

ABB machinery drives

## Firmware manual

### Supplement ACS355 Solar pump inverter (+N827)



# List of related manuals

<b>Drive manuals and guides</b>	<b>Code (English)</b>
<i>ACS355 user's manual</i>	<a href="#">3AUA0000066143</a>
<i>ACS355 drives with IP66/67/UL Type 4x enclosure supplement</i>	<a href="#">3AUA0000066066</a>

You can find manuals and other product documents in PDF format on the Internet. See section [Document library on the Internet](#) on the inside of the back cover. For manuals not available in the Document library, contact your local ABB representative.

# Firmware manual

## ACS355

Supplement  
Solar pump inverter (+N827)

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## 1

# Safety



## About this chapter

This chapter contains safety instructions which you must follow when installing, operating and servicing the ACS355 solar pump inverter. If ignored, physical injury or death may follow, or damage may occur to the drive, motor or driven equipment. Read the safety instructions before you work on the solar pump inverter.

## Use of warnings

Warnings caution you about conditions which can result in serious injury or death and/or damage to the equipment, and advise on how to avoid the danger. The following warning symbols are used in this manual:



**Electricity warning** warns of hazards from electricity which can cause physical injury and/or damage to the equipment.



**General warning** warns about conditions, other than those caused by electricity, which can result in physical injury and/or damage to the equipment.



**WARNING!** Only qualified electricians are allowed to carry out the work described in this chapter.

**Note:**

- Before installing, commissioning or using the inverter, read the safety instructions chapter in the *ACS355 user's manual (3AUA0000066143[English])*.
- Before changing any default settings of a function, read the warnings and notes for specific software function. For each function, the warnings and notes are given in the subsection describing the related user-adjustable parameters.

## Safety instructions

Only qualified electricians are allowed to install and maintain the inverter. Follow the safety instructions listed below. Ignoring the safety instructions can cause injury or death.

- Never work on the photovoltaic generator or inverter and its input/output cables when the inverter is connected to the power system or to the photovoltaic generator.
- Before working inside the inverter cabinet, switch off or isolate the auxiliary voltage supply from the inverter.
  - Isolate the inverter from the photovoltaic generator using the safety switch of the generator or by using the isolation switch.
  - Do not touch the input of the isolation switch that has high DC voltage.
- After disconnecting the inverter from the power system or the DC input supply, wait for at least 5 minutes to discharge the intermediate circuit capacitors.
- Measure with a multimeter to ensure that no voltage is present.
  - Impedance should be at least 1 M $\Omega$ .
  - Voltage should be close to 0 V between inverter phases L1, L2, L3 and frame, and between module terminals Brk+ and Brk-.
- Do not make any insulation or voltage withstand tests on the inverter or on the inverter modules.

**Note:**

- The DC connection terminals Brk+ and Brk- carry a dangerous DC voltage of up to 800V.
- Depending on the external and internal wiring, dangerous voltages of 115 V to 230 V may be present at the different terminals in the auxiliary connection unit.
- The photovoltaic generator cells exposed to light supply DC voltage to the inverter even at a low intensity.





## ■ Grounding

These warnings are intended to personnel responsible for the grounding the inverter.



**WARNING!** Ignoring the following instructions can cause physical injury or death, increased electromagnetic interference and equipment malfunction.

- Ground the inverter and adjoining equipment to ensure personnel safety in all circumstances, and to reduce electromagnetic emission and interference.
- Make sure that grounding conductors are adequately sized as required by safety regulations.
- When shielded cables are used, make a 360° high frequency grounding of cable entries at the cabinet lead-through to suppress electromagnetic disturbances. In addition, connect the cable shields to protective earth (PE) to meet safety regulations.

### Note:

- The power cable shields are suitable for equipment grounding conductors only when adequately sized to meet safety regulations.
- The touch current of the inverter is higher than 3.5 mA AC or 10 mA DC as stated by IEC/EN 62109, 5.2.5. Hence a fixed protective earth connection is required.





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# Introduction

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## About this chapter

This chapter provides an overview of the contents, purpose, compatibility, and the intended audience of this manual. This chapter also includes the quick start steps to operate the ACS355 solar pump inverter.

## Purpose

The ACS355 solar pump inverter is an enhancement of the ACS355 firmware. This ACS355 supplement manual intends to serve as a quick start guide for installing, commissioning and operating the ACS355 solar pump inverter. This manual includes all the required parameter settings and program features specific to the solar pump inverter.

Use this supplement manual along with the *ACS355 User's manual (3AUA0000066143[English])* for general instructions on installation and maintenance.

## Compatibility

You can use this manual with the ACS355 solar pump inverter of both single phase and three phase type.

## Target audience

This manual is intended for personnel who install, commission, operate and service the solar pump inverter. The reader of this manual is expected to know the standard electrical wiring practices, electronic components, and electrical schematic symbols.



## Contents

This manual consists of the following chapters:

- [Safety](#) (page 7) provides an overview of the safety instruction to follow when using the solar pump inverter.
- [Introduction](#) (page 11) provides an overview of this manual.
- [Quick start-up](#) (page 15) provides the basic information about mechanical and electrical installation and also includes instructions to quickly operate the solar pump inverter.
- [Start-up and controls](#) (page 25) provides an overview of the solar pump inverter and describes the inverter controls to operate the solar pump inverter.
- [Program features](#) (page 31) provides an overview of all the solar pump inverter core features such as MPPT function, dual supply mode, dry run function, and so on.
- [Signals and parameters](#) (page 37) describes the user adjustable settings of the required groups for operating the solar pump inverter.
- [Fault tracing](#) (page 57) lists all the alarm and fault messages related to the solar pump inverter and describes the possible cause and corrective actions.

## Related documents

See [List of related manuals](#) on page 2 (inside the front cover).

## Terms and abbreviations

This manual uses the following terms and abbreviations:

Term/Abbreviation	Expansion	Explanation
MPPT	Maximum power point tracking	An algorithm to derive maximum power from PV cells.
PV cells	Photo voltaic cells	An electrical device to convert light energy to electricity.
Def	Default	Parameter default value.
FbEq	Fieldbus equivalent	The scaling between the value and the integer used in serial communication.
Type	Data type	Data type
B	Boolean	Data type boolean
I	Integer	Data type integer
Pb	Packed boolean	Data type packer boolean
R	Real	Data type real
S	String	Data type string
P	Power in kW	Power input to determine flow output on the PQ performance curve

Term/Abbreviation	Expansion	Explanation
Q	Flow rate in m <sup>3</sup> /h	Flow rate to determine the flow output on the PQ performance curve.
E	European	Refers to types 01E- and 03E- with European parameterization. EMC filter connected, 50 Hz frequency.
U	United States	Refers to types 01U- and 03U- with US parameterization. EMC filter disconnected, 60 Hz frequency.
AM	Asynchronous motor	Three-phase AC voltage induction motor with squirrel cage rotor.
PMSM	Permanent magnet synchronous motor	Three-phase AC voltage synchronous motor with permanent magnet rotor and sinusoidal back emf voltage.





# 3

## Quick start-up

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### About this chapter

This chapter includes the basic information about mechanical and electrical installation of ACS355 solar pump inverter. This chapter also provides steps to quickly operate the solar pump inverter.

For general instructions on installation and maintenance of ACS355 Drives, see *ACS355 User's manual (3AUA0000066143[English])*.

### Safety instructions

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**WARNING!** All electrical installation and maintenance work on the inverter must be carried out by qualified electricians only.

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Follow the safety instructions listed below.

- Never work on the inverter, the braking chopper circuit, the motor cable or the motor when input power is applied to the inverter.
- After disconnecting the input power, always wait for 5 minutes to let the intermediate circuit capacitors discharge. Always ensure by measuring that no voltage is actually present.
- A rotating permanent magnet motor generates a dangerous voltage. Always ensure to lock the motor shaft mechanically before connecting a permanent magnet motor to the inverter, and before doing any work on an inverter system connected to a permanent magnet motor.

## Mechanical installation

In back mounting, fasten the inverter to the wall with screws using four mounting holes. In side mounting with frame sizes R0...R2, fasten the inverter to the wall with screws using three mounting holes. The inverter can also be mounted onto a DIN rail.

Fasten the clamping plate to the plate at the bottom of the inverter with the provided screws. For frame sizes R0...R2, fasten the I/O clamping plate to the clamping plate with the provided screws.

### Free space requirements

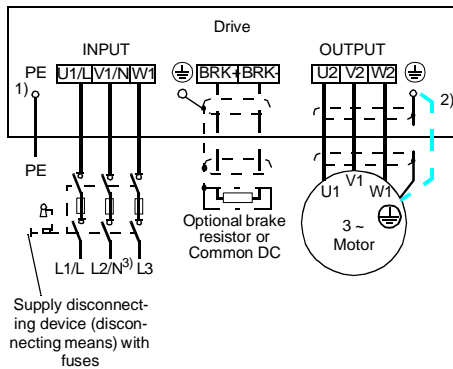
Frame size	Free space required					
	Above		Below		On the sides	
	mm	in	mm	in	mm	in
R0...R4	75	3	75	3	0	0

#### Note:

- When placing inverters on top of each other in the panel or cabinet, make sure that the hot air from the inverters below do not enter directly to the inverter above.
- The maximum ambient air temperature is 50°C (122°F) at the rated current. The current is derated for 40 to 50°C (104 to 131°F).

## Installing the power cables

### Connection diagram



<sup>1)</sup> Ground the other end of the PE conductor at the distribution board.

<sup>2)</sup> Use a separate grounding cable if the conductivity of the cable shield is insufficient (smaller than the conductivity of the phase conductor) and there is no symmetrically constructed grounding conductor in the cable.

<sup>3)</sup> In one-phase installations, connect the neutral cable here.

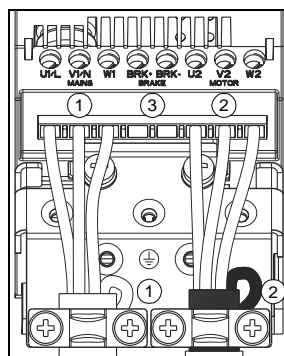
#### Note:

- Do not use an asymmetrically constructed motor cable.
- Route the motor cable, input power cable and control cables separately.
- Make sure that the maximum cable lengths are not exceeded. For detailed information, see the user's manual.



## ■ Connection procedure

1. Strip the input power cable. Ground the bare shield of the cable (if any) 360 degrees under the grounding clamp. Fasten the grounding conductor (PE) of the input power cable under the screw of the grounding clamp. Connect the phase conductors to the U1, V1 and W1 terminals.
2. Strip the motor cable. Ground the bare shield of the cable 360 degrees under the grounding clamp. Twist the shield to form as short a pigtail as possible and fasten it under the screw of the grounding clamp. Connect the phase conductors to the U2, V2 and W2 terminals.
3. Connect DC input to the BRK+ and BRK- terminals with a shielded cable using the same procedure as for the motor cable.
4. Secure the cables outside the drive mechanically.



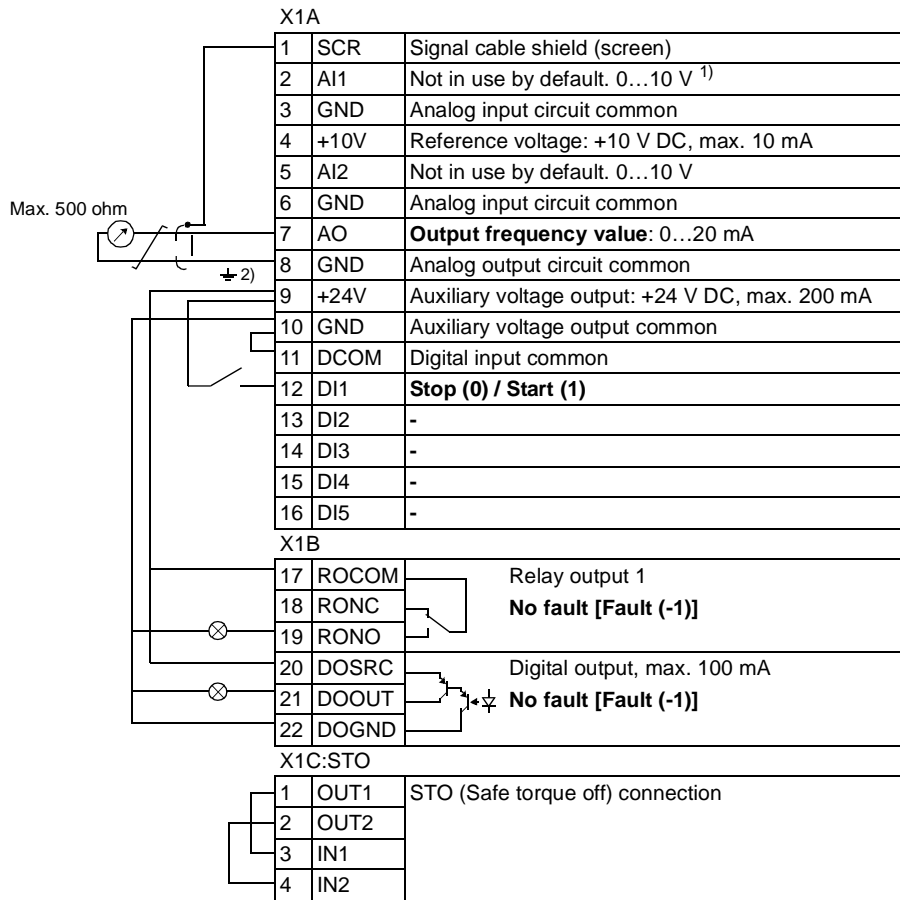
Frame size	Tightening torque	Max. wire size
	N·m (lbf-in)	
R0...R2	0.8 (7)	4.0/6.0 mm <sup>2</sup> (10 AWG)
R3	1.7 (15)	10.0/16.0 mm <sup>2</sup> (6 AWG)
R4	2.5 (22)	25.0/35.0 mm <sup>2</sup> (2 AWG)

To identify the frame size of your inverter, see [Fuse ratings](#), page 21.



## Installing the control cables

### ■ Default I/O connections



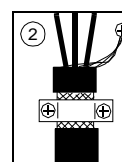
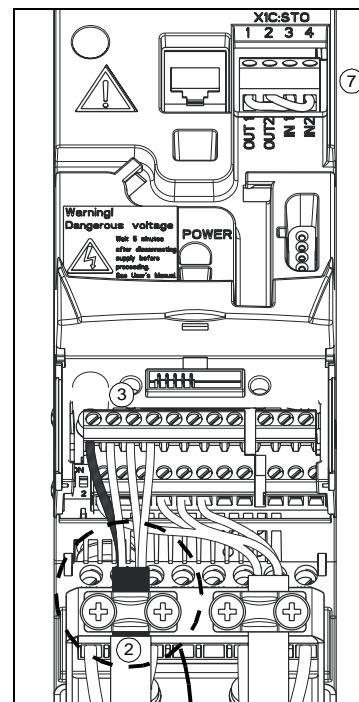
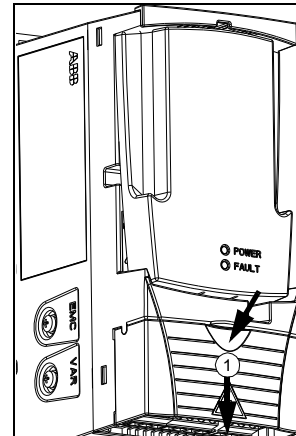
<sup>1)</sup> AI1 is used as a speed reference if vector mode is selected.

<sup>2)</sup> 360 degree grounding under a clamp.

Tightening torque = 0.4 N·m / 3.5 lbf·in.

### ■ Connection procedure

1. Remove the terminal cover by simultaneously pushing the recess and sliding the cover off the frame.
2. Strip the outer insulation of the analog signal cable and ground the bare shield 360 degrees under the clamp.
3. Connect the conductors to the appropriate terminals. Use a tightening torque of 0.4 N·m (3.5 lbf·in).
4. For double-shielded cables, twist also the grounding conductors of each pair in the cable together and connect the bundle to the SCR terminal (terminal 1).
5. Secure all cables outside the drive mechanically.
6. Unless you need to install the optional fieldbus module, slide the terminal cover back in place.
7. Connect STO conductors to the appropriate terminals. Use a tightening torque of 0.4 N·m (3.5 lbf·in).



## Start-up

If the inverter power rating matches the motor power rating, the inverter is ready to run. If any parameter tuning such as acceleration and deceleration times, maximum and minimum speeds, and so on is required, see *ACS355 User's manual (3AUA0000066143[English])* for further information.

## Technical data

### ■ UL checklist

- The ACS355 drive is an IP20 (UL open or NEMA 1 type) drive to be used in a heated, indoor controlled environment. The drive must be installed in clean air according to enclosure classification. Cooling air must be clean, free from corrosive materials and electrically conductive dust. For detailed specifications, see *ACS355 User's manual (3AUA0000066143[English])*.
- The maximum ambient air temperature is 50°C (122°F) at rated current. The current is derated for 40 to 50°C (104 to 131°F).
- The drive is suitable for use in a circuit capable of delivering not more than 100 kA rms symmetrical amperes at the inverter maximum rated voltage.
- The cables located within the motor circuit must be rated for at least 75°C (167°F) UL-compliant installations.
- The input cable must be protected with fuses or circuit breakers. Suitable IEC (class gG) and UL (class T) fuses are listed in the *Technical data* section of the user's manual.
- For installation in the United States, branch circuit protection must be provided in accordance with the National Electrical Code (NEC) and any applicable local codes. To fulfil this requirement, use the UL-classified fuses.
- For installation in Canada, branch circuit protection must be provided in accordance with Canadian Electrical Code and any applicable provincial codes. To fulfil this requirement, use the UL-classified fuses.
- The drive provides overload protection in accordance with the National Electrical Code (NEC).



## ■ Fuse ratings

Use standard fuses with all ABB general machinery drives. For fuse ratings of ACS355 drives, refer the technical data on *Power cable sizes and fuses* in the *ACS355 User's manual (3AUA0000066143[English])*.

For input fuse connection see fuse ratings in the table below. Refer to gG for AC and UR or gG for DC. The uR fuse ratings are determined by the maximum instantaneous DC current because the fuse works fast.

**Important:** Select fuses with current ratings two times higher than the DC current calculated from the nominal power. For gG fuses, select fuses with current ratings one size smaller than the DC current.

Type code	Frame size	IEC Fuse AC side	DC Fuse PV side	
		Fuse [A]	Fuse Type	
		Type gG	UR	gG
<b>1-phase supply voltage 200 to 240 V units</b>				
ACS355-01X-04A7-2	R1	16	10	10
ACS355-01X-06A7-2	R1	16	10	10
ACS355-01X-07A5-2	R2	20	16	10
ACS355-01X-09A8-2	R2	25	16	16
<b>3-phase supply voltage 200 to 240 V units</b>				
ACS355-03X-03A5-2	R0	10	10	10
ACS355-03X-04A7-2	R1	10	10	10
ACS355-03X-06A7-2	R1	16	10	10
ACS355-03X-07A5-2	R1	16	16	10
ACS355-03X-09A8-2	R2	16	16	16
ACS355-03X-13A3-2	R2	25	25	25
ACS355-03X-17A6-2	R2	25	35	25
ACS355-03X-24A4-2	R3	63	35	35
ACS355-03X-31A0-2	R4	80	50	50
ACS355-03X-46A2-2	R4	100	80	63
<b>3-phase supply voltage 380 to 480 V units</b>				
ACS355-03X-01A9-4	R0	10	10	10
ACS355-03X-02A4-4	R1	10	10	10
ACS355-03X-03A3-4	R1	10	10	10
ACS355-03X-04A1-4	R1	16	10	10
ACS355-03X-05A6-4	R1	16	10	10



Type code	Frame size	IEC Fuse AC side	DC Fuse PV side	
		Fuse [A] Type gG	Fuse Type	
			UR	gG
ACS355-03X-07A3-4	R1	16	16	10
ACS355-03X-08A8-4	R1	20	25	16
ACS355-03X-12A5-4	R3	25	25	16
ACS355-03X-15A6-4	R3	35	35	25
ACS355-03X-23A1-4	R3	50	50	35
ACS355-03X-31A0-4	R4	80	63	50
ACS355-03X-38A0-4	R4	100	80	50
ACS355-03X-44A0-4	R4	100	80	63



## Operating instructions

The ACS355 solar pump inverter is developed using the ACS355 firmware. Install the ACS355 Solar pump inverter as defined in sections [Mechanical installation](#), [Installing the power cables](#), and [Installing the control cables](#). Before operating the solar pump inverter, set the required parameters defined in the following steps.

Step	Action	Additional information
1	Install the solar pump inverter.	See section <i>Mechanical installation</i> in <i>ACS355 User's manual</i> (3AUA0000066143[English]).
2	Connect the power cables and the control cables.	See section <i>Connecting the power cables</i> and <i>Connecting the control cables</i> in <i>ACS355 User's manual</i> (3AUA0000066143[English]).
3	Enter the commissioning data parameters in <a href="#">Group 99: START-UP DATA</a> .	See section 99 <i>START-UP DATA</i> in <i>ACS355 User's manual</i> (3AUA0000066143[English]).
4	Set the basic application data using either the control panel or the Drive window light PC tool application: <a href="#">Group 10: START/STOP/DIR</a> <a href="#">Group 11: REFERENCE SELECT</a> <a href="#">Group 20: LIMITS</a> <a href="#">Group 60: PUMP CONTROL</a> <a href="#">Group 61: FLOW CALCULATION</a> <a href="#">Group 99: START-UP DATA</a>	See section <i>Control panels</i> in <i>ACS355 User's manual</i> (3AUA0000066143[English]). The inverter is supported by version 2.91 or later of the Drive Window Light 2 PC tool which includes a graphical Sequence programming tool.
5	Monitor the inverter signals in <a href="#">Group 01: OPERATING DATA</a> .	See section <i>Actual Signals</i> in <i>ACS355 User's manual</i> (3AUA0000066143[English]).







# 4

## Start-up and controls

### About this chapter

This chapter provides an overview of the solar pump inverter, different control panels compatible with solar pump inverter and the start-up modes for operating the solar pump inverter.

### Solar pump inverter overview

The ABB ACS355 solar pump inverter is a low voltage AC drive of 0.3 to 18.5KW rating designed to operate with energy drawn from photovoltaic cells (PV). The inverter is customized to operate in dual supply mode, so the grid connected supply is used in the absence of energy from PV cells. The inverter functions with the latest in technology maximum power point tracking (MPPT) algorithm to derive maximum power from the PV cells at any instant.

The inverter is specifically designed to meet the requirements of pump manufacturers and the original equipment manufacturers (OEM). For more details of the solar pump inverter features, see section [Program features](#), page 31.

### Control modes

The ACS355 solar pump inverter operates in local control mode and in remote control mode identical to the ACS355 firmware.

- Local control—interfaces through the panel.
- Remote control—interfaces through external control signal. For the external control through digital input, refer the [Default I/O connections](#), page 18.

To switch between local and remote control modes use the LOC/REM key on the control panel.

For more information, see section *How to start, stop and switch between local and remote control* in *ACS355 user's manual (3AUA0000066143[English])*.

**Note:** Ensure that the inverter is in local control before starting or stopping the inverter.

## Start-up modes

The basic start-up procedure to operate the solar pump inverter is identical to the ACS355 firmware. See section *Starting up the drive* in *ACS355 User's manual (3AUA0000066143[English])*.

The ACS355 solar pump inverter includes an additional feature to start/stop the inverter either in the auto or manual mode. The parameter **6001 AUTO/MANUAL SEL** enables setting the auto/manual mode. For details of setting auto/manual mode using control panel, see *Selecting Auto/Manual mode*, page 27.

### ■ Auto mode

In auto mode, the inverter does not need any manual start/stop input. The inverter starts automatically if current DC bus voltage is more than the start DC voltage set in parameter **6003 START DC VOLT**. To use the auto mode, set the parameter **6001 AUTO/MANUAL SEL** to AUTO [0].

### ■ Manual mode

In manual mode, start the drive by externally connecting to either of the digital inputs common DI1, DI2 or DI3 pins as shown in *Default I/O connections*. The inverter waits for the activation of digital inputs defined in parameter **6002 MANUAL START CMD**. To use the manual mode, set the parameter **6001 AUTO/MANUAL SEL** to MANUAL [1].

**Note:** Only one input can be selected at a time.

## Control panels

The ACS355 solar pump inverter works with either of the two different control panel types:


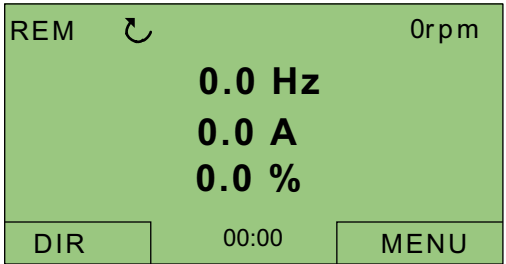


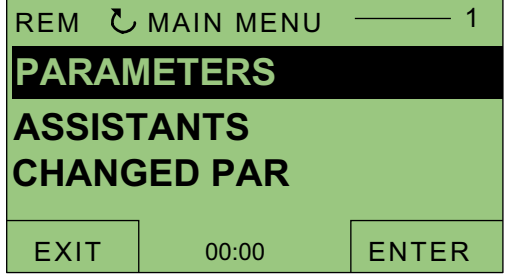


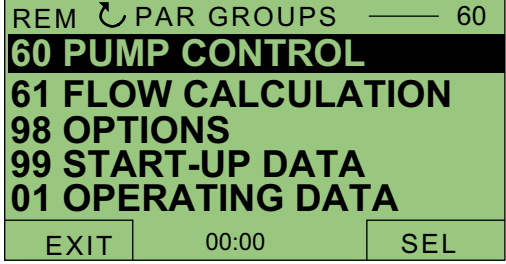


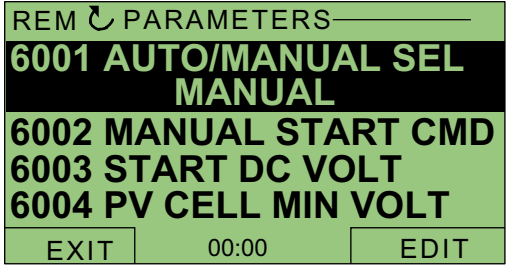


- Basic control panel—provides basic tools for manual entry of parameter values.
- Assistant control panel—includes pre-programmed assistants to automate the most common parameter setups and provides language support.

The sections below explain the procedure to view or edit the parameter values in the control panel.



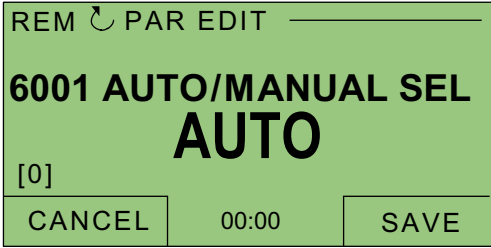

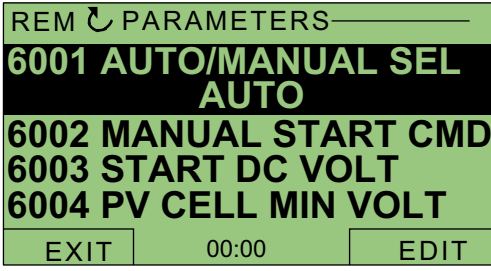
For more information, see section *control panels* in *ACS355 User's manual (3AUA0000066143 [English])*.



## ■ Selecting Auto/Manual mode




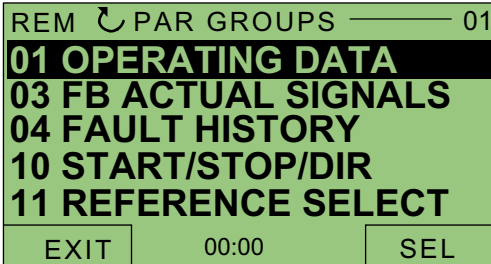



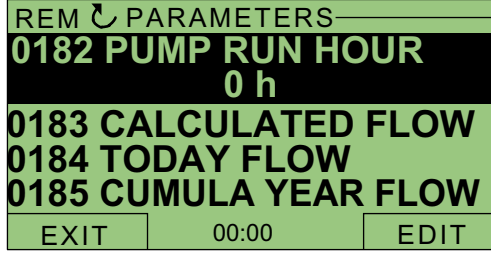
Step	Description	Keys	Control panel
1	Press MENU to go to the main menu.		
2	Select PARAMETERS with the UP/DOWN keys and press ENTER.	 	
3	Select 60 PUMP CONTROL with the UP/DOWN keys and press SEL.	 	
4	Select the parameter 6001 AUTO/MANUAL SEL with the UP/DOWN keys. Press EDIT to change the parameter value.	 	
5	Press the UP/DOWN keys to change the parameter value. For more details, see parameter <a href="#">6001 AUTO/MANUAL SEL</a> , page 38. <b>Note:</b> MANUAL is the default selection.		



Step	Description	Keys	Control panel
6	Press SAVE to store the modified value or press CANCEL to leave the set mode. Any modifications not saved are cancelled.	 	
7	Press EXIT to return to the main menu.		

### ■ Viewing pump signals




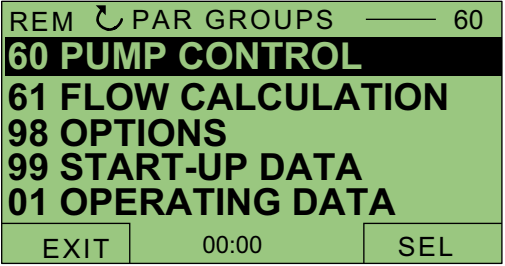



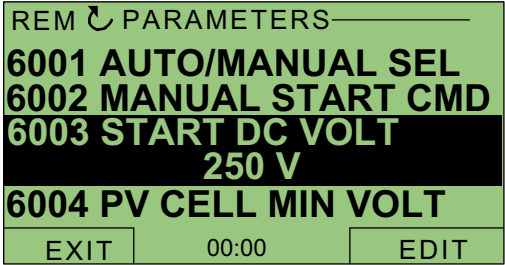



The parameters 0182...0185 display the actual signals of the pump. These values are read only. To view these values in the control panel, follow these steps:

Step	Description	Keys	Control panel
1	Select 01 OPERATING DATA with the UP/DOWN keys and press SEL.	  	
2	Press the UP/DOWN keys to view the actual values displayed below individual parameters. For more details, see section <a href="#">Group 01: OPERATING DATA</a> , page 39. Press EXIT to return to the main menu.	  	


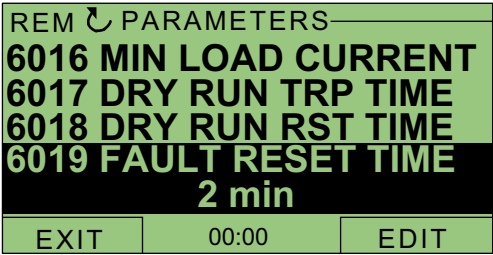

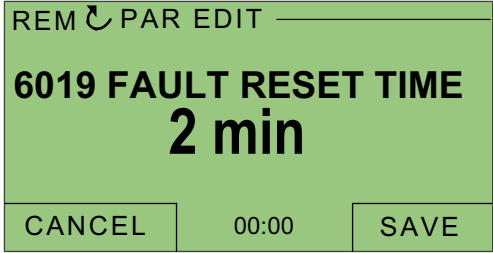


## ■ Editing pump parameters

The parameters 6001...6019 are user adjustable parameters to control the pump operation. The below steps explain the editing of inverter start voltage and inverter reset time. Similarly, edit the other pump parameters in this group.

Step	Description	Keys	Control panel
<b>Setting inverter starting voltage</b>			
1	Select 60 PUMP CONTROL with the UP/DOWN keys and press SEL.	  	 REM ↻ PAR GROUPS — 60 <b>60 PUMP CONTROL</b> 61 FLOW CALCULATION 98 OPTIONS 99 START-UP DATA 01 OPERATING DATA EXIT 00:00 SEL
2	Select parameter 6003 START DC VOLT with the UP/DOWN keys. Press EDIT to change the parameter value. You can edit the minimum DC voltage to start the inverter. <b>Note:</b> If you change this value while the inverter is running, the changed value is effective only during the next start.	  	 REM ↻ PARAMETERS — <b>6001 AUTO/MANUAL SEL</b> <b>6002 MANUAL START CMD</b> <b>6003 START DC VOLT</b> <b>250 V</b> <b>6004 PV CELL MIN VOLT</b> EXIT 00:00 EDIT
3	Press the UP/DOWN keys to change the parameter value and press SAVE to store the modified value or press CANCEL to leave the set mode. Any modifications not saved are cancelled. Press EXIT to return to the listing of parameter groups, and again to return to the main menu.	 	 REM ↻ PAR EDIT — <b>6003 START DC VOLT</b> <b>250 V</b> CANCEL 00:00 SAVE



Step	Description	Keys	Control panel
<b>Setting inverter reset time</b>			
1	<p>Select parameter 6019 FAULT RESET TIME with the UP/DOWN keys. Press EDIT to change the parameter value.</p> <p>You can set the auto reset time to start the inverter after it has tripped in the event of under-voltage fault, PV cell maximum voltage fault or when actual speed decreases below the minimum motor speed limit.</p>		
2	<p>Press the UP/DOWN keys to change the parameter value. Press SAVE to store the modified value or press CANCEL to leave the set mode. Any modifications not saved are cancelled.</p>		



## 5

# Program features

## About this chapter

This chapter describes the main features included in the ACS355 solar pump inverter.

## MPPT overview

### ■ Theory

The ACS355 solar pump inverter uses the maximum power point tracking (MPPT) control program to improve the efficiency of solar energy systems. The output of the photovoltaic (PV) cell is proportional to its area and intensity, while the output voltage is limited by p-n junction from 0.6 to 0.7 V. Therefore when the output voltage is constant, output power is proportional to intensity and surface area. The current and voltage at which the PV cell generates maximum power is known as the maximum power point.

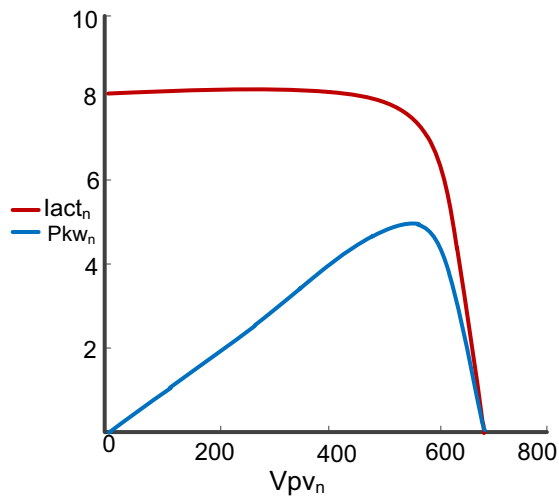
### ■ Operation

The MPPT controller follows different strategies to derive the maximum power from the PV array. The internal MPPT algorithm is used to derive maximum power from the PV cell at any instant. This is achieved by modifying the operating voltage or current in the PV cell until the maximum power is obtained.

When the output voltage is zero, the PV cells create short circuit current. If the PV cells are not connected to any load, the output voltage is equal to the open circuit voltage. The maximum power point is obtained at the knee of the I-V curve. See the I-V characteristics shown below.



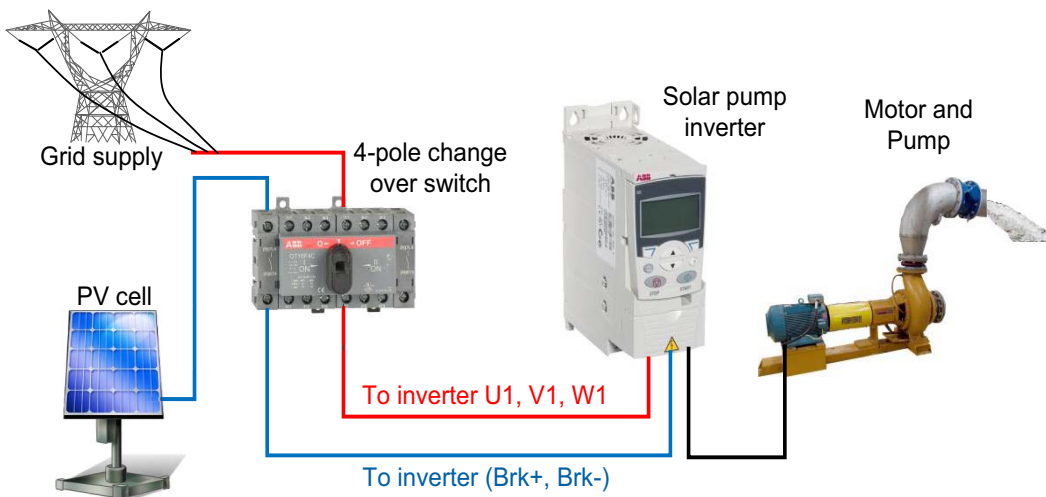
## I-V characteristics



The I-V curve is not constant since intensity and temperature changes during day time. Under constant temperature, current changes linearly with intensity and voltage changes logarithmically with intensity. Since the voltage variation is small with respect to intensity changes, maximum power varies proportionally with intensity.

## Dual supply mode

The ACS355 solar pump inverter operates in dual supply mode either with a three phase input supply from the grid or with DC input supply from PV cells. A four-pole changeover switch enables switching between the two supply modes.



**Note:** Use a two pole switch in series when the inverter is connected to DC.



## Dry run function

The ACS355 solar pump inverter detects a *DRY RUN FAULT* at instances when the water flow is not available at the pump inlet or when a blockage occurs in the pump. During these conditions the solar pump inverter consumes less current than the minimum load current or the actual motor current is less than the minimum load current for the defined trip time.

**Note:** The dry run function is disabled during the initial start up time.

For more details, see parameter groups:

- *6016 MIN LOAD CURRENT*, page 48
- *6017 DRY RUN TRP TIME*, page 48

## Boost voltage factor

The ACS355 solar pump inverter uses the boost voltage factor for increasing the pump speed. When the actual DC bus voltage is greater than the boost voltage, the pump speed increases by the defined boost factor. The MPPT algorithm achieves this increased speed limit only if the actual DC bus voltage is appropriate to the boost factor.

For more details, see parameter groups:

- *6008 BOOST VOLT*, page 48
- *6009 BOOST FACTOR*, page 48

## Voltage limit

The solar pump inverter operates within the voltage limits defined for PV cells and beyond these limits the inverter trips. At maximum voltage limit, the inverter detects a *PV MAX VOLT* fault.

For more details, see parameter groups:

- *6004 PV CELL MIN VOLT*, page 48
- *6005 PV CELL MAX VOLT*, page 48

## Speed limit

The ACS355 solar pump inverter operates within the defined speed limits set in the *Group 60: PUMP CONTROL* parameters.

- Minimum pump speed—Below this value, the MPPT directs the inverter to stop the pump operation. The inverter restarts automatically only after the fault reset time. This operation of the inverter prevents the pump from running at a lower speed.
- Maximum pump speed—The pump operates within this speed limit defined by MPPT in *6007 PUMP MAXIMUM SPD*, provided that the maximum speed limit of the inverter in *2002 MAXIMUM SPEED* is equal to or higher than this value.

**Note:** Ensure that the pump speed is always defined within the allowed speed limit of the inverter.



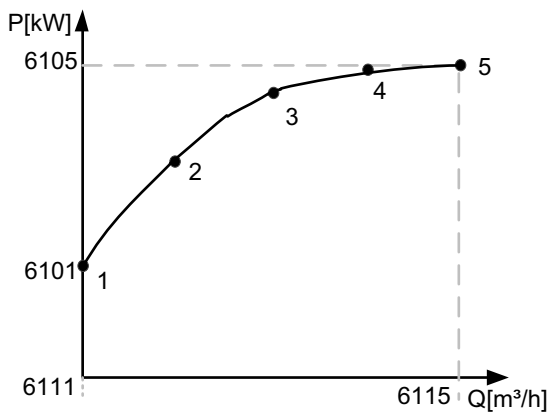
For more details, see parameter groups:

- [6006 PUMP MINIMUM SPD](#), page 48
- [6007 PUMP MAXIMUM SPD](#), page 48
- [2002 MAXIMUM SPEED](#), page 47

## Flow calculation

The flow calculation function provides a reasonably accurate calculation of the flow without the installation of a separate flow meter. The PQ (power/flow) performance curve enables calculating the flow output from the pump. The P and Q values are provided by the pump manufacturer. Locate the P and Q values on the graph (see below PQ curve) and trace the location of the five points on the curve to evaluate the efficiency of the flow output.

### PQ Curve



The solar pump inverter records and stores the flow rate on each day and provides the required data for current day and current year.

For more details, see parameter groups:

- [0183 CALCULATED FLOW](#), page 39
- [0184 TODAY FLOW](#), page 39
- [0185 CUMULA YEAR FLOW](#), page 39
- [6101 PQ CURVE P1...6105 PQ CURVE P5](#), page 49
- [6111 PQ CURVE Q1...6115 PQ CURVE Q5](#), page 49
- [6121 PUMP EFFICIENCY](#), page 49

#### Note:

- The flow calculations are available only with assistant control panel. Ensure that the assistant control panel is fixed before starting the inverter.
- Do not use the flow calculation function outside the normal operating range of the pump.
- Do not use the flow calculation function for invoicing purposes.
- Ensure the power and flow points are in incremental order with non-zero values.

## PID control macro

The ACS355 solar pump drive is designed to work with MPPT algorithm. Hence the PID control macro is disabled and similarly when the PID control macro is enabled, the MPPT algorithm is disabled.

See section *PID control macro* in *ACS355 user's manual (3AUA0000066143[English])*.

## Excluded functions

The following features of ACS355 firmware are not supported in the solar pump inverter.

- Counter
- Timer
- Frequency input
- Sequential programming
- Jogging
- Constant speed
- IR compensation
- Mechanical brake





## 6

# Signals and parameters

## About this chapter

This chapter describes the actual signals and user-adjustable parameters of the MPPT function specific to the ACS355 solar pump inverter. Refer these parameters in addition to the actual signals and parameters described in the *ACS355 User's manual (3AUA0000066143 [English])*.

## Quick commissioning

The listed pump parameter codes enable quick commissioning of the ACS355 solar pump inverter. The pump operating signals enable monitoring the pump operation. For detailed description of each code, refer to the individual group parameters.

### ■ Pump parameters

For description of individual signals, see the respective group table.

Code	Parameter name	Type	Range	Unit	Default
<i>Group 10: START/STOP/DIR, page 40</i>					
1001	EXT1 COMMANDS	LIST	0...37	-	SOLAR [37]
<i>Group 11: REFERENCE SELECT, page 43</i>					
1102	EXT1/EXT2 SEL	LIST	-5...+12	-	EXT1 [0]
1103	REF1 SELECT	LIST	0...37	-	SOLAR [37]
<i>Group 20: LIMITS, page 47</i>					
2002	MAXIMUM SPEED	UINT	0...30000	rpm	-
2003	MAX CURRENT	REAL	0.0...1.8 I <sub>2N</sub> A	A	-



Code	Parameter name	Type	Range	Unit	Default
<b>Group 60: PUMP CONTROL, page 47</b>					
6001	AUTO/MANUAL SEL	LIST	0...1	-	MANUAL [1]
6002	MANUAL START CMD	LIST	0...3	-	DI1 [0]
6003	START DC VOLT	UINT	110...800 <sup>1</sup>	V	400 V unit: 250 200 V unit: 144
6004	PV CELL MIN VOLT	UINT	110...800 <sup>1</sup>	V	400 V unit: 250 200 V unit: 144
6005	PV CELL MAX VOLT	UINT	110...800 <sup>1</sup>	V	400 V unit: 640 200 V unit: 368
6006	PUMP MINIMUM SPD	UINT	0...3000	rpm	0
6007	PUMP MAXIMUM SPD	UINT	0...3000	rpm	1500
6008	BOOST VOLT	UINT	125...600 <sup>1</sup>	V	400 V unit: 450 200 V unit: 259
6009	BOOST FACTOR	REAL	0.75...1.25	-	1.00
6016	MIN LOAD CURRENT	REAL	0...2* Drive rating	A	0
6017	DRY RUN TRP TIME	UINT	0...5	min	2
6018	DRY RUN RST TIME	UINT	2...300	min	2
6019	FAULT RESET TIME	UINT	2...20	min	2
<b>Group 61: FLOW CALCULATION, page 49</b>					
6101... 6105	PQ CURVE P1... PQ CURVE P5	REAL	0...3276.0	kW	0
6111... 6115	PQ CURVE Q1... PQ CURVE Q5	REAL	0...3276.0	m <sup>3</sup> /h	0
6121	PUMP EFFICIENCY	UINT	0...100	%	100
6122	PUMP NOM SPEED	UINT	0...3000	rpm	1500
6123	CALC LOW SPEED	UINT	100...3000	rpm	500
6124	FLOW CAL GAIN	REAL	0.50...2.00	-	1
6131	RESET FLOW	LIST	0...1	-	DONE [0]
<b>Group 99: START-UP DATA, page 51</b>					
9903	MOTOR TYPE	LIST	1...2	-	-
9904	MOTOR CTRL MODE	LIST	1...3	-	-
9905	MOTOR NOM VOLT	UINT	0.5...1.5 * U <sub>1N</sub> <sup>2</sup>	V	-
9906	MOTOR NOM CURR	REAL	0.2...2.0 * I <sub>2N</sub> <sup>3</sup>	A	-

Code	Parameter name	Type	Range	Unit	Default
9907	MOTOR NOM FREQ	REAL	10.0...600.0	Hz	-
9908	MOTOR NOM SPEED	UINT	50...30000	rpm	-
9909	MOTOR NOM POWER	REAL	0.2...3.0 * P <sub>N</sub> <sup>4</sup>	kW	-

<sup>1</sup> Range is different for 1-phase and 3-phase inverters.

<sup>2</sup> Incoming AC voltage as displayed on the inverter name plate.

<sup>3</sup> Rated current as displayed on the inverter name plate.


<sup>4</sup> Rated power as displayed on the inverter name plate.

## Actual signals

The Group 01: OPERATING DATA includes the solar pump inverter operating data and actual signals for monitoring the pump. The inverter sets the values for actual signals based on measurements or calculations. These signals are read-only.

### ■ Group 01: OPERATING DATA

The below table lists the signals specific to the ACS355 solar pump inverter.

Index	Name/Selection	Description	FbEq
0182	PUMP RUN HOUR	Actual run time of the pump in hours. <b>Note:</b> You can reset the counter to zero when the control panel is in parameter mode. Non-zero values are not accepted.  To reset the counter, press the  UP/DOWN keys simultaneously.	1 = 1 h
0183	CALCULATED FLOW	Calculated flow rate of water in cubic meter per hour. The calculation is based on the correction factor defined in <a href="#">6124 FLOW CAL GAIN</a> .	100 = 1 m <sup>3</sup> /h
0184	TODAY FLOW	Measured flow for the current day in cubic meter. <b>Note:</b> You can reset this value using <a href="#">6131 RESET FLOW</a> .	10 = 1 m <sup>3</sup>
0185	CUMULA YEAR FLOW	Measured flow for current year in cubic deca meter. The value displayed is the measured flow from first day to current day of the year. <b>Note:</b> You can reset this value using <a href="#">6131 RESET FLOW</a> .	1 = 1 m <sup>6</sup>



## Parameter groups

The solar pump inverter includes the following signals and parameter groups:

**Group 10: START/STOP/DIR**—Defines external sources for commands that enables start, stop and direction changes. This group also enables to lock the direction or to control the direction.

**Group 11: REFERENCE SELECT**—Defines how the inverter selects between command sources.

**Group 20: LIMITS**—Defines the minimum and maximum limit for driving the motor.

**Group 60: PUMP CONTROL**—Defines the data required for pump control.

**Group 61: FLOW CALCULATION**—Defines the data required for flow calculation.

**Group 99: START-UP DATA**—Defines the data required to set up the inverter and to enter motor information.

### ■ Group 10: START/STOP/DIR

This parameter group defines sources for external start, stop and direction control. This group also enables locking the direction or controlling the direction.

Index	Name/ Value	Description	FbEq
1001	EXT1 COMMANDS	Defines the connections and source for start, stop and direction commands for external control location 1 (EXT1).	1 = 1
	NOT SEL	No start, stop and direction command source.	0
	DI1	Start and stop through digital input DI1. 0 = stop, 1 = start. Direction is fixed according to parameter <a href="#">1003 DIRECTION</a> (setting REQUEST = FORWARD).	1
	DI1,2	Start and stop through digital input DI1. 0 = stop, 1 = start. Direction is set through digital input DI2. 0 = forward, 1 = reverse. To control the direction, set the parameter <a href="#">1003 DIRECTION</a> = REQUEST.	2
	DI 1P,2P	<ul style="list-style-type: none"> <li>Pulse start through digital input DI1. 0 -&gt; 1: Start.</li> </ul> <b>Note:</b> To start the inverter, activate the digital input DI2 prior to the pulse fed to DI1. <ul style="list-style-type: none"> <li>Pulse stop through digital input DI2. 1 -&gt; 0: Stop.</li> </ul> The direction of rotation is fixed according to parameter <a href="#">1003 DIRECTION</a> (setting REQUEST = FORWARD). <b>Note:</b> If you deactivate (no input) the stop input (DI2), the control panel start and stop keys are disabled.	3



Index	Name/ Value	Description	FbEq															
	DI1P,2P,3	<ul style="list-style-type: none"> <li>Pulse start through digital input DI1. 0 -&gt; 1: Start.</li> </ul> <p><b>Note:</b> To start the inverter, activate the digital input DI2 prior to the pulse fed to DI1.</p> <ul style="list-style-type: none"> <li>Pulse stop through digital input DI2. 1 -&gt; 0: Stop.</li> <li>Direction through digital input DI3.</li> </ul> <p>0 = forward, 1 = reverse.</p> <p>To control direction, set parameter <b>1003 DIRECTION</b> = REQUEST.</p> <p><b>Note:</b> If you deactivate (no input) the stop input (DI2), the control panel start and stop keys are disabled.</p>	4															
	DI1P,2P,3P	<ul style="list-style-type: none"> <li>Pulse start forward through digital input DI1.</li> </ul> <p>0 -&gt; 1: Start forward.</p> <ul style="list-style-type: none"> <li>Pulse start reverse through digital input DI1.</li> </ul> <p>0 -&gt; 1: Start reverse.</p> <p><b>Note:</b> To start the inverter, activate the digital input DI3 prior to the pulse fed to DI1/DI2.</p> <ul style="list-style-type: none"> <li>Pulse stop through digital input DI3. 1 -&gt; 0: Stop.</li> </ul> <p>To control direction, set parameter <b>1003 DIRECTION</b> = REQUEST.</p> <p><b>Note:</b> If you deactivate (no input) the stop input (DI3), the control panel start and stop keys are disabled.</p>	5															
	KEYPAD	Start, stop and direction commands through control panel when EXT1 is active. To control the direction, set the parameter <b>1003 DIRECTION</b> = REQUEST.	8															
	DI1F, 2R	<p>Start, stop and direction commands through digital inputs DI1 and DI2.</p> <table border="1"> <thead> <tr> <th>DI1</th> <th>DI2</th> <th>Operation</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>Stop</td> </tr> <tr> <td>1</td> <td>0</td> <td>Start forward</td> </tr> <tr> <td>0</td> <td>1</td> <td>Start reverse</td> </tr> <tr> <td>1</td> <td>1</td> <td>Stop</td> </tr> </tbody> </table> <p>To control direction, set the parameter <b>1003 DIRECTION</b> = REQUEST.</p>	DI1	DI2	Operation	0	0	Stop	1	0	Start forward	0	1	Start reverse	1	1	Stop	9
DI1	DI2	Operation																
0	0	Stop																
1	0	Start forward																
0	1	Start reverse																
1	1	Stop																
	COMM	Fieldbus interface as the source for the start and stop commands (control word 0301 FB CMD WORD 1. bits 0...1). The fieldbus controller sends the control word to the drive through the fieldbus adapter or embedded fieldbus (Modbus). For details of control word bits, see section <i>DCU communication profile</i> in <i>ACS355 User's manual (3AUA0000066143[English])</i> .	10															



Index	Name/ Value	Description	FbEq
	TIMED FUNC 1	Timed start/stop control. Timed function 1, Active = start and Inactive = stop. See parameter Group 36: <i>TIMED FUNCTIONS</i> in <i>ACS355 User's manual (3AUA0000066143[English])</i> .	11
	TIMED FUNC 2	See selection TIMED FUNC 1.	12
	TIMED FUNC 3	See selection TIMED FUNC 1.	13
	TIMED FUNC 4	See selection TIMED FUNC 1.	14
	DI5	Start and stop through digital input DI5. 0 = stop, 1 = start. Direction fixes based on parameter <i>1003 DIRECTION</i> (REQUEST = FORWARD).	20
	DI5,4	Start and stop through digital input DI5. 0 = stop, 1 = start. Direction control through DI4. 0 = forward, 1 = reverse. To control direction, set the parameter <i>1003 DIRECTION</i> = REQUEST.	21
	SOLAR	Solar mode. If <i>6001 AUTO/MANUAL SEL</i> is set as <ul style="list-style-type: none"> <li>• Auto [0]—inverter starts only when the DC bus voltage is greater than the value in <i>6003 START DC VOLT</i></li> <li>• Manual [1]—inverter starts at the rising edge of the parameter as set in <i>6002 MANUAL START CMD</i>, provided the DC bus voltage is greater than <i>6003 START DC VOLT</i></li> </ul>	37
1003	DIRECTION	Controls or fixes the rotational direction of the motor.	1 = 1
	FORWARD	Fixed to forward	1
	REVERSE	Fixed to reverse	2
	REQUEST	Allows rotational direction control	3

**Note:** 1001 EXT1 COMMANDS: Timer stop/start, Counter stop/start and Sequence programming is not applicable for solar pump inverter.

## ■ Group 11: REFERENCE SELECT

This parameter group defines panel reference types, external control location selection and external reference sources and limits.

Index	Name/ Value	Description	FbEq
1102	EXT1/EXT2 SEL	Defines the source from which the drive reads the signal that selects between the two external control locations, EXT1 or EXT2.	1 = 1
	EXT1	EXT1 active. The control signal sources are defined by parameters <a href="#">1001 EXT1 COMMANDS</a> and <a href="#">1103 REF1 SELECT</a> .	0
	DI1	Digital input DI1. 0 = EXT1, 1 = EXT2.	1
	DI2	See selection DI1.	2
	DI3	See selection DI1.	3
	DI4	See selection DI1.	4
	DI5	See selection DI1.	5
	EXT2	EXT2 active. The control signal sources are defined by parameters <a href="#">1002 EXT2 COMMANDS</a> and <a href="#">1106 REF2 SELECT</a> .	7
	COMM	Fieldbus interface as the source for EXT1/EXT2 selection, that is Control word 0301 FB CMD WORD 1 bit 5 (with ABB drives profile 5319 EFB PAR 19 bit 11). The fieldbus controller sends the control word to inverter through fieldbus adapter or embedded fieldbus (Modbus). For Control word bits, see sections <i>DCU communication profile</i> and <i>ABB drives communication profile</i> in <i>ACS355 User's manual (3AUA0000066143[English])</i> .	8
	TIMED FUNC 1	Timed EXT1/EXT2 control selection. Timed function 1, active = EXT2 and inactive = EXT1. See parameter Group 36: <a href="#">TIMED FUNCTIONS</a> in <i>ACS355 User's manual (3AUA0000066143[English])</i> .	9
	TIMED FUNC 2	See selection TIMED FUNC 1.	10
	TIMED FUNC 3	See selection TIMED FUNC 1.	11
	TIMED FUNC 4	See selection TIMED FUNC 1.	12
	DI1 (INV)	Inverted digital input DI1. 1 = EXT1, 0 = EXT 2	-1
	DI2 (INV)	See selection DI1 (INV).	-2
DI3 (INV)	See selection DI1 (INV).	-3	
DI4 (INV)	See selection DI1 (INV).	-4	



Index	Name/ Value	Description	FbEq
	DI5 (INV)	See selection DI1 (INV).	-5
1103	REF1 SELECT	Selects the signal source for external reference REF1. For more details, see section <i>Block diagram: Reference source for EXT1</i> in <i>ACS355 User's manual (3AUA0000066143[English])</i> .	1 = 1
	KEYPAD	Control panel	0
	AI1	Analog input AI1	1
	AI2	Analog input AI2	2
	AI1/JOYST	<p>Analog input AI1 as joystick. At maximum reference, the</p> <ul style="list-style-type: none"> <li>• minimum input signal runs the motor in reverse direction.</li> <li>• maximum input signal runs the motor in forward direction.</li> </ul> <p>The minimum and maximum references are defined by parameters 1104 REF1 MIN and 1105 REF1 MAX,</p> <p><b>Note:</b> To control direction, set the parameter <b>1003 DIRECTION = REQUEST</b></p> <div style="text-align: center;"> <p>Par. 1301 = 20%, par 1302 = 100%</p> <p>Speed ref (REF1)</p> <p>1105</p> <p>1104</p> <p>0</p> <p>-1104</p> <p>-1105</p> <p>2 V/4 mA    6    10 V/20 mA</p> <p>AI1</p> <p>1104</p> <p>-1104</p> <p>Hysteresis 4% of full scale</p> </div> <p><b>WARNING!</b> If parameter 1301 MINIMUM AI1 is set to 0 V and analog signal is lost (0 V), the rotation of the motor is reversed to the maximum reference.</p> <p>Set the following parameters to activate a fault when analog input signal is lost:</p> <ul style="list-style-type: none"> <li>• 1301 MINIMUM AI1 = 20% (2 V or 4 mA).</li> <li>• 3021 AI1 FAULT LIMIT = 5% or higher.</li> <li>• 3001 AI&lt;MIN FUNCTION&gt; = FAULT.</li> </ul> <p>For parameter details, see <i>ACS355 User's manual (3AUA0000066143[English])</i>.</p>	3
AI2/JOYST	See select AI1/JOYST.	4	

Index	Name/ Value	Description	FbEq
	DI3U,4D(R)	Digital input DI3: Reference increase. Digital input DI4: Reference decrease. Stop command resets the reference to zero. Parameter 2205 ACCELER TIME 2 defines the rate of reference change.	5
	DI3U,4D	Digital input DI3: Reference increase. Digital input DI4: Reference decrease. The program stores the active speed reference (not reset by a stop command). When the drive is restarted, the motor ramps up at the selected acceleration rate to the stored reference. Parameter 2205 ACCELER TIME 2 defines the rate of reference change.	6
	COMM	Fieldbus reference REF1.	8
	COMM+AI1	Summation of fieldbus reference REF1 and analog input AI. See section Reference selection and correction in <i>ACS355 User's manual (3AUA0000066143[English])</i> .	9
	COMM*+AI1	Multiplication of fieldbus reference REF1 and analog input AI. See section Reference selection and correction in <i>ACS355 User's manual (3AUA0000066143[English])</i> .	10
	DI3U, 4D(R)	<ul style="list-style-type: none"> <li>Digital input DI3: Reference increase.</li> <li>Digital input DI4: Reference decrease.</li> </ul> Stop command resets the reference to zero. Parameter 2205 ACCELER TIME 2 defines the rate of the reference change.	11
	DI3U, 4D(NC)	<ul style="list-style-type: none"> <li>Digital input DI3: Reference increase.</li> <li>Digital input DI4: Reference decrease.</li> </ul> Program stores the active speed reference (not reset by a stop command). When you restart the inverter, the motor ramps up at the selected acceleration rate to the stored reference. Parameter 2205 ACCELER TIME 2 defines the rate of the reference change.	12
	AI1+AI2	Calculated reference using the equation: $REF = AI1(\%) + AI2(\%) - 50(\%)$	14
	AI1*AI2	Calculated reference using the equation: $REF = AI1(\%) \times (AI2(\%) / (50\%))$	15
	AI1-AI2	Calculated reference using the equation: $REF = AI1(\%) + 50(\%) - AI2(\%)$	16



Index	Name/ Value	Description	FbEq
	AI1/AI2	Calculated reference using the equation: $REF = AI1(\%) \times (50\%) / (AI2(\%))$	17
	KEYPAD(RNC)	Defines the control panel as reference source. The stop command resets the reference to zero (R represents reset). <b>Note:</b> The reference value is not saved if the control source is changed (EXT1 to EXT2 or EXT2 to EXT2).	20
	KEYPAD(NC)	Defines the control panel as reference source. The stop command does not reset the reference to zero. The reference is stored. <b>Note:</b> The reference is not saved if the control source is changed (EXT1 to EXT2 or EXT2 to EXT2).	21
	SOLAR	SOLAR mode. The inverter takes the speed reference calculation from MPPT.	37
1105	REF1MAX	Defines the maximum value for external reference REF1. This value corresponds to the maximum setting of the used source signal. For solar operation this signal limits the maximum speed reference calculated internally.	-
	0.0...500.0 Hz/ 0...30000 rpm	Maximum value in rpm. If <b>9904 MOTOR CTRL MODE</b> is set as SCALAR: FREQ, the unit is Hz.	1 = 0.1 Hz/ 1 rpm

**Note:** These parameters are not applicable for solar pump inverter:

- 1102 EXT1/2 SELECT: Timer function
- 1103 REF1 SELECT: Frequency input and sequence programming



## ■ Group 20: LIMITS

This parameter group defines the inverter operation limits. The parameter specific to the solar pump inverter is listed below. For other parameters in this group, refer *Actual signals and parameters* in *ACS355 User's manual (3AUA0000066143[English])*.

**Note:** Speed values are used in vector control and frequency values are used in scalar control. Select the control mode in [9904 MOTOR CTRL MODE](#).

Index	Name/Value	Description	FbEq
2002	MAXIMUM SPEED	Maximum speed limit.	-
	0...30000	Maximum speed.	1 = 1 rpm
2003	MAX CURRENT	Defines the allowed maximum motor current	-
	0.0...1.8 I <sub>2N</sub> A	Current	1 = 0.1 A

## ■ Group 60: PUMP CONTROL

This group defines the parameter codes for controlling the pump.

Index	Name/Value	Description	FbEq
6001	AUTO/MANUAL SEL	Allows the inverter to start in Auto/Manual mode. For more details refer <a href="#">Start-up modes</a> , page 26.	1 = 1
	AUTO	The inverter starts automatically if current DC bus voltage is more than the 6003 START DC VOLT.	0
	MANUAL	The inverter waits for the activation of digital inputs defined in 6002 MANUAL START CMD.	1
6002	MANUAL START CMD	Start command for inverter to start in manual mode.	1 = 1
	DI1	Start and stop through digital input DI1. 0 = Stop, 1 = Start	0
	DI2	Start and stop through digital input DI2. 0 = Stop, 1 = Start	1
	DI3	Start and stop through digital input DI3. 0 = Stop, 1 = Start	2
	DI1P, 2P	Pulse starts through digital input DI1. 0 -> 1: Start. Pulse stops through digital input DI2. 1 -> 0: Stop <b>Note:</b> To start the inverter, activate DI2 prior to feeding pulse to DI1.	3



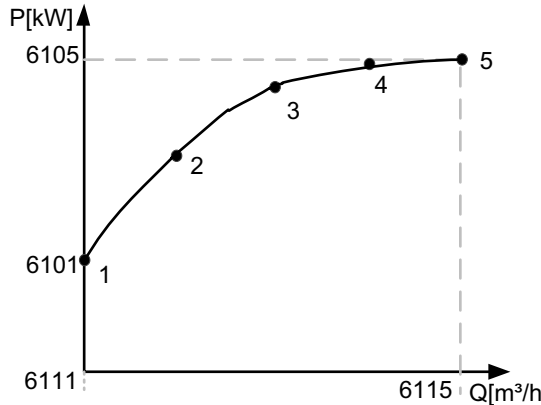
Index	Name/Value	Description	FbEq
6003	START DC VOLT	Minimum DC voltage to start the inverter. <b>Note:</b> If you change this value while the inverter is running, the changed value is effective only during the next start.	1 = 1 V
6004	PV CELL MIN VOLT	Minimum DC voltage below which the inverter cannot operate. <b>Note:</b> The inverter stops modulating below this voltage.	1 = 1 V
6005	PV CELL MAX VOLT	Maximum DC voltage. At any value above this voltage, the inverter trips due to <i>PV MAX VOLT</i> fault.	1 = 1 V
6006	PUMP MINIMUM SPD	Minimum motor speed allowed. At any value below this speed, the inverter stops functioning and auto restarts after the time defined in <i>6019 FAULT RESET TIME</i> . This setting avoids unnecessary operation of pump at low speed.	1 = 1 rpm
6007	PUMP MAXIMUM SPD	Maximum motor speed allowed.	1 = 1 rpm
6008	BOOST VOLT	DC voltage above which the 6009 BOOST FACTOR is effective. Below this value, the motor speed follows the V/F factor.	1 = 1 V
6009	BOOST FACTOR	Defines the factor at which the inverter functions the best. This parameter is effective when DC voltage is above the value in 6008 BOOST VOLT.	100 = 1 V
6016	MIN LOAD CURRENT	Minimum load current for dry run protection of inverter. When actual motor current is less than this value for the time defined in 6017 DRY RUN TRP TIME, the inverter trips due to dry run fault.	1 = 1 A
6017	DRY RUN TRP TIME	Dry run trip time in minutes. See 6016 MIN LOAD CURRENT.	1 = 1 min
6018	DRY RUN RST TIME	Auto reset time in case of a dry run fault. The inverter auto starts after this reset time.	1 = 1 min
6019	FAULT RESET TIME	Auto restart time of the solar inverter in minutes after the inverter tripped due to under-voltage fault, PV cell maximum voltage fault or when actual speed decreases below the minimum motor speed defined in <i>6006 PUMP MINIMUM SPD</i> .	1 = 1 min





## ■ Group 61: FLOW CALCULATION

This group defines the parameter codes for flow calculation.

Index	Name/Value	Description	FbEq
6101	PQ CURVE P1	Input power of pump in kW at point 1 on the PQ performance curve.   <p>For description of PQ curve, see section <a href="#">Flow calculation</a>, page 34.</p>	10 = 1 kW
6102	PQ CURVE P2	Input power of pump at point 2 on the PQ curve.	10 = 1 kW
6103	PQ CURVE P3	Input power of pump at point 3 on the PQ curve.	10 = 1 kW
6104	PQ CURVE P4	Input power of pump at point 4 on the PQ curve.	10 = 1 kW
6105	PQ CURVE P5	Input power of pump at point 5 on the PQ curve.	10 = 1 kW
6111	PQ CURVE Q1	Flow rate in cubic meters per hour at point 1 on the PQ curve.	10 = 1 m³/h
6112	PQ CURVE Q2	Flow rate in cubic meters per hour at point 2 on the PQ curve.	10 = 1 m³/h
6113	PQ CURVE Q3	Flow rate in cubic meters per hour at point 3 on the PQ curve.	10 = 1 m³/h
6114	PQ CURVE Q4	Flow rate in cubic meters per hour at point 4 on the PQ curve.	10 = 1 m³/h
6115	PQ CURVE Q5	Flow rate in cubic meters per hour at point 5 on the PQ curve.	10 = 1 m³/h
6121	PUMP EFFICIENCY	Efficiency of the pump.	1 = 1%



Index	Name/Value	Description	FbEq
6122	PUMP NOM SPEED	Nominal speed of the pump. This value is used for flow calculation in <a href="#">0183 CALCULATED FLOW</a> , page 39.	1 = 1 rpm
6123	CALC LOW SPEED	Minimum speed limit below which flow is not calculated.	1 = 1 rpm
6124	FLOW CAL GAIN	Flow calculation gain for possible calculation correction.	100 = 1
6131	RESET FLOW	Enables manual reset of actual signals in <a href="#">0184 TODAY FLOW</a> , page 39 and <a href="#">0185 CUMULA YEAR FLOW</a> , page 39.	1 = 1



## ■ Group 99: START-UP DATA


This group defines special start-up data required to set up the inverter and to enter motor information.

Index	Name/Value	Description	FbEq
9901	LANGUAGE	Selects the panel display language on the assistant control panel. <b>Note:</b> With the ACS-CP-D assistant control panel, the following languages are available: English (0), Chinese (1), Korean (2) and Japanese (3).	1 = 1
	ENGLISH	British English	0
	ENGLISH (AM)	American English	1
	DEUTSCH	German	2
	ITALIANO	Italian	3
	ESPAÑO	Spanish	4
	PORTUGUES	Portuguese	5
	NEDERLANDS	Dutch	6
	FRANÇAIS	French	7
	DANSK	Danish	8
	SUOMI	Finnish	9
	SVENSKA	Swedish	10
	RUSSKI	Russian	11
	POLSKI	Polish	12
	TÜRKÇE	Turkish	13
	CZECH	Czech	14
	MAGYAR	Hungarian	15
	ELLINIKA	Greek	16

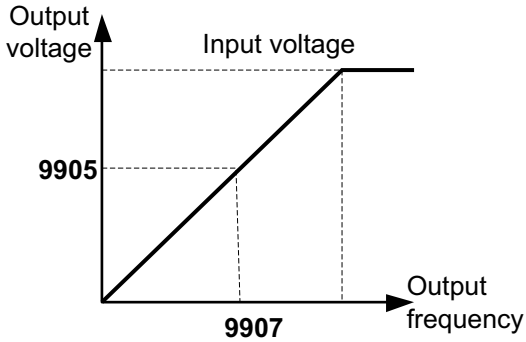



Index	Name/Value	Description	FbEq
9902	APPL MACRO	Selects the application macros. See <i>Application macros in ACS355 User's manual (3AUA0000066143 [English])</i> .	1 = 1
	ABB STANDARD	Standard macro for solar mode.	1
	3-WIRE	3-wire macro for constant speed applications.	2
	ALTERNATE	Alternate macro for start forward and start reverse applications.	3
	MOTOR POT	Motor potentiometer macro for digital signal speed control applications.	4
	HAND/AUTO	Hand/Auto macro used when two control devices are connected to the inverter: <ul style="list-style-type: none"> <li>• Device 1 communicates through the interface defined by external control location EXT1.</li> <li>• Device 2 communicates through the interface defined by external control location EXT2.</li> </ul> <b>Note:</b> Either EXT1 or EXT2 is active at a time. The switching between EXT1 or EXT2 happens through digital input.	5
	PID CONTROL	PID control for applications in which the inverter controls a process value. <b>Example:</b> For pressure controlled by the inverter running a pressure boost pump, the measured pressure and reference pressure are connected to the inverter.	6
	TORQUE CTRL	Torque control macro.	8
	AC500 MODBUS	AC500 PLC macro. See <i>Modbus macro in ACS355 User's manual (3AUA0000066143 [English])</i> .	10
	LOAD FD SET	FlashDrop parameter values as defined by the FlashDrop file. For Parameter view, see 16 <i>SYSTEM CONTROLS</i> in <i>ACS355 User's manual (3AUA0000066143 [English])</i> . FlashDrop is an optional device for fast copying of parameters to unpowered inverters. FlashDrop allows easy customization of the parameter list. For example, the selected parameters can be hidden. For more information, see <i>MFD-01 FlashDrop user's manual (3AFE86591074[English])</i> .	31
USER S1 LOAD	User 1 macro loaded into use. <b>Note:</b> Before loading, check that the saved parameter settings and the motor model are suitable for the application.	0	



Index	Name/Value	Description	FbEq
	USER S1 SAVE	Save User 1 macro. Stores the current parameter settings and the motor model.	-1
	USER S2 LOAD	User 2 macro loaded into use. <b>Note:</b> Before loading, check that the saved parameter settings and the motor model are suitable for the application.	-2
	USER S2 SAVE	Save User 2 macro. Stores the current parameter settings and the motor model.	-3
	USER S3 LOAD	User 3 macro loaded into use. <b>Note:</b> Before loading, check that the saved parameter settings and the motor model are suitable for the application.	-4
	USER S3 SAVE	Save User 3 macro. Stores the current parameter settings and the motor model.	-5
9903	MOTOR TYPE	Selects the motor type. <b>Note:</b> Value cannot be changed while the inverter is operating.	1 = 1
	<i>AM</i>	Asynchronous motor	1
	<i>PMSM</i>	Permanent magnet synchronous motor	2
9904	MOTOR CTRL MODE	Selects the motor control modes.  <b>WARNING!</b> The VECTOR:TORQ motor control mode is not functional for solar mode.	1 = 1
	VECTOR: SPEED	Vector control mode without sensor. Reference 1 = Reference speed in RPM Reference 2 = Reference speed in %. Absolute maximum speed is 100%, which is equal to the value in <i>2002 MAXIMUM SPEED</i> (or 2001 MINIMUM SPEED if the absolute value of the minimum speed is greater than maximum speed).	1
	SCALAR: FREQ	Scalar control mode. Reference 1 = Reference frequency in Hz. Reference 2 = Reference frequency as %. The absolute maximum frequency is 100%, equal to the value in <i>20.08 MAXIMUM FREQ</i> (or <i>20.07 MINIMUM FREQ</i> if the absolute value of the minimum speed is greater than the maximum speed).	3



Index	Name/Value	Description	FbEq
9905	MOTOR NOM VOLT	<p>Defines the motor nominal voltage.</p> <ul style="list-style-type: none"> <li>For AM, nominal voltage is the value displayed on the motor name plate.</li> <li>For PMSM, nominal voltage is back emf voltage at nominal speed.</li> </ul> <p>The inverter cannot supply the motor with a voltage greater than the input voltage.</p> <p><b>Note:</b> The output voltage is not limited by the nominal motor voltage, but increases linearly up to the value of the input voltage.</p> <p><i>Motor nominal voltage plot</i></p>  <p><b>Warning!</b> The stress on the motor insulations depends on the inverter supply voltage. This also applies when the motor voltage rating is lower than the inverter rating and the supply voltage of the inverter.</p> <p>The rms voltage can be limited to the motor nominal voltage by setting the maximum frequency of the inverter in 2008 to the motor nominal frequency.</p>	-
	200 V units: 46...345 V 400 V E units: 80...600 V 400 V U units: 92...690 V	Voltage	1 = 1 V
9906	MOTOR NOM CURR	Defines the nominal motor current as displayed on the motor rating plate.	-
	0.2...2.0 I <sub>2N</sub>	Current	1 = 0.1 A
9907	MOTOR NOM FREQ	<p>Defines the nominal motor frequency at which the output voltage equals the motor nominal voltage:</p> $\text{FieldWeakeningPoint} = \frac{\text{NominalFrequency} \times \text{SupplyVoltage}}{\text{MotorNominalVoltage}}$	-
	0.0...600.0 Hz	Frequency	1 = 0.1 Hz

Index	Name/Value	Description	FbEq
9908	MOTOR NOM SPEED	Defines the nominal motor speed as displayed on the motor rating plate.	-
	50...30000 rpm	Speed	1 = 1 rpm
9909	MOTOR NOM POWER	Defines the nominal motor power as displayed on the motor rating plate.	-
	0.2...3.0 $P_N$ kW	Power	1 = 0.1 kW/ 0.1 hp
9910	ID RUN	Controls self-calibration process called Motor ID run. During this process, the inverter operates the motor and makes measurements to identify motor characteristics and create a model used for internal calculations.	1 = 1
	OFF/IDMAGN	The motor ID run process is not run. Identification magnetization is performed depending on the motor control mode. See <a href="#">9904 MOTOR CTRL MODE</a> , page 53. In identification magnetization, the motor model is calculated at first start by magnetizing the motor for 10 to 15 seconds at zero speed (motor not rotating, except that a permanent magnet synchronous motor can rotate a fraction of a revolution). The model is recalculated always at start after motor parameter changes. <ul style="list-style-type: none"> <li>Parameter 9904 = 1 (VECTOR: SPEED): Identification magnetization is performed.</li> <li>Parameter 9904 = 3 (SCALAR: FREQ): Identification magnetization is not performed.</li> </ul> <b>Note:</b> The parameter 9904 = 2 (VECTOR: TORQ) is not functional in the ACS355 solar pump inverter.	0
	ON	ID run for control accuracy. The ID run takes about one minute. An ID run is effective when: <ul style="list-style-type: none"> <li>parameter 9904 = 1 [VECTOR: SPEED] is used</li> <li>operation point is near zero speed</li> </ul> <b>Note:</b> Ensure the following points: <ul style="list-style-type: none"> <li>De-couple the motor from the driven equipment.</li> <li>Check the direction of rotation of the motor before starting the ID run. During the run, the motor rotates in the forward direction.</li> <li>If motor parameters are changed after ID run, repeat the ID run.</li> </ul>  <b>WARNING!</b> The motor operates at up to approximately 50...80% of the nominal speed during the ID run. <b>ENSURE THAT IT IS SAFE TO RUN THE MOTOR BEFORE PERFORMING THE ID RUN!</b>	1



Index	Name/Value	Description	FbEq
9912	MOTOR NOM TORQUE	Calculated motor nominal torque in N-m. (Calculation is based on parameter 9900 MOTOR NOM POWER and 9908 MOTOR NOM SPEED values).	-
	0...3000.0 N-m	Read-only	1 = 0.1 N-m
9913	MOTOR POLE PAIRS	Calculated motor pole pair numbers. (Calculation is based on parameter 9907 MOTOR NOM FREQ and 9908 MOTOR NOM SPEED values).	-
	-	Read-only	1 = 1
9914	PHASE INVERSION	Inverts two phases in the motor cable. This changes the direction of the motor rotation without exchanging the cable positions of two motor cable phase conductors at the drive output terminals or at the motor connection box.	-
	NO	Phases not inverted	0
	YES	Phases inverted	1





## 7

# Fault tracing

## About this chapter

This chapter tells how to reset faults and view the fault history. It also lists the fault codes specific to ACS355 solar pump inverter.

## Safety



**WARNING!** Only qualified electricians are allowed to maintain the inverter. Read the safety instructions in the chapter Safety, page before you work on the inverter.

For general fault tracing information of ACS355 firmware, refer the following topics in *ACS355 User's manual (3AUA0000066143[English])*:

- Alarm messages generated by the drive
- Alarms generated by the basic control panel
- Fault messages generated by the drive

## Alarm and fault indications

A fault is indicated with a red LED. See section LEDs in *ACS355 User's manual (3AUA0000066143[English])*.



An alarm or fault message on the panel display indicates an abnormal inverter status. Using the information given in this chapter, most alarm and fault causes can be identified and corrected. If not, contact your local ABB representative.

To display the alarms on the control panel, set parameter 1610 DISPLAY ALARMS to value 1 (YES). See 16 SYSTEM CONTROLS in *ACS355 User's manual (3AUA0000066143[English])*.



The four-digit code number in parenthesis after the fault is for the fieldbus communication. See chapters *Fieldbus control with embedded fieldbus* and *Fieldbus control with fieldbus adapter* in *ACS355 User's manual (3AUA0000066143[English])*.

## How to reset

During a fault condition, you can reset the inverter by pressing the keypad key  (basic control panel) or  (assistant control panel) through digital input or fieldbus or by switching off the supply voltage for a while. The source for the fault reset signal is selected by parameter 1604 FAULT RESET SEL. You can restart the motor after the fault is removed.

## Fault history

The fault history stores all the detected faults. The latest faults are stored together with the time stamp.

Parameters 0401 LAST FAULT, 0412 PREVIOUS FAULT 1 and 0413 PREVIOUS FAULT 2 store the most recent faults. Parameters 0401...0409 show the inverter operation data at the time the latest fault occurred. The assistant control panel provides additional information about the fault history.

For more information, see section *Fault logger mode* in *ACS355 User's manual (3AUA0000066143[English])*.

## Fault messages

The following faults messages are generated by the ACS355 solar pump inverter.

Code	Fault	Cause	What to do
210	DRY RUN FAULT	The inverter consumes less current than the current set in <a href="#">6016 MIN LOAD CURRENT</a> . This condition occurs when there is no water flowing in the pump.	<ul style="list-style-type: none"> <li>• Check the availability of water at the pump inlet.</li> <li>• Check for any blockage in the pump.</li> </ul>
216	PV MAX VOLT	The DC bus voltage in the inverter is above the voltage set in <a href="#">6005 PV CELL MAX VOLT</a> .	<ul style="list-style-type: none"> <li>• Check the number of PV cells connected in series.</li> <li>• Ensure that voltage is less than the voltage set in <a href="#">6005 PV CELL MAX VOLT</a>.</li> </ul> Maximum allowed voltage: <ul style="list-style-type: none"> <li>• 400 V unit: 800 V</li> <li>• 200 V unit: 400 V</li> </ul>



## Alarm messages

The following alarm messages are generated by the ACS355 solar pump inverter.

Code	Fault	Cause	What to do
2036	LOW SPEED	This alarm occurs when the speed reference calculated by internal MPPT algorithm is less than the pump minimum speed set in <i>6006 PUMP MINIMUM SPD.</i>	Check the pump minimum speed set in <i>6006 PUMP MINIMUM SPD.</i>
2037	START DELAY ACTIVE	This alarm occurs when the fault auto reset delay is active. The drive is in standby mode until the fault reset time is complete.	Check the time set in <i>6019 FAULT RESET TIME.</i>





## Further information

### Product and service inquiries

Address any inquiries about the product to your local ABB representative, quoting the type designation and serial number of the unit in question. A listing of ABB sales, support and service contacts can be found by navigating to [www.abb.com/searchchannels](http://www.abb.com/searchchannels).

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