• 15R00SDB100 •

# SOLARDRIVE PLUS

AC DRIVE FOR SOLAR PUMPING APPLICATIONS

# PROGRAMMING GUIDE

Agg. 14/05/2020
R. 00
SW Ver. 4.10x

***English***

- This manual is integrant and essential to the product. Carefully read the instructions contained herein as they provide important hints for use and maintenance safety.
- This product is to be used only for the purposes it has been designed to. Other uses should be considered improper and dangerous. The manufacturer is not responsible for possible damages caused by improper, erroneous and irrational uses.
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# USER MANUALS MENTIONED IN THIS PROGRAMMING GUIDE

The following User Manuals from Enertronica Santerno are mentioned throughout this Programming Guide:

- **15P00SDB100** Solardrive Plus – Installation Manual
- **15W0102B300** Safe Torque Off Function – Application Manual
- **15W0102B500** Motor Drives Accessories - User Manual
- **15G0851B100** DATA LOGGER ES851 - Programming Guide
- **15P4600B100** BRIDGE MINI - User manual
- **15J0901B100** RemoteDrive DRIVE REMOTE CONTROL - User Manual

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# 1. GENERAL INFORMATION

## 1.1. General Information on the Product

The **Solardrive Plus** drives are designed to be utilized in pumping applications exploiting the energy produced by a PV field.

They may be powered directly from a DC current PV field or the three-phase grid, or from an AC genset. They control an electric submersible pump (ESP).

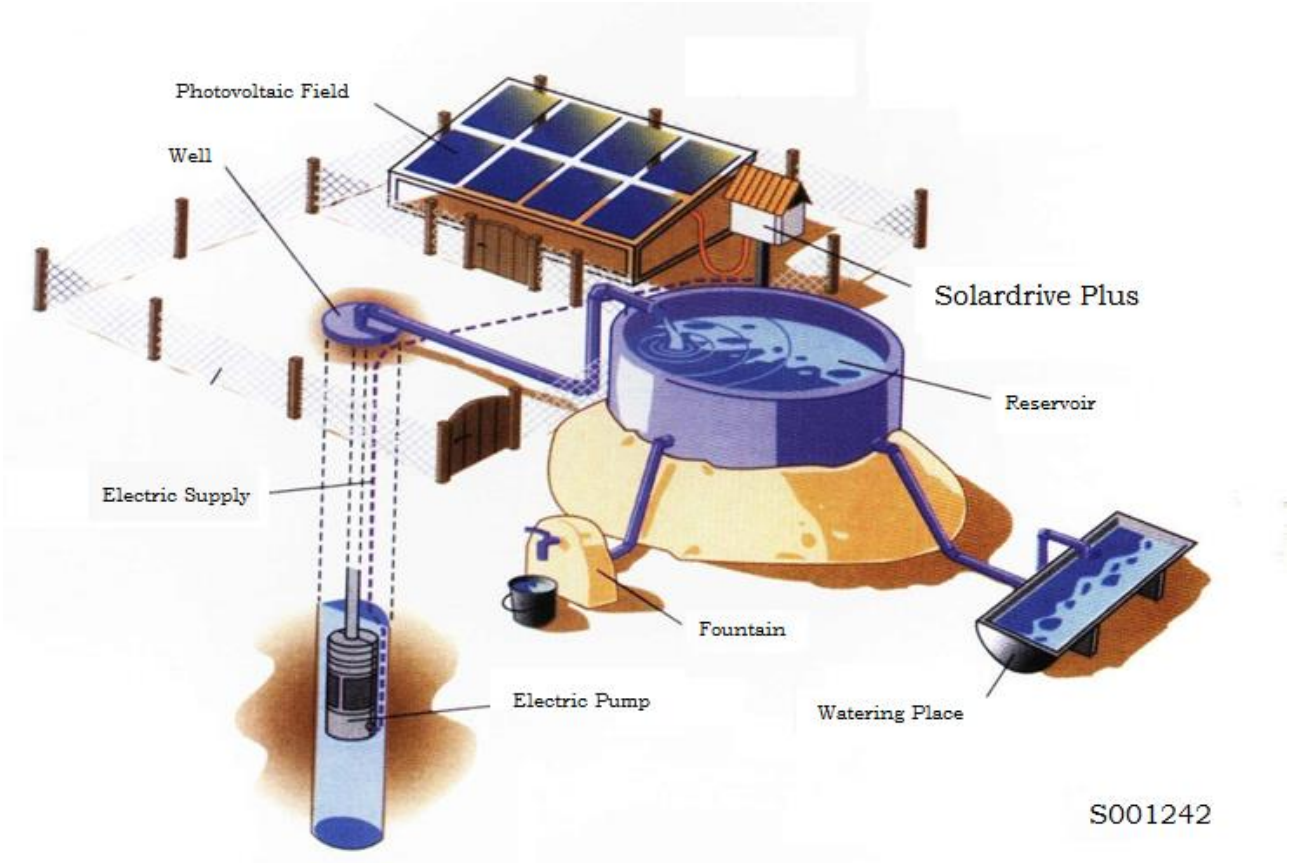



**Figure 1: Solardrive Plus application**

The **Solardrive Plus** line includes the following products:

### 1.1.1. Solardrive Plus

They are stand-alone inverters, which must be mounted inside a box or cabinet by the customer together with

- all the safety devices,
- the components required for the connection to the PV field and
- the components required for the connection to the pump.

### 1.1.2. Solardrive Plus Box

The **Solardrive Plus Box** models consist of a Solardrive Plus housed in a box.

This is a complete solution for medium-low power ranges, comprising the drive and all the safety devices, the components required for the connection to the PV field and the components required for the connection to the pump.


**Figure 2: Solardrive Plus Box**

The **Solardrive Plus Box product** line is suitable for motor mechanical power ratings ranging from 3 to 22 kW, with nominal currents up to 52 A, and output voltages up to 415 Vac 60 Hz.

| Size | Nominal current | | Applicable motor power | | | |
|---|---|---|---|---|---|---|
| | at 40°C | at 50°C | at 40°C | | at 50°C | |
| | A | A | kW | HP | kW | HP |
| 0018 | 17 | 13.6 | 5.5 | 7.5 | 4 | 5.5 |
| 0021 | 25 | 25 | 11 | 15 | 11 | 15 |
| 0024 | 40 | 40 | 15 | 20 | 15 | 20 |
| 0032 | 52 | 41.6 | 22 | 30 | 18.5 | 25 |

### 1.1.3. Solardrive Plus Cabinet

The **Solardrive Plus Cabinet** models consist of a Solardrive Plus housed in a cabinet.

This is a complete solution for large power ranges, comprising the drive and all the safety devices, the components required for the connection to the PV field and the components required for the connection to the pump.

The **Solardrive Plus Cabinet** line is suitable for motor mechanical power ratings ranging from 26 to 315 kW, with nominal currents up to 640 A, and output voltages up to 415 Vac 60 Hz.

| Taglia | Nominal current | | Applicable motor power | | | |
|---|---|---|---|---|---|---|
| | at 40°C | at 50°C | at 40°C | | at 50°C | |
| | A | A | kW | HP | kW | HP |
| 0051 | 80.0 | 72.0 | 37 | 50 | 30 | 40 |
| 0069 | 105.0 | 84.0 | 51 | 70 | 37 | 50 |
| 0088 | 150.0 | 150.0 | 75 | 100 | 75 | 100 |
| 0164 | 230.0 | 184.0 | 110 | 150 | 92 | 125 |
| 0201 | 330.0 | 264.0 | 170 | 230 | 132 | 180 |
| 0259 | 400.0 | 320.0 | 190 | 260 | 170 | 230 |
| 0401 | 640.0 | 512.0 | 315 | 430 | 240 | 330 |

The Solardrive Plus and systems are designed and manufactured in Italy by Enertronica Santerno S.p.A.

## 1.2. Scope of this Manual

This manual covers:

- All products of the **Solardrive Plus** line.

## 1.3. For Whom this Manual is Intended

This manual must be read by:

- Installers
- Operators
- Plant manager

# 2. PROGRAMMING

## 2.1. General specifications

### 2.1.1. Overview

This section provides any information required to setup and monitor the drives of the Solardrive Plus series manufactured by Enertronica Santerno SpA.

Setup/monitoring may be obtained using one of the following options:

- Display/keypad unit;
- Serial link through RS485 standard port.

Any information sent to/from the drive via the display/keypad unit may be obtained also via serial link using the RemoteDrive software application offered by Enertronica Santerno

RemoteDrive allows the following functions: image acquisition, keypad simulation, oscilloscope functions and multifunction tester, data logger, table compiler including history data, parameter setup and data reception-transmission-storage from and to a calculator, scan function for the automatic detection of the connected drives (up to 247 drives may be connected).

You can also create your own dedicated software via serial communication link. This manual provides any information concerning addressing (Address field) and scaling (Range field) for the drive interfacing.

### 2.1.2. Menus and Submenus

This User Manual (Programming Guide) is divided into different Menus. Their sequence is the same as their display sequence in the display/keypad and the RemoteDrive software

Programming parameters and Measure parameters are divided into:

**Mxxx** Measures (always Read Only):

| Mxxx | Description | |
|---|---|---|
| Range | Drive representation<br>(integer) | Display on the display/keypad and the RemoteDrive<br>(may be a decimal figure)<br>plus unit of measure |
| Active | Type of control the measure is related to | |
| Address | Modbus address which the measure can be read from<br>(integer) | |
| Function | Measure description | |

**Pxxx** Parameters (always R/W):

| Pxxx | Description | |
|---|---|---|
| Range | Drive representation<br>(integer) | Display on the display/keypad and the RemoteDrive<br>(may be a decimal figure)<br>plus unit of measure |
| Default | Factory-setting of the parameter<br>(as represented for the drive) | Factory-setting of the parameter<br>(as displayed)<br>plus unit of measure |
| Level | User level (BASIC / ADVANCED / ENGINEERING) | |
| Address | Modbus address which the parameter can be read from<br>(integer) | |
| Control | This optional field is displayed when a parameter is not active for all types of motor controls (IFD / VTC / FOC) | |
| Function | Parameter description | |

**Cxxx** Parameters (Read Only when the drive is running and the motor is operating; R/W when the drive is in stand-by or in Run, but the motor is stopped).

| Cxxx | Description | |
|---|---|---|
| **Range** | Drive representation<br>(integer) | Display on the display/keypad and the RemoteDrive<br>(may be a decimal figure)<br>plus unit of measure |
| **Default** | Factory-setting of the parameter<br>(as represented for the drive) | Factory-setting of the parameter<br>(as displayed)<br>plus unit of measure |
| **Level** | User level (BASIC / ADVANCED / ENGINEERING) | |
| **Address** | Modbus address which the parameter can be read from/written to<br>(integer) | |
| **Control** | This optional field is displayed when a parameter is not active for all types of motor controls (IFD / VTC / FOC) | |
| **Function** | Parameter description | |

**Rxxx** Parameters (Read Only when the drive is running and the motor is operating; R/W when the drive is in stand-by or in Run, but the motor is stopped).

| Rxxx | Description | |
|---|---|---|
| **Range** | Drive representation<br>(integer) | Display on the display/keypad and the RemoteDrive<br>(may be a decimal figure)<br>plus unit of measure |
| **Default** | Factory-setting of the parameter<br>(as represented for the drive) | Factory-setting of the parameter<br>(as displayed)<br>plus unit of measure |
| **Level** | User level (BASIC / ADVANCED / ENGINEERING) | |
| **Address** | Modbus address which the parameter can be read from/written to<br>(integer) | |
| **Control** | This optional field is displayed when a parameter is not active for all types of motor controls (IFD / VTC / FOC) | |
| **Function** | Parameter description | |

*NOTE*

*Unlike **Cxxx** parameters, **Rxxx** parameters become active only after the drive has been switched off and switched on again, or after resetting its control board by pressing the **RESET** button for more than 5 seconds*

**Ixxx** Inputs. These are not parameters, but inputs (the values allocated to these inputs are not stored to non-volatile memory. Ixxx value is always 0 when the drive is powered on).

| Ixxx | Description | |
|---|---|---|
| **Range** | Drive representation (integer) | Display on the display/keypad and the RemoteDrive (may be a decimal figure) plus unit of measure |
| **Level** | User level (BASIC / ADVANCED / ENGINEERING) | |
| **Address** | Modbus address which the input can be read from/written to (integer) | |
| **Control** | This optional field is displayed when a parameter is not active for all types of motor controls (IFD / VTC / FOC) | |
| **Function** | Input description | |

*NOTE*

*Use the **ESC** key to enter the value of an **Ixxx** input.*
*If the **SAVE/ENTER** key is used, **W17 SAVE IMPOSSIBLE** (warning) is displayed.*

*NOTE*

*When changing a **Pxxx** or **Cxxx** parameter via the display/keypad, you may activate its new value immediately (flashing cursor) or when you quit the programming mode (fixed cursor).*
*Typically, numeric parameters immediately come to effect, while alphanumeric parameters have a delayed effect.*

*NOTE*

*When changing a **Pxxx** or **Cxxx** parameter via the RemoteDrive, the drive will immediately use the new parameter value.*

### 2.1.3. Alarms and Warnings

The last part of this User Manual covers alarms **(Axxx)** and warnings **(Wxxx)** displayed by the drive:

| Axxx | Description |
|---|---|
| **Description** | |
| **Event** | |
| **Possible cause** | |
| **Solution** | |

## 2.2. Using the Display/Keypad unit

### 2.2.1. Overview

This section contains several examples about navigating in the display/keypad unit and the UPLOAD and DOWNLOAD functions of the programming settings of the drive when using the keypad.

For any details on special settings of the Display/keypad module (contrast, backlight, etc…) and for details concerning custom navigation through the root page, the Keypad measurements and the Status page and the custom PID unit of measure, please contact Enertronica Santerno S.p.A.

The menu tree is detailed in section 2.2.2.

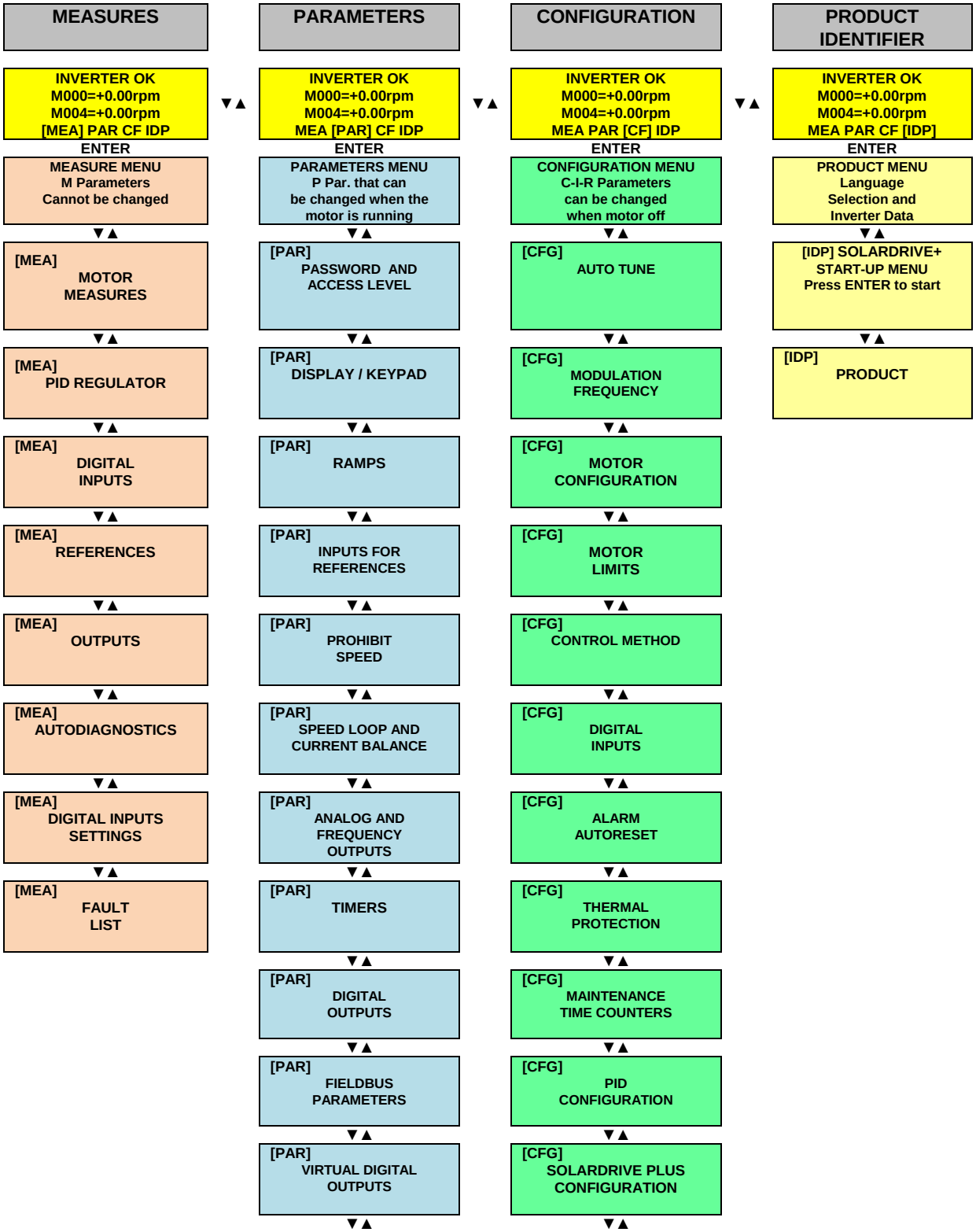
The complete tree structure is displayed, but the actual structure depends on the user level set in **P001** and on the implemented programming. When **P264** = Linear (linear navigation), the parameters displayed are no longer grouped into menus, and you can scroll through all parameters using the ▲ and ▼ keys.

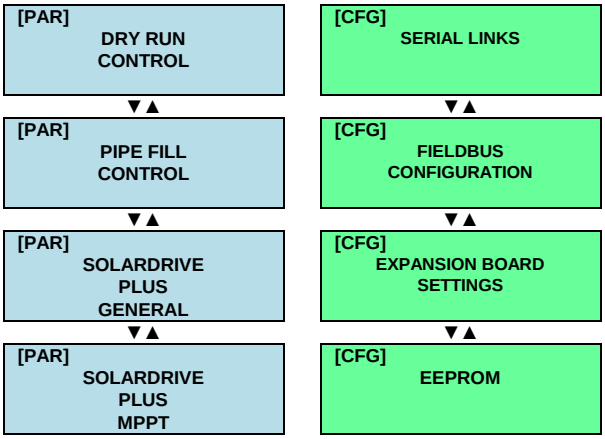
When **P264** = Modified Pars. Only, only the parameters having different values than the factory settings are displayed, and you can scroll through all parameters using the ▲ and ▼ keys.

The sections below show how to use function keys to navigate through the parameters and to change parameter values (**P264** = BY MENU).

The function keys and their functionality are described below.

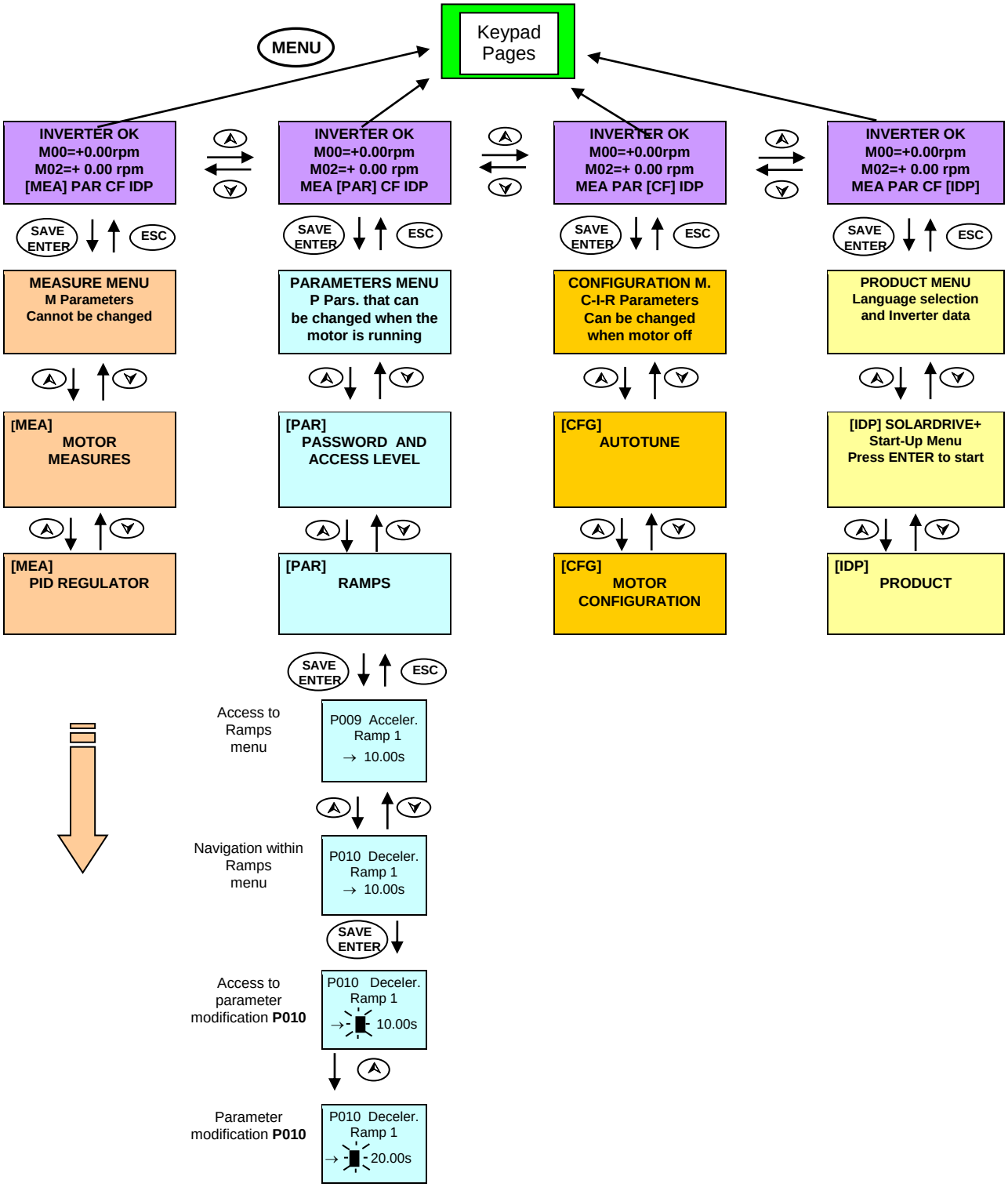
## 2.2.2. Menu Tree




[PAR]
DRY RUN
CONTROL
▼▲
[PAR]
PIPE FILL
CONTROL
▼▲
[PAR]
SOLARDRIVE
PLUS
GENERAL
▼▲
[PAR]
SOLARDRIVE
PLUS
MPPT
[CFG]
SERIAL LINKS
▼▲
[CFG]
FIELDBUS
CONFIGURATION
▼▲
[CFG]
EXPANSION BOARD
SETTINGS
▼▲
[CFG]
EEPROM

### 2.2.3. Navigation

**Figure 3: Navigation example**




If the **ESC** key is pressed to quit, the new parameter value will be acknowledged but not saved to non-volatile memory, and will therefore be lost at power off. Press **SAVE/ENTER** to confirm parameter alteration

### 2.2.4. Parameter Modification

Factory setting allows parameter modification. The parameters included in the Parameters Menu (**Pxxx** parameters) can be changed at any moment, whereas the parameters included in the Configuration Menu (**Cxxx**, **Rxxx**, **Ixxx** parameters) can be changed only when the motor is stopped.

For safer operating conditions, the configuration parameters must be changed only when the drive is disabled (the **ENABLE-A** and **ENABLE-B** commands are inactive): to do so, **P003** must be set to **0 (stand-by only)**.

To disable parameter changes, just change **P000** (write enable) and save its new setting. **P000** and **P002** (password) are both factory-set to 1. If **P000=0**, an inexpert user cannot change parameter values, but if **P000=1,** an advanced user will be able to change the parameter values.

For even safer operating conditions, you can change the password stored in **P002**; in that case, you must set **P000** accordingly.

*NOTE*

*Note down and keep at hand the value set in **P002**.*

Press the **SAVE/ENTER** key for parameter modifications; when a flashing cursor appears, press ▲ and ▼ to change the parameter value. Do one of the following to quit the editing mode:

- Press **ESC** with **P269b** = 0: [No] → the parameter value used by the drive is changed and is maintained until the drive is shut down, then the value is lost when the drive is powered on again.
- Press **ESC** with **P269b** =1: [YES] → the previous value is restored.
- **Press SAVE/ENTER** → the parameter value is used by the inverter and stored to non-volatile memory and is not deleted when the drive is shut down.

Inputs (**Ixxx**) cannot be saved to non-volatile memory and are automatically set to their default values.

**Rxxx** parameters become active only when the drive control board has been reset by pressing the **RESET** key for a few seconds or by switching off the drive

### 2.2.5. Programming the Root Page

When the drive is turned on, the Root page is displayed as the starting page. The Root page allows you to access the main menus (Measures, Parameters, Configuration, Product ID) or to shift to the Keypad pages using the **MENU** key.

The first row shows the drive status (see Table 15).

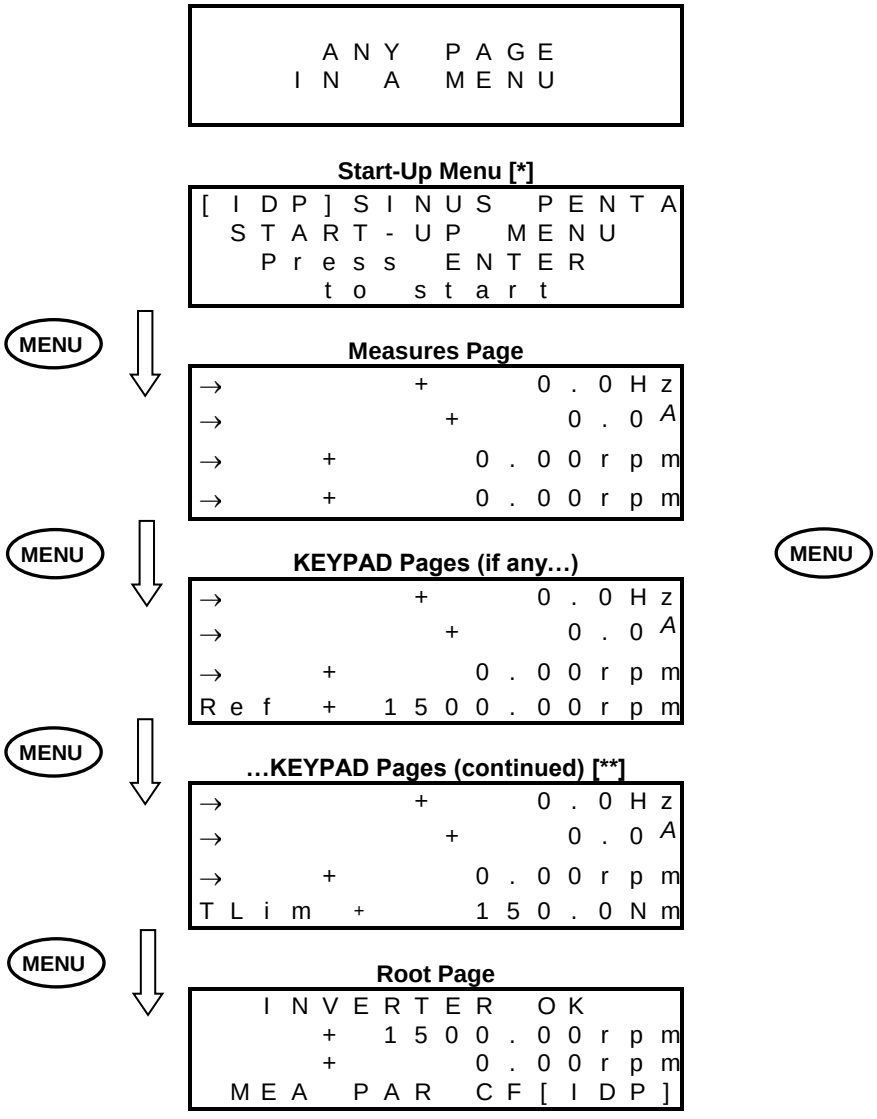
**Root page**

```
  I N V E R T E R   O K
      +  1 5 0 0 . 0 0 r p m
      +            0 . 0 k W
 M E A [ P A R ] C F   I D P
```

You can customise the root page using parameter **P265** (contact Enertronica Santerno).

### 2.2.6. Using the MENU Key

The **MENU** key allows going to the next menu. From the Root page, press the MENU key to enable circular navigation.




*NOTE*

*The Start-Up menu is available only if **P265**=3:Start.*

*NOTE*

*The Keypad pages are available only if the relevant references / feedback / limits are activated.*

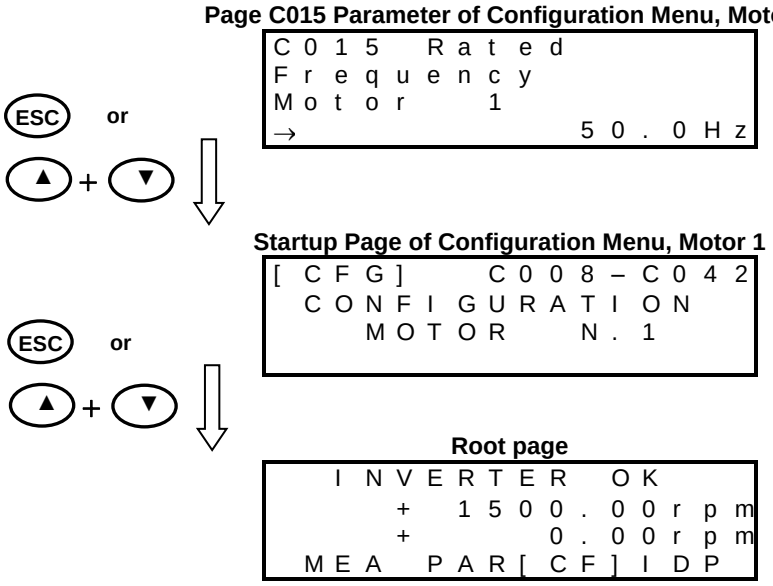
### 2.2.7. ESC Key

Press the **ESC** key and to do the following:

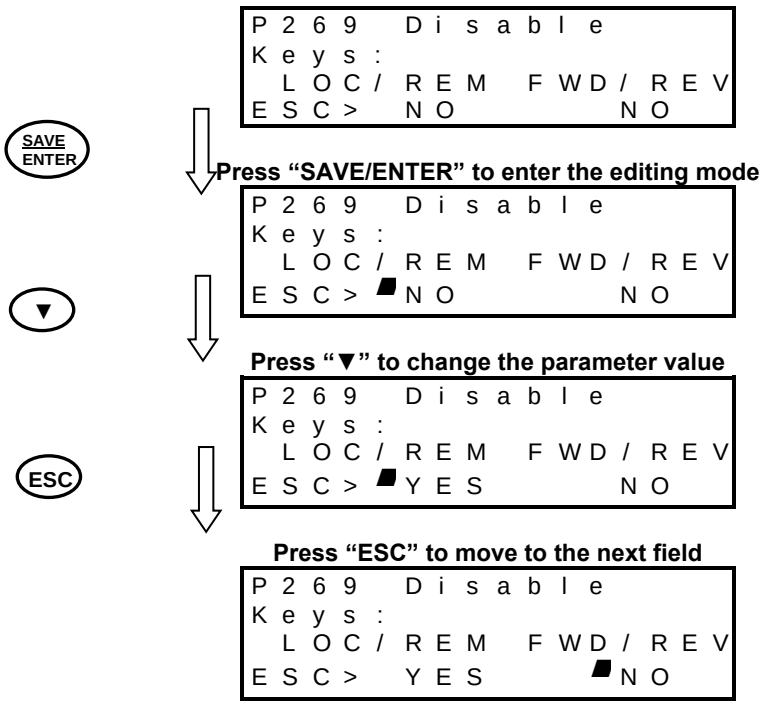
1. move up one level in the menu tree;
2. go to the next field when changing a parameter having multiple value fields;
3. quit the editing mode without storing the value to EEPROM, or go back to the previous value based on **P269b.**

1. In the example below, starting from parameter **C015** in the Motor Configuration Menu (section 2.6.4) inside the Configuration Menu, you can move up to the Root page by pressing the **ESC** key.

**Page C015 Parameter of Configuration Menu, Motor 1**




2. When using the **SAVE/ENTER** key to change a parameter including multiple fields (ESC> is displayed for the **ESC** key) press **ESC** to move to the next field. In the example below, 2 programmable fields are displayed for **P269**:



3. Press the following keys to quit the last page displayed:

- **ESC** without saving the value to EEPROM if **P269b** = **0:[No]** → press **ESC** to confirm the parameter, that will not be saved (the previous value will be restored at next power on);
- **ESC** without saving the value to EEPROM if **P269b** = **1:[No]** → press **ESC** to restore the previous value;
- **SAVE/ENTER** (new values are saved to Eeprom).

### 2.2.8. RESET Key (Alarm and Control Board Reset)

The **RESET** key is used to reset the drive after an alarm trips and the cause responsible for the alarm has been removed.

Press the **RESET** key for **more than 5 seconds to reset the control board and reinitiate it.** This procedure may be useful when changes made to **Rxxx** parameters (which activate only after resetting the equipment) must immediately come to effect, with no need to switch off the drive.

### 2.2.9. TX/RX Key (Download/Upload from/to the Keypad)

Use the keypad to perform the following functions:

1. UPLOAD (parameters stored in the drive are copied to the display/keypad);
2. DOWNLOAD (parameters stored in the keypad are copied to the drive).

Press the **TX/RX** key to go to the UPLOAD page; press the **TX/RX** key again to toggle between the UPLOAD and DOWNLOAD pages.

***WARNING***

***A Warning is displayed (one among W41 to W46) when trying to DOWNLOAD parameters to a drive whose SW Version, IDP, PIN or current/voltage classes are different from those of the drive previously used for parameter UPLOAD. In that case, download is not allowed.***

*NOTE*

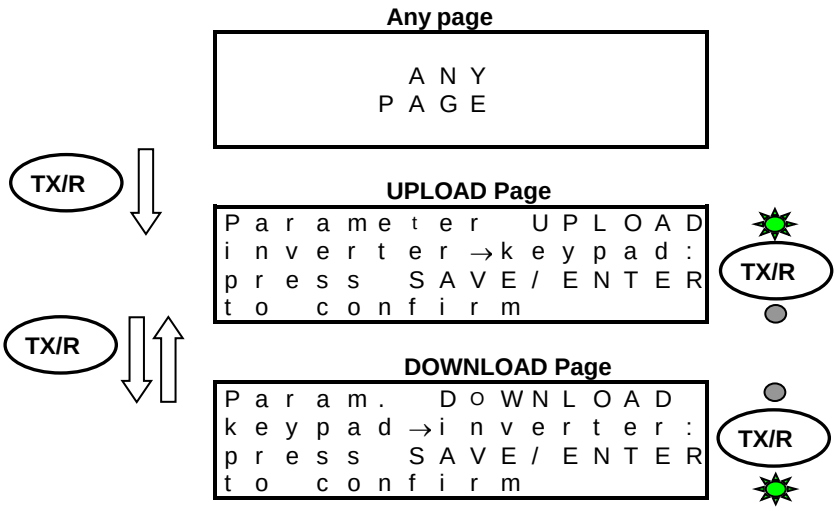
*The DOWNLOAD function allows the parameters stored in the keypad to be copied to the drive. However, parameters are not stored to the non-volatile memory of the drive.*

*To store the downloaded parameters to the non-volatile memory of the drive, go to the EEPROM menu and execute a "Save Work" command once the download procedure is complete. Otherwise, when power is lost, the parameters downloaded to the drive are lost.*

The **TX/RX** key is disabled under the following conditions:

- no password is entered in **P000**
- the OPERATOR mode is activated with the **MENU** Key (**P264b** = OPERATOR)
- the drive is running.

In the example below, you can go to the UPLOAD page from any page (the upper LED starts flashing). If you then press the **TX/RX** key, you can go to the UPLOAD and DOWNLOAD pages.




Press **SAVE/ENTER** from the UPLOAD (/DOWNLOAD) page to confirm UPLOADING (/DOWNLOADING). The relevant LED will come on (fixed light).

If the **SAVE/ENTER** key is not pressed for confirmation within 10 seconds from the selection of the UPLOAD (/DOWNLOAD) page, the starting page is automatically displayed.

While UPLOADING, **W08 UPLOADING (**flashing warning) appears.

If parameters are successfully uploaded, the following warning appears:

**W11 UPLOAD OK**

If not, the **W12 UPLOAD KO** warning appears. Retry parameter upload.

While DOWNLOADING, **W07 DOWNLOADING (**flashing warning) appears.

If parameters are successfully downloaded, the following warning appears:

**W09 DOWNLOAD OK**

If not, alarm **A073** trips, and download must be retried before restarting the drive.

### 2.2.10. LOC/REM Key

To enable the Local/Remote operating mode (Remote sources are command and/or reference sources other than the display/keypad) press the **LOC/REM** key in the display/keypad, or use a digital input configured as **Loc/Rem** (see **C180**).

*NOTE*

*The **LOC/REM** key is enabled when no digital input is configured as **Loc/Rem**, or when a digital input is configured as a **Loc/Rem** button (see **C180a**).*
*The **LOC/REM** key is disabled when a digital input is configured as a **Loc/Rem** selector switch (see **C180a**). For further information, please contact Enertronica Santerno.*

**C148** sets whether toggling between Remote mode and Local mode is activated only when the drive is disabled, or whether toggling from Remote to Local mode does not affect the drive running conditions (bumpless commands), but it does affect the reference. You can also choose to keep running conditions and reference unaffected (any command is bumpless). For more details, please refer to the description of parameter **C148** (Control Method Menu, section 2.6.6).

In LOCAL mode (the L-CMD and L-REF LEDs come on), when drive references and commands are sent via display/keypad, the Keypad page allows changing the given reference using the ▲ and ▼.

When not in LOCAL mode, press the **MENU** key to access the Keypad pages from the root page. Only the Keypad pages relating to the Keypad source will be displayed along with the Measure Keypad page.

Example: Parameter **C147** (Torque Limit Reference Selection) is set to Keypad. From the root page, press the **MENU** key once to display the Measure Keypad page, and press the **MENU** key twice to display the Keypad page relating to the torque limit and allowing changing the torque limit reference using the ▲ and ▼ keys.

The Keypad page allows entering custom measures (see parameters **P268b** to **P268e**, contact Enertronica Santerno).

From the Keypad pages, press the **SAVE/ENTER** key to access the Keypad Help page containing any details about the measures displayed in the Keypad page.

### 2.2.11. SAVE/ENTER Key

The **SAVE/ENTER** key allows selecting a lower level when navigating within the programming menus. It also allows changing a parameter value (to change a parameter value, press the SAVE/ENTER key from the page of the parameter you want to change). An example is given in Figure 3.
From the Keypad pages, the **SAVE/ENTER** key allows accessing the Keypad Help page containing any details about the measures displayed in the Keypad page.

### 2.2.12. START-UP Key

The **START-UP** key goes to the Start Up Menu for the setup of the main parameters of the Solardrive Plus (see section 2.4).

## 2.2.13. Indicator LEDs on the Display/Keypad

Eleven LEDs are located on the keypad, along with a 4-line, 16-character LCD display, a buzzer and 12 function keys. The display shows the parameter values, the diagnostic messages and the variables processed by the drive.
The figure below shows the location of the indicator LEDs and their functionality.

| RUN LED – GREEN | | |
|---|---|---|
| ● | Motor not powered | |
| ✳ | Motor powered, but no torque (idle) | |
| ● | Motor powered and running | |
| **PV OK LED – GREEN** | | |
| ● | DC voltage out of required working range | |
| ● | DC voltage within working range | |
| **ALARM LED – RED** | | |
| ● | Inverter Ok | |
| ● | Alarm tripped | |
| **LIMIT LED – YELLOW** | | |
| ● | No active limit | |
| ● | Voltage or current limit active | |
| **WARNING LED – YELLOW** | | |
| ● | No active Warning | |
| ● | Warning showed on the display | |
| **TX and RX LED – GREEN** | | |
| TX | RX | |
| ● | ● | No parameter transfer in progress |
| ✳ | ● | Download: waiting for confirmation |
| ● | ✳ | Upload: waiting for confirmation |
| ● | ● | Parameter downloading from keypad to inverter |
| ● | ● | Parameter uploading from inverter to keypad |
| **L-CMD LED – GREEN** | | |
| ● | Commands sent from sources other than keypad | |
| ✳ | Commands sent both from keypad and terminal board | |
| ● | Commands sent from keypad only | |
| **L-REF – GREEN** | | |
| ● | Reference sent from sources other than keypad | |
| ✳ | Reference sent both from keypad and terminal board | |
| ● | Reference sent from keypad only | |

| Key | |
|---|---|
| ● | LED off |
| ✳ | LED flashing |
| ● | LED on (fixed) |


**Figure 4: Display/Keypad of the Solardrive Plus**

### 2.2.14. Root Page

```
  I N V E R T E R   O K
→       +  1 5 0 0 . 0 0 r p m
→       +              0 . 0 k W
  M E A   P A R   C F [ I D P ]
```

The Root page is factory-set as the startup page to be displayed when the drive is turned on.

*NOTE*

*You can access the four main menus only from the root page:*
***MEA*** *→ Measures;*
***PAR*** *→ Programming parameters;*
***CF*** *→ Configuration parameters;*
***IDP*** *→ Product identification.*

Line 1 on this page displays the drive operating status (see the description of parameter M089 in section 2.5.5).

The specific states of the Solardrive Plus applications are the following:

| State | Description |
|---|---|
| IFD WAIT MPPT | Timeout for solar radiation conditions allowing the motor to run. See section 2.6.11 |
| INSOLATION KO | PV field conditions inadequate to run the motor (weak solar radiation) |
| INSOLATION OK | PV field conditions capable of running the motor, timeout set in **P801** (section 2.6.10). Press **RESET** to start the motor. |
| STARTING | Timeout set in **P802** (section 2.6.10) due to a reset alarm. Press **RESET** to start the motor. |

Lines 2 and 3 display two measures which may be selected with parameters **P268**, **P268a**. These measures can be scaled through parameters **P268y** and **P268z**. For further details, contact Enertronica Santerno. As defaults, the following measures are displayed:

- Actual motor speed (measure **M004**)
- Actual output power (measure **M028**)

Line 4 displays the four main menus of the drive. The selected menu is displayed in square brackets: use the ▲ and ▼ keys to select a different menu. Press the **SAVE/ENTER** key to access the selected menu.

## 2.2.15. Keypad Page and Local Mode

keypad

```
→                    +    0 . 0 Hz
→                      +  0 . 0 A
→                         5 5 0 v
→          +           0 . 0 0 rpm
```

Keypad Help

```
→ M006   Mot. Freq.
→ M026   I(RMS) Out
→ M029   Vbus-DC
→ M004   Motor Spd
```

To access the Keypad pages, press the **MENU key** from the Root Page or press the **LOC/REM key** after selecting the Local mode.

The measures displayed on the Keypad page can be set up through parameters **P268b** to **P268e**. From the Keypad page, press the **SAVE/ENTER** key to display the Keypad Help page, describing the measures displayed on the Keypad page. The Keypad Help page is displayed for a few seconds.

As default, there are displayed:

- Output frequency (measure **M006**)
- Output current (measure **M026**)
- DC bus voltage (measure **M029**)
- Motor speed (measure **M004**)

*NOTE*

*If parameter **P264b** (Navigation mode via **MENU key**) is set to Operator, navigation is locked once the Keypad Page is displayed. Hold down the **ESC** key for a few seconds to resume navigation*

The following Keypad Pages are available:

Measures only → four lines displaying measures only

Speed → line 4 shows the speed reference, that can be changed with the ▲ and ▼ keys.

If the Local Mode is NOT selected, pressing the MENU key allows viewing only the pages containing the references sent via keypad (See Control Method Menu, section 2.6.6).

**LOCAL MODE**

In **LOCAL** mode (the L-CMD and L-REF LEDs come on when the Local mode is active), only the commands and references sent via keypad are enabled, while any other control source or reference source is disabled (see Control Method Menu, section 2.6.6). The keypad page displayed when the **LOC/REM** key is pressed is as follows:

```
→                    +    0 . 0 Hz
→                      +  0 . 0 A
→                         5 5 0 v
Ref    + +           0 . 0 0 rpm
```

Use the▲ and ▼ keys to change the reference shown in line 4 on the Keypad Page.

## 2.3. Manual Mode (Local Mode)

Operation in manual mode allows doing the following:

- Manually set the speed of rotation of the connected motor (drive output frequency);
- Manually send the START and STOP commands to the motor.

Do the following to set manual mode:

1. Press the emergency pushbutton.
2. Press the LOC/REM key from the display/keypad. The L-CMD LED and the L-REF LED will come on and the display will show the following:

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| → | | | | | | + | | | 0 | . | 0 | H | z | |
| → | | | | | | | + | | | 0 | . | 0 | *A* | |
| → | | | | + | | | | 0 | . | 0 | 0 | r | p | m |
| R | e | f | | + | 1 | 5 | 0 | 0 | . | 0 | 0 | r | p | m |

3. Press ▲ and ▼; set the desired speed reference (Ref).
4. Release the emergency pushbutton.
5. Press START to start the motor. The motor will follow the acceleration ramp set in parameter **P009** (see section 2.6.1).
6. Press STOP to stop the motor. The motor will follow the deceleration ramp set in parameter **P009** (see section 2.6.1).

When in manual mode, the motor speed may be adjusted by pressing ▲ and ▼.

Do the following to return to operation in automatic mode:

7. Press the emergency button.
8. Press the LOC/REM key from the display/keypad. The L-CMD LED and the L-REF LED will turn off and the display will show the following:

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | N | V | E | R | T | E | R | | O | K | | | |
| → | | | | + | | | | | 0 | . | 0 | 0 | r | p | m |
| → | | | | + | | | | | 0 | . | 0 | 0 | r | p | m |
| | M | E | A | | P | A | R | | C | F | [ | I | D | P | ] |

9. Release the emergency button.

## 2.4. Start Up Menu

### 2.4.1. Overview

For easier startup of the Solardrive Plus, you can activate the Start-Up Menu. The Start-Up Menu is a wizard allowing programming the main parameters.

The Start-UP Menu is displayed by pressing the START-UP key from the keypad.

The following is the root page of the Start-Up menu:

```
[ I D P ] S O L A R D R I V E
  S T A R T - U P   M E N U
    P r e s s   E N T E R
    t o   s t a r t
```

Press **ENTER** to enter the wizard.

Before entering the control parameters, you are asked to choose a dialogue language:

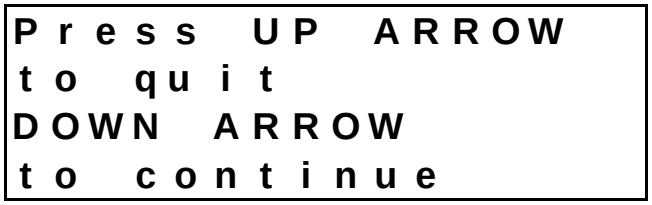
```
P 2 6 3   L a n g u a g e

→@@@@@@@@@@@@@@@@
```

Once the dialogue language has been selected, the Start-up menu appears. The available parameters are listed below:

| Parameter | Description |
|---|---|
| **C015** | Rated mains voltage |
| **C016** | Rated motor rpm |
| **C017** | Rated motor power |
| **C018** | Rated motor current |
| **C019** | Rated motor voltage |
| **C029** | Max. motor speed |
| **C800** | Minimum Pump Speed |
| **P009** | Acceleration time to start 1 |
| **P010** | Deceleration Time to stop 1 |
| **P018** | Start Acceleration Time |
| **P019** | End Deceleration Time |
| **P020** | Speed Threshold for Initial and Final Ramps |
| **C265** | Motor thermal protection |
| **C267** | Motor thermal time constant |

After setting the last parameter and moving the cursor forward, the following page will appear:




Press ▲ to quit the Start-up menu. The default page of the system will be displayed

### 2.4.2. First Start Up

The Solardrive Plus accepts the IFD control mode only (**C010**).

**1) Wiring:** Follow the instructions stated in Solardrive Plus – Installation Manual.

**2) Power on:** Power on the drive with the emergency button pressed to prevent the motor from running. Check if the display/keypad turns on.

**3) Parameter setting:** The equipment startup is made easier by the Start Up Menu (section 2.4), which is a wizard for the set up of the main motor control parameters.

From the Start Up Menu, set the motor ratings:

- **C015** (fmot1) **Rated motor frequency**
- **C016** (rpmnom1) **Rated motor rpm**
- **C017** (Pmot1) **Rated power**
- **C018** (Imot1) **Rated current**
- **C019** (Vmot1) **Rated voltage**
- **C029** (Speedmax1) **Max. allowable speed.**

Enter the main parameter for pumping applications:

- **C800** (SpeedMinPump) **Minimum Pump Speed:**
  When the pump speed drops below the threshold in **C800**, the pump is stopped. See 2.6.9.

- **P009** (Tup1) **Acceleration Time at Start 1:**
  Acceleration ramp, expressed in seconds for the system to go from 0 rpm to the maximum allowable speed set in **C029**. See section 2.6.9.

- **P010** (Tdn1) **Deceleration Time at Stop 1:**
  Deceleration ramp, expressed in seconds for the system to go to the maximum allowable speed set in **C029** to 0 rpm. See section 2.6.1.

- **P018** (Tacc_in) **Acceleration Start Time:**
  Ramp applied during the initial stage of the ramp, from the motor startup to the instant when the frequency set in parameter **P020** is attained. See section 2.6.1.

- **P019** (Tdec_fin) **End Deceleration Time:**
  Ramp applied during the final stage of the ramp, starting from the speed value set in **C020**. See section 2.6.1.

- **P020** (Spd_IFramps) **Speed Threshold for Initial and Final Ramps:**
  Threshold used for ramps **P018** and **P019**. See section 2.6.1.

- **C265** (ThermProt M1) **Motor Thermal Protection Enable and Type of Derating for M1:**
  Motor thermal protection configuration. See section 2.6.8.

- **C267** (ThermConstM1) **Thermal Time Constant for motor M1**. See section 2.6.8.

The motor V/f pattern may be programmed in **C013**. For loads with quadratic torque in respect to the rpm (centrifugal pumps, fans, etc.), set **C034** (preboost1) to 0%.

**4) Overload:** Set parameters **C043**, **C044** and **C045** as the maximum desired overload current.

**5) Startup:** Press the **LOC/REM** key on the Display/keypad: the L-CMD LED and L-REF LED come on and the drive will enter the local mode. Set the speed reference by pressing

▲ and ▼ (see section 2.3).
Activate the **ENABLE-A** input (terminal 15), **ENABLE-B** input (terminal S) by releasing the emergency button. Press the **START** button and the motor will start running. Make sure that the motor is rotating in the correct direction. If not, set parameter **C014** (Phase Rotation) to [1:Yes], or open the **ENABLE-A, ENABLE-B** and **START** inputs, remove voltage from the drive and, after waiting at least 20 minutes, swap two of the motor phases.
Press **STOP** to stop the motor. When the startup procedure is completed, set the drive in remote mode by pressing **LOC/REM**. The L-CMD LED and L-REF LED will turn off.

**6) Possible failures:**

If no failure occurred, go to step 7. Otherwise, check the drive connections paying particular attention to supply voltages, DC link and input reference. Also check if alarm messages are displayed. In the Measures Menu (section 2.5), check the reference speed (**M001**), the supply voltage to the control section (**M030**), the DC link voltage (**M029**), and the condition of control terminals (**M033**). Check to see if these readouts match with the measured values.

**7) Additional parameter modifications:**

When parameter **P003** = Standby Only (condition required for changing C parameters), you can change **Cxxx** parameters in the Configuration Menu only when the drive is DISABLED or STOPPED, whereas if **P003** = Standby + Fluxing, you can change **Cxxx** parameters when the motor is stopped but the drive is enabled.

**8) Adjusting criteria:**

Specific parameters might be adjusted for optimum operation of the Solardrive:

| Parameter | Tuning criterion |
|---|---|
| **C800**<br>see 2.6.9 | **Minimum pump speed**<br>When the speed set in **C800** is attained and if the electrical power absorbed by the motor is too high, the pump might frequently start and stop when solar radiation is weak. Decrease **C800** accordingly to obtain smooth operation of the pump avoiding lubrication issues or overheating conditions. The expected behaviour is that when the speed value set in **C800** is attained, the pump flow rate is low but not zero. |
| **P009, P010, P018, P019**<br>see 2.6.1 | **Ramps**<br>If **P009** and **P018** are set too short, especially when the pump inertia is high, the pump might stop due to weak solar radiation at start, and impulsive power absorption. If this is the case, increase the ramp times to get slower start stages. The effects obtained by the time set in parameter **P009** is stronger when solar radiation is strong. The time set in **P009** is the minimum time required to attain the maximum power. |
| **P020**<br>see 2.6.1, 2.6.9 | **Speed Threshold for Initial and Final Ramps**<br>Set **P020** so that the speed threshold for the initial/final ramps is the same as **C800** if not required otherwise, for example for a 50Hz motor with 1 pole pair, if **C800**=1500rpm, **P020**=50%. |
| **P800**<br>see 2.6.10 | **Minimum Solar Radiation Voltage**<br>This is the DC voltage value required to start the motor. If “Insolation KO” is not displayed, decrease **P800** and/or check the dimensioning of the PV field.<br>If the system restarts often at dawn, increase the values in **P800** and **P801**. |
| **P801**<br>see 2.6.10 | **Minimum Solar Radiation Time**<br>If the system restarts often at dawn, increase the value in **P801** to get a longer delay between two pump start stages and to allow solar radiation to reach values that make the pump start. |
| **P810, P811**<br>see 2.6.11 | **MPPT Minimum Voltage**<br>**MPPT Maximum Voltage**<br>Set the minimum and maximum MPPT reference based on the PV field data considering all ambient conditions (e.g. temperature/solar radiation). If **P810** is set too low, the pump might frequently start/stop at dawn or when solar radiation is weak, because the available power is not sufficient to start the pump even if voltage is applied to the PV field.<br>In case the pump frequently stops when solar radiation is high, increase **P810** to operate the system at higher field voltage values. |
| **P813**<br>see 2.6.11 | **Load Curve Exponent**<br>This parameter is the power load exponent vs. pump speed. For centrifugal pumps or quadratic torque loads, set **P813**=3. For volumetric pumps or other linear loads, set **P813**=2. |
| **P814, P815**<br>see 2.6.11 | **Voltage Regulator Integral Gain**<br>**Voltage Regulator Proportional Gain**<br>The proportional gain and integral gain of the voltage regulator determine the promptness of the response from the field voltage |

| | |
|---|---|
| | regulator. If the drive stops due to sudden changes in solar radiation (clouds) or hydraulic load (flow rate variations when hydraulic valves are open), adjust the voltage regulator based on the criteria below:<br>1) Increase integral gain **P814** and proportional gain **P815**. The integral gain determines the response time of the voltage regulator: when it is increased, the pump speed is expected to change rapidly. The proportional gain acts promptly and timely on the pump speed reference. As a first attempt, change **P814** and **P815** without changing their ratio (e.g. double both **P814** and **P815**).<br>2) Monitor speed reference of pump **M001**. If too noisy or oscillatory, decrease gains **P814** and **P815.**<br>The regulator is to be adjusted when the motor speed is adjusted to values lower than the maximum value set in **C029** with MPPT enabled **P818**=0. When speed is equal to **C029**, power made available from the PV field is greater than the power absorbed by the pump and the regulator is inactive. Otherwise, wait for ambient conditions to become correct (e.g. weaker solar radiation) or decrease power made available from the PV field (e.g. cut off some strings). |
| **P822**<br>see 2.6.11 | **MPPT Initial Voltage Gain**<br>The optimum value for **P822** is the ratio between MPPT voltage and open-circuit voltage of the PV field. The value obtained is the lower limit for **P822**.<br>Example: from the datasheet of the PV panel:<br>Open-circuit voltage: 38.58 V<br>Voltage at maximum power: 30.90 V<br>Minimum value for **P822** = 30.90/38.58*100 = 80.09%.<br>If **P822** is set to higher values, the maximum power at start takes longer time to be attained. The closer the value to the theoretical value, the quicker the maximum power is attained. If **P822** is set too low, the motor might stop even when solar radiation is strong and the system might restart frequently at dawn.<br>It is therefore recommended that a value approx. 5% higher than the theoretical value be set (as far as the example is concerned, **P822** = 85%). |

**8) Reset:** If an alarm trips, find the cause responsible for the alarm and reset the drive. Enable input MDI3 (terminal 16) for some time, or press the **RESET** key on the display/keypad.

## 2.5. Measures Menu

### 2.5.1. Overview

The Measures Menu contains the variables measured by the drive that can be used by the user.

In the display/keypad, measures are divided into subgroups.

This manual covers the measurements for the solar pumping application. For information on other available measurements, please contact Enertronica Santerno S.p.A.

The measure subgroups are the following:

**Motor Measures Menu**
This menu contains: the values of the speed reference at constant rpm, the values of the reference being used and the speed values of the connected motor expressed in rpm; the drive rated frequency and the electrical variables measured by the drive mains side, the DC-bus and output.

**PID Controller Menu**
This menu contains the values relating to the PID controller of the drive.

**Digital Inputs Menu**
This menu contains the state of the drive digital inputs and the indication of the functions programmed for the digital inputs of the drive.

**References Menu**
This menu contains the following values: analog references, the encoder input and the frequency input references, the speed/torque or reference/feedback values of the PID coming from serial link or fieldbus.

**Outputs Menu**
This menu contains the state of the drive digital outputs, analog outputs and frequency outputs.

**Autodiagnostics Menu**
This menu contains the temperature values, the operation time counter and the supply time counter, the active alarm and the drive status.

**Digital Input Settings Menu**
This menu contains the functions assigned to the digital inputs.

**Fault List Menu**
This menu contains the trip log of the last eight alarms tripped and the values of some measures being used when the alarm trip was stored.

**PowerOff Log Menu**
This menu contains the value of some measures being used at the drive power off.

### 2.5.2. Motor Measures Menu

This menu contains speed values and electrical variables measured by the drive on the mains side, DC bus and output.

| M001 | Speed Reference at Constant RPM | |
|---|---|---|
| Range | ± 32000 (integer part)<br>± 99 (decimal part) | ± 32000.99 rpm<br>Note: The actual range depends on the value set in the parameters for the motor max. speed and min. speed.<br>**C028**–**C029** Motor 1 |
| Active | Active only when a speed reference is used for the selected motor. | |
| Address | 1650 (integer part) 1651 (decimal part) | |
| Function | Value of the speed reference obtained when the motor rotates at constant speed, once the preset ramp time is over. | |

| M002 | Speed Ramp Output | |
|---|---|---|
| Range | ± 32000 (integer part)<br>± 99 (decimal part) | ± 32000.99 rpm<br>Note: The actual range depends on the value set in the parameters for the motor max. speed and min. speed.<br>**C028**–**C029** Motor 1 |
| Active | Active only when a speed reference is used for the selected motor. | |
| Address | 1652 (integer part) 1653 (decimal part) | |
| Function | This is the measure of the speed value processed with respect to the ramp time. | |

| M004 | Motor Speed | |
|---|---|---|
| Range | ± 32000 (integer part)<br>± 99 (decimal part) | ± 32000.99 rpm |
| Active | Always active. | |
| Address | 1654 (integer part) 1655 (decimal part) | |
| Function | Motor speed value. | |

| M006 | Drive Output Frequency | |
|---|---|---|
| Range | ± 10000 | ± 1000.0 Hz (see Table 11) |
| Active | Always active. | |
| Address | 1656 | |
| Function | This is the measure of the voltage frequency output of the drive. | |

| M026 | Output Current | |
|---|---|---|
| Range | 0 ÷ 65535 | 0 ÷ 6553.5 A<br>Note: The actual range depends on the drive size. |
| Active | Always active. | |
| Address | 1676 | |
| Function | Measurement of the RMS of the output current. | |

| M026a | Motor Thermal Capacity | |
|---|---|---|
| Range | 0 ÷ 1000 | 0.0 ÷ 100.0% |
| Active | Always active. | |
| Address | 1728 | |
| Function | Heating of the connected motor.<br>This parameter indicates the current level of the motor heating following I2t pattern set in the Motor Thermal Protection Menu (section 2.6.8). This value is expressed as a percentage of the allowable asymptotic value. | |

| M027 | Output Voltage | |
|---|---|---|
| Range | 0 ÷ 65535 | 0 ÷ 65535 V<br>Note: The actual range depends on the drive voltage class. |
| Active | Always active. | |
| Address | 1677 | |
| Function | Measure of the RMS of the output voltage. | |

| M027a | Power Factor | |
|---|---|---|
| Range | 0 ÷ 1000 | 0 ÷ 1.000 |
| Active | Always active. | |
| Address | 1742 | |
| Function | Estimation of power factor (or cos phi), i. e. the ratio between active power and apparent power at the drive output. | |

| M028 | Output Power | |
|---|---|---|
| Range | –32768 ÷ +32767 | –3276.8 ÷ +3276.7 kW<br>Note: The actual range depends on the drive voltage class. |
| Active | Always active. | |
| Address | 1678 | |
| Function | Measure of the active power produced by the drive.<br>A negative value indicates input power (the motor is regenerating energy). | |

| M028a | Energy Consumption | |
|---|---|---|
| Range | 0 ÷ 1000000000 | 0 ÷ 10000000.00 kWh |
| Active | Always active. | |
| Address | 1723-1724 (LSWord, MSWord) | |
| Function | Counter of the drive energy consumption.<br>This is a value expressed in 32 bits divided into two 16-bit words: the low part and the high part. | |

| M029 | DC-Bus Voltage | |
|---|---|---|
| Range | 0 ÷ 1400 | 0 ÷ 1400 V |
| Active | Always active. | |
| Address | 1679 | |
| Function | Measure of the voltage in the drive DC-link. | |

| M029a | DC-Bus Voltage Reference | |
|---|---|---|
| Range | 0 ÷ 1400 | 0 ÷ 1400 V |
| Active | Always active. | |
| Address | 1725 | |
| Function | This is the setpoint value of the DC voltage computed by the algorithm for the Maximum Power Point Tracking (MPPT). This is the voltage value that the drive forces to the PV field. | |

| M030 | Supply Voltage | |
|---|---|---|
| Range | 0 ÷ 1000 | 0 ÷ 1000 V |
| Active | Always active. | |
| Address | 1680 | |
| Function | Measure of the RMS value of the drive supply voltage. | |

### 2.5.3. Digital Inputs Menu

This menu allows checking the state of the command sources for the digital inputs (local terminals, serial link and fieldbus), the terminal board resulting from their combination and the terminals which are actually used for the drive control. The terminals which are actually used to control the drive also consider any timers applied to the digital inputs.

| M031 | Delayed Digital Inputs | |
|---|---|---|
| Range | Bit-controlled measure | See Table 1 |
| Active | Always active. | |
| Address | 1681 | |
| Function | Status of the control terminal board used by the drive.<br>This is the terminal board resulting from the combination of the preset command sources (local terminal board, serial link and fieldbus), where:<br>- Inputs **MDI1** to **MDI8** are the result of the OR between the different control sources.<br>- The **ENABLE (E)** status is the result of the AND of inputs **MDI2&S** of the physical terminals and of **MDI2** inputs of all the other programmed control sources.<br>- The **ENABLE SW (ESW)** is the result of the AND of the inputs programmed as **ENABLE SW** (**C152**) of all the programmed command sources.<br>See also the Control Method Menu, section 2.6.6.<br>Refer to Figure 5 for the **ENABLE** and **ENABLE SW** status.<br>For further information, contact Enertronica Santerno. | |

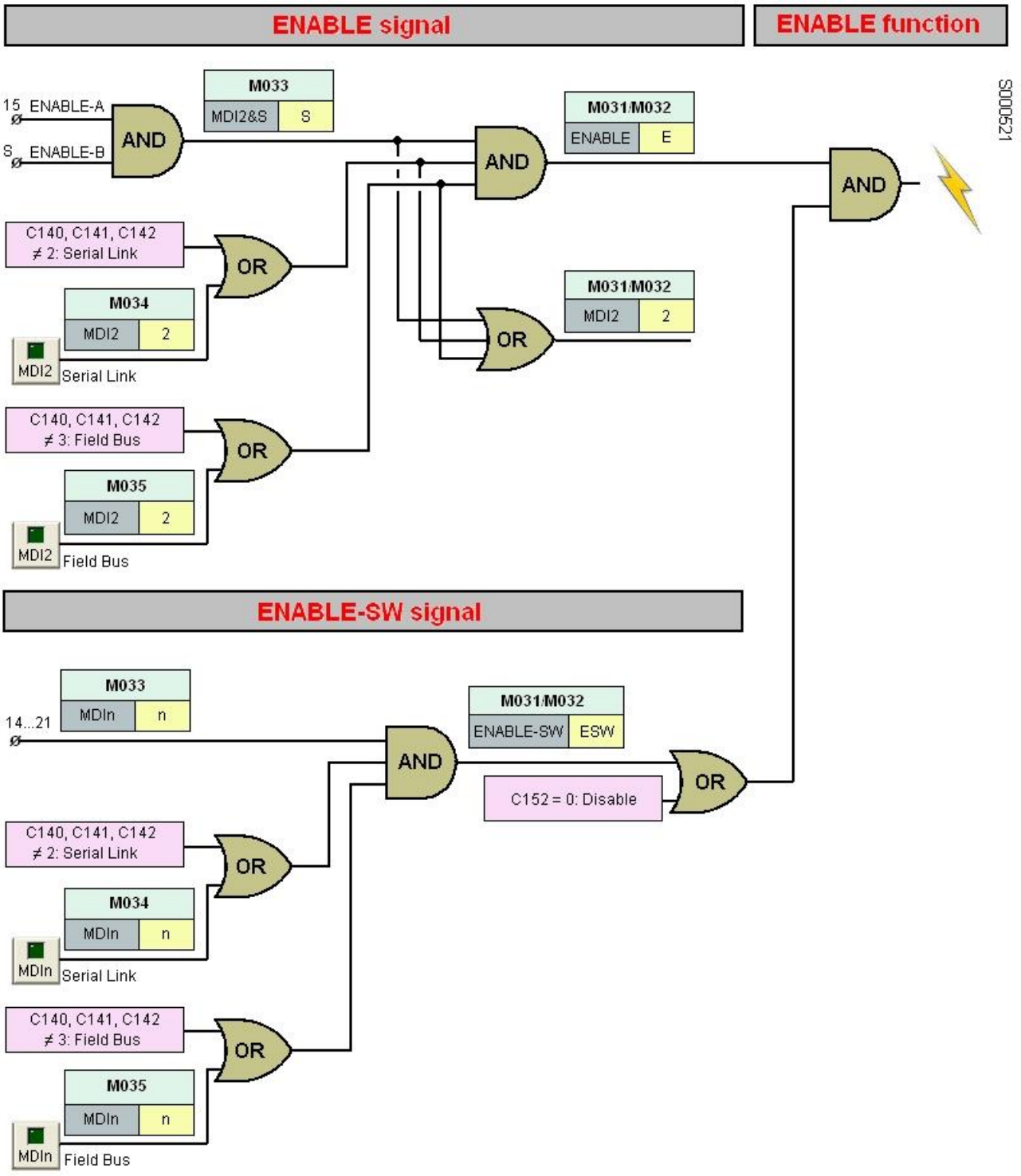



**Figure 5: The ENABLE Function**

| M032 | Instant Digital Inputs | |
|---|---|---|
| Range | Bit-controlled measure | See Table 1. |
| Active | Always active. | |
| Address | 1682 | |
| Function | Status of the virtual control terminal board before applying the timers to the digital inputs (if no timer is applied, it matches with **M031**).<br>See Control Method Menu **–** section 2.6.6. | |

**Table 1: Coding of Measures M031, M032**

| Bit n. | Digital Input | Bit n. | Digital Input |
|---|---|---|---|
| 0 | MDI1 | 5 | MDI6/ECHA/FINA |
| 1 | MDI2 | 6 | MDI7/ECHB |
| 2 | MDI3(RESET) | 7 | MDI8/FINB |
| 3 | MDI4 | 8 | ENABLE-SW |
| 4 | MDI5 | 9 | ENABLE |

| M033 | Local Control Terminal Board | |
|---|---|---|
| Range | Bit-controlled measure | See Table 2. |
| Active | Always active. | |
| Address | 1683 | |
| Function | Status of the digital inputs in the drive physical terminal board.<br>The status of **MDI2&S (S)** input is the result of a logic AND between **ENABLE-A** and **ENABLE-B** physical signals. | |

**Table 2: Coding of Measures M033**

| Bit n. | Digital Input | Bit n. | Digital Input |
|---|---|---|---|
| 0 | MDI1 | 4 | MDI5 |
| 1 | MDI2&S (S) | 5 | MDI6/ECHA/FINA |
| 2 | MDI3(RESET) | 6 | MDI7/ECHB |
| 3 | MDI4 | 7 | MDI8/FINB |

### 2.5.4. Outputs Menu

This menu allows checking the status of the digital outputs, the analog outputs and the frequency outputs located in the terminal board.

| M056 | Digital Outputs | |
|---|---|---|
| Range | Bit-controlled measure | See Table 3 |
| Active | Always active. | |
| Address | 1706 | |
| Function | Status of digital outputs MDO1÷4 and status of the precharge contactor. | |

**Table 3: Coding of Measure M056**

| Bit n°. | Digital Output |
|---|---|
| 0 | MDO1/FOUT |
| 1 | MDO2 |
| 2 | MDO3 |
| 3 | MDO4 |
| 6 | Status of the precharge contactor |

### 2.5.5. Autodiagnostics Menu

This menu allows the user to check the functioning times and the relevant counters (for maintenance purposes) of the Solardrive Plus; it also allows reading out the analog channels used for temperature sensors and the relevant temperature values, as well as the drive status.

| M052<br>M054 | Functioning Times | |
|---|---|---|
| Range | 0 ÷ 2147483647 (0 ÷ 7FFFFFFFh) | 0 ÷ 429496729.4 sec |
| Address | Supply Time: 1702-1703 (LSWord, MSWord)<br>Operation Time: 1704-1705 (LSWord, MSWord) | |
| Function | This screen displays the ST (Supply Time) and the OT (Operation Time).<br>The Operation Time is the activation time of the drive IGBTs.<br>Both values are expressed in 32 bits divided into two 16-bit words: the low part and the high part. | |

Functioning Times:

```
Supply Time
M054=     53:25:01
Operation Time
M052=     29:35:51
```

| M062 | Ambient temperature Measure | |
|---|---|---|
| Range | ± 32000 | ± 320.0 °C |
| Active | Always active. | |
| Address | 1712 | |
| Function | Ambient temperature measured on the surface of the control board. | |

| M064 | IGBT Temperature Measure | |
|---|---|---|
| Range | ± 32000 | ± 320.0 °C |
| Active | Always active. | |
| Address | 1714 | |
| Function | Measure of the IGBT temperature.<br><br>If the temperature readout is <–30.0 °C or >150.0 °C, warning **W50 NTC Fault** appears. | |

| M065 | Operation Time Counter | |
|---|---|---|
| Range | 0 ÷ 65000 | 0 ÷ 650000h |
| Active | Always active. | |
| Address | 1715 | |
| Function | Time elapsed after resetting the operation time counter. The Operation Time is the activation time of the drive IGBTs. | |

| M066 | Supply Time Counter | |
|---|---|---|
| Range | 0 ÷ 65000 | 0 ÷ 650000h |
| Active | Always active. | |
| Address | 1716 | |
| Function | Time elapsed after resetting the supply time counter. | |

| M089 | Drive Status |
|---|---|
| Range | See Table 15 |
| Active | Always active. |
| Address | 1739 |
| Function | Describes the current condition of the drive. |

| M090 | Active Alarm |
|---|---|
| Range | See Table 13 |
| Active | Always active. |
| Address | 1740 |
| Function | Alarm tripped at the moment. |

## 2.5.6. Fault List Menu

Scroll the **Fault List Menu** to display the codes of the last eight alarms tripped.
Press the **SAVE/ENTER** key to access the alarm submenu and navigate to each value measured by the drive when the alarm tripped.
The diagram below shows a navigation example for the **Fault List Menu** (relating to alarm n.1 in particular). Note that n.1 is the last alarm tripped and n.8 is the first alarm tripped.
The measures marked with **Mxxx** are the same measures covered in this section.
If the Data Logger ES851 is installed (even the ES851 RTC version only) or if the Bridge Mini is installed, the date and time when the alarm tripped are displayed instead of the Supply Time (ST) and the Operation Time (OT) respectively.

**Navigation Example - Fault List Menu**

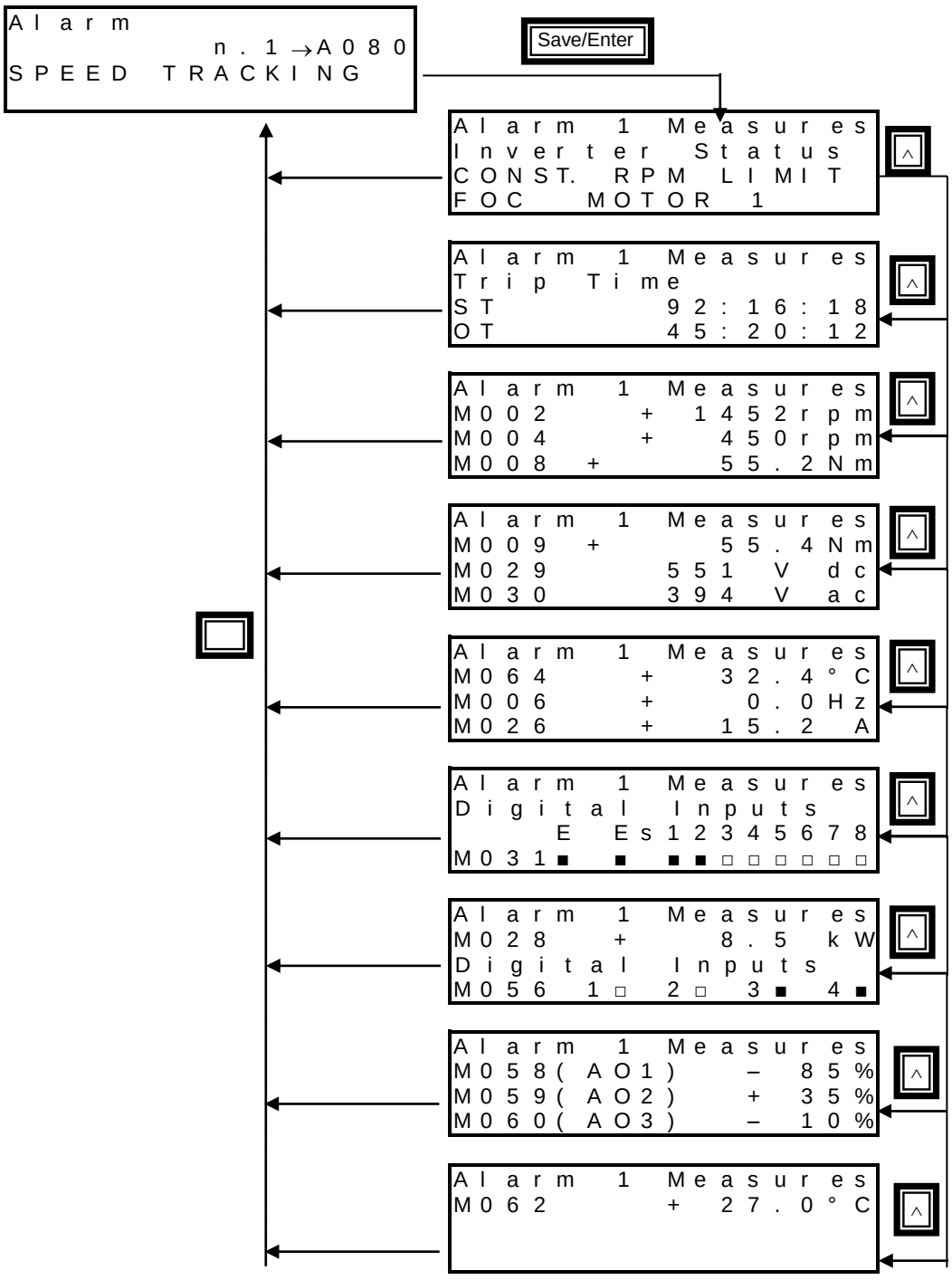


**Table 4: Modbus base addresses in the Fault Lists**

| Fault List | Modbus Base Address |
|---|---|
| **FL1** | 7712 |
| **FL2** | 7744 |
| **FL3** | 7776 |
| **FL4** | 7808 |
| **FL5** | 7840 |
| **FL6** | 7872 |
| **FL7** | 7904 |
| **FL8** | 7936 |

**Table 5: List of the measures in the Fault Lists**

| Measure | Function | Range | Value | Modbus Offset Address |
|---|---|---|---|---|
| **M090** | Active Alarm | See Table 13 | - | 0 |
| **M052** | Supply Time | See measurement description | - | 1: LSW<br>2: MSW |
| **M054** | Operation Time | See measurement description | - | 3: LSW<br>4: MSW |
| **M089** | Inverter Status | See Table 15 | - | 5 |
| **M026** | Output Current | 0 ÷ 65535 | 0 ÷ 6553.5 A | 6 |
| **M004** | Motor Speed | ±32000 | ±32000 rpm | 7 |
| **M002** | Speed Reference after Ramps | ±32000 | ±32000 rpm | 8 |
| **M008** | Torque Demand | ±32000 | ±32000 Nm | 9 |
| **M009** | Torque Generated by the Motor | ±32000 | ±32000 Nm | 10 |
| **M029** | DC-bus Voltage | 0 ÷ 1400 | 0 ÷ 1400 V | 11 |
| **M030** | Grid Voltage | 0 ÷ 1000 | 0 ÷ 1000 V | 12 |
| **M064** | IGBT Temperature | ±32000 | ± 320.0 °C | 13 |
| **M006** | Inverter Output Frequency | ±10000 | ±1000.0 Hz | 14 |
| **M031** | Delayed Digital Inputs | See measurement description | - | 16 |
| **-** | Selected Motor (high byte) | 0 ÷ 2 | 0: Mot1<br>1: Mot2<br>2: Mot3 | 17 |
| | Selected Control (low byte) | 0 ÷ 2 | 0: IFD<br>1: VTC<br>2: FOC | |
| **M028** | Output Power | 0 ÷ 65535 | 0 ÷ 6553.5 kW | 19 |
| **M056** | Digital Outputs | See measurement description | | 20 |
| **M058** | Analog output AO1 | ±100 | ±100 % | 21 |
| **M059** | Analog output AO2 | ±100 | ±100 % | 22 |
| **M060** | Analog output AO3 | ±100 | ±100 % | 23 |
| **M062** | Ambient Temperature | ±32000 | ± 320.0 °C | 24 |

To get the Modbus address of a given measure in a Fault List, sum up the base address to the measurement's offset.

Example:

The address of measure **M058** in Fault List **FL6** is as follows:

7872 + 21 = 7893

## 2.5.7. Power Off List Menu

This menu contains the measures of some characteristic variables detected at the drive power off, in conjunction with the alarm (if any) tripped at that moment.
Press the **SAVE/ENTER** key to access the submenu and navigate to the measures detected by the drive when the alarm tripped. Measures and codes are the same as the ones shown in the Fault List Menu (section 2.5.6).
If the Data Logger ES851 is installed (even the ES851 RTC version only) or if the Bridge Mini is installed, the date and time when the alarm tripped are displayed instead of the Supply Time (ST) and the Operation Time (OT) respectively.
The diagram below shows a navigation example for the **Power Off List**.

**Navigation Example – PowerOff List Menu**

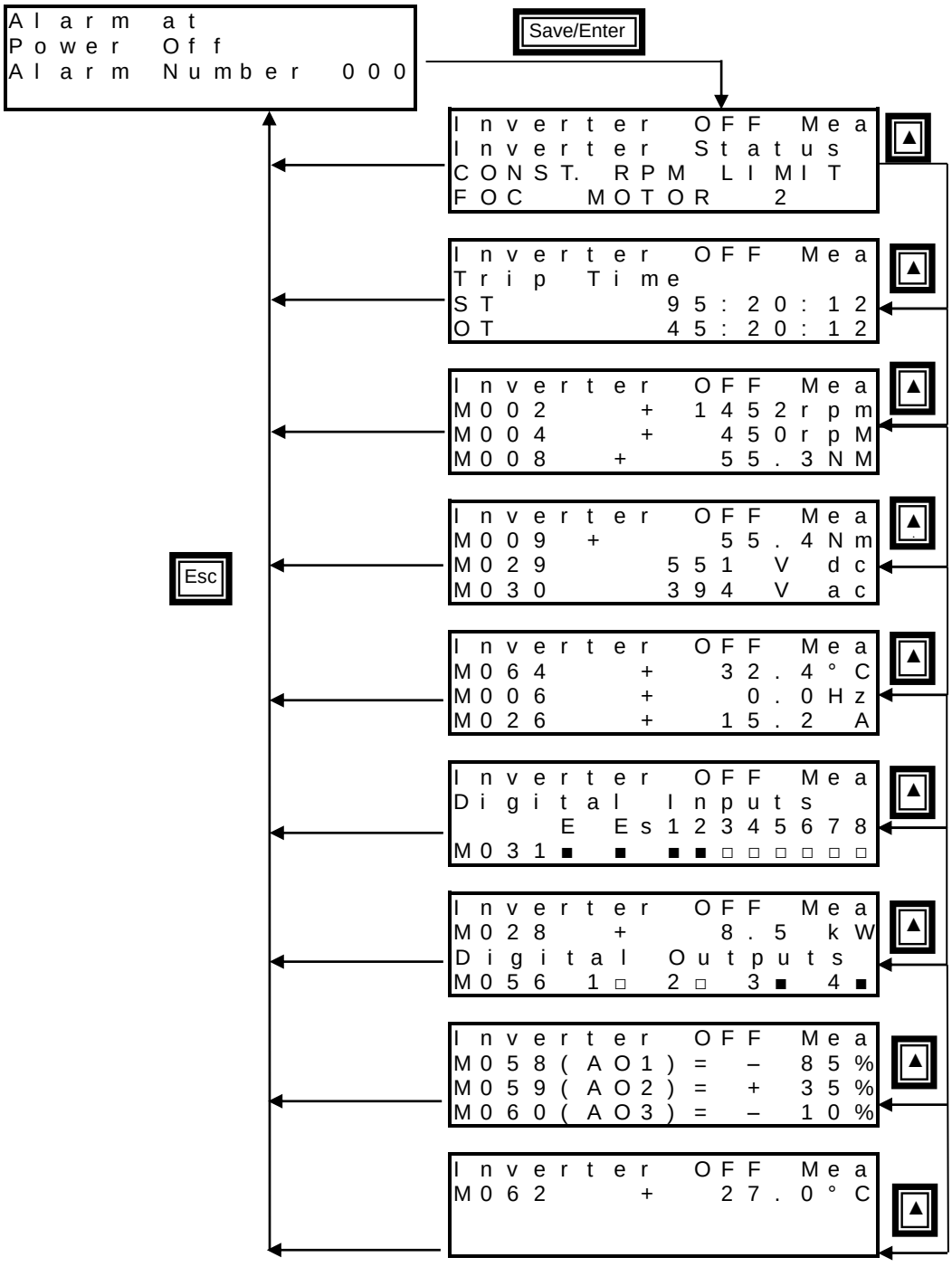


**Table 6: List of the measures in the Power Off List**

| Measure | Function | Range | Value | Modbus Address |
|---|---|---|---|---|
| **M090** | Active Alarm | See Table 13 | - | 5044 |
| **M052** | Supply Time | See measurement description | - | 5045: LSW<br>5046: MSW |
| **M054** | Operation Time | See measurement description | - | 5047: LSW<br>5048: MSW |
| **M089** | Inverter Status | See Table 15 | - | 5049 |
| **M026** | Output Current | 0 ÷ 65535 | 0 ÷ 6553.5 A | 5050 |
| **M004** | Motor Speed | ±32000 | ±32000 rpm | 5051 |
| **M002** | Speed Reference after Ramps | ±32000 | ±32000 rpm | 5052 |
| **M008** | Torque Demand | ±32000 | ±32000 Nm | 5053 |
| **M009** | Torque Generated by the Motor | ±32000 | ±32000 Nm | 5054 |
| **M029** | DC-bus Voltage | 0 ÷ 1400 | 0 ÷ 1400 V | 5055 |
| **M030** | Grid Voltage | 0 ÷ 1000 | 0 ÷ 1000 V | 5056 |
| **M064** | IGBT Temperature | ±32000 | ± 320.0 °C | 5057 |
| **M006** | Inverter Output Frequency | ±10000 | ±1000.0 Hz | 5058 |
| **M031** | Delayed Digital Inputs | See measurement description | - | 5060 |
| **-** | Selected Motor (high byte) | 0 ÷ 2 | 0: Mot1<br>1: Mot2<br>2: Mot3 | 5061 |
| | Selected Control (low byte) | 0 ÷ 2 | 0: IFD<br>1: VTC<br>2: FOC | |
| **M028** | Output Power | 0 ÷ 65535 | 0 ÷ 6553.5 kW | 5063 |
| **M056** | Digital Outputs | See measurement description | | 5064 |
| **M058** | Analog output AO1 | ±100 | ±100 % | 5065 |
| **M059** | Analog output AO2 | ±100 | ±100 % | 5066 |
| **M060** | Analog output AO3 | ±100 | ±100 % | 5067 |
| **M062** | Ambient Temperature | ±32000 | ± 320.0 °C | 5068 |

## 2.6. Parameters Menu

This manual covers only the menus and parameters for the solar pumping application. For more details on other available parameters, please contact Enertronica Santerno S.p.A.

### 2.6.1. Ramps Menu

#### *2.6.1.1. Overview*

An acceleration/deceleration ramp is a function allowing linear variations of the motor speed.

The ramp time is the time the motor takes to reach its max. speed when it starts from zero speed (or the time the motor takes to reach 0 speed when decelerating).

Two sets of two values to be programmed for the motor start and stop are available. Each set of values identifies the acceleration time and the deceleration time, and each value set is allocated to the unit of measure of the basic time. The default value is the first set of two values. When the motor runs at constant speed, and follows the speed reference generated by the MPPT regulator, a set of two values for acceleration/deceleration defined by other parameters (acceleration and deceleration after start stage) is applied.

Two values are allocated to the specific function for the start/end ramp.

The Fire Mode operation features two parameters with acceleration ramp times and deceleration ramp times.

The Ramps menu allows setting the acceleration times and the deceleration times of the available speed ramps.

The set ramp time corresponds to the time the speed reference takes to reach the max. speed (from 0 rpm) as an absolute value between min. speed and max. speed of the selected motor (**C028** and **C029** for motor 1, and so on).

The time unit of measure may have the following values:

0 → 0.01 s

1 → 0.1 s

2 → 1 s

3 → 10 s

The programmable range may be 0s – 327000s.

Example of a speed ramp:

**Table 7: Example of a Speed Ramp**

| P014 | | Range P009 – P010 | |
|---|---|---|---|
| **Value** | **Coding** | **Min** | **Max** |
| 0 | 0.01 s | 0 | 327.00 s |
| 1 | 0.1 s | 0 | 3270.0 s |
| 2 | 1 s | 0 | 32700 s |
| 3 | 10 s | 0 | 327000 s |

*2.6.1.2. List of Parameters P009 to P033*

| Parameter | Function | User Level | Default Value | MODBUS Address |
|---|---|---|---|---|
| **P009** | Acceleration Time at Start 1 | BASIC | Depending on size | 609 |
| **P010** | Deceleration Time at Stop 1 | BASIC | Depending on size | 610 |
| **P012** | Acceleration Time at Start 2 | ADVANCED | Depending on size | 612 |
| **P013** | Deceleration Time at Stop 2 | ADVANCED | Depending on size | 613 |
| **P014** | Unit of Measure for Ramps 1 and 2 | ADVANCED | Depending on size | 614 |
| **P015** | Acceleration Time after Start | ADVANCED | Depending on size | 615 |
| **P016** | Deceleration Time after Start | ADVANCED | Depending on size | 616 |
| **P018** | Start Acceleration Time | ADVANCED | Depending on size | 618 |
| **P019** | End Deceleration Time | ADVANCED | Depending on size | 619 |
| **P020** | Speed Threshold for Initial and Final Ramps | ADVANCED | 50.0% | 757 |
| **P032** | Acceleration Ramp in Fire Mode | ENGINEERING | Depending on size | 632 |
| **P033** | Deceleration Ramp in Fire Mode | ENGINEERING | Depending on size | 633 |

| P009 | Acceleration Time at Start 1 | |
|---|---|---|
| Range | 0 ÷ 32700 | 0 ÷ 327.00 s se **P014**=0 → 0.01 s<br>0 ÷ 3270.0 s se **P014**=1 → 0.1 s<br>0 ÷ 32700 s se **P014**=2 → 1 s<br>0 ÷ 327000 s se **P014**=3 → 10 s |
| Default | Depending on size | |
| Level | BASIC | |
| Address | 609 | |
| Function | Ramp for motor start.<br>Determines the time the reference takes to go from 0 rpm to the max. preset speed (considering the max. value between absolute values for max. speed and min. speed of the motor). | |

| P010 | Deceleration Time at Stop 1 | |
|---|---|---|
| Range | 0 ÷ 32700 | 0 ÷ 327.00 s se **P014**=0 → 0.01 s<br>0 ÷ 3270.0 s se **P014**=1 → 0.1 s<br>0 ÷ 32700 s se **P014**=2 → 1 s<br>0 ÷ 327000 s se **P014**=3 → 10 s |
| Default | Depending on size | |
| Level | BASIC | |
| Address | 610 | |
| Function | Ramp for motor stop.<br>Determines the time the reference takes to go from the max. preset speed (considering the max. value between absolute values for max. speed and min. speed set for the motor) to zero rpm. | |

| P012 | Acceleration Time at Start 2 | |
|---|---|---|
| Range | 0 ÷ 32700 | 0 ÷ 327.00 s se **P014**=0 → 0.01 s<br>0 ÷ 3270.0 s se **P014**=1 → 0.1 s<br>0 ÷ 32700 s se **P014**=2 → 1 s<br>0 ÷ 327000 s se **P014**=3 → 10 s |
| Default | Depending on size | |
| Level | ADVANCED | |
| Address | 612 | |
| Function | Same as ramp 1 (see **P009**). | |

*NOTE*

*Values for ramp 2 can be applied to the reference provided that multiramp digital inputs are set up and that ramp 2 is selected (for more details, contact Enertronica Santerno).*

| P013 | Deceleration Time at Stop 2 | |
|---|---|---|
| Range | 0 ÷ 32700 | 0 ÷ 327.00 s if **P014**=0 → 0.01 s<br>0 ÷ 3270.0 s if **P014**=1 → 0.1 s<br>0 ÷ 32700 s if **P014**=2 → 1 s<br>0 ÷ 327000 s if **P014**=3 → 10 s |
| Default | Depending on size | |
| Level | ADVANCED | |
| Address | 613 | |
| Function | Same as ramp 1 (see **P010**). | |

*NOTE*

*Values for ramp 2 can be applied to the reference provided that multiramp digital inputs are set up and that ramp 2 is selected (for more details, contact Enertronica Santerno).*

| P014 | Unit of Measure for Ramps 1 and 2 | |
|---|---|---|
| Range | 0 ÷ 3 | 0 → 0.01 s<br>1 → 0.1 s<br>2 → 1 s<br>3 → 10 s |
| Default | Depending on size | |
| Level | ADVANCED | |
| Address | 614 | |
| Function | Defines the unit of measure for the time periods for speed ramp 1 (**P009** and **P010)**, for speed ramp 2 (**P012** and **P013**), and for ramps in Fire Mode (**P032** and **P033**). The allowable programmable range may be extended from 0 s to 327000s.<br>E.g.<br>**P014**=1 then **P009**=100; this means **P009** = 100 x 0.1 s = 10 s<br>**P014**=0 then **P009**=100; this means **P009** = 100 x 0.01 s = 1 s<br>**P014**=3 then **P009**=100; this means **P009** = 100 x 10 s = 1000 s | |

| P015 | Acceleration Time after Start | |
|---|---|---|
| Range | 0 ÷ 32700 | 0 ÷ 327.00 s if **P020**=0 → 0.01 s |
| Default | Depending on size | |
| Level | ADVANCED | |
| Address | 615 | |
| Function | Ramp applied when the motor runs at constant speed and applied to the reference generated by the algorithm for the Maximum Power Point Tracking (MPPT).<br>See also parameter **P009** (ramp for motor stop). | |

| P016 | Deceleration Time after Start | |
|---|---|---|
| Range | 0 ÷ 32700 | 0 ÷ 327.00 s if **P020**=0 → 0.01 s |
| Default | Depending on size | |
| Level | ADVANCED | |
| Address | 616 | |
| Function | Ramp applied when the motor runs at constant speed and applied to the reference generated by the algorithm for the Maximum Power Point Tracking (MPPT).<br>See also parameter **P010** (deceleration ramp time). | |

| P018 | Start Acceleration Time | |
|---|---|---|
| Range | 0 ÷ 32700 | 0 ÷ 327.00 s if **P020**=0 → 0.01 s |
| Default | Depending on size | |
| Level | ADVANCED | |
| Address | 615 | |
| Function | Ramp applied during the initial stage of the ramp, from the motor start to the instant when the frequency set in parameter **P020** is attained.<br>See also parameter **P009** (ramp for motor stop). | |

| P019 | End Deceleration Time | |
|---|---|---|
| Range | 0 ÷ 32700 | 0 ÷ 327.00 s if **P020**=0 → 0.01 s |
| Default | Depending on size | |
| Level | ADVANCED | |
| Address | 619 | |
| Function | Ramp applied during the final stage of the ramp, from the instant when the frequency set in parameter **P020** is attained until the motor stops.<br>See also parameter **P010** (deceleration ramp time). | |

| P020 | Speed Threshold for Initial and Final Ramps | |
|---|---|---|
| Range | 0 ÷ 1500 | 0 ÷ 150.0%<br>The maximum value depends on **C800** (see section 2.6.9) and **C029** (see 2.6.4). |
| Default | 500 | 50.0% |
| Level | ADVANCED | |
| Address | 757 | |
| Function | This is the output frequency, considered as a percentage in respect to the nominal motor frequency (parameter **C015**), below which the following ramps are applied:<br>- ramp **P018** while accelerating,<br>- ramp **P019** while decelerating.<br>The maximum value for this parameter is:<br>**C800 / C015 * p *** 100<br>where *p* is the number of pole pairs of the motor. In that way, the speed threshold will not drop below the value set in **C800**. | |

## 2.6.2. Dry-run Control Menu

### *2.6.2.1. Overview*

Thanks to the Dry-run detection function, the drive is capable of detecting when the pump is working under Dry-run conditions or when cavitation is about to occur.

The Dry-run Control algorithm is based on electrical measurements of the motor and does not require pressure measurements, as these are not always available and, moreover, are dependent on the application. This allows the Dry-run Control to be kept activated even in speed control only.

The reference variables for the Dry-run Control conditions may be selected via parameter **P710:**

- Electric power
- Power factor (*cosphi*)

The latter guarantees greater sensitivity and accuracy.

The user may choose the most suitable measurement based on the type of application.

These values are computed and displayed runtime and are part of the custom measurements to be displayed on the keypad for easier calibration.

### *2.6.2.2. Calibration*

The Dry-run zone is to be defined based on the plant and the characteristic curves of the connected pump.

As shown in the figure below, the zone is limited by 2 points at two different operating frequency values.

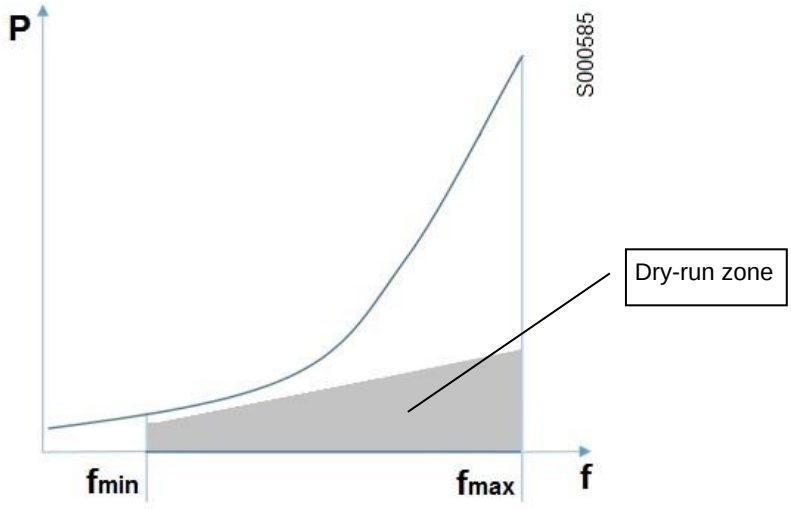



**Figure 6: Dry-run zone**

The two Dry-run points are set in parameters **P710a-P710b** and **P710c-P710d.**

Parameter **P711** inhibits the Dry-run detection below a preset operating frequency.

The calibration guidelines for two different applications are given below:

- Stop water flow from the plant (valve closure).
- Reach maximum speed and set **P710c**.
- Set **P710d** to a value lower than the selected Dry-run measurement (electric power or power factor).
- Repeat the steps above by adopting a low speed reference.

*2.6.2.3. Dry-run Activation*

The Dry-run function activates if both the following conditions are true:

- Operation in Dry-run zone
- Speed reference greater than the minimum value between **P711** and **C029** (with suitable adjustment of the units of measures controlled internally to the drive)

If the Dry-run condition persists for a time longer than **P712**, the action defined in **P716** is carried out.

To facilitate testing or expand activation logics, parameter **P715** is available, allowing allocating an MDI to the deactivation of the Dry-run function.

If the Dry-run function is active, resetting its activation is possible either manually (by pressing the reset button on the keypad) or automatically if the system quits the Dry-run detection mode for a time longer than **P713**.

When **P716** is set as Alarm or Warning, the countdown of the automatic reset is displayed.

The automatic reset allows for the service re-activation without manual activation after a transient condition has occurred, such as a transient lower level of water in a well.

*2.6.2.4. List of Parameters P710 to P716*

| Parameter | Function | User Level | Default Value | MODBUS Address |
|---|---|---|---|---|
| **P710** | Quantity for Dry-Run Detection | ADVANCED | 1: Power factor | 888 |
| **P710a** | Low Frequency for Dry-Run Threshold | ADVANCED | 0.00% | 889 |
| **P710b** | Dry-Run Threshold at Low Frequency | ADVANCED | 0 | 890 |
| **P710c** | High Frequency for Dry-Run Threshold | ADVANCED | 100.00% | 891 |
| **P710d** | Dry-Run Threshold at High Frequency | ADVANCED | 0 | 892 |
| **P711** | Minimum Frequency for Dry-Run Enable | ADVANCED | 0.00% | 893 |
| **P712** | Dry-Run Trip Time | ADVANCED | 20.0 s | 894 |
| **P713** | Dry-Run Autoreset Time | ADVANCED | 30 s | 895 |
| **P714** | Filter Time Constant for Detection Quantity | ADVANCED | 300 ms | 896 |
| **P715** | MDI for Dry-Run Disable | ADVANCED | 0: Disable | 897 |
| **P716** | Dry-Run Action Selector | ADVANCED | 0: Disable | 898 |

| P710 | Quantity for Dry-Run Detection | |
|---|---|---|
| Range | 0 ÷ 1 | 0: Electrical Power<br>1: Power Factor |
| Default | 1 | 1: Power Factor |
| Level | ADVANCED | |
| Address | 888 | |
| Function | Defines the measurement for the Dry-run detection. | |

| P710a | Low Frequency for Dry-Run Threshold | |
|---|---|---|
| Range | 0 ÷ 10000 | 0 ÷ 100.00 % |
| Default | 0 | 0.00 % |
| Level | ADVANCED | |
| Address | 889 | |
| Function | Speed for the first point defining the Dry-run function.<br>Expressed as a percentage of **C015**: nominal motor frequency. | |

| P710b | Dry-Run Threshold at Low Frequency | |
|---|---|---|
| Range | 0 ÷ 10000 | 0 ÷ 100.00 |
| Default | 0 | 0.00 |
| Level | ADVANCED | |
| Address | 890 | |
| Function | Value of the Dry-run detection measurement, selected in **P710**, at first point speed **P710a**. | |

| P710c | High Frequency for Dry-Run Threshold | |
|---|---|---|
| Range | 0 ÷ 10000 | 0 ÷ 100.00 % |
| Default | 10000 | 100.00 % |
| Level | ADVANCED | |
| Address | 891 | |
| Function | Speed for the second point defining the Dry-run function.<br>Expressed as a percentage of **C015**: nominal motor frequency. | |

| P710d | Dry-Run Threshold at High Frequency | |
|---|---|---|
| Range | 0 ÷ 10000 | 0 ÷ 100.00 |
| Default | 0 | 0.00 |
| Level | ADVANCED | |
| Address | 892 | |
| Function | Value of the Dry-run detection measurement, selected in **P710**, at second point speed **P710c**. | |

| P711 | Minimum Frequency for Dry-Run Enable | |
|---|---|---|
| Range | 0 ÷ 10000 | 0 ÷ 100.00 |
| Default | 0 | 0.00 |
| Level | ADVANCED | |
| Address | 892 | |
| Function | Frequency below which the Dry-run condition detection is kept disabled.<br>Expressed as a percentage of **C015**: nominal motor frequency. | |

| P712 | Dry-Run Trip Time | |
|---|---|---|
| Range | 0 ÷ 32000 | 0 ÷ 3200.0 s |
| Default | 200 | 20.0 s |
| Level | ADVANCED | |
| Address | 894 | |
| Function | Minimum time for the Dry-run condition to be true before triggering the function activation as per **P716**. | |

| P713 | Dry-Run Autoreset Time | |
|---|---|---|
| Range | 0 ÷ 3200 | 0 ÷ 3200 s |
| Default | 30 | 30 s |
| Level | ADVANCED | |
| Address | 895 | |
| Function | Timeout for condition reset from the latest Dry-run detection event.<br>If **P716** is set as Alarm or Warning, this value is the start point of the reset countdown. | |

| P714 | Filter Time Constant for Detection Quantity | |
|---|---|---|
| Range | 0 ÷ 32000 | 0 ÷ 32000 ms |
| Default | 300 | 300 ms |
| Level | ADVANCED | |
| Address | 896 | |
| Function | First order filter time constant applied to the reference variable chosen in **P710.**<br>Useful in case of electric noise affecting the variable. | |

| P715 | MDI for Dry-Run Disable | |
|---|---|---|
| Range | 0 ÷ 24 | 0 ÷ 24:XMDI8 |
| Default | 0 | 0: Disable |
| Level | ADVANCED | |
| Address | 897 | |
| Function | If a digital input is set, when the signal is high, the Dry-run detection is disabled. | |

| P716 | Dry-Run Action Selector | |
|---|---|---|
| Range | 0 ÷ 3 | 0: Disable<br>1: Alarm<br>2: Warning<br>3: Only MDO |
| Default | 0 | 0: Disable |
| Level | ADVANCED | |
| Address | 898 | |
| Function | When a Dry-run condition is detected for a time equal to at least the time set in **P712**, the selected action is executed.<br>The default setting is “No action”. The possible options are the triggering of an alarm (inverter stop) or a warning signal (displayed on the keypad, but the inverter is kept running).<br>If an MDO for Dry-run detection is allocated to this function from the **Digital Outputs Menu**, its status will be changed in cases 1, 2 and 3.<br>Option 3 is required to have only the **MDO** command without any additional signal. | |

## 2.6.3. Pipe Fill Control Menu

*2.6.3.1. Overview*

The hydraulic systems are affected by the “water hammer” phenomenon, occurring in case of sudden changes in pressure and that may damage piping, thus adversely affecting the lifetime of the system.

The water hammer phenomenon may occur if pipes are filled in an abrupt way.

The Pipe Fill function has been developed to smoothly control pipe fill and avoid water hammer phenomena damaging hydraulic outlets (such as irrigation nozzles) by limiting the system filling rate.

The Pipe Fill logic is a general-purpose one to better meet the customer’s application requirements, i.e. vertical or horizontal systems:

- In vertical systems, the more pipes are full, the greater the pressure. In that case, the acceleration ramp must be slower and maintain constant flow rate for the time required for pressure stabilization.
- In horizontal systems, pressure does not increase during pipe fill, so the pipe fill rate may be attained quickly and can be kept constant for the time required to fill the whole pipe length.

The figures below show the pipe fill rate trend over time in case of vertical and horizontal plant.

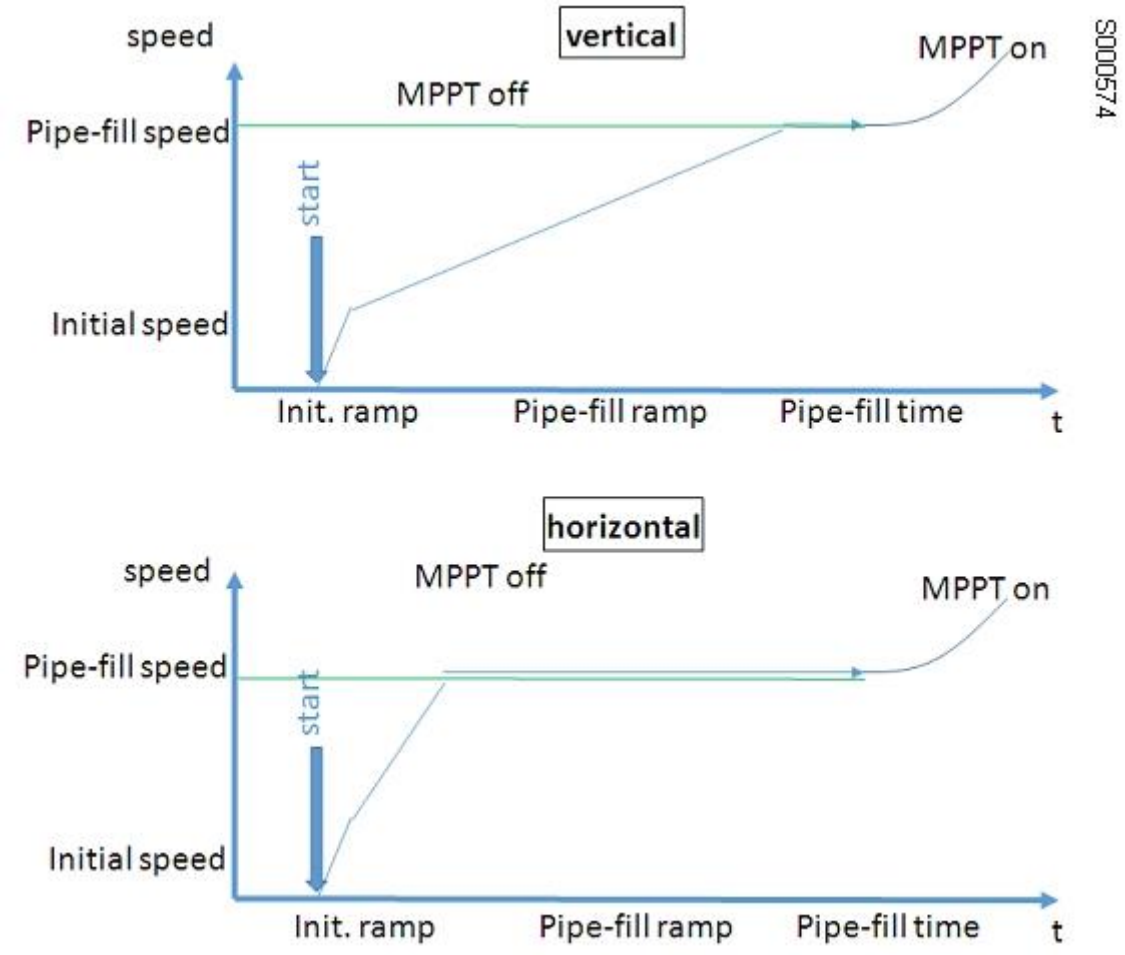



**Figure 7: Pipe Fill function**

If the PID regulator is adopted, parameter **P734** allows choosing whether to stop pipe fill when the preset fill time is over, or even when the PID reference is attained.

When the PID is disabled, the Pipe Fill function will stop when the preset fill time is achieved and will be resumed to reach the reference fill rate via the active ramps.

*2.6.3.2. List of Parameters P730 to P734*

| Parameter | Function | User Level | Default Value | MODBUS Address |
|---|---|---|---|---|
| **P730** | Pipe Fill Ramp | ADVANCED | 10.0 s | 932 |
| **P731** | Pipe Fill Rate | ADVANCED | 30.00% | 933 |
| **P732** | Pipe Fill Time | ADVANCED | 5s | 934 |
| **P734** | Pipe Fill Enable Mode | ADVANCED | 0: Disable | 936 |

| **P730** | **Pipe Fill Ramp** | |
|---|---|---|
| **Range** | 0 ÷ 32000 | 0 ÷ 3200.0 s |
| **Default** | 100 | 10.0 s |
| **Level** | ADVANCED | |
| **Address** | 932 | |
| **Function** | Determines the time taken to go from zero rpm to the value set in **P731**. | |

| **P731** | **Pipe Fill Rate** | |
|---|---|---|
| **Range** | 0 ÷ 32000 | 0 ÷ 320.00 % |
| **Default** | 3000 | 30.00 % |
| **Level** | ADVANCED | |
| **Address** | 933 | |
| **Function** | Determines the pipe fill rate for the reference during the Pipe Fill stage. | |

| **P732** | **Pipe Fill Time** | |
|---|---|---|
| **Range** | 0 ÷ 32000 | 0 ÷ 32000 s |
| **Default** | 5 | 5 s |
| **Level** | ADVANCED | |
| **Address** | 934 | |
| **Function** | Indicates the time when the pipe fill rate is kept at the value set in **P731**. | |

| **P734** | **Pipe Fill Enable Mode** | |
|---|---|---|
| **Range** | 0 ÷ 1 | 0: Disabled<br>1: Enabled |
| **Default** | 0 | 0: Disabled |
| **Level** | ADVANCED | |
| **Address** | 936 | |
| **Function** | 0: Disabled<br>The Pipe Fill function is inactive and the active ramps are implemented.<br>1: Enabled<br>The function is active; exiting the Pipe Fill mode is conditioned only when the preset times are over<br>2: Enabled + PID feedback<br>The function is active; exiting the Pipe Fill mode is conditioned when the preset times are over or when the PID reference is attained. | |

## 2.6.4. Motor Configuration Menu

*2.6.4.1. Overview*

The Solardrive Plus software controls the motor according to the IFD (Voltage/Frequency Control) algorithm, where the output voltage is computed based on frequency and special parameterization.

*2.6.4.2. Motor Ratings*

**Table 8: Motor Ratings**

| Motor Ratings | Parameter |
|---|---|
| Rated frequency | **C015** |
| Rated rpm | **C016** |
| Rated power | **C017** |
| Rated current | **C018** |
| Rated voltage | **C019** |
| No-load power | **C020** |
| No-load current | **C021** |

*2.6.4.3. Parameters for IFD control*

This group of parameters defines the V/f pattern trend of the drive when it is used as an IFD control algorithm. When setting the type of V/f pattern (**C013**), the following curves can be used:

- Constant torque
- Quadratic
- Free setting

The diagram below illustrates three types of programmable curves compared to the theoretical V/f curve.

If **C013 = Constant Torque,** Preboost parameter **C034** allows changing the starting voltage value if compared to the theoretical V/f curve (this allows torque compensation for losses caused by the stator impedance and a greater torque at lower revs).

If **C013 = Quadratic,** the drive will follow a V/f pattern with a parabolic trend. You can set the starting voltage value (**C034**), the desired voltage drop if compared to the relevant constant torque (use **C032**) and the frequency allowing implementing this torque reduction (use **C033**).

If **C013 = Free Setting,** you can program the starting voltage (**C034 Preboost**), the increase in voltage to 1/20 of the rated frequency (**C035 Boost0**), and the increase in voltage (**C036 Boost1**) at programmable frequency (**C037 Frequency for Boost1**).

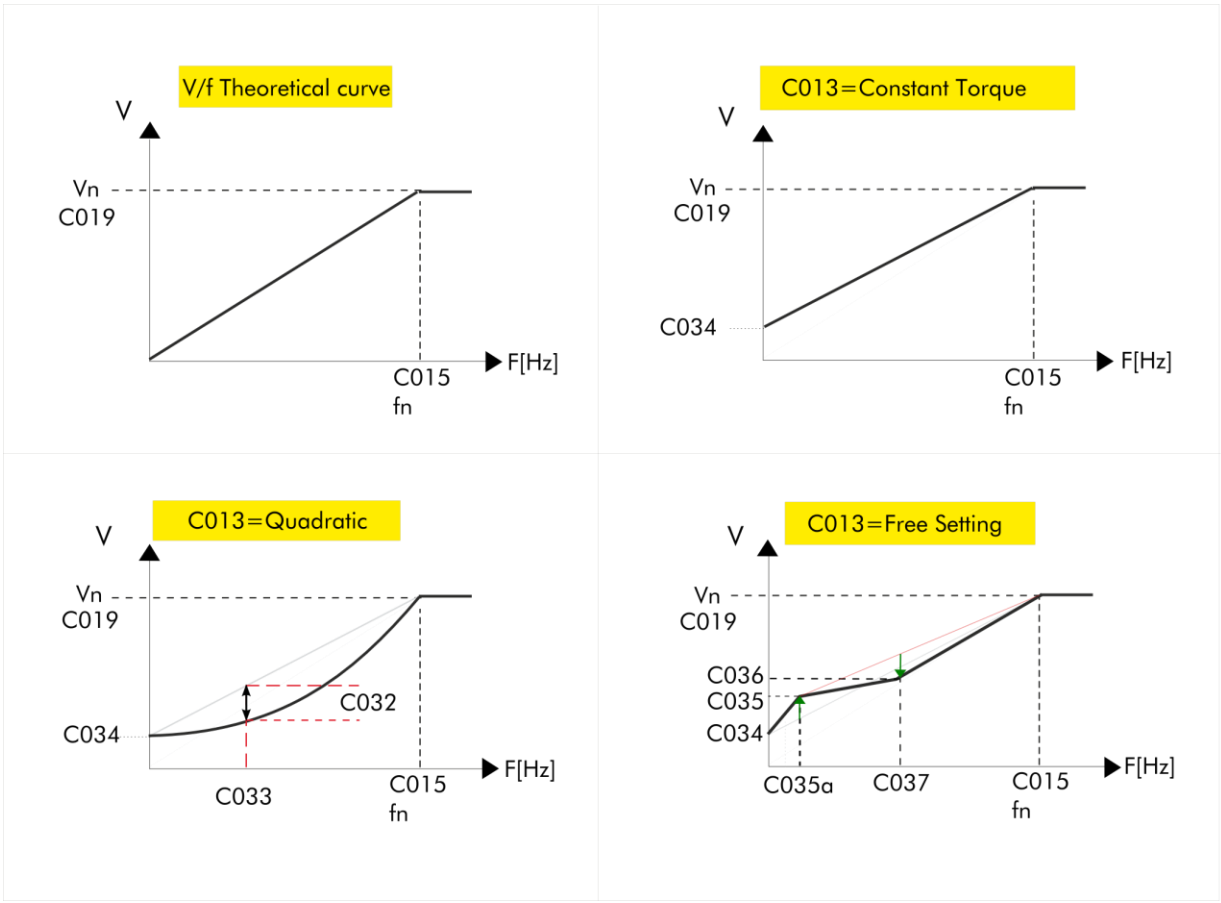



**Figure 8: Types of programmable V/f curves**

The voltage produced by the drive may be changed also by setting the **Automatic Increase in Torque Curve** parameter (**C038**).
For the description of the parameters used in the figure above, see Table 9.

**Table 9: IFD control parameters for the connected motors**

| Description | Parameter |
|---|---|
| **Rated frequency:**<br>Rated frequency of the connected motor (current rating). | **C015** |
| **Rated voltage:**<br>rated voltage of the connected motor (voltage rating). | **C019** |
| **V/f curve type:**<br>Type of V/f curve applied. | **C013** |
| **Torque reduction with quadratic curve:**<br>Torque reduction using V/f quadratic curve. | **C032** |
| **Rated speed referring to torque reduction with quadratic curve:**<br>Speed actuating the torque reduction using a quadratic curve. | **C033** |
| **Voltage preboost:**<br>Determines the voltage produced by the drive at min. output frequency fomin. | **C034** |
| **Voltage Boost 0:**<br>Determines the voltage variations in respect to the nominal voltage at the frequency set up by the relevant parameter. | **C035** |
| **Boost 0 application frequency:**<br>Determines the Boost 0 application frequency. | **C035a** |
| **Voltage Boost 1:**<br>Determines the frequency for the application of the boost at preset frequency. | **C036** |
| **Boost 1 application frequency:**<br>Determines the Boost 1 application frequency at preset frequency. | **C037** |
| **Autoboost:**<br>Variable torque compensation expressed as a percentage of the rated motor voltage. The preset value expresses the voltage increase when the motor is running at rated torque. | **C038** |

*2.6.4.4. List of parameters C008 to C042*

| Parameter | Function | User Level | Default Value | MODBUS Address |
|---|---|---|---|---|
| **C008** | Rated Mains Voltage | BASIC | 2:[380÷480V] | 1008 |
| **C010** | Type ff Control Algorithm | NOT ADJUSTABLE | 0: IFD | 1010 |
| **C011** | Type ff Reference | NOT ADJUSTABLE | 0: Speed (MASTER mode) | 1011 |
| **C012** | Speed Feedback from Encoder | NOT ADJUSTABLE | 0: Speed (MASTER mode) | 1012 |
| **C013** | Type of V/F Curve | BASIC | Depending on size | 1013 |
| **C014** | Phase Rotation | ENGINEERING | 0: No | 1014 |
| **C015** | Rated Motor Frequency | BASIC | 50.0 Hz | 1015 |
| **C016** | Rated Motor Rpm | BASIC | 1420 rpm | 1016 |
| **C017** | Rated Motor Power | BASIC | Depending on size | 1017 |
| **C018** | Rated Motor Current | BASIC | Depending on size | 1018 |
| **C019** | Rated Motor Voltage | BASIC | 400.0 V | 1019 |
| **C020** | Motor No-Load Power | ADVANCED | 0.0% | 1020 |
| **C021** | Motor No-Load Current | ADVANCED | 0% | 1021 |
| **C022** | Motor Stator Resistance | ENGINEERING | Depending on size | 1022 |
| **C023** | Leakage Inductance | ENGINEERING | Depending on size | 1023 |
| **C024** | Mutual Inductance | ADVANCED | 250.00mH | 1024 |
| **C026** | Time Constant Of Bus Voltage Low-Pass Filter | ENGINEERING | 0 ms | 1026 |
| **C028** | Min. Motor Speed | BASIC | 0 rpm | 1028 |
| **C029** | Max. Motor Speed | BASIC | 1500 rpm | 1029 |
| **C031** | Max. Speed Alarm | ADVANCED | 0: Disabled | 1031 |
| **C032** | Reduction in Quadratic Torque Curve | ADVANCED | 30% | 1032 |
| **C033** | Rated Revs Referring to Reduction in Quadratic Torque Curve | ADVANCED | 20% | 1033 |
| **C034** | Voltage Preboost for IFD | BASIC | Depending on size | 1034 |
| **C035** | Voltage Boost 0 at Programmable Frequency | ADVANCED | Depending on size | 1035 |
| **C035a** | Frequency for Boost 0 Application | ADVANCED | 5% | 1052 |
| **C036** | Voltage Boost 1 at Programmable Frequency | ADVANCED | Depending on size | 1036 |
| **C037** | Frequency for Application of Voltage Boost 1 | ADVANCED | Depending on size | 1037 |
| **C038** | Autoboost | ADVANCED | Depending on size | 1038 |
| **C039** | Slip Compensation | ADVANCED | 0: Disabled | 1039 |
| **C040** | Voltage Drop at Rated Current | ADVANCED | 0: Disabled | 1040 |
| **C042** | Vout Saturation Percentage | ENGINEERING | 100% | 1042 |

| C008 | Rated Mains Voltage | |
|---|---|---|
| Range | 0 ÷ 8 | 0: [ 200 ÷ 240 ] V<br>1: 2T Regen.<br>2: [ 380 ÷ 480 ] V<br>3: [ 481 ÷ 500 ] V<br>4: 4T Regen.<br>5: [ 500 ÷ 600 ] V<br>6: 5T Regen.<br>7: [ 600 ÷ 690 ] V<br>8: 6T Regen. |
| Default | 2 | 2: [ 380 ÷ 480 ] V |
| Level | BASIC | |
| Address | 1008 | |
| Function | This parameter defines the rated voltage of the mains powering the drive, thus allowing obtaining voltage ranges to be used for the drive operation. The value set in this parameter depends on the **Drive voltage class.**<br>To supply the drive via a non-stabilized DC source, the corresponding AC voltage range must be used (see Table 10). DO NOT USE xT Regen settings in this case. | |

**Table 10: Equivalence between AC mains range and DC range**

| AC MAINS | DC range |
|---|---|
| 200÷240 Vac | 280÷338 Vdc |
| 380÷480 Vac | 530÷678 Vdc |
| 481÷500 Vac | 680÷705 Vdc |
| 500÷600 Vac | 705÷810 Vdc |
| 600÷690 Vac | 810÷970 Vdc |

| C013 | Type of V/F Pattern | |
|---|---|---|
| Range | 0 ÷ 2 | 0: Constant Torque<br>1: Quadratic<br>2: Free Setting |
| Default | Depending on the size | |
| Level | BASIC | |
| Address | 1013 | |
| Function | Allows selecting different types of V/f pattern.<br><br>If **C013 = Constant torque**, voltage at zero frequency can be selected (Preboost **C034**).<br><br>If **C013 = Quadratic**, you can select voltage at zero frequency (preboost, **C034**), max. voltage drop with respect to the theoretical V/f pattern, **C032**, and the frequency allowing implementing max. voltage drop, **C033**.<br><br>If **C013 = Free Setting**, you can set voltage at zero frequency (preboost, **C034**); voltage increase to 20% of the rated frequency (Boost0, **C035**); and voltage increase to a programmed frequency (Boost1, **C036**; frequency for Boost1, **C037**). | |

| C014 | Phase Rotation | |
|---|---|---|
| Range | 0÷1 | 0: [No]; 1: [Yes] |
| Default | 0 | 0: [No] |
| Level | ENGINEERING | |
| Address | 1014 | |
| Function | Allows reversing the mechanical rotation of the connected motor. | |

***WARNING***

***When activating C014, the mechanical rotation of the connected motor and its load is reversed accordingly.***

| C015 | Rated Motor Frequency | |
|---|---|---|
| Range | 10 ÷ 10000 | 1.0 Hz ÷ 1000.0 Hz (See upper limits in Table 11) |
| Default | 500 | |
| Level | BASIC | |
| Address | 1015 | |
| Function | This parameter defines the rated motor frequency (nameplate rating). | |

**Table 11: Maximum value of the output frequency depending on the drive size**

| Size | Max. output frequency (Hz) (*) |
|---|---|
| | 2T/4T |
| Smaller than 0015 | 1000 |
| 0015 to 0129 (**) | 625 |
| 0150 to 0162 | 500 |
| Greater than 0162 | 400 |

(**) From 0023 to 0030 (437.5Hz), 0040 (1000Hz) and 0049 (800Hz)

| Size | Max. output frequency (*) |
|---|---|
| | 5T/6T |
| Smaller than 0076 | 500 |
| 0076 to 0524 | 400 |
| Greater than 0524 | 200 |

*(*) NOTE*

*The maximum output frequency is limited to the speed level programmed in parameters **C028, C029 [–32000 ÷ 32000]rpm.** This results in **$Fout_{max}$= ($RPM_{max}$*NPole)/120.***

| C016 | Rated Motor RPM | |
|---|---|---|
| Range | 1 ÷ 32000 | 1 ÷ 32000 rpm |
| Default | 1420 | |
| Level | BASIC | |
| Address | 1016 | |
| Function | This parameter defines the rated motor rpm (nameplate rating). | |

| C017 | Rated Motor Power | |
|---|---|---|
| Range | 1 ÷ 32000 | 0.1 ÷ 3200.0 kW (Upper limited to twice the default value) |
| Default | Depending on the size | |
| Level | BASIC | |
| Address | 1017 | |
| Function | This parameter defines the rated motor power (nameplate rating). | |

| C018 | Rated Motor Current | |
|---|---|---|
| Range | 1 ÷ 32000 | 0.1 ÷ 3200.0 A (Depending on the size) |
| Default | Depending on the size | |
| Level | BASIC | |
| Address | 1018 | |
| Function | This parameter defines the rated motor current (nameplate rating). | |

| C019 | Rated Motor Voltage | |
|---|---|---|
| Range | 50 ÷ 12000 | 5.0 ÷ 1200.0 V |
| Default | 4000 | 400.0 V |
| Level | BASIC | |
| Address | 1019 | |
| Function | This parameter defines the rated motor voltage (nameplate rating). | |

| C020 | Motor No-load Power | |
|---|---|---|
| Range | 0 ÷ 1000 | 0.0 ÷ 100.0% |
| Default | 0 | 0.0% |
| Level | ADVANCED | |
| Address | 1020 | |
| Function | This parameter defines the power absorbed by the motor at rated voltage and rated rpm when no load is connected to the motor. | |

| C021 | Motor no-load current | |
|---|---|---|
| Range | 1 ÷ 100 | 1 ÷ 100% |
| Default | 0 | 0% |
| Level | ADVANCED | |
| Address | 1021 | |
| Function | This parameter defines the current absorbed by the motor at rated voltage and rated rpm when no load is connected to the motor. It is expressed as a percentage of the motor rated current **C018**. | |

| C022 | Motor Stator Resistance | |
|---|---|---|
| Range | 0 ÷ 32000 | 0.000 ÷ 32.000Ω |
| Default | Depending on the size | |
| Level | ENGINEERING | |
| Address | 1022 | |
| Function | This parameter defines stator resistance Rs.<br>If a star connection is used, it matches with the value of the resistance of one phase (half the resistance measured between two terminals); if a delta connection is used, it matches with 1/3 of the resistance of one phase. | |

| C023 | Leakage Inductance | |
|---|---|---|
| Range | 0 ÷ 32000 | 0.00 ÷ 320.00mH |
| Default | Depending on the size | |
| Level | ENGINEERING | |
| Address | 1023 | |
| Function | This parameter defines the global leakage inductance of the connected motor.<br>If a star connection is used, it matches with the value of the inductance of one phase; if a delta connection is used, it matches with 1/3 of the inductance of one phase. | |

| C024 | Mutual Inductance | |
|---|---|---|
| Range | 0 ÷ 65000 | 0.00 ÷ 650.00mH |
| Default | 25000 | 250.00mH |
| Level | ADVANCED | |
| Address | 1024 | |
| Function | This parameter defines the mutual inductance of the connected motor.<br>The approximate value of the mutual inductance results from no-load current according to the formula below:<br>$M \cong (Vmot – Rstat*Io) / (2\pi fmot* Io)$ | |

| C026 | Time Constant of Bus Voltage Low-pass Filter | |
|---|---|---|
| Range | 0 ÷ 32000 | 0.0 ÷ 3200.0 ms |
| Default | 0 | 0.0 ms |
| Level | ENGINEERING | |
| Address | 1026 | |
| Function | This parameter defines the time constant of the low-pass filter of the bus voltage readout.<br>Changing this value can avoid motor oscillations, especially when no load is connected to the motor. | |

| C028 | Min. Motor Speed | |
|---|---|---|
| Range | –32000 ÷ 32000 (*) | –32000 ÷ 32000 rpm (*) |
| Default | 0 | 0 rpm |
| Level | BASIC | |
| Address | 1028 | |
| Function | This parameter defines the minimum speed of the connected motor. This is the reference speed forced when the active speed reference is at its minimum value. | |

*NOTE*

*The value set as the min. speed is used as the saturation of the global reference; the speed reference will never be lower than the value set as min. speed.*

| C029 | Max. motor speed | |
|---|---|---|
| Range | 0 ÷ 32000 (*see note in parameter **C028**) | 0 ÷ 32000 rpm (*see note in parameter **C028**) |
| Default | 1500 | 1500 rpm |
| Level | BASIC | |
| Address | 1029 | |
| Function | This parameter defines the maximum speed of the connected motor.<br>This is the reference speed forced when the active speed reference is at its maximum value. | |

*NOTE*

*According to factory setting, when the equipment is AC power supplied (from optional, auxiliary AC grid), the motor speed reference is equal to the value in parameter **C029**.*

| C031 | Max. Speed Alarm | |
|---|---|---|
| Range | 0 ÷ 32000 | 0: [Disabled] ÷ 32000 rpm |
| Default | 0 | 0: Disabled |
| Level | ADVANCED | |
| Address | 1031 | |
| Function | If it is not set to zero, this parameter determines the speed value to be entered for the maximum speed alarm (**A076**). | |

| C032 | Reduction in Quadratic Torque Curve | |
|---|---|---|
| Range | 0 ÷ 1000 | 0 ÷ 100.0% |
| Default | 300 | 30.0% |
| Level | ADVANCED | |
| Address | 1032 | |
| Control | IFD | |
| Function | If the V/f curve pattern **C013 (C056, C099) = Quadratic**, this parameter defines the maximum voltage reduction in terms of theoretical V/f pattern, which is implemented at the frequency programmed in **C033** (see section 2.6.4.3). | |

| C033 | Rated Revs Referring to Reduction in Quadratic Torque Curve | |
|---|---|---|
| Range | 1 ÷ 100 | 1 ÷ 100% |
| Default | 20 | 20% |
| Level | ADVANCED | |
| Address | 1033 | |
| Control | IFD | |
| Function | If the V/f curve pattern **C013 = Quadratic**, this parameter defines the frequency implementing the max. torque reduction in terms of theoretical V/f pattern set in **C032** (see section 2.6.4.3). | |

| C034 | Voltage Preboost for IFD | |
|---|---|---|
| Range | 0 ÷ 50 | 0.0 ÷ 5.0 % |
| Default | Depending on the size | |
| Level | BASIC | |
| Address | 1034 | |
| Control | IFD | |
| Function | Torque compensation at minimum frequency produced by the drive.<br>IFD control: determines the increase of the output voltage at 0Hz. | |

| C035 | Voltage Boost 0 at Programmable Frequency | |
|---|---|---|
| Range | –100 ÷ +100 | –100 ÷ +100 % |
| Default | Depending on the size | |
| Level | ADVANCED | |
| Address | 1035 | |
| Control | IFD | |
| Function | Torque compensation at preset frequency (parameter **C035a**).<br>This parameter defines the output voltage variation at preset frequency in respect to the frequency resulting from the constant V/f ratio (voltage/frequency constant). It is expressed as a percentage of the nominal motor voltage (**C019**). | |

| C035a | Frequency for Boost 0 Application | |
|---|---|---|
| Range | 0 ÷ 99 | 0 ÷ 99 % |
| Default | 5 | 5% |
| Level | ADVANCED | |
| Address | 1052 | |
| Control | IFD | |
| Function | Frequency for the application of the boost preset with parameter **C035**.<br>It is expressed as a percentage of the nominal motor frequency (**C015**). | |

| C036 | Voltage Boost 1 at Programmable Frequency | |
|---|---|---|
| Range | –100 ÷ +400 | –100 ÷ +400 % |
| Default | Depending on the size | |
| Level | ADVANCED | |
| Address | 1036 | |
| Control | IFD | |
| Function | Torque compensation at preset frequency (parameter **C037**). Determines how output voltage varies at preset frequency with respect to voltage obtained with a constant V/f pattern (constant voltage frequency). It is expressed as a percentage of the nominal motor frequency (**C019**). | |

| C037 | Frequency for Application of Voltage Boost 1 | |
|---|---|---|
| Range | 6 ÷ 99 | 6 ÷ 99 % |
| Default | Depending on the size | |
| Level | ADVANCED | |
| Address | 1037 | |
| Control | IFD | |
| Function | Frequency for application of voltage Boost with parameter **C036**. This is expressed as a percentage of the motor rated frequency (**C015**). | |

| C038 | Autoboost | |
|---|---|---|
| Range | 0 ÷ 10 | 0 ÷ 10 % |
| Default | Depending on the size | |
| Level | ADVANCED | |
| Address | 1038 | |
| Control | IFD | |
| Function | Variable torque compensation expressed as a percentage of the motor rated voltage. The preset value expresses the voltage increase when the motor is running at its rated torque. | |

| C039 | Slip Compensation | |
|---|---|---|
| Range | 0 ÷ 200 | [0: Disabled] ÷ 200 % |
| Default | 0 | [0: Disabled] |
| Level | ADVANCED | |
| Address | 1039 | |
| Control | IFD | |
| Function | This parameter represents the motor rated slip expressed as a value percent. If set to 0, this function is disabled. | |

| C040 | Voltage Drop at Rated Current | |
|---|---|---|
| **Range** | 0÷500 | 0÷50.0% |
| **Default** | 0 | 0: Disabled |
| **Level** | ADVANCED | |
| **Address** | 1040 | |
| **Control** | IFD | |
| **Function** | Defines the voltage increase required to compensate the voltage drop between the inverter and the motor due to the presence of a filter. The voltage increase is given by:<br>DeltaV = (**C040**/100) * Vmot * Iout/Imot * fout/fmot, where Iout is the output current, fout is the output frequency, Vmot, Imot and fmot are the rated motor voltage, rated motor current and rated motor frequency respectively (parameters **C019**, **C018** and **C015**).<br>Example:<br>**C040 = 10%** Voltage drop at rated current<br>**C013 = Constant torque** Type of V/f pattern<br>**C015 = 50 Hz** Rated frequency<br>**C019 = 380 V** Rated voltage<br>**C018 = 50 A** Rated current<br>If the drive output frequency is 25 Hz, it should deliver 190V. When the output current is 40A (**C018**) the voltage actually produced is<br>Vout = 190 + ((10/100 * 380) * 40/50 * 25/50) = 190 + 15.2 = 205.2 V. | |

| C042 | Vout Saturation Percentage | |
|---|---|---|
| **Range** | 10 ÷ 120 | 10 ÷ 120 % |
| **Default** | 100 | 100% |
| **Level** | ENGINEERING | |
| **Address** | 1042 | |
| **Function** | This parameter sets the bus voltage value percent used to generate the output voltage of the drive. Changes made to this parameter affect the motor performance in terms of flux weakening. | |

## 2.6.5. Limits Menu

### *2.6.5.1. Overview*

The **Limits Menu** defines the current/torque limits applied to the control functions (IFD, VTC or FOC controls) selected for the connected motor.

For IFD control, **current** limits are used. Three limit current levels are available, which are expressed as a percentage of the motor rated current:

1) Current limit while accelerating;
2) Current limit at constant rpm;
3) Current limit while decelerating.

Two special parameters are also available; one sets the decrease of the limit current value when the motor runs at constant power (flux weakening), while the other parameter disables the frequency decrease in case of acceleration current limit (this is useful for inertial loads).

### *2.6.5.2. List of Parameters C043 to C050*

| Parameter | Function | User Level | Default Value | MODBUS Address |
|---|---|---|---|---|
| **C043** | Current limit while accelerating | BASIC | 150% | 1043 |
| **C044** | Current limit at constant rpm | BASIC | 150% | 1044 |
| **C045** | Current limit while decelerating | BASIC | Depending on size | 1045 |
| **C046** | Current limit decrease in flux weakening | ADVANCED | 0: Disabled | 1046 |
| **C050** | Frequency decrease during acceleration limit | ADVANCED | 0: Enabled | 1050 |

| C043 | Current Limit while Accelerating | |
|---|---|---|
| **Range** | 0 ÷ 400 (*) | 0: Disabled<br>1.0% ÷ 400.0% (*) |
| **Default** | 150 | 150% |
| **Level** | BASIC | |
| **Address** | 1043 | |
| **Control** | IFD | |
| **Function** | This parameter defines the current limit while accelerating; it is expressed as a percentage of the rated current of the motor.<br>No limit is applied if this parameter is set to 0: Disabled. | |

(*)*The maximum allowable value depends on the drive size.*

| C044 | Current Limit at Constant rpm | |
|---|---|---|
| **Range** | 0 ÷ 400 (*) | 0: Disabled<br>1.0% ÷ 400.0% (*) |
| **Default** | 150 | 150% |
| **Level** | BASIC | |
| **Address** | 1044 | |
| **Control** | IFD | |
| **Function** | This parameter defines the current limit at constant rpm; it is expressed as a percentage of the rated current of the motor.<br>No limit is applied if this parameter is set to 0: Disabled. | |

(*)*The maximum allowable value depends on the drive size.*

| C045 | Current Limit while Decelerating | |
|---|---|---|
| Range | 0 ÷ 400 (*) | 0: Disabled<br>1.0% ÷ 400.0% (*) |
| Default | Depending on the size | |
| Level | BASIC | |
| Address | 1045 | |
| Control | IFD | |
| Function | This parameter defines the current limit while decelerating; it is expressed as a percentage of the rated current of the motor.<br>No limit is applied if this parameter is set to 0: Disabled. | |

(*)*The maximum allowable value depends on the drive size.*

| C046 | Current Limit Decrease in Flux Weakening | |
|---|---|---|
| Range | 0 ÷ 1 | 0: Disabled<br>1: Enabled |
| Default | 0 | 0: Disabled |
| Level | ADVANCED | |
| Address | 1046 | |
| Control | IFD | |
| Function | This parameter enables the current limit decrease function in flux weakening. The current limit is multiplied by the ratio between the motor rated torque and the frequency forced to the drive:<br><br>limit = current limit being used * (Fmot/ Fout). | |

| C050 | Frequency Decrease during Acceleration Limit | |
|---|---|---|
| Range | 0 ÷ 1 | 0: Enabled<br>1: Disabled |
| Default | 0 | 0: Enabled |
| Level | ADVANCED | |
| Address | 1050 | |
| Control | IFD | |
| Function | This parameter enables output frequency decrease during acceleration limit. | |

## 2.6.6. Control Method Menu

*NOTE*

*For a detailed description on parameters that are not described in this manual, please contact Enertronica Santerno S.p.A.*

### *2.6.6.1. Overview*

As per factory setting, the drive receives digital commands from the terminal board and the speed references:

- From the internal MPPT regulator, if DC power supply from PV field is active (PV mode);
- From REF analog input if AC power supply is active (AC mode – if available).

### *2.6.6.2. List of Parameters C140 to C148*

| Parameter | Function | User Level | Default Value | MODBUS Address |
|---|---|---|---|---|
| **C140** | Selection of Command Source 1 | ADVANCED | 1: Terminals | 1140 |
| **C141** | Selection of Command Source 2 | ADVANCED | 1: Terminals | 1141 |
| **C142** | Selection of Command Source 3 | ENGINEERING | 0 | 1142 |
| **C143** | Selection of Reference when PV | ADVANCED | 12: MPPT | 1143 |
| **C144** | Selection of Reference when AC | ADVANCED | 1: REF | 1144 |
| **C145** | Selection of Reference Source 3 | ENGINEERING | 0 | 1145 |
| **C146** | Selection of Reference Source 4 | ENGINEERING | 0 | 1146 |
| **C147** | Selection of Limit Source | ENGINEERING | 0 | 1147 |
| **C148** | Switching from Remote to Local Control | ENGINEERING | 0: Stand-by or Fluxing | 1148 |

| **C140 C141 C142** | **Selection of Command Source 1, 2, 3** | |
|---|---|---|
| **Range** | 0 ÷ 5 | 0: Disabled,<br>1: Terminals<br>2: Serial Link,<br>3: Fieldbus,<br>4: Terminals B,<br>5: Keypad |
| **Default** | **C140** ÷ **C141**= 1<br>**C142** = 0 | **C140** ÷ **C141**= 1: Terminals<br>**C142** = 0: Disabled |
| **Level** | **C140** ÷ **C141** ADVANCED; **C142** ENGINEERING | |
| **Address** | 1140 (1141,1142) | |
| **Function** | Selection of the drive command source. | |

| C143 | Selection of Reference when PV | |
|---|---|---|
| Range | 0 ÷ 12 | 0: Disabled<br>1: REF<br>2: AIN1<br>3: AIN2<br>4: Frequency input<br>5: Serial Link<br>6: Fieldbus<br>7: Keypad<br>8: Encoder<br>9: UpDown from MDI<br>10: XAIN4<br>12: MPPT |
| Default | 12 | 12: MPPT |
| Level | ADVANCED | |
| Address | 1143 | |
| Function | This parameter selects the reference source when DC power supply (PV field) is active.<br>If 12: MPPT, the motor speed reference is generated by the internal regulator in order to guarantee operation at the Maximum Power Point Tracking of the PV field. | |

*NOTE*

*If parameter* **C143** *is set other than* **12: MPPT**, *the equipment might not run correctly.*

| C144 | Selection of Reference when AC | |
|---|---|---|
| Range | 0 ÷ 9 | 0: Disabled<br>1: REF<br>2: AIN1<br>3: AIN2<br>4: Frequency input<br>5: Serial Link<br>6: Fieldbus<br>7: Keypad<br>8: Encoder<br>9: UpDown from MDI |
| Default | 1 | 1: REF |
| Level | ADVANCED | |
| Address | 1144 | |
| Function | This parameter selects the reference source when AC power supply (optional) is active.<br>If set to 1: REF, the motor speed reference is taken from REF analog input. Factory setting: +10 V DC to REF input produces a speed reference for the motor equal to the speed value set in parameter **C029** (see section 2.6.4). | |

## 2.6.7. Autoreset Menu

*2.6.7.1. Overview*

The Autoreset function can be enabled in case an alarm trips. You can enter the maximum number of autoreset attempts and the time required for resetting the attempt number. If the Autoreset function is disabled, you can program an autoreset procedure at power on, which resets an active alarm when the drive is shut off. Undervoltage alarms or mains loss alarms can be saved in the fault list in the Autoreset Menu.

To activate the Autoreset function, set a number of attempts other than zero in parameter **C255**. When the number of reset attempts is the same as the value set in **C255**, the autoreset function is disabled. It will be enabled again only when a time equal to or longer than the time set in **C256** has passed.

If the drive is turned off when an alarm is active, the alarm tripped is stored to memory and will be active at next power on. Regardless of the Autoreset function setup, an automatic reset of the last alarm stored can be obtained when the drive is next turned on (**C257** [Yes]). Undervoltage alarm **A047** (DC bus voltage below allowable threshold with motor running) or Mains Loss alarm **A064** (mains loss when the motor is running and the Power Down function is disabled) are not stored in the fault list when the drive is powered off (factory-setting). To enable parameter storage, set **C258** to [Yes].

The Solardrive Plus is factory-set to alarm autoreset functionality (when an alarm trips, it is automatically reset when the alarm reset conditions occur). When the alarm is reset, the motor starts after a timeout set in **P802** (see section 2.6.11).

*2.6.7.2. List of Parameters C255 to C258*

| Parameter | FUNCTION | User Level | Default Value | MODBUS Address |
|---|---|---|---|---|
| **C255** | Autoreset attempt number | ENGINEERING | 4 | 1255 |
| **C256** | Attempt counting reset time | ENGINEERING | 300 sec | 1256 |
| **C257** | Alarm reset at Power On | ENGINEERING | 1: [Yes] | 1257 |
| **C258** | Enable Undervoltage and Mains Loss alarms | ENGINEERING | 0: [Disabled] | 1258 |

| **C255** | **Autoreset Attempt Number** | |
|---|---|---|
| **Range** | 0 ÷ 100 | 0 ÷ 100 |
| **Default** | 4 | 4 |
| **Level** | ENGINEERING | |
| **Address** | 1255 | |
| **Function** | If set other than 0, this parameter enables the Autoreset function and sets the max. allowable number of reset attempts. The autoreset attempt count is reset when a time equal to the time set in **C256** passes starting from the last alarm tripped. | |

| **C256** | **Attempt Counting Reset Time** | |
|---|---|---|
| **Range** | 0; 1000 | 0; 1000 sec |
| **Default** | 300 | 300 sec |
| **Level** | ENGINEERING | |
| **Address** | 1256 | |
| **Function** | Determines the time that passes from the last alarm tripped to reset the autoreset attempt number. | |

| C257 | Alarm Reset at Power On | |
|---|---|---|
| Range | 0; 1 | 0: [Disabled]; 1: [Yes] |
| Default | 0 | 1: [Yes] |
| Level | ENGINEERING | |
| Address | 1257 | |
| Function | At power on, this parameter enables the automatic reset of the alarms tripped when the drive is powered off. | |

| C258 | Enable Undervoltage and Mains Loss Alarms | |
|---|---|---|
| Range | 0; 1 | 0: [Disabled]; 1: [Yes] |
| Default | 0 | 0: [Disabled] |
| Level | ENGINEERING | |
| Address | 1258 | |
| Function | This parameter saves Undervoltage and Mains Loss alarms to the fault list. | |

## 2.6.8. Motor Thermal Protection Menu

*2.6.8.1. Overview*

The Motor Thermal Protection function protects the motor against overloads.

It is also possible to set the heatsink temperature to make cooling fans start operating (this function is not available for all models).

For each programmable motor, thermal protection can be configured in 3 modes, which can be selected with parameter **C265**, depending on the cooling system being used (configuration modes 1, 2 and 3):

| Value | Descr. | IEC 34-6 Compliance | Description |
|---|---|---|---|
| **0:NO** | [Disable] | - | The Motor Thermal Protection function is disabled. |
| **1:YES** | [No Derating] | IC410 | The Motor Thermal Protection function is active with trip current **I*t** independent of operating speed (No derating); |
| **2:YES A** | [Forced Cooling] | IC411 | The Motor Thermal Protection function is active with trip current **I*t** depending on operating speed, with fan-cooled motor de-rating (Forced Cooling); |
| **3:YES B** | [Fan on Shaft] | IC416 | The Motor Thermal Protection function is active; trip current **I*t** depends on operating speed and de-rating is suitable for motors having a fan keyed to the shaft (Fan on Shaft) (factory setting). |

When **C265**=1, 2 and 3, the motor thermal model is considered. The heating of a motor is proportional to the square of the current flowing ($I_o^2$). The Motor overheated alarm (**A075**) will trip after the time "t" computed based on the motor thermal model is over.

The alarm can be reset only after a given time depending on the thermal constant (**C267**) of the motor, thus allowing for the correct cooling of the motor.

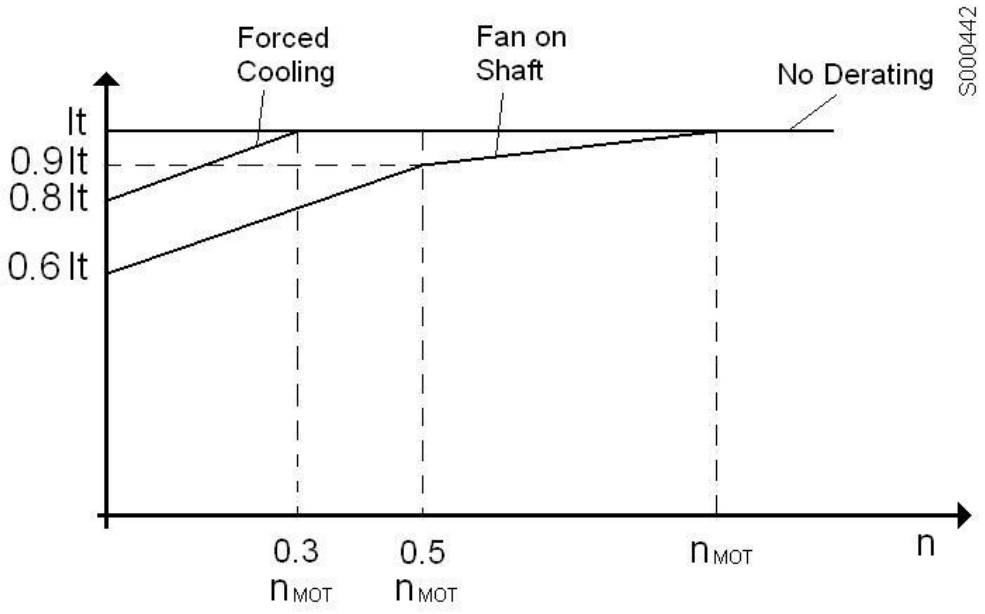



**Figure 9: Trip current drop depending on speed values**

The graph above shows how trip current **I*t** drops depending on the generated speed based on the value set in parameter **C265**.

*NOTE*

*The motor heating can be monitored with measure **M026a**.*
*This value is expressed as a percentage of the asymptotic value that can be attained.*

When **C274**=Enabled, the thermal protection function is implemented from a PTC sensor: the PTC alarm (**A055**) trips when voltage acquired by AIN2 used as a PTC signal input exceeds a preset threshold value when the characteristic temperature is attained. Alarm A055 can be reset only if temperature decreases by 5% with respect to the trip temperature.

### *2.6.8.2. List of Parameters C264 to C274*

| Parameter | Function | User Level | Default Value | MODBUS Address |
|---|---|---|---|---|
| **C264** | Heatsink Temperature for Fan Activation | ADVANCED | 50°C | 1264 |
| **C264a** | Fan Activation Logic Selector | AVDANCED | 0: Default | 1280 |
| **C265** | Thermal Protection Mode for Motor 1 | BASIC | 3: [Fan Shaft] | 1265 |
| **C266** | Pick-Up Current for Motor 1[Imot%] | ADVANCED | 105% | 1266 |
| **C267** | Thermal Time Constant for Motor 1 | BASIC | 720 s | 1267 |
| **C274** | PTC Thermal Protection Enable | BASIC | 0:[Disabled] | 1274 |

| **C264** | **Heatsink Temperature for Fan Activation** | |
|---|---|---|
| **Range** | 0 ÷ 50 | 0 ÷ 50°C |
| **Default** | 50 | 50°C |
| **Level** | ADVANCED | |
| **Address** | 1264 | |
| **Function** | This parameter sets the heatsink threshold for the activation of its cooling fans according to the control logic set in **C264a**.<br>This parameter is active only if **C264a**=0: Default or 2: By Temperature Only.<br><br>The actual temperature of the heatsink can be displayed in measure parameter **M064**. | |

| **C264a** | **Fan Activation Logic Selector** | |
|---|---|---|
| **Range** | 0 ÷ 2 | 0: [Default]<br>1: [Always On]<br>2: [By Temperature Only] |
| **Default** | 0 | 0: [Default] |
| **Level** | ADVANCED | |
| **Address** | 1280 | |
| **Function** | This parameter defines the control logic of the heatsink cooling fans.<br>0: [Default]: The heatsink cooling fans are on whenever the drive is enabled (and IGBTs are switching); when the drive is disabled, fans are off only if the heatsink temperature drops below **C264**.<br>1: [Always On]: Fans are always on.<br>2: [By Temperature Only]: Fans are on only if the heatsink temperature is higher than the value set in **C264**, regardless of the drive status. | |

| C265 | Thermal Protection Mode for Motor 1 | |
|---|---|---|
| Range | 0 ÷ 3 | 0 : [Disabled]<br>1 : [No Derating]<br>2 : [Forced Cooling]<br>3: [Fan on Shaft] |
| Default | 1 | 1 : [No Derating] |
| Level | BASIC | |
| Address | 1265 | |
| Function | This parameter enables the Motor Thermal Protection function.<br>It also selects the type of thermal protection among different trip patterns. | |

| C266 | Pick-Up Current for Motor 1 | |
|---|---|---|
| Range | 1 ÷ min [120; [((Imax/Imot)*100) ]. | 1 ÷ min [120%; [((Imax/Imot)*100) %]. |
| Default | 105 | 105% |
| Level | ADVANCED | |
| Address | 1266 | |
| Function | This parameter sets the thermal protection trip current expressed as a percentage of the motor rated current. | |

| C267 | Thermal Time Constant for Motor 1 | |
|---|---|---|
| Range | 1 ÷ 10800 | 1 ÷ 10.800s |
| Default | 720 | 720s (corresponding to Class IEC 20) |
| Level | BASIC | |
| Address | 1267 | |
| Function | This parameter sets the thermal time constant of the connected motor. The time constant is the time within which the calculated thermal stage has reached 63% of its final value.<br>The motor attains its thermal time constant when it operates in constant load conditions for a time equal to approx. 5 times the constant set in this parameter. | |

| C274 | PTC Thermal Protection Enable | |
|---|---|---|
| Range | 0 ÷ 1 | 0: Disabled ÷ 1: Enabled |
| Default | 0 | Disabled |
| Level | ADVANCED | |
| Address | 1274 | |
| Function | This parameter enables the PTC probe (AIN2 analog input) | |

## 2.6.9. Solardrive – Configuration Parameters Menu

*NOTE*

*This section is applicable to software versions starting from 4.050.*

### *2.6.9.1. Overview*

This menu includes the configuration parameters of the equipment, namely:

- The configuration of the digital inputs controlling external information;
- The minimum speed of the pump motor;
- The setting of the current decrease based on the heatsink temperature.

**Digital Input Configuration**

Some digital inputs (MDIs) are allocated to specific functions of the Solardrive Plus Box/Cabinet. In particular:

| MDI | FUNCTION | DESCRIPTION |
|---|---|---|
| **MDI1** | Motor start command | Full tank sensor |
| **MDI4 (*)** | PV Field isolation loss | – Signal from isolation control board<br>– Signal for PV field earthing fuse auxiliary contact |
| **MDI5 (*)** | DC/AC switch auxiliary contact | Determines the drive operation in PV mode (power supply from PV field) or AC power supply (auxiliary AC power supply) |
| **MDI6 (*)** | SPD tripped | Signal from SPD tripped |

(*) Optional functions

**Table 12: Digital inputs**

*NOTE*

*The Solardrive Plus Box/Cabinet is standard supplied with the parameters above already set to the value fitting the application required.*

**Minimum Pump Speed**

Centrifugal pumps typically feature minimum speed ratings affecting adequate flow rate. If flow rate is inadequate, the pumps might get damaged. If power made available from the PV field is not adequate to guarantee this minimum speed, the drive stops the motor until power is adequate to run the motor. How the connected motor is restarted is described in section 2.6.10.

**Current Reduction based on Heatsink Temperature**

If the heatsink temperature exceeds a safety parameter, the output current is limited to a preset value so that the pump may operate even when high temperatures are achieved without stopping the drive due to overtemperature (alarm **A094**).

Current vs temperature is described in the figure below:

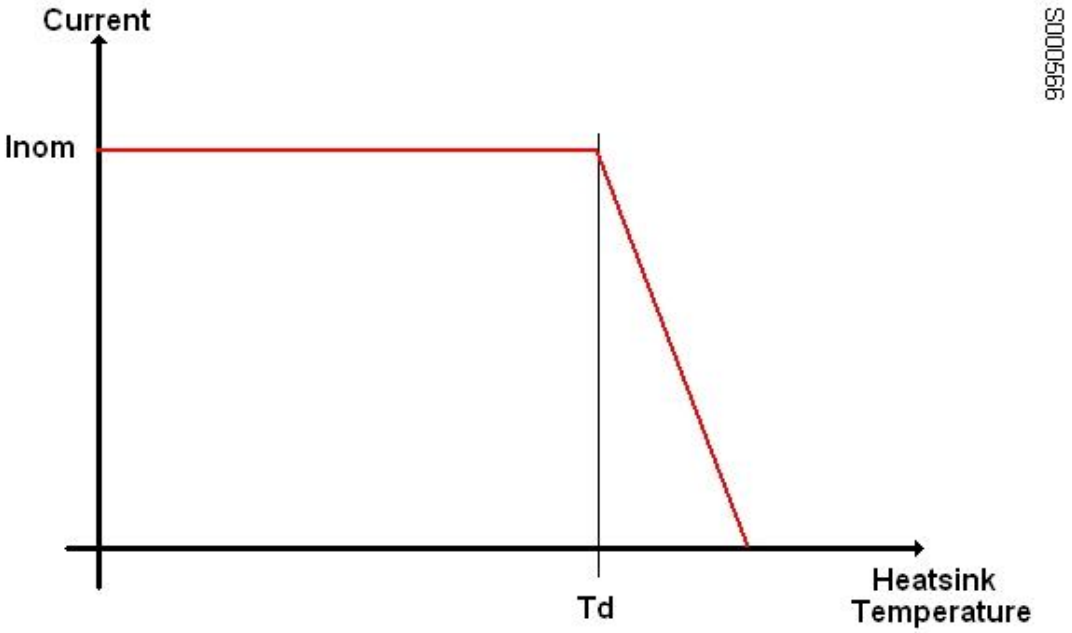



**Figure 10: Current reduction based on heatsink temperature**

Parameterization enables setting Td (initial current reduction) and the curve slope for temperature values >Td.

*2.6.9.2. List of Parameters C800 to C810*

| Parameter | Function | User Level | Default Value | MODBUS Address |
|---|---|---|---|---|
| **C800** | Minimum Pump Speed | BASIC | 0 rpm | 755 |
| **C801** | MDI Switch PV/AC Supply | ADVANCED | 5: MDI5 | 753 |
| **C802** | Mains Loss Alarm Enabled | ENGINEERING | Yes | 754 |
| **C803** | MDI for PV Isolation Loss Detection | ADVANCED | 0: Disable | 1165 |
| **C804** | Delay for PV Isolation Loss Detection | ADVANCED | 0 ms | 1306 |
| **C805** | PV Isolation Type | ADVANCED | 1: PV isolation | 774 |
| **C806** | MDI for Surge Protection Device | ADVANCED | 0: Disable | 1166 |
| **C807** | Delay for Surge Protection Device Tripped | ADVANCED | 0 ms | 1307 |
| **C808** | Action Selector for Surge Protection Device Tripped | ADVANCED | 0: Warning | 751 |
| **C809** | Heatsink Temperature for Initial Current Decrease | ADVANCED | 80°C | 775 |
| **C810** | Current Decrease Percent for Heatsink Temperature | ADVANCED | 10%/°C | 772 |

| **C800** | **Minimum Pump Speed** | |
|---|---|---|
| **Range** | 0÷32000 | 0÷32000 rpm |
| **Default** | 0 | 0 rpm |
| **Level** | BASIC | |
| **Address** | 755 | |
| **Function** | This is the minimum speed for the speed operation in DC current when the MPPT function is enabled. If speed drops below this threshold for a time 6 * **P812** (6-fold the MPPT Activation Period), the pump is stopped during the ramp according to the preset ramps (see section 2.6.1) and is restarted when the time set in parameter **P802** has elapsed. | |

| C801 | MDI Switch PV/AC Supply | |
|---|---|---|
| Range | 0 ÷ 16<br>0 ÷ 24 when ES847 or ES870 is fitted | 0 → Inactive<br>1 ÷ 8 → MDI1 ÷ MDI8<br>9 ÷ 12 → MPL1 ÷ MPL4<br>13 ÷ 16 → TFL1 ÷TFL4<br>17 ÷ 24 → XMDI1 ÷ XMDI8 |
| Default | 5 | 5: MDI5 |
| Level | ADVANCED | |
| Address | 753 | |
| Function | This parameter sets the digital input to the switch for DC or AC operation of the Solardrive Plus. The programmed input is active if the switch is in DC position, while it is inactive if in AC position.<br><br>**If your Solardrive Plus is not equipped with the DC/AC switch, the input is to be programmed as 0 → Inactive.** | |

| C802 | Mains Loss Alarm Enabled | |
|---|---|---|
| Range | 0÷1 | 0: No<br>1: Yes |
| Default | 1 | 1: Yes |
| Level | ENGINEERING | |
| Address | 754 | |
| Function | Set **C802** = [1: Yes ] to enable **A064** Mains Loss alarm.<br>This parameter is helpful only if the equipment is provided with the DC/AC switch, and it takes effect only when the switch is in AC position. | |

| C803 | MDI for PV Isolation Loss Detection | |
|---|---|---|
| Range | 0 ÷ 16<br>0 ÷ 24 when ES847 or ES870 is fitted | 0 → Inactive<br>1 ÷ 8 → MDI1 ÷ MDI8<br>9 ÷ 12 → MPL1 ÷ MPL4<br>13 ÷ 16 → TFL1 ÷TFL4<br>17 ÷ 24 → XMDI1 ÷ XMDI8 |
| Default | 0 | 0: Disable |
| Level | ADVANCED | |
| Address | 1165 | |
| Function | This parameter sets the digital input allocated to isolation loss control. If the programmed input is inactive, the drive operation is as described in parameter **C805** after the time set in parameter **C805**.<br><br>**If your Solardrive Plus does not feature the isolation loss control functionality, set this parameter to 0: Disable.** | |

| C804 | Delay for PV Isolation Loss Detection | |
|---|---|---|
| Range | 0 ÷ 32000 | 0 ÷ 32000 ms |
| Default | 0 | 0: Disable |
| Level | ADVANCED | |
| Address | 1306 | |
| Function | Delay associated with parameter **C803**. | |

| C805 | PV Isolation Type | |
|---|---|---|
| Range | 0÷4 | 0: No control<br>1: PV isolation<br>2: PV isolation + Alarm<br>3: PV Earthed |
| Default | 1 | 1: PV isolation |
| Level | ADVANCED | |
| Address | 774 | |
| Function | This parameter sets the type of isolation control implemented on the PV field:<br><br>**0**: No isolation control<br>**1**: Isolated field; isolation control implemented by way of ES942 board. In case of isolation loss, warning **W53** appears.<br>**2**: Isolated field; isolation control implemented by way of ES942 board. In case of isolation loss, alarm **A134** trips.<br>**3**: Earthed field with isolation control by way of earthing fuse. If the fuse blows, alarm **A134** trips. | |

| C806 | MDI for Surge Protection Device | |
|---|---|---|
| Range | 0 ÷ 16<br>0 ÷ 24 when ES847 or ES870 is fitted | 0 → Inactive<br>1 ÷ 8 → MDI1 ÷ MDI8<br>9 ÷ 12 → MPL1 ÷ MPL4<br>13 ÷ 16 → TFL1 ÷TFL4<br>17 ÷ 24 → XMDI1 ÷ XMDI8 |
| Default | 0 | 0: Disable |
| Level | ADVANCED | |
| Address | 1166 | |
| Function | This parameter sets the digital input allocated to the SPD. If the programmed input is inactive, alarm **A135** trips, or warning **W54** is displayed when the timeout set in **C807** has elapsed based on parameter **C808**.<br><br>**If your Solardrive Plus is not equipped with a SPD, this parameter is to be set to 0: Disable.** | |

| C807 | Delay for Surge Protection Device Tripped | |
|---|---|---|
| Range | 0 ÷ 32000 | 0 ÷ 32000 ms |
| Default | 0 | 0: Disable |
| Level | ADVANCED | |
| Address | 1307 | |
| Function | Delay associated with parameter **C806**. | |

| C808 | Action Selector for Surge Protection Device Tripped | |
|---|---|---|
| Range | 0 ÷ 1 | 0: Warning<br>1: Alarm |
| Default | 0 | 0: Warning |
| Level | ADVANCED | |
| Address | 751 | |
| Function | This parameter sets the action of the system when the SPD trips: based on its value, a warning appears, that does not stop the motor, or an alarm trips, that stops the motor. | |

| C809 | Heatsink Temperature for Initial Current Decrease | |
|---|---|---|
| **Range** | 0 ÷ 90 | 0: Disable<br>1 ÷ 90°C |
| **Default** | 80 | 80°C |
| **Level** | ADVANCED | |
| **Address** | 775 | |
| **Function** | Heatsink temperature for current decrease.<br>If set to “0”, this function is disabled.<br>The current heatsink temperature may be displayed in measure **M064** (see section 2.5.5).<br>If the detected temperature exceeds the preset value, the nominal current is reduced by a given percentage per extra degree equal to the value set in parameter **C810**.<br>The typical effect of current decrease is a slower motor speed of rotation. | |

| C810 | Current Decrease Percent for Heatsink Temperature | |
|---|---|---|
| **Range** | 0 ÷ 100 | 0 ÷ 100%/°C |
| **Default** | 10 | 10%/°C |
| **Level** | ADVANCED | |
| **Address** | 772 | |
| **Function** | If the temperature detected on the heatsink (measure **M064**) is higher than the value set in **C809**, the nominal current is reduced by a given percentage per extra degree equal to the value set in this parameter. | |

*NOTE*

*If the motor speed drops below the value set in parameter **C800** due to current decrease for overtemperature, alarm **A074** – Overload (see section 2.7.3) trips after a timeout set in parameters **P018**, **P019** (see section 2.6.1).*

## 2.6.10. Solardrive – General Parameters Menu

*NOTE*

*This section is applicable to software versions starting from 4.050.*

### *2.6.10.1. Overview*

This menu includes the parameters determining the motor startup based on PV field solar radiation conditions.

If the motor starts when the power made available from the PV field is inadequate to keep it running, the motor will immediately stop. In order to extend durability of the connected motor, the number of false starts is to be reduced to a minimum. For that reason, before activating the Maximum Power Point Tracking (MPPT) algorithm and make the motor start at the speed determined by this algorithm, DC voltage delivered from the PV field has to exceed a preset threshold (**P800**) and this condition is to be maintained for the time set in **P801**; this function will reduce to a minimum the false starts of the motor.

Once the motor has started, it is kept running until power made available from the PV field is adequate to ensure that the motor speed exceeds the minimum allowable speed set in parameter **C800** (see section 2.6.9).

### *2.6.10.2. List of Parameters P800 to P802*

| Parameter | Function | User Level | Default Value | MODBUS Address |
|---|---|---|---|---|
| **P800** | Minimum Solar Radiation Voltage | ENGINEERING | 610 V | 634 |
| **P801** | Minimum Time for Radiation OK | ENGINEERING | 240.0 s | 635 |
| **P802** | Delay Start after Alarm | ENGINEERING | 300 s | 756 |

| **P800** | **Minimum Solar Radiation Voltage** | |
|---|---|---|
| **Range** | 550 ÷ 1198 | 550 ÷ 1198 V |
| **Default** | 610 | 610 V |
| **Level** | ENGINEERING | |
| **Address** | 634 | |
| **Function** | If DC voltage is kept over this value for a value higher than **P801**, the MPPT control is activated and the motor starts.<br><br>When minimum voltage MPPT (parameter **P810**, see section 2.6.11) power is not adequate to keep power over parameter **C800** (see section 2.6.9) or voltage drops below the value ensuring the drive correct operation, the motor stops. | |

| **P801** | **Minimum Time for Radiation OK** | |
|---|---|---|
| **Range** | 0÷30000 | 0.0÷3000.0 s |
| **Default** | 2400 | 240.0 s |
| **Level** | ENGINEERING | |
| **Address** | 635 | |
| **Function** | Time when DC voltage is to be kept over **P800** in order to activate MPPT control and start the motor. Each time the motor stops due to low power conditions, time **P801** is applied again.<br>This parameter also sets the maximum number of restarts/hour forced by the connected pump. For example, if the pump is to be restarted 10 times, parameter **P801** must be set to a value not lower than:<br>**P801** = 3600/10 = 360.0 s. | |

| P802 | Delay Start after Alarm | |
|---|---|---|
| **Range** | 0÷65000 | 0÷65000 s |
| **Default** | 300 | 300 s |
| **Level** | ENGINEERING | |
| **Address** | 756 | |
| **Function** | When an alarm trips and the motor stops, the motor will be restarted when the timeout set in this parameter has elapsed if the operating conditions of the system are restored.<br>The motor will be restarted also based on parameters **P801** and **P802**. | |

## 2.6.11. Solardrive – MPPT Parameters Menu

*NOTE*

*This section is applicable to software versions starting from 4.050.*

### *2.6.11.1. Overview*

This menu contains the parameters to configure the MPPT algorithm.

Parameters **P810** and **P811** set the operating range of the Maximum Power Point Tracking (MPPT) algorithm. Parameter **P812** defines when the Maximum Power Point Tracking (MPPT). This control algorithm acts on the motor speed in order to keep DC voltage at this value. The MPPT control algorithm is given in Figure 11.

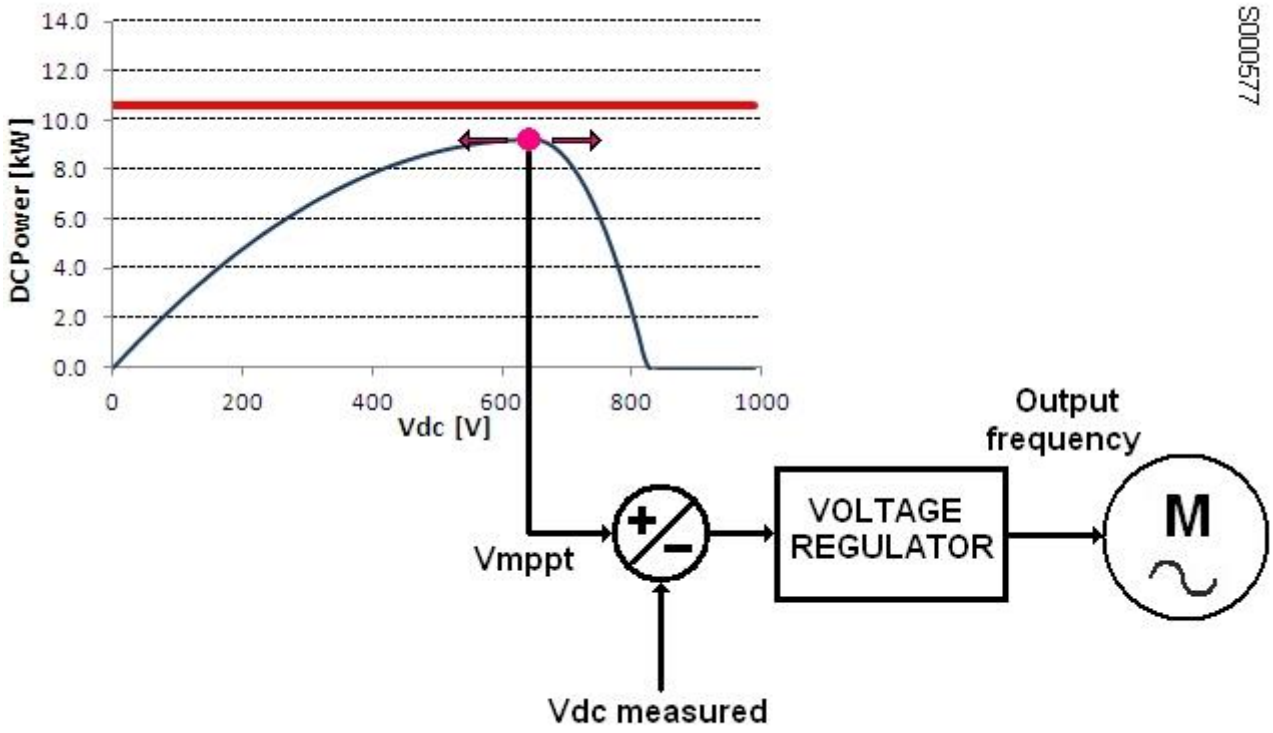



**Figure 11: Voltage control algorithm**

If the power made available from the PV field is equal to or lower than the power required to drive the motor at its nominal frequency, the algorithm will reduce frequency to exploit the maximum available power.

Otherwise, if the available power exceeds the power required to drive the motor at its nominal frequency, the motor will controlled at this frequency and DC voltage will not be adjusted. Figure 12 shows how the working point varies based on the available power.

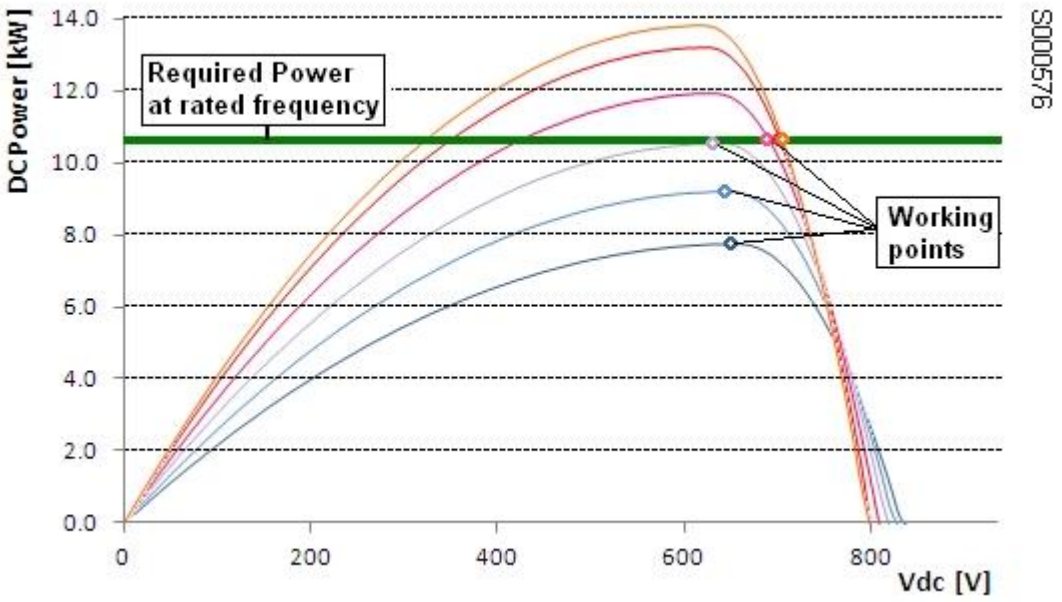



**Figure 12: Working point based on DC power**

*2.6.11.2. List of Parameters P810 to P824*

| Parameter | Function | User Level | Default Value | MODBUS Address |
|---|---|---|---|---|
| **P810** | Minimum MPPT Voltage | ENGINEERING | 550.0 V | 636 |
| **P811** | Maximum MPPT Voltage | ENGINEERING | 900.0 V | 637 |
| **P812** | MPPT Execution Period | ENGINEERING | 10.00 s | 638 |
| **P813** | Load Curve Exponent | ENGINEERING | 3.00 | 737 |
| **P814** | Voltage Regulator Integral Gain | ENGINEERING | 1.60 | 722 |
| **P815** | Voltage Regulator Proportional Gain | ENGINEERING | 0.20 | 723 |
| **P816** | Time Constant Vdc Filter | ENGINEERING | 200 ms | 724 |
| **P817** | MPPT Manual Voltage Reference | ENGINEERING | 700.0 V | 732 |
| **P818** | MPPT in Manual Mode | ENGINEERING | 0: No | 733 |
| **P819** | Maximum Delta V MPPT | ENGINEERING | 4.0 V | 734 |
| **P820** | Minimum Delta V MPPT | ENGINEERING | 1.0 V | 742 |
| **P821** | Time Constant Electric Power Filter | ENGINEERING | 500 ms | 743 |
| **P822** | MPPT Start Voltage Gain | ENGINEERING | 90 % | 744 |
| **P823** | Undervoltage Dynamic Limitation – Delta V | ENGINEERING | 30 V | 640 |
| **P824** | Undervoltage Dynamic Limitation – Delta Freq | ENGINEERING | 2.00 % | 641 |
| **P825** | Undervoltage Protection | ENGINEERING | 2: Disabled and Smart MPPT | 639 |

| **P810** | **Minimum MPPT Voltage** | |
|---|---|---|
| **Range** | 5500÷9000 | 550.0÷900.0 V |
| **Default** | 5500 | 550.0 V |
| **Level** | ENGINEERING | |
| **Address** | 636 | |
| **Function** | Minimum output value of the MPPT algorithm. The DC voltage value forced to the PV field is limited to this value.<br>The maximum value that can be set is limited by the value set in **P811**. | |

| P811 | Maximum MPPT Voltage | |
|---|---|---|
| Range | 5500÷9000 | 550.0÷900.0 V |
| Default | 9000 | 900.0 V |
| Level | ENGINEERING | |
| Address | 637 | |
| Function | Maximum output value of the MPPT algorithm. The DC voltage value forced to the PV field is limited to this value.<br>The minimum value that can be set is limited by the value set in **P810.** | |

| P812 | MPPT Execution Period | |
|---|---|---|
| Range | 20÷12000 | 0.20÷120.00 s |
| Default | 1000 | 10.00 s |
| Level | ENGINEERING | |
| Address | 638 | |
| Function | Execution time period of the MPPT algorithm. | |

| P813 | Load Curve Exponent | |
|---|---|---|
| Range | 0÷65000 | 0.00÷650.00 |
| Default | 300 | 3.00 |
| Level | ENGINEERING | |
| Address | 737 | |
| Function | Within the control algorithm, the pump motor load function is as follows:<br>$P = k * v^a$<br>Where **P** is power, **k** a constant, **v** the motor speed of rotation, **a** an exponent represented by this parameter.<br>This is worth 3.00 by default, so power is represented as a cubic function of speed. | |

| P814 | Voltage Regulator Integral Gain | |
|---|---|---|
| Range | 0÷30000 | 0.00÷300.00 |
| Default | 1600 | 1.60 |
| Level | ENGINEERING | |
| Address | 722 | |
| Function | Voltage regulator integral constant. This regulator has the voltage value detected by the MMPT algorithm as the setpoint and the motor supply voltage frequency as the output. | |

| P815 | Voltage Regulator Proportional Gain | |
|---|---|---|
| Range | 0÷30000 | 0.00÷300.00 |
| Default | 20 | 0.20 |
| Level | ENGINEERING | |
| Address | 723 | |
| Function | Voltage regulator proportional constant. This regulator has the voltage value detected by the MMPT algorithm as the setpoint and the motor supply voltage frequency as the output. | |

| P816 | Vdc Filter Time Constant | |
|---|---|---|
| Range | 0÷30000 | 0÷30000 ms |
| Default | 200 | 200 ms |
| Level | ENGINEERING | |
| Address | 724 | |
| Function | Time constant of the low-pass filter applied to the DC voltage measure at the voltage regulator input. | |

| P817 | MPPT Manual Voltage Reference | |
|---|---|---|
| Range | 2100÷11000 | 210.0÷1100.0 V |
| Default | 7000 | 700.0 V |
| Level | ENGINEERING | |
| Address | 732 | |
| Function | Reference for voltage regulator if manual MPPT has been enabled by setting **P818** = Yes. | |

| P818 | MPPT in Manual Mode | |
|---|---|---|
| Range | 0÷1 | 0: No<br>1: Yes |
| Default | 0 | 1: No |
| Level | ENGINEERING | |
| Address | 733 | |
| Function | Set **P818** = [1: Yes ] to disable the MPPT algorithm. The reference value of the DC voltage is given by parameter **P817**. | |

| P819 | Maximum MPPT Delta V | |
|---|---|---|
| Range | 1÷200 | 0.1÷20.0 V |
| Default | 40 | 4.0 V |
| Level | ENGINEERING | |
| Address | 734 | |
| Function | Maximum variation of the voltage reference between two cycles of the MPPT algorithm. | |

| P820 | Minimum MPPT Delta V | |
|---|---|---|
| Range | 1÷200 | 0.1÷20.0 V |
| Default | 10 | 1.0 V |
| Level | ENGINEERING | |
| Address | 742 | |
| Function | Minimum variation of the voltage reference between two cycles of the MPPT algorithm. | |

| P821 | Electric Power Time Constant Filter | |
|---|---|---|
| Range | 0÷30000 | 0÷30000 ms |
| Default | 500 | 500 ms |
| Level | ENGINEERING | |
| Address | 743 | |
| Function | Time constant of the low-pass filter applied to the estimation of the PV field input power utilized by the MPPT control algorithm. | |

| P822 | MPPT Start Voltage Gain | |
|---|---|---|
| Range | 70÷99 | 70÷99 % |
| Default | 90 | 90 % |
| Level | ENGINEERING | |
| Address | 744 | |
| Function | When the motor is started, this is the initial value of the voltage reference of the MPPT algorithm intended as a percentage of the DC voltage measured at start.<br>The optimum value for **P822** is the ratio between MPPT voltage and open-circuit voltage of the PV field. The value obtained is the lower limit for **P822**.<br>Example: from the datasheet of the PV panel:<br>Open-circuit voltage: 38.58 V<br>Voltage at maximum power: 30.90 V<br>Minimum value for **P822** = 30.90/38.58*100 = 80.09%.<br>If **P822** is set to higher values, the maximum power at start takes longer time to be attained. The closer the value to the theoretical value, the quicker the maximum power is attained. If **P822** is set too low, the motor might stop even when solar radiation is strong and the system might restart frequently at dawn.<br>It is therefore recommended that a value approx. 5% higher than the theoretical value be set (as far as the example is concerned, **P822** = 85%). | |

| P823 | Undervoltage Dynamic Limitation – Delta V | |
|---|---|---|
| Range | 0÷1000 | 0÷1000 V |
| Default | 30 | 30 V |
| Level | ENGINEERING | |
| Address | 640 | |
| Function | This parameter sets the range disabling the undervoltage protection (see parameter **P825**). It is to be considered as the deviation between the reference voltage and the actual voltage. | |

| P824 | Undervoltage Dynamic Limitation – Delta Freq | |
|---|---|---|
| Range | 0÷10000 | 0÷100.00 % |
| Default | 200 | 2.00 % |
| Level | ENGINEERING | |
| Address | 641 | |
| Function | This parameter sets the range disabling the undervoltage protection (see parameter **P825**). It is to be considered as the deviation between the reference frequency and the actual frequency. | |

| P825 | Undervoltage Protection | |
|---|---|---|
| Range | 0÷3 | 0: Disabled<br>1: Dynamic Limitation and Vout MPPT<br>2: Disabled and Smart MPPT<br>3: Dynamic Lim+Vout MPPT+Smart MPPT |
| Default | 2 | 2: Disabled and Smart MPPT |
| Level | ENGINEERING | |
| Address | 639 | |
| Function | This parameter allows enabling two functions preventing the MPPT algorithm from operating in the positive slope Power/Voltage characteristic intrinsically unstable. The functions are as follows:<br>• Dynamic limitation and MPPT Vout: optimum control of the rapid variation in solar radiation conditions obtained by applying output frequency reductions in order to avoid voltage drops that could power off the drive. Parameters **P823** and **P824** allow configuring the responsiveness of the undervoltage protection. It is enabled for values 1 and 3 of the parameter.<br>• Smart MPPT: An optimized MPPT function is utilized for hydraulic applications. It is enabled for values 2 and 3. | |

## 2.7. Alarms and Warnings

***WARNING***

***If a protection trips or the drive enters the emergency mode, the drive is locked and the motor starts idling!***

### 2.7.1. What Happens When a Protection Trips

*NOTE*

*Before operating the drive in emergency conditions, carefully read this section and the following section,* ***What To Do When an Alarm Trips****.*

The drive alarms are detailed below.

When a protection / alarm trips:

1) the **ALARM** LED on the keypad comes on;
2) the page displayed on the keypad is the root page of the **FAULT LIST**;
3) the **FAULT LIST** is refreshed;

In factory-setting, when the drive is switched on after an alarm has tripped—which has not been reset—it is kept in emergency condition.

**If the drive is in emergency mode when switched on, this could be due to an alarm tripped before the drive was reset**.

To avoid storing the alarms tripped before the drive is switched off, set parameter **C257** in the Autoreset Menu, section 2.6.7.

The drive stores the moment when an alarm trips to the **FAULT LIST** (supply–time and operation–time). The drive status when the alarm tripped and some measures sampled when the alarm tripped are also stored to the Fault List.

The readout and storage of the fault list can be very useful to detect the cause responsible for the alarm and its possible solution (see also section 2.5.6).

*NOTE*

*Alarms* ***A001*** *to* ***A039*** *relate to the main microcontroller (DSP Motorola) of the control board, which detected a fault on the control board itself. No fault list is available for Alarms* ***A001*** *to* ***A039*** *and no Reset command can be sent via serial link; alarms can be reset through the* ***RESET*** *terminal on the terminal board or the* ***RESET*** *key on the keypad. No software for the keypad interface is available; the drive parameters and measures cannot be accessed via serial link.*

*Avoid resetting alarms* ***A033*** *and* ***A039****, as they trip when the flash memory is not provided with its correct software. Alarms* ***A033*** *and* ***A039*** *can be reset only when proper software is downloaded for the inverter flash memory.*

### 2.7.2. What To Do When an Alarm Trips

***WARNING***

***If a protection trips or the drive is in emergency condition, the drive is locked and the motor starts idling!***

***WARNING***

***Before resetting an alarm, press the emergency button to disable the drive and to prevent the connected motor from running at uncontrolled speed.***

## Proceed as follows:

1. Press the Emergency Button, as to deactivate the **ENABLE-A** and **ENABLE-B** signals on terminal **MDI2** and to disable the drive and to lock the motor, unless parameter **C181**=1 (the Safety Start function is active): after resetting an alarm or after supplying the drive, this will start only if the **ENABLE-A** and **ENABLE-B** contacts are open and closed.
2. If the motor is idling, wait until it stops.

Check the **FAULT LIST** carefully for any information about the alarm tripped, in order to determine the cause responsible for the alarm and its possible solutions.

**Any information stored to the FAULT LIST is also required when contacting Enertronica Santerno's Customer Service.**

3. In the following sections, find the relative alarm code and follow the instructions.
4. Solve any external problems that may have been responsible for the protection trip.
5. If the alarm tripped due to the entry of wrong parameter values, set new correct values and save them.
6. Reset the alarm.
7. If the alarm condition persists, please contact Enertronica Santerno Customer Service.

A **RESET** command must be sent to reset the alarms tripped. Do one of the following:

- Enable the **RESET** signal in MDI3 terminal in the hardware terminal board;
- Press the RESET key on the keypad;
  To activate the **Autoreset** function, enable parameter **C255** (see section 2.6.7); the drive will automatically try to reset the alarms tripped.

***WARNING***

***The autoreset function is factory set as active. See section 2.6.7.***

### 2.7.3. Alarm List

The alarm list is given below. The alarms that are not significant to the Solardrive Plus are given in brackets and are not described in detail.

**Table 13: List of the possible alarms**

| Alarm | Name | Description |
|---|---|---|
| **A001 ÷ A032** | … | *Control board failure* |
| **A033** | TEXAS VER KO | Incompatible Texas Software Version |
| **A039** | FLASH KO | Texas Flash not programmed |
| **A040** | User Fault | Alarm caused by the user |
| **A041** | PWMA Fault | General hardware fault from IGBT, side A |
| **A042** | Illegal XMDI in DGI | Illegal configuration of XMDI in the Digital Inputs Menu |
| **A043** | False Interrupt | *Control board failure* |
| **A044** | SW OverCurrent | Software overcurrent |
| **A045** | Bypass Circuit Fault | Fault of the precharge By–Pass |
| **A046** | Bypass Connector Fault | Precharge By–Pass connector fault |
| **A047** | UnderVoltage | Dc bus voltage lower than Vdc_min |
| **A048** | OverVoltage | Dc bus voltage exceeding Vdc_max |
| **A049** | RAM Fault | *Control board failure* |
| **A050** | PWMA0 Fault | Hardware Fault from IGBT converter, side A |
| **A051** | PWMA1 Fault | Hardware overcurrent, side A |
| **A052** | Illegal XMDI in DGO | Illegal configuration of XMDI in the Digital Outputs Menu |
| **A053** | PWMA Not ON | Hardware failure, IGBT A power on impossible |
| **A054** | Option Board not in | Failure in detecting preset optional I/O board |
| **A055** | PTC Alarm | External PTC tripped |
| **A056** | PTC Short Circuit | External PTC in short circuit |
| **A057** | Illegal XMDI in MPL | Illegal configuration of XMDI in the Virtual Digital Outputs (MPL) Menu |
| **A059** | (Encoder Fault) | (Error of motor speed measure) |
| **A060** | (NoCurrent Fault) | (Current is zero in FOC control) |
| **A061** | Ser WatchDog | Watchdog tripped in serial link 0 (9-pole D connector) |
| **A062** | SR1 WatchDog | Watchdog tripped in serial link 1 (RJ45) |
| **A063** | Generic Motorola | *Control board failure* |
| **A064** | Mains Loss | No power is supplied from the mains |
| **A065** | (AutoTune Fault) | (Autotune failed) |
| **A066** | REF < 4mA | REF Current input (4÷20mA) lower than 4mA |
| **A067** | AIN1 < 4mA | AIN1 Current input (4÷20mA) lower than 4mA |
| **A068** | AIN2 < 4mA | AIN2 Current input (4÷20mA) lower than 4mA |
| **A069** | XAIN5 < 4mA | XAIN5 Current input (4÷20mA) lower than 4mA |
| **A070** | (Fbs WatchDog) | (Fieldbus Watchdog tripped) |
| **A071** | 1ms Interrupt OverTime | *Control board failure* |
| **A072** | Parm Lost Chk | Parameter download/upload error |
| **A073** | Parm Lost COM1 | Parameter download/upload error |
| **A074** | Drive OverHeated | Drive thermal protection tripped |
| **A075** | Motor OverHeated | Motor thermal protection tripped |
| **A076** | (Speed Alarm) | (Motor speed too high) |
| **A078** | MMI Trouble | *Control board failure* |
| **A079** | (Encoder not conf.) | (FOC control but Encoder not properly configured) |
| **A080** | (Tracking Error) | (Encoder speed tracking error) |
| **A081** | KeyPad WatchDog | Communication watchdog via keypad |
| **A082** | Illegal Encoder Cfg | Functions programmed for MDI6 and MDI7 or encoder B selected and encoder board not detected. |
| **A083** | External Alarm 1 | External alarm 1 |
| **A086** | XAIN5 > 20mA | XAIN5 Current input (4÷20mA or 0÷20mA) greater than 20mA |
| **A087** | ±15V LOSS | ± 15V Loss |
| **A088** | ADC Not Tuned | *Control board failure* |
| **A089** | Parm Lost COM2 | Parameter download/upload error |
| **A090** | Parm Lost COM3 | Parameter download/upload error |
| **A091** | (Braking Resistor Overload) | (Overvoltage tripped with braking resistor activated due to continuous operation time exceeding the max. programmed time) |

| Alarm | Name | Description |
|---|---|---|
| **A092** | SW Version KO | *Control board failure* |
| **A093** | Bypass Circuit Open | By-Pass relay open |
| **A094** | HeatSink OverTemperature | IGBT heatsink temperature too high |
| **A095** | (Illegal Drive Profile Board) | (Drive Profile board not correctly configured) |
| **A096** | Fan Fault | Fault of the cooling fans |
| **A097** | (Motor Not Connected) | (Motor not connected) |
| **A098** | (Illegal Motor Selected) | (Illegal motor selected via MDI) |
| **A099** | 2nd Sensor Fault | Fault of fan sensor 2 |
| **A100** | (MDI6 Illegal Configuration) | Function programmed for MDI6 along with frequency input A |
| **A101** | (MDI8 Illegal Configuration) | Function programmed for MDI8 along with frequency input B |
| **A102** | REF > 20mA | REF Current input (4÷20mA or 0÷20mA) greater than 20mA |
| **A103** | AIN1 > 20mA | AIN1 Current input (4÷20mA or 0÷20mA) greater than 20mA |
| **A104** | AIN2 > 20mA | AIN2 Current input (4÷20mA or 0÷20mA) greater than 20mA |
| **A105** | PT100 Channel 1 Fault | Hardware address out of measure range of the drive |
| **A106** | PT100 Channel 2 Fault | Hardware address out of measure range of the drive |
| **A107** | PT100 Channel 3 Fault | Hardware address out of measure range of the drive |
| **A108** | PT100 Channel 4 Fault | Hardware address out of measure range of the drive |
| **A109** | Amb.Overtemp. | Ambient overtemperature |
| **A110 ÷ A120** | … | *Control board failure* |
| **A129** | No Output Phase | Output phase loss |
| **A134** | PV Isolation KO | PV field isolation loss |
| **A135** | SPD Input Triggered | Surge Protective Device (SPD) tripped |
| **A136** | Dry Run | Dry run: no water is delivered to the working pump |
| **A140** | Torque Off not Safe | Malfunctioning of ENABLE-A and ENABLE-B inputs for STO function |

| **A001 ÷ A032**<br>**A043**<br>**A049**<br>**A063**<br>**A071**<br>**A078**<br>**A088**<br>**A092**<br>**A110 ÷ A120** | |
|---|---|
| **Description** | Control board failure |
| **Event** | There may be several causes: the board autodiagnostics file constantly checks its operating conditions. |
| **Possible cause** | • Strong electromagnetic disturbance or radiated interference.<br>• Possible failure of the microcontroller or other circuits on the control board. |
| **Solution** | 1. Reset the alarm: send a **RESET** command.<br>2. If the alarm persists, please contact ENERTRONICA SANTERNO's Customer Service. |

| **A033** | **Texas Software KO** |
|---|---|
| **Description** | Incompatible Software Texas version |
| **Event** | When switched on, DSP Motorola detected an incompatible version of the software downloaded to Flash Texas (software version incompatible with Motorola). |
| **Possible cause** | The wrong software was downloaded. |
| **Solution** | 1. Download the correct DSP Texas software version.<br>2. If the alarm persists, please contact ENERTRONICA SANTERNO's Customer Service. |

| A039 | Texas Flash not Programmed |
|---|---|
| Description | Texas Flash not programmed |
| Event | When switched on, DSP Motorola detected that Flash Texas is not correctly programmed. |
| Possible cause | A prior attempt to download DSP Texas software failed. |
| Solution | 1. Download the correct DSP Texas software version.<br>2. If the alarm persists, please contact ENERTRONICA SANTERNO's Customer Service. |

| A040 | User Alarm |
|---|---|
| Description | Alarm trip caused by the user (as a testing procedure) |
| Event | The user has forced the alarm to trip. |
| Possible cause | Value 1 was entered to address MODBUS 1400 via serial link. |
| Solution | Reset the alarm: send a **RESET** command. |

| A041 | IGBT Fault Side A |
|---|---|
| Description | General hardware fault from IGBT, side A |
| Event | Power converter A generated a general alarm. |
| Possible cause | • Electromagnetic disturbance or radiated interference.<br>• Overcurrent, IGBT overtemperature, IGBT fault. |
| Solution | 1. Reset the alarm: send a **RESET** command.<br>2. If the alarm persists, please contact ENERTRONICA SANTERNO's Customer Service. |

| A042 | Illegal XMDI in DGI |
|---|---|
| Description | Illegal configuration of XMDI in the Digital Inputs Menu. |
| Event | The drive has detected a parameter configuration error. |
| Possible cause | Wrong settings. |
| Solution | Check settings and enter correct settings.<br>Contact ENERTRONICA SANTERNO's Customer Service. |

| A044 | SW Overcurrent |
|---|---|
| **Description** | Software overcurrent detection. |
| **Event** | Immediate current limit tripped |
| **Possible cause** | • Abrupt variations of the connected load<br>• Output short-circuit or ground short-circuit<br>• Strong electromagnetic disturbance or radiated interference.<br><br>If alarm **A044** tripped while accelerating:<br>• Too short acceleration ramp;<br><br>If alarm **A044** tripped while decelerating:<br>• Too short deceleration ramp. |
| **Solution** | 1. Check if the drive and the motor are properly dimensioned with respect to the connected load.<br>2. Make sure that no output short-circuit is to be found between two phases or between one phase and the grounding (terminals U, V, W). (Remove voltage from the motor, set IFD control and operate the drive in no-load conditions.)<br>3. Check if the command signals are sent to the drive using screened cables where required. Detect external sources for electromagnetic disturbance, check wiring and make sure that antidisturbance filters are installed on the coils of contactors and electrovalves (if fitted inside the cabinet).<br>4. If necessary, set longer acceleration times (see section 2.6.1).<br>5. If necessary, set longer deceleration times (see section 2.6.1).<br>6. If necessary, decrease the values set in the Limits Menu, section 2.6.5. |

| A045 | Bypass Circuit Fault |
|---|---|
| **Description** | Bypass precharge Fault |
| **Event** | The drive forced to close its relay or contactor for the short-circuit of the precharge resistors in DC-link capacitors (DC bus), but it did not detect the relevant closing signal while precharging. See also **A046**. |
| **Possible cause** | • Disconnection of auxiliary signal.<br>• Precharge relay/contactor failure. |
| **Solution** | 1. Reset the alarm: send a **RESET** command.<br>2. If the alarm persists, please contact ENERTRONICA SANTERNO's Customer Service. |

| A046 | Bypass Connector Fault |
|---|---|
| **Description** | Precharge bypass connector fault. |
| **Event** | Auxiliary signal for the closing of the bypass connector of the short-circuit precharge resistor is considered as closed before the relevant closing command is sent.<br>See also **A045**. |
| **Possible cause** | • Precharge bypass connector reversed.<br>• Precharge relay/contactor failure. |
| **Solution** | 1. Reset the alarm: send a **RESET** command.<br>2. If the alarm persists, please contact ENERTRONICA SANTERNO's Customer Service. |

| A047 | Undervoltage |
|---|---|
| **Description** | DC bus voltage lower than Vdc_min |
| **Event** | Voltage measured in DC bus (DC-link) capacitors has exceeded the minimum allowable value for proper operation of the drive class being used. |
| **Possible cause** | • Check that voltage has not dropped below 400 Vac.<br>• This alarm may trip even when grid voltage temporarily drops below this threshold (e.g. direct load input).<br>• If the drive is powered directly by the bus bar, the bus feeder is responsible for the alarm trip.<br>• Failure in DC bus voltage measurement circuit. |
| **Solution** | 1. Check voltage in terminals **R**, **S**, **T**. V Check mains voltage value **M030** and DC bus voltage value **M029**. Also check the values of **M030** and **M029** sampled in the FAULT LIST when the alarm tripped.<br>2. If the alarm persists, please contact ENERTRONICA SANTERNO's Customer Service. |

| A048 | Overvoltage |
|---|---|
| **Description** | Overvoltage in DC bus (voltage in DC-link). |
| **Event** | Voltage measured in DC bus (DC-link) capacitors has exceeded the maximum allowable value for proper operation of the drive class being used. |
| **Possible cause** | • Check that voltage does not exceed 1198 Vdc.<br>• Very inertial loads and a too short deceleration ramp (see section 2.6.1).<br>• Alarm **A048** can trip even when the motor is pulled by the load (eccentric load).<br>• If the drive is powered directly by the bus bar, the bus feeder is responsible for the alarm trip.<br>• Failure in DC bus voltage measurement circuit. |
| **Solution** | 1. Check voltage in terminals **R**, **S**, **T**. Check mains voltage value M030 and DC bus voltage value M029. Also check the values of M030 and M029 sampled in the FAULT LIST when the alarm tripped.<br>2. In case of very inertial loads and if the alarm tripped when decelerating, try to set a longer deceleration ramp. If short stop times are needed or if the motor is pulled by the load, activate the resistive braking unit.<br>3. If the alarm persists, please contact ENERTRONICA SANTERNO's Customer Service. |

| A050 | IGBT Fault A |
|---|---|
| **Description** | Hardware fault from IGBT converter, side A, or brake overcurrent |
| **Event** | The IGBT drivers of power converter A have detected IGBT failure or overcurrent conditions in the brake circuit (models S14, S22, S32 5T/6T only) |
| **Possible cause** | • Strong electromagnetic disturbance or radiated interference.<br>• Overcurrent, Overtemperature, IGBTs, IGBT fault.<br>• Unsuitable braking resistor (models S14, S22, S32 5T/6T only). |
| **Solution** | 1. Reset the alarm: send a RESET command.<br>2. If the alarm persists, please contact ENERTRONICA SANTERNO's Customer Service. |

| A051 | Overcurrent HW A |
|---|---|
| Description | Hardware overcurrent, side A. |
| Event | Hardware overcurrent detected by the drive output current circuit. |
| Possible cause | See **A044 SW Overcurrent**. |
| Solution | See **A044 SW Overcurrent**. |

| A052 | Illegal XMDI in DGO |
|---|---|
| Description | Illegal configuration of XMDI in the Digital Outputs Menu. |
| Event | The drive has detected a parameter configuration error. |
| Possible cause | Wrong settings. |
| Solution | Check settings and enter correct settings.<br>Contact ENERTRONICA SANTERNO's Customer Service. |

| A053 | Not PWONA |
|---|---|
| Description | Hardware failure; IGBT A power on failure. |
| Event | IGBT A power on controlled by Motorola microcontroller has failed. |
| Possible cause | Control board failure. |
| Solution | 1. Reset the alarm: send a **RESET** command.<br>2. If the alarm persists, please contact ENERTRONICA SANTERNO's Customer Service. |

| A054 | Optional Board not In |
|---|---|
| Description | ES847 or ES870 not in. |
| Event | The drive has detected a parameter configuration error. |
| Possible cause | Wrong settings. |
| Solution | 1. Check consistency of parameter **R023** (for further detail, please contact ENERTRONICA SANTERNO's Customer Service).<br>2. Reset the alarm: send a **RESET** command.<br>3. If the alarm persists, please contact ENERTRONICA SANTERNO's Customer Service. |

| A055 | PTC Alarm |
|---|---|
| Description | External PTC resistor tripped. |
| Event | The drive detected the opening of the PTC connected to **AIN2** input (R > 3600 ohm) |
| Possible cause | • Opening of the PTC due to motor overheating.<br>• Incorrect wiring of PTC.<br>• Incorrect setting of **SW1** hardware switch on the control board. |
| Solution | 1. Allow the motor to cool, then reset the alarm.<br>2. Make sure that the PTC is correctly connected to **AIN2** analog input (for further detail, please contact ENERTRONICA SANTERNO's Customer Service).<br>3. Make sure that **SW1** hardware switch is correctly set. |

| A056 | PTC Short Circuit |
|---|---|
| Description | External PTC resistor short circuit. |
| Event | Detected the short circuit of the PTC connected to **AIN2** input (R < 10 ohm). |
| Possible cause | • Short circuit in the PTC.<br>• Incorrect wiring of PTC.<br>• Incorrect setting of **SW1** hardware switch on the control board. |
| Solution | 1. Make sure that the PTC is correctly connected to **AIN2** analog input (for further detail, please contact ENERTRONICA SANTERNO's Customer Service).<br>2. Make sure that **SW1** hardware switch is correctly set.. |

| A057 | Illegal XMDI in MPL |
|---|---|
| Description | Illegal configuration of XMDI in the Virtual Digital Outputs (MPL) Menu. |
| Event | The drive has detected a parameter configuration error. |
| Possible cause | Wrong settings. |
| Solution | Check settings and enter correct settings.<br>Contact ENERTRONICA SANTERNO's Customer Service. |

| A061<br>A062 | Serial Link Watchdog |
|---|---|
| Description | **A061**: Serial Link Watchdog 0 tripped<br>**A062**: Serial Link Watchdog 1 tripped |
| Event | The serial link watchdog has tripped.<br>Communication failure: no read/write query sent to serial link for a time longer than the time set in the parameters relating to serial link watchdog.<br>This alarm does not trip if, due to parameters in the Control Method Menu – section 2.6.6, or due to the status of the source selection or LOC/REM inputs (Digital Input Menu), the information sent from serial link is not currently used for the commands or the references. |
| Possible cause | • Serial link is disconnected.<br>• Communication failure on remote master side.<br>• Watchdog operating times too short. |
| Solution | 1. Check serial link.<br>2. Make sure that the remote master constantly sends read/write queries with max. intervals between two queries lower than the preset watchdog operating time.<br>3. Set longer watchdog operating times (see **R005** for serial link 0 and **R012** for serial link 1). |

| A064 | Mains Loss |
|---|---|
| Description | Mains loss. |
| Event | Mains loss (only if AC power supply is available and parameter **C802** = 1: Yes). |
| Possible cause | • One supply cable is disconnected.<br>• Mains supply too weak.<br>• Mains gap. |
| Solution | 1. Check voltage in terminals R, S, T. Check mains voltage value M030. Also check the value of M030 sampled in the FAULT LIST when the alarm tripped.<br>2. This alarm can be disabled by means of parameter **C802** (see section 2.6.9). |

| A066<br>A067<br>A068<br>A069 | Current input < 4mA |
|---|---|
| Description | A066: REF Current input (4÷20mA) lower than 4mA<br>A067: AIN1 Current input (4÷20mA) lower than 4mA<br>**A068**: AIN2 Current input (4÷20mA) lower than 4mA<br>**A069:** XAIN5 current input (4÷20mA) lower than 4mA |
| Event | A current value lower than 4 mA has been detected over one input (REF, AIN1, AIN2, XAIN5) set with the following range: 4÷20mA. |
| Possible cause | • Wrong setting of SW1 on the control board (except for A069). (for further detail, please contact ENERTRONICA SANTERNO's Customer Service)<br>• Signal cable disconnected.<br>• Failure in the current signal source. |
| Solution | 1. Check correct setting of switches **SW1** (except for **A069**).<br>2. Check if the current signal cable is correctly connected to the relative terminal.<br>3. Check the source of the current signal. |

| A072<br>A073<br>A089<br>A090 | Parameter Upload/Download Error from Keypad to Drive |
|---|---|
| Description | Upload/download failed, one of the controls of the parameter consistency detected a fault. |
| Event | A communication error occurred while uploading/downloading the programming parameters from the keypad to the drive. |
| Possible cause | Temporary interruption to the serial link between keypad and control board. |
| Solution | Check the connection between the keypad and the control board, reset the alarm and perform a new upload/download procedure. |

| A074 | Overload |
|---|---|
| Description | Drive thermal protection tripped. |
| Event | The output current has been exceeding the drive rated current for long time periods. |
| Possible cause | • Current equal to **Ipeak** + 20% for **3 seconds**, or<br>• Current equal to **Imax** for **60 seconds**<br>• Current reduction due to overtemperature (parameters **C809**, **C810**) has caused speed to drop below the value set in **C800** (see section 2.6.9). |
| Solution | Check the drive current output during ordinary operation (**M026**, see section 2.5.2); check the mechanical conditions of the connected load (load locked / overload). |

| A075 | Motor Overheated |
|---|---|
| Description | Motor thermal protection tripped. |
| Event | The software motor thermal protection tripped. Output current has been exceeding the motor rated current for long periods. |
| Possible cause | • Poor mechanical conditions of the connected load<br>• Wrong setting of parameters in the Motor Thermal Protection Menu, section 2.6.8). |
| Solution | 1. Check mechanical conditions of the connected load.<br>2. Check parameters **C265**, **C266**, **C267** in the Motor Thermal Protection Menu, section 2.6.8. |

| A081 | Keypad Watchdog |
|---|---|
| Description | Watchdog for the communication to the keypad. |
| Event | Communication failed when the keypad was enabled as a reference source or a command source or when it was in Local mode (Watchdog time is equal to approx. 1.6 seconds) |
| Possible cause | • Keypad cable disconnected.<br>• Failure of one of the two connectors of the keypad.<br>• Strong electromagnetic disturbance or radiated interference.<br>• Keypad failure.<br>• Incorrect setting in parameters relating to serial link 1 (see the Serial Link Menu – contact ENERTRONICA SANTERNO's Customer Service). |
| Solution | 1. Check the connection of the keypad cable.<br>2. Make sure that the keypad cable connectors are intact (on both drive side and keypad side).<br>3. Check communication parameters of serial link 1. |

| A083 | External Alarm |
|---|---|
| Description | External alarm 1 |
| Event | The External Alarm functionality has been programmed, but the relevant digital input is disabled (see the Digital Inputs Menu – for more details contact ENERTRONICA SANTERNO's Customer Service). If multiple digital command sources are programmed, the alarm trips if one of the terminals in the active sources is disabled (see section 2.6.6). |
| Possible cause | The cause for the alarm trip does not depend on the drive; check for the reason why the contact connected to terminal **MDIx** where the External Alarm function is programmed opens. |
| Solution | Check external signal. |

| A087 | ±15V Loss |
|---|---|
| Description | Loss of ±15V. |
| Event | The voltage level of ±15V is inadequate. |
| Possible cause | Possible failure of the control board or other circuits in the Solardrive Plus. |
| Solution | 1. Reset the alarm: send a **RESET** command.<br>2. If the alarm persists, please contact ENERTRONICA SANTERNO's Customer Service. |

| A093 | Precharge: Bypass open |
|---|---|
| Description | Bypass relay open. |
| Event | The control board requested the closure of the bypass relay (or contactor) for the short-circuit of the DC-link capacitor precharge resistors, **but no closing signal is sent** (auxiliary of the relay) during functioning (precharge already closed). |
| Possible cause | Failure in the relay control circuit or in the auxiliary signal circuit detecting relay closing. |
| Solution | 1. Reset the alarm: send a **RESET** command.<br>2. If the alarm persists, please contact ENERTRONICA SANTERNO's Customer Service. |

| A094 | Heatsink Overheated |
|---|---|
| Description | IGBT heatsink temperature too high. |
| Event | IGBT power heatsink overheated even if the cooling fan is on (see also **A096** and **A099**). |
| Possible cause | • Ambient temperature exceeding 40 °C.<br>• Too high motor current.<br>• Excessive carrier frequency for the application required. |
| Solution | 1. Check ambient temperature.<br>2. Check motor current.<br>3. Decrease IGBT carrier frequency (contact ENERTRONICA SANTERNO's Customer Service). |

| A096 | Fan Fault |
|---|---|
| Description | Fan alarm. |
| Event | Power heatsink overheated with fan locked or disconnected or faulty (see also **A094** and **A099**). |
| Possible cause | Fan locked or disconnected or faulty. |
| Solution | Replace fan. |

| A099 | Sensor 2 Fault |
|---|---|
| Description | Fan sensor 2 fault. |
| Event | Power heatsink overheated with cooling fan off (see also **A094** and **A096**). |
| Possible cause | Failure in temperature control device and/or cooling system. |
| Solution | Please contact ENERTRONICA SANTERNO's Customer Service. |

| A102<br>A103<br>A104<br>A086 | Current Input > 20 mA |
|---|---|
| Description | **A102:** REF Current input (4÷20mA or 0÷20mA) greater than 20mA<br>**A103:** AIN1 Current input (4÷20mA or 0÷20mA) greater than 20mA<br>**A104:** AIN2 Current input (4÷20mA or 0÷20mA) greater than 20mA<br>**A086:** XAIN5 Current input (4÷20mA or 0÷20mA) greater than 20mA |
| Event | A current value greater than 20mA has been detected over one input (REF, AIN1, AIN2, XAIN5) set with the following ranges: 4÷20mA or 0÷20mA. |
| Possible cause | • Wrong setting of **SW1** on the control board (except for **A086**).<br>• Failure in the current signal source. |
| Solution | 1. Check setting of SW1(except for A086).<br>2. Check the current signal source. |

| A105<br>A106<br>A107<br>A108 | PT100 Channel 1,2,3,4 Fault |
|---|---|
| Description | **A105**: PT100 Channel 1 fault<br>**A106**: PT100 Channel 2 fault<br>**A107**: PT100 Channel 3 fault<br>**A108**: PT100 Channel 4 fault |
| Event | Hardware input out of the measure range of the drive. |
| Possible cause | • Wrong setting of SW1 or SW2 on optional control board ES847<br>• Failure in the current signal source. |
| Solution | 1. Check setting of SW1 and SW2.<br>2. Check the current signal source. |

| A109 | Ambient Overtemperature |
|---|---|
| Description | The ambient temperature is too high. |
| Event | The control board has detected a too high ambient temperature. |
| Possible cause | Inverter or cabinet overheated; failure of control board NTC. |
| Solution | 1. Open the cabinet and check its conditions. Also check measure M062.<br>2. Reset the alarm: send a RESET command.<br>3. If the alarm persists, please contact ENERTRONICA SANTERNO's Customer Service. |

| A134 | PV Isolation KO |
|---|---|
| Description | PV field isolation loss. |
| Event | • Eearthed PV field: Fuse blown on one of the PV field poles.<br>• Isolated PV field: Isolation loss detected by isolation loss control board. |
| Possible cause | • PV field earth fault.<br>• PV field isolation loss.<br>• Fault in the digital input detecting PV field isolation loss (see parameter **C803** in section 2.6.9). |
| Solution | 1. Power off the inverter immediately.<br>2. Try to assess the cause of the PV isolation loss fault.<br>3. Restore the fuse (in case of earthed PV field).<br>4. Reset the alarm: send a **RESET** command. |

| A135 | Input SPD Triggered |
|---|---|
| Description | SPD tripped. |
| Event | The SPD has tripped due to overvoltage detected between the PV field poles. |
| Possible cause | • PV field overvoltage (lightning, electric discharge).<br>• Wrong PV field dimensioning causing overvoltage.<br>• Fault in the digital input detecting PV field isolation loss (see parameter **C803** in section 2.6.9). |
| Solution | 1. Power off the inverter immediately.<br>2. Try to assess the cause of the PV isolation loss fault<br>3. Restore the SPD by replacing its cartridges.<br>4. Reset the alarm: send a **RESET** command. |

| A136 | Dry Run |
|---|---|
| Description | Dry Run: no water is being delivered to the pump, or the dangerous cavitation phenomenon is about to occur. |
| Event | The drive has been working under Dry-run conditions (see Figure 6) for a time longer than **P712** and with a speed reference higher than the minimum value between **P711** and **C029.** |
| Possible cause | No water in the hydraulic circuit. |
| Solution | Restore water level in the hydraulic circuit. |

| A140 | Torque Off not Safe |
|---|---|
| Description | Malfunctioning of **ENABLE-A** and **ENABLE-B** inputs for the STO function |
| Event | The redundant circuitry for the drive enable (simultaneous activation of the **ENABLE-A** and **ENABLE-B** inputs) is no longer active, so opening those inputs does not guarantee that the STO function is properly implemented.<br>For more details, please consult the Safe Torque Off Function – Application Manual. |
| Possible cause | Fault in the circuitry dedicated to the Safe Torque Off function. |
| Solution | 1. Reset the alarm: send a **RESET** command.<br>2. If the alarm persists, please contact ENERTRONICA SANTERNO's Customer Service. |

### 2.7.4. Warnings

**Warning** messages are displayed on the display/keypad. They are flashing messages that usually appear in line 1 or 2 of the first three lines of the display.

When a warning occurs, the Warning LED on the display/keypad turns on.

*NOTE*

*Warnings are neither protections nor alarms, and are not stored to the fault list.*

Some warnings simply state what's happening or suggest what to do when using the keypad.

However, most of the warning messages are **Coded warnings**: they are displayed with letter **"W" followed by two digits** stating which warning is active at that moment. Example:

| W 3 2 O P E N E N A B L E |
|---|

Warning messages are detailed in the following section.

### 2.7.5. Warning List

**Table 14: Warning list**

| Warning | Message | Description |
|---|---|---|
| **W03** | SEARCHING… | The user interface is searching the data of the next page to display. |
| **W04** | DATA READ KO | SOFTWARE WARNINGS CONCERNING DATA READING. |
| **W06** | HOME SAVED | The page displayed has been saved as the home page displayed at power on. |
| **W07** | DOWNLOADING | The keypad is **writing** to the drive the WORK zone parameters saved on its own flash memory. |
| **W08** | UPLOADING | The keypad is **reading** from the drive the WORK zone parameters that will be saved on its own flash memory. |
| **W09** | DOWNLOAD OK | Parameters were successfully downloaded (**written**) from the keypad to the drive. |
| **W11** | UPLOAD OK | Parameters were successfully uploaded (**read**) from the drive to the keypad. |
| **W12** | UPLOAD KO | The keypad interrupted parameter upload to the drive.<br>Parameter **reading** has failed. |
| **W13** | NO DOWNLOAD | A Download procedure was queried, but no parameter is saved to the flash memory. |
| **W16** | PLEASE WAIT… | Wait until the system completes the operation required. |
| **W17** | SAVE IMPOSSIBLE | Parameter save is not allowed. |
| **W18** | PARAMETERS LOST | The keypad interrupted parameter download to the drive. Parameter **writing** has failed. As a result, not all parameters have been updated (parameter inconsistency). |
| **W19** | NO PARAMETERS LOAD | UPLOAD impossible. |
| **W20** | NOT NOW | The required function is not available at the moment. |
| **W21** | CONTROL ON | The required function is inhibited because the drive is running: **ENABLE-A** and **ENABLE-B** are active. |
| **W23** | DOWNLOAD VER. KO | Download failed because parameters saved to keypad memory relate to a SW version or product ID incompatible with the drive SW version or product ID. |
| **W24** | VERIFY DATA | Download preliminary operation underway, the system is checking the integrity and compatibility of the parameters saved in the keypad memory. |
| **W28** | OPEN START | Open and close the **START** signal to start the drive. |
| **W31** | ENCODER OK | Encoder tuning procedure finished: the encoder is correctly connected. |
| **W32** | OPEN ENABLE | Open and close the **ENABLE-A** and **ENABLE-B** signals to enable the drive. |
| **W33** | WRITE IMPOSSIBLE | Writing procedure impossible. |
| **W34** | ILLEGAL DATA | Illegal value entered, operation failed. |
| **W35** | NO WRITE CONTROL | Writing procedure impossible because Control is active and the drive is running. |
| **W36** | ILLEGAL ADDRESS | Illegal address entered, operation failed. |
| **W37** | ENABLE LOCKED | The drive is disabled and does not acknowledge the **ENABLE-A** and **ENABLE-B** commands because it is writing a **Cxxx** parameter.<br>**WARNING** **The drive will start up as soon as writing is over!!!** |
| **W38** | LOCKED | Editing mode cannot be accessed because parameter modification is disabled: **P000** is different from **P002**. |
| **W39** | KEYPAD DISABLED | Editing mode cannot be accessed because the keypad is disabled. |
| **W40** | FAN FAULT | Fan locked or disconnected or faulty. |

| Warning | Message | Description |
|---|---|---|
| **W41** | SW VERSION KO | Download impossible because of different SW Versions. |
| **W42** | IDP KO | Download impossible because of different IDPs (Identification Products). |
| **W43** | PIN KO | Download impossible because of different PINs (Part Identification Numbers). |
| **W44** | CURRENT CLASS KO | Download impossible because of different current classes. |
| **W45** | VOLTAGE CLASS KO | Download impossible because of different voltage classes. |
| **W46** | DOWNLOAD KO | Download impossible (generic cause). |
| **W48** | OT Time over | The preset threshold for the drive Operation Time has been exceeded. |
| **W49** | ST Time over | The preset threshold for the drive Supply Time has been exceeded. |
| **W50** | NTC Fault | NTC sensor for heatsink temperature disconnected or faulty. |
| **W51** | DRY RUN | The pump is operating in Dry-run mode. |
| **W53** | PV ISOL. KO | PV field isolation loss. |
| **W54** | SPD TRIGGERED | SPD tripped. |

### 2.7.6. State List

The state of the Solardrive appears in the first row of the display on the root page (see section 2.2).

**Table 15: State list**

| Number | State | Description |
|---|---|---|
| 0 | ALARM!!! | Alarm tripped |
| 1 | STARTING UP | The drive is starting up |
| 2 | MAINS LOSS | Mains loss |
| 3 | TUNING | The drive is tuning |
| 4 | SPEED SEARCHING | Searching for motor speed |
| 5 | DCB at START | DC Braking at start |
| 6 | DCB at STOP | DC Braking at stop |
| 7 | DCB HOLD | DC current for Hold function |
| 8 | MANUAL DCB | Manual DC Braking |
| 9 | LIMIT WHILE ACCEL. | Current/torque limit while accelerating |
| 10 | LIMIT WHILE DECEL. | Current/torque limit while decelerating |
| 11 | LIMIT AT ST. SPD | Current/torque limit at constant rpm |
| 12 | BRAKING | Braking module startup or deceleration ramp extension |
| 13 | RUN AT ST. SPEED | Drive running at speed set point |
| 14 | ACCELERATING | Drive running with motor in acceleration stage |
| 15 | DECELERATING | Drive running with motor in deceleration stage |
| 16 | INVERTER OK | Drive on Stand-by with no alarms tripped |
| 17 | FLUXING | Motor fluxing stage |
| 18 | FLUXED MOTOR | Motor fluxed |
| 19 | FIRE MODE RUN | Constant rpm in Fire Mode |
| 20 | FIRE MODE ACC. | Acceleration in Fire Mode |
| 21 | FIRE MODE DEC. | Deceleration in Fire Mode |
| 22 | INVERTER OK* | Drive on Stand-by with no alarms tripped;<br>void warranty due to alarm trip in Fire Mode |
| 25 | SPARE | Board in Spare mode |
| 27 | WAIT NO ENABLE | Waiting for opening **ENABLE-A** and **ENABLE-B** commands |
| 28 | WAIT NO START | Waiting for opening **START** command |
| 29 | PIDOUT min DISAB | Drive disabled due to PID output < Min. |
| 30 | REF min DISABLED | Drive disabled due to REF < Min. |
| 31 | IFD WAIT REF. | Drive enabled with IFD control<br>waiting for reference in order to start |
| 32 | IFD WAIT START | Drive enabled with IFD control<br>waiting for START in order to start |
| 33 | DISABLE NO START | When fluxing, the RUN command was not given within the max. time set in **C183**. The drive is kept disabled until the RUN command is given. |

| Number | State | Description |
|---|---|---|
| 40 | IFD WAIT MPPT | Waiting for adequate solar radiation conditions able to start the motor |
| 41 | INSOLATION KO | Waiting for adequate solar radiation conditions able to start the motor |
| 42 | INSOLATION OK | PV field power adequate to start the motor; waiting for timeout set in **P801** (section 2.6.10). Press **RESET** to reset the value and start the motor. |
| 43 | STARTING | Timeout set in **P802** (section 2.6.10) after an alarm is reset. Press **RESET** to reset the value and start the motor. |