 10 = 1 V
185.21	Phase B calibration	Used in factory calibration.	230 V
	0 … 500 V		1 = 1 V / 10 = 1 V
185.22	Phase C calibration	Used in factory calibration.	230 V
	0 … 500 V		1 = 1 V / 10 = 1 V

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
186 Calibration coefficients			
186.20	Phase A corr factor	Sets the phase A calibration factor for grid voltage. Used in factory calibration.	1
	0 … 2		1 = 1 / 10000 = 1
186.21	Phase B corr factor	Sets the phase B calibration factor for grid voltage. Used in factory calibration.	1
	0 … 2		1 = 1 / 10000 = 1
186.22	Phase C corr factor	Sets the phase C calibration factor for grid voltage. Used in factory calibration.	1
	0 … 2		1 = 1 / 10000 = 1

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
188 Grid monitoring			
188.01	Country code	Sets the installation country. Changing this value sets the default and/or mandatory values for all other country parameters. This value is initially set by first start assistant.	0
	0 … 34		1 = 1
188.02	Nominal LL voltage	Sets the nominal line-to-line voltage.	400 V
	-		1 = 1 V
188.03	Nominal phase voltage	Sets the nominal phase voltage.	230 V
	-		1 = 1 V
188.04	Nominal frequency	Sets the nominal grid frequency.	50 Hz
	-		1 = 1 Hz / 10 = 1 Hz
188.05	Refresh	Refreshes the grid monitoring parameter settings.	Done
	Done		0
	Yes		1
188.06	Voltage source	Selects the voltage to be used for checking grid voltage limits.	Main
	Main		0
	Phase		1
188.10	Initial connection delay	Sets the time delay for initial grid connection.	5 s
	-		1 = 1 s
188.11	Reconnection delay	Sets the reconnection time delay.	300 s
	-		1 = 1 s
188.12	Quick disturbance limit	Sets the limit for quick disturbance protection.	0 s
	-		1 = 1 s
188.13	Quick reconnection delay	Sets the quick reconnection time delay.	5 s
	-		1 = 1 s
188.16	External trip	Signals external grid monitoring trip. Inverter is disconnected from the AC grid.	0
	0 … 1		1 = 1
188.19	Zero cross monitor enable	Enables the zero cross detection in grid monitoring.	1
	-		1 = 1
188.20	Connect underfrequency type	Sets the type for connection underfrequency protection.	Disabled
	Disabled		0
	Disconnected		1
	Reconnection		2
188.21	Connect underfrequency limit	Sets the limit that is used only on connecting to the grid. When the inverter is connected, this limit is disabled. See parameter *188.20 Connect underfrequency type*.	-2 Hz

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
	-		1 = 1 Hz / 100 = 1 Hz
188.22	Connect overfrequency type	Sets the type for connection overfrequency protection.	Disabled
	Disabled		0
	Disconnected		1
	Reconnection		2
188.23	Connect overfrequency limit	Sets the limit that is used only on connecting to the grid. When the inverter is connected, this limit is disabled. See parameter *188.22 Connect overfrequency type*.	2 Hz
	-		1 = 1 Hz / 100 = 1 Hz
188.24	Connect undervoltage type	Defines how *188.25 Connect undervoltage limit* behaves. When enabled, connecting to grid is allowed only when the grid voltage is above the limit. When disabled, the limit is not checked.	Disable
	Disable		0
	Enable		1
188.25	Connect undervoltage limit	Sets the limit that is used only when the inverter is not connected. The limit is disabled when the inverter is connected. The purpose is to allow different connect and disconnect limits. See parameter *188.24 Connect undervoltage type*.	80
	-		1 = 1
188.26	Connect overvoltage type	Defines how *188.27 Connect overvoltage limit* behaves. When enabled, connecting to grid is allowed only the when grid voltage is below the limit. When disabled, the limit is not checked.	Disable
	Disable		0
	Enable		1
188.27	Connect overvoltage limit	Sets the limit that is used only when the inverter is not connected. The limit is disabled when the inverter is connected. The purpose is to allow different connect and disconnect limits. See parameter *188.26 Connect overvoltage type*.	120
	-		1 = 1
188.30	Underfrequency enable 1	Enables underfrequency protection.	1
	-		1 = 1
188.31	Underfrequency limit 1	Sets the limit for underfrequency protection.	-1 Hz
	-		1 = 1 Hz / 10 = 1 Hz
188.32	Underfrequency time 1	Sets the trip time for underfrequency protection.	100 ms
	-		1 = 1 ms
188.33	Underfrequency enable 2	Enables underfrequency protection.	1
	-		1 = 1
188.34	Underfrequency limit 2	Sets the limit for underfrequency protection.	-1 Hz

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
	-		1 = 1 Hz / 10 = 1 Hz
188.35	Underfrequency time 2	Sets the trip time for underfrequency protection.	100 ms
	-		1 = 1 ms
188.40	Overfrequency enable 1	Enables overfrequency protection.	1
	-		1 = 1
188.41	Overfrequency limit 1	Sets the limit for overfrequency protection.	1 Hz
	-		1 = 1 Hz / 10 = 1 Hz
188.42	Overfrequency time 1	Sets the trip time for overfrequency protection.	100 ms
	-		1 = 1 ms
188.43	Overfrequency enable 2	Enables overfrequency protection.	1
	-		1 = 1
188.44	Overfrequency limit 2	Sets the limit for overfrequency protection.	1 Hz
	-		1 = 1 Hz / 10 = 1 Hz
188.45	Overfrequency time 2	Sets the trip time for overfrequency protection.	100 ms
	-		1 = 1 ms
188.50	Undervoltage enable 1	Enables undervoltage protection.	1
	-		1 = 1
188.51	Undervoltage limit 1	Sets the limit for undervoltage protection.	80
	-		1 = 1
188.52	Undervoltage time 1	Sets the trip time for undervoltage protection.	100 ms
	-		1 = 1 ms
188.53	Undervoltage enable 2	Enables undervoltage protection.	0
	-		1 = 1
188.54	Undervoltage limit 2	Sets the limit for undervoltage protection.	80
	-		1 = 1
188.55	Undervoltage time 2	Sets the trip time for undervoltage protection.	0 ms
	-		1 = 1 ms
188.63	Overvoltage enable 1	Enables overvoltage protection.	1
	-		1 = 1
188.64	Overvoltage limit 1	Sets the limit for overvoltage protection.	110
	-		1 = 1
188.65	Overvoltage time 1	Sets the trip time for overvoltage protection.	100 ms
	-		1 = 1 ms
188.66	Overvoltage enable 2	Enables overvoltage protection.	0
	-		1 = 1
188.67	Overvoltage limit 2	Sets the limit for overvoltage protection.	120
	-		1 = 1
188.68	Overvoltage time 2	Sets the trip time for overvoltage protection.	0 ms

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
	-		1 = 1 ms
188.69	Overvoltage enable 3	Enables overvoltage protection.	0
	-		1 = 1
188.70	Overvoltage limit 3	Sets the limit for overvoltage protection.	130
	-		1 = 1
188.71	Overvoltage time 3	Sets the trip time for overvoltage protection.	0 ms
	-		1 = 1 ms
188.72	Sliding overvoltage enable	Enables sliding overvoltage protection.	0
	-		1 = 1
188.73	Sliding overvoltage limit	Sets the limit for sliding overvoltage protection.	120
	-		1 = 1
188.74	Sliding overvoltage time	Sets the trip time for sliding overvoltage protection.	100 ms
	-		1 = 1 ms
188.80	Combinatory trip	Enables combinatory protection.	0
	-		1 = 1
188.81	Combinatory trip time	Sets a trip time for combinatory protection.	100 ms
	-		1 = 1 ms
188.84	Comb pos seq voltage limit	Sets the positive sequence voltage limit in percentage of the nominal line-to-line AC voltage for combinatory protection.	130
	-		1 = 1
188.85	Comb neg seq voltage limit	Sets the negative sequence voltage limit in percentage of the nominal line-to-line AC voltage for combinatory protection.	10
	-		1 = 1
188.86	Comb underfrequency limit	Sets the limit for combinatory underfrequency protection.	-5 Hz
	-		1 = 1 Hz / 10 = 1 Hz
188.87	Comb overfrequency limit	Sets the limit for combinatory overfrequency protection.	5 Hz
	-		1 = 1 Hz / 10 = 1 Hz
188.110	Rate of change of freq enable	Enables the rate of change of frequency limit.	0
	-		1 = 1
188.111	Rate of change of freq limit	Sets the rate in which the frequency is allowed to change.	1
	-		1 = 1 Hz / 10 = 1 Hz
188.120	1-phase AI	Enable/disable single phase anti-islanding.	Enable
	Disable		0
	Enable		1

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
188.121	AI injection frequency	Frequency of anti-islanding stimulus pulse.	5 Hz
	5 … 20 Hz		1 = 1 Hz
188.122	AI injection offset	Offset for amplitude of AI stimulus pulse.	1 %
	0 … 100 %		100 = 1 %
188.123	AI injection gain	Gain for amplitude of AI stimulus pulse.	0.04
	0.01 … 1		100 = 1
188.124	AI trip limit	Sets AI trip limit as percentage of the nominal voltage.	0.7 %
	0 … 100 %		100 = 1 %
188.125	AI injection ramp	Sets the ramp time for anti-island injection in percent of nominal in second	250 %/s
	0 … 1000 %/s		1 = 1 %/s

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
189 Inverter control			
189.01	Inverter operation	Enables inverter operation. Inverter does not connect to the grid unless it is enabled. Disabling immediately disconnects the inverter from the AC grid.	0
	0 … 1		1 = 1
189.02	RCMU	Enables ground current sensor fidelity test and ground current monitoring.	1
	0 … 1		1 = 1
189.03	Ground impedance test	Enables ground impedance test. The test is done at power up and before grid connection.	1
	0 … 1		1 = 1
189.04	Grounded delta source	Informs the inverter's ground current measurement feature that the AC grid is corner-grounded.	0
	0 … 1		1 = 1
189.05	Udc stability test	Enables input voltage stability test.	1
	0 … 1		1 = 1
189.06	Grid relay test	Enables grid relay test when inverter connects to AC grid.	1
	0 … 1		1 = 1
189.07	Night mode	Sets the night mode.	Sleep
	Monitor	Inverter stays powered up from AC grid during the night time.	0
	Sleep	Inverter is powered down during the night time. The rise of the DC voltage or control unit interaction wakes up the inverter from sleep.	1
189.10	DC overvoltage warning limit	Defines the input voltage limit in which the overvoltage warning is shown and where inverter disconnects from the AC grid.	1000 V
	0 … 2 000 V		1 = 1 V
189.11	Fault reset	Resets faults	Done
	Done	Done (no action).	0
	Reset	Reset counters to zero.	1
189.13	Ignd redundancy	Enables redundant ground current measurement supervision.	1
	0 … 1		1 = 1
189.14	Ignd redundancy fault level	Sets the fault level for ground current redundancy supervision.	0.03 A
	0 … 0.30 A		1 = 1 A / 100 = 1 A
189.15	Uac redundancy	Enables redundant grid voltage measurement supervision.	1
	0 … 1		1 = 1

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
189.16	Uac redundancy fault level	Sets the fault level for redundant grid voltage supervision in percents of nominal line-to-line grid voltage.	2 %
	0 … 10 %		1 = 1 %
189.20	Disconnection delay	Defines the time limit for disconnection. Active power must be less than disconnecting level for this amount of time for the inverter to disconnect.	30 min
	0 … 180 min		1 = 1 min
189.21	Disconnection power	Defines the power level for inverter to disconnect from grid. See *Program features*.	1 %
	0 … 10 %		10 = 1 %
189.30	Output DC protection	Enables output DC current monitoring and protection.	1
	0 … 1		1 = 1
189.32	DC protection filter	Sets the time constant for the current measurement filter that is used for output DC current protection.	200 ms
	0 … 1000 ms		1 = 1 ms
189.33	DC protection limit	Sets the allowed level of DC component in the measured inverter current.	1 A
	0 … 10 A		1 = 1 A / 100 = 1 A
189.34	DC protection delay	Sets the delay for DC protection.	3
	0 … 20		1 = 1
189.35	DC switch open limit	Sets the level for detecting open DC switch.	0 mA
	0 … 2 000 mA		1 = 1 mA
189.36	DC switch noise level	Sets the noise level in detecting open DC switch.	25 mA
	0 … 2 000 mA		1 = 1 mA
189.37	DC protection filter slow	Sets the time constant for current measurement filter that is used for slow output DC current protection.	1000 ms
	0 … 10 000 ms		1 = 1 ms
189.38	DC protection limit slow	Sets the allowed level of DC component in the measured inverter current. This value is used in slow detection.	0.25 A
	0 … 10 A		1 = 1 A / 1000 = 1 A

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
190 External measurements			
190.01	Phase voltage U1	RMS value of phase voltage U1.	-
	0 … 2 000 V		1 = 1 V / 100 = 1 V
190.02	Phase voltage V1	RMS value of phase voltage V1.	-
	0 … 2 000 V		1 = 1 V / 100 = 1 V
190.03	Phase voltage W1	RMS value of phase voltage W1.	-
	0 … 2 000 V		1 = 1 V / 100 = 1 V
190.04	Phase voltage 1 max	The maximum RMS value of phase voltage 1.	-
	0 … 2 000 V		1 = 1 V / 100 = 1 V
190.05	Phase voltage 1 min	The minimum RMS value of phase voltage 1.	-
	0 … 2 000 V		1 = 1 V / 100 = 1 V
190.06	Main voltage U1-V1	RMS value of line-to-line voltage U1-V1.	-
	0 … 2 000 V		1 = 1 V / 100 = 1 V
190.07	Main voltage V1-W1	RMS value of line-to-line voltage V1-W1.	-
	0 … 2 000 V		1 = 1 V / 100 = 1 V
190.08	Main voltage W1-U1	RMS value of line-to-line voltage W1-U1.	-
	0 … 2 000 V		1 = 1 V / 100 = 1 V
190.09	Main voltage 1 max	The maximum RMS value of line-to-line voltage 1.	-
	0 … 2 000 V		1 = 1 V / 100 = 1 V
190.10	Main voltage 1 min	The minimum RMS value of line-to-line voltage 1.	-
	0 … 2 000 V		1 = 1 V / 100 = 1 V
190.11	Phase voltage 1 pos seq	RMS value of phase voltage 1 positive sequence.	-
	0 … 2 000 V		1 = 1 V / 100 = 1 V
190.12	Phase voltage 1 neg seq	RMS value of phase voltage 1 negative sequence.	-
	0 … 2 000 V		1 = 1 V / 100 = 1 V
190.13	Main voltage 1 pos seq	RMS value of line-to-line voltage 1 positive sequence.	-
	0 … 2 000 V		1 = 1 V / 100 = 1 V
190.14	Main voltage 1 neg seq	RMS value of line-to-line Voltage 1 negative sequence.	-
	0 … 2 000 V		1 = 1 V / 100 = 1 V

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
190.15	Frequency 1	Estimated frequency of the measured voltage 1.	-
	0 … 100 Hz		1 = 1 Hz / 100 = 1 Hz
190.20	Phase voltage U2	RMS value of phase voltage U2.	-
	0 … 2 000 V		1 = 1 V / 100 = 1 V
190.21	Phase voltage V2	RMS value of phase voltage V2.	-
	0 … 2 000 V		1 = 1 V / 100 = 1 V
190.22	Phase voltage W2	RMS value of phase voltage W2.	-
	0 … 2 000 V		1 = 1 V / 100 = 1 V
190.25	Main voltage U2-V2	RMS value of line-to-line voltage U2-V2.	-
	0 … 2 000 V		1 = 1 V / 100 = 1 V
190.26	Main voltage V2-W2	RMS value of line-to-line voltage V2-W2.	-
	0 … 2 000 V		1 = 1 V / 100 = 1 V
190.27	Main voltage W2-U2	RMS value of line-to-line voltage W2-U2.	-
	0 … 2 000 V		1 = 1 V / 100 = 1 V
190.30	Phase voltage 2 pos seq	RMS value of phase voltage 2 positive sequence.	-
	0 … 2 000 V		1 = 1 V / 100 = 1 V
190.31	Phase voltage 2 neg seq	RMS value of phase voltage 2 negative sequence.	-
	0 … 2 000 V		1 = 1 V / 100 = 1 V
190.32	Main voltage 2 pos seq	RMS value of line-to-line voltage 2 positive sequence.	-
	0 … 2 000 V		1 = 1 V / 100 = 1 V
190.33	Main voltage 2 neg seq	RMS value of line-to-line voltage 2 negative sequence.	-
	0 … 2 000 V		1 = 1 V / 100 = 1 V
190.34	Frequency 2	Estimated frequency of the measured voltage 2.	-
	0 … 100 Hz		1 = 1 Hz / 100 = 1 Hz

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
196 System			
196.01	Language	Select language	Not selected
	Not selected	Default value of the parameter. The language has not been selected.	0
	English UK	English (United Kingdom)	2
	Deutsch	German (Germany)	3
	Italiano	Italian (Italy)	4
	Español	Spanish (Spain	5
	Français	French (France)	8
196.02	Passcode	ABB internal use.	-
196.06	Param restore	Restores the original settings of the application, that is, the parameter factory default values.	Done
	Done	Restoring is completed.	0
	Restore defs	All parameter values are restored to default values, except Ext-IO, fieldbus and operation settings.	1
	Clear all	All parameter values are restored to default values.	2
196.07	Param save	Saves the valid parameter values to the permanent memory. **Note**: A new parameter value is saved automatically when changed from the PC tool or panel but not when altered through a fieldbus connection.	Done
	Done		0
	Save		1
196.08	Control board boot	Changing the value of this parameter to 1 reboots the control board. The inverter must first be disabled with the parameter *189.01 Inverter operation*.	-
	0 … 1		1 = 1
196.51	Clear fault and event logger	Changing the value of this parameter to 1 clears the fault and event logger.	-
	0 … 65535		1 = 1

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
202 Fan settings			
202.01	Reset internal fan run time	Resets the run time counter of internal fan.	0
	0 … 1		1 = 1
202.02	Reset external fan 1 run time	Resets the run time counter of external fan 1.	0
	0 … 1		1 = 1
202.03	Reset external fan 2 run time	Resets the run time counter of external fan 2.	0
	0 … 1		1 = 1
202.04	Internal fan life time	Shows the remaining life time of internal fan in hours.	40 880 h
	0 … 999 999 h		- / 1 = 1 h
202.05	External fan 1 life time	Shows the remaining life time of external fan 1 in hours.	43 800 h
	0 … 999 999 h		- / 1 = 1 h
202.06	External fan 2 life time	Shows the remaining life time of external fan 2 in hours.	43 800 h
	0 … 999 999 h		- / 1 = 1 h

No.	Name/Value/Range	Description	Default FbEq (16b/32b)
209 Misc			
209.06	Minimum ground impedance	Sets the fault level for ground impedance.	1 MOhm
	0 ... 10 MOhm		- / 100 = 1 MOhm
209.10	Ext-IO status word	Bits of this parameter indicate the output power.	
	Grid connected	True when connected to the grid.	0
	Power level 20%	True when the output power is over 20 %.	1
	Power level 40%	True when the output power is over 40 %.	2
	Power level 70%	True when the output power is over 70 %.	3
	Reserved		4...15
209.11	Limit priority	Defines whether active or reactive current has priority when current must be limited.	Active current
	Active current	Limits reactive current before active current.	0
	Reactive current	Limits active current before reactive current.	1
209.25	Input current fault level	Sets the input current fault level.	65 A
	0 … 100 A		1 = 1 A

4

Fieldbus interfaces

Contents of this chapter

This chapter describes how the inverter can be connected and controlled or monitored by external devices over a communication network (fieldbus) using fieldbus interfaces.

Overview of embedded fieldbus system

The PRO-33.0-TL inverter has an embedded fieldbus systems as a standard. The embedded fieldbus allows the inverter to communicate with a third party device which uses the Modbus RTU protocol.

Connecting inverter to embedded fieldbus

Connect the fieldbus cable to terminal X2 on the inverter(s). X2 is the connection point for the daisy-chained RS-485 transmission line with one master and multiple slaves. Set the termination resistor switches, S1, so that only the inverter at the end of line is terminated. A connection example and the pin configuration are described in the *PRO-33.0-TL Product manual* (3AUA0000123261 [English]).

Setting up embedded fieldbus interface

Set up the inverter for embedded fieldbus communication from the communication menu or with the parameters in the group *158 Embedded fieldbus*. Modbus RTU is enabled by default. Set a unique node address for each inverter with the parameter *158.03 Node address*. Check also other communication settings including baud rate and parity. The new settings will take effect once refreshed with the parameter *158.06 Comm control*. If the setting of the parameter *158.01 Protocol enable* is changed, the inverter must be rebooted to activate the protocol.

Accessing inverter parameters

PRO-33.0-TL inverter parameters can be accessed in several different ways through the holding registers. Holding registers are 16-bit, read/write values. The table below describes the Modbus holding registers available in the inverter. Registers 0 through 68 are defined in detail in a separate table. Registers 100 through 65535 are defined with the parameter *158.33 Addressing mode*.

Start address	End address	Description
0	68	Data I/O
69	88	Not used
89	99	Modbus error codes
100	65535	Read/write registers

Data I/O registers, 0-68

A preferred way to access the inverter parameters is to use the Data I/O registers which are located in the beginning of the register map as shown in the table on page *108*. The Data I/O registers are configured with the parameters *158.01* – *158.169*.

Error code registers, 89-99

The error code registers can be used if the Modbus error code 0x04 occurs. The registers contain information about the last query. The internal error register is cleared when a query has finished successfully.

Ref	Name (all profiles)	Description
89	Reset Error Registers	Reset internal error registers (registers 91..95). 0 = do nothing 1 = reset
90	Error Function Code	Function code of the failed query
91	Error Code	This error code is set when the device responds with an error code of 4 (Device Failure). • "0x00 - No error • "0x02 - Low/High limit exceeded • "0x03 - Faulty Index - access to an unavailable index of an array parameter • "0x05 - Incorrect Data Type - value does not match the data type of the parameter • "0x65 - General Error - Undefined error when handling a Modbus query
92	Failed Register	The last register that failed to be read or written. This register can be any of the following: discrete input, coil, input register, or holding register.
93	Last Register Written Successfully	The last register that was written successfully. This register can be any of the following: discrete input, coil, input register, or holding register.
94	Last Register Read Successfully	The last register that was read successfully. This register can be any of the following: discrete input, coil, input register, or holding register.
95-99	Not used	

Read/write registers, 100-65535

The inverter parameters can also be accessed through the holding registers with different addressing modes. The addressing modes are described in the table below. The addressing mode is selected with the parameter *158.33 Addressing mode*.

- Mode 7 is active by default. It can always be used. The mode supports 32-bit values but can also be used to read 16-bit parameters. In this case the value is in 32-bit format and master has to be able to handle this.
- Mode 1 must be selected when master can handle only 16-bit values. Some parameters cannot be accessed with this mode.
- Mode 6 supports both 16- and 32-bit parameters but there are limitations in the group and parameter indexes.

Modbus function codes and data models

The various reading, writing and other operations are categorized with function codes in the Modbus protocol. The following table describes the function codes supported by the PRO-33.0-TL inverter.

Addressing mode	
Mode 1	This mode can access the 16-bit value of any parameter in the inverter. (16-bit values, groups 1..255, indexes 1..255) RegisterAddress = 256*ParamGroup + ParamIndex - 1
Mode 6	This mode can access both 16-bit and 32-bit values of parameters. (16-bit values, groups 101..199, indexes 1..99) RegisterAddress = 100*(ParamGroup – 100) + ParamIndex - 1 (32-bit values, groups 101..199, indexes 1..99) RegisterAddress = 20000 + 200*(ParamGroup – 100) + 2*ParamIndex – 1
Mode 7	(32-bit values, groups 101..227, indexes 1..255) RegisterAddress = 512*(ParamGroup – 100) + 2*ParamIndex - 1

The following table describes the supported Modbus function codes.

Function	**Code (hex)**	**Supported Subcodes**
Read Coil Status	0x01	N/A
Read Discrete Input Status	0x02	N/A
Write Single Holding Register	0x06	N/A
Read Multiple Holding Registers	0x03	N/A
Force Single Coil	0x05	N/A

Function	Code (hex)	Supported Subcodes
Diagnostics	0x08	• 0x00 – Query – echo/loopback testing • 0x01 – Restart – restart and initialize the EFB. This is the only command that brings the device out of the listen-only mode. • 0x04 – Force Listen Only • 0x0A – Clear Counters • 0x0B – Read Bus Message Count • 0x0C – Read Bus CRC Error Count • 0x0D – Read Bus Exception Count • 0x0E – Read Slave Message Count • 0x0F – Read Slave No Response Count • 0x10 – Read Slave NACK Count • 0x11 – Read Slave Busy Count • 0x12 – Read Bus Overrun Count • 0x14 – Clear Overrun Counter
Get Comm. Event Counter	0x0B	N/A
Force Multiple Coils	0x0F	N/A
Write Multiple Holding Registers	0x10	N/A
Mask Write Register	0x16	N/A
Read/Write Multiple Holding Registers	0x17	N/A
Encapsulated Interface Transport	0x2B	0x0E – Read Device Identification – Allows reading identification and other information. Supported “Read Device ID Codes” (access type): • 0x00 – Request to get the basic device identification (stream access) • 0x04 – Request to get one specific identification object (individual access) Supported Object IDs: • 0x00 – Vendor Name – “ABB” +”Serial No” + “Sw Version” + “Modbus Protocol ID” • 0x01 – Product Code – “Serial Number” • 0x02 – Major Minor Revision – ” Firmware Version” + ” Modbus Protocol ID” • 0x04 – Product Type “PRO-33.0-TL-OUTD-SX400”

Modbus holding registers

The table below describes the default configuration of the Data I/O registers. This configuration is used by the VSN700 logger. The content of the register is defined with a parameter described in the column parameter. The column 32-bit describes if the register can be read only as a 32-bit value, otherwise the register can be read as a 16-bit value.

Register	Parameter	Parameter name	Description	32-bit
0	*158.101*	Data I/O1	Inverter operation	
1	158.102	Data I/O2	External power limit	

Register	Parameter	Parameter name	Description	32-bit
2	158.103	Data I/O3	User Qref	
3	158.104	Data I/O4	DC voltage	
4	158.105	Data I/O5	Line current	
5	158.106	Data I/O6	Frequency	
6	158.107	Data I/O7	Apparent power	
7	158.108	Data I/O8	Power	
8	158.109	Data I/O9	Reactive power	
9	158.110	Data I/O10	CosPhi	
10	158.111	Data I/O11	Input current	
11	158.112	Data I/O12	Tripping fault	
12	158.113	Data I/O13	Active warning 1	
13	158.114	Data I/O14	Active warning 2	
14	158.115	Data I/O15	Active warning 3	
15	158.116	Data I/O16	Active warning 4	
16	158.117	Data I/O17	Active warning 5	
17	158.118	Data I/O18	Latest warning	
18	158.119	Data I/O19	Main status word	
19	158.120	Data I/O20	Cpu usage	
20	158.121	Data I/O21	Connection Diagnostic	32-bit
21	158.122	Data I/O22	Reserved	
22	158.123	Data I/O23	Disconnect Diagnostic	32-bit
23	158.124	Data I/O24	Reserved	
24	158.125	Data I/O25	Output Power Diagnostic	32-bit
25	158.126	Data I/O26	Reserved	
26	158.127	Data I/O27	Uptime	32-bit
27	158.128	Data I/O28	Reserved	
28	158.129	Data I/O29	Operation time	
29	158.130	Data I/O30	Internal fan speed	
30	158.131	Data I/O31	External fan 1 speed	
31	158.132	Data I/O32	External fan 2 speed	
32	158.133	Data I/O33	Grid connections	32-bit
33	158.134	Data I/O34	Reserved	
34	158.135	Data I/O35	Control board temperature	
35	158.136	Data I/O36	Inverter temperature A	
36	158.137	Data I/O37	Inverter temperature B	

Register	Parameter	Parameter name	Description	32-bit
37	158.138	Data I/O38	Inverter temperature C	
38	158.139	Data I/O39	Current: [1]	
39	158.140	Data I/O40	Current: [2]	
40	158.141	Data I/O41	Current: [3]	
41	158.142	Data I/O42	Current: [4]	
42	158.143	Data I/O43	Current: [5]	
43	158.144	Data I/O44	Current: [6]	
44	158.145	Data I/O45	Current: [7]	
45	158.146	Data I/O46	Current: [8]	
46	158.147	Data I/O47	Total Energy	32-bit
47	158.148	Data I/O48	Reserved	
48	158.149	Data I/O49	Phase voltage U1	
49	158.150	Data I/O50	Phase voltage V1	
50	158.151	Data I/O51	Phase voltage W1	
51	158.152	Data I/O52	Main voltage U1-V1	
52	158.153	Data I/O53	Main voltage V1-W1	
53	158.154	Data I/O54	Main voltage W1-U1	
54	158.155	Data I/O55	Registers 54 – 68 freely configurable	
68	158.169	Data I/O69		

Product name and serial number

The product name and serial number can be read through the Modbus interface. This chapter describes the coding of the name and serial number.

The product name and serial string is obtained by concatenating the complete range of parameters. Each parameter is a 32-bit word holding 4 ASCII characters, one per byte. The ASCII is read from MSB to LSB of the 32-bit parameter.

For example, the parameter *107.30 Product name1* should contain the value:

1347571501 (decimal)

50524F2D (hex)

The four hex bytes translate into ASCII:

- 50 = 'P'
- 52 = 'R'
- 4F = 'O'
- 2D = '-'

that is, PRO-".

Device identification information can also be read with the Modbus function code 0x2B/0x0E. This is described in more detail in chapter *Modbus function codes and data models* on page *107*.

The table below describes the product name and serial number requester mapping when addressing mode 7 is used.

Register	Description
3644	Product Name 1 (ASCII) 4char
3646	Product Name 2 (ASCII) 4char
3648	Product Name 3 (ASCII) 4char
3650	Product Name 4 (ASCII) 4char
3652	Product Name 5 (ASCII) 4char
3654	Product Name 6 (ASCII) 4char
3656	Product Name 7 (ASCII) 4char
3664	Serial number 1 (ASCII) 4char
3666	Serial number 2 (ASCII) 4char
3668	Serial number 3 (ASCII) 4char
3670	Serial number 4 (ASCII) 4char
3672	Serial number 5 (ASCII) 4char
3674	Serial number 6 (ASCII) 4char
3676	Serial number 7 (ASCII) 4char

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3AXD50000015823 Rev A (EN) 2014-12-18

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