ENERTRONICA
SANTERNO

A GUIDE TO

Santerno Solar Drive Plus

MET-TP

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Cairo, Egypt

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T A B L E O F C O N T E N T S

1. Introduction

Introduction

Welcome to the Solar Drive Plus course in the **MET-TP** series. Al-**M**awared **E**ngineering and **T**rading **T**raining **P**rogram offers a training service so that you can plan over the time the growth of the device knowledge, from the frequency inverters to the soft starters for asynchronous motors up to the PLC "Programmable Logic Controller"; Touch screens and SCADA system. Courses are targeted to engineers, technicians, users and installers and to the service personal as well. MET suggests courses that are mainly oriented to the use of the drives and of the automation system.

Our highly trained engineers will guide you step by step through each training course, allowing you to perform each step by yourself from small examples to large applications to help you practice everything you learn during the training course.

This course covers the **Solar Drive Plus from Enertronica Santerno Company - ITALY.** Upon completion of this course you will be able to:

- Connect the Solar Drive Plus to the PVs
- Choose the best configuration for Solar Drive Plus modules (analog, digital or communication).
- Navigate to all necessary common parameters
- Navigate to all necessary Solar parameters
- Check all Alarms.
- Setup the Remote Drive Software
- Navigate at the Remote Drive Software

After you have completed this course, if you wish to determine how well you have retained the information covered, you can use the Solar Drive at the lab for practical experience.

2. Company Overview

Believe in Quality

Experience and high responsiveness

Year 2001 is not only a date for ALMAWARED ENGINEERING AND TRADING S.A.E (MET). It represents the starting of a company that is today specialized in the industrial automation, mechanical and electrical power transmission field, thanks to the entrepreneurial capabilities from foundation members Mr. Abdel Aziz Aboul Atta, Ms. Bahia Khairy, Eng. Mohamed Abdel Aziz, Eng. Khalid Abdel Aziz and Eng. Khalid Ateya, expertise and firm commitment of the promoting partners.

MET partners achieved the quality certificates, with the aim to grant a good quality system for the different market needs to satisfy most of their customers' needs by providing complete solutions or individual tailor-made solutions. Only a long experience allows a company to reach in a flexible and wide way to market demands, with a complete range of products and services.

Flexibility and rapidity of product range

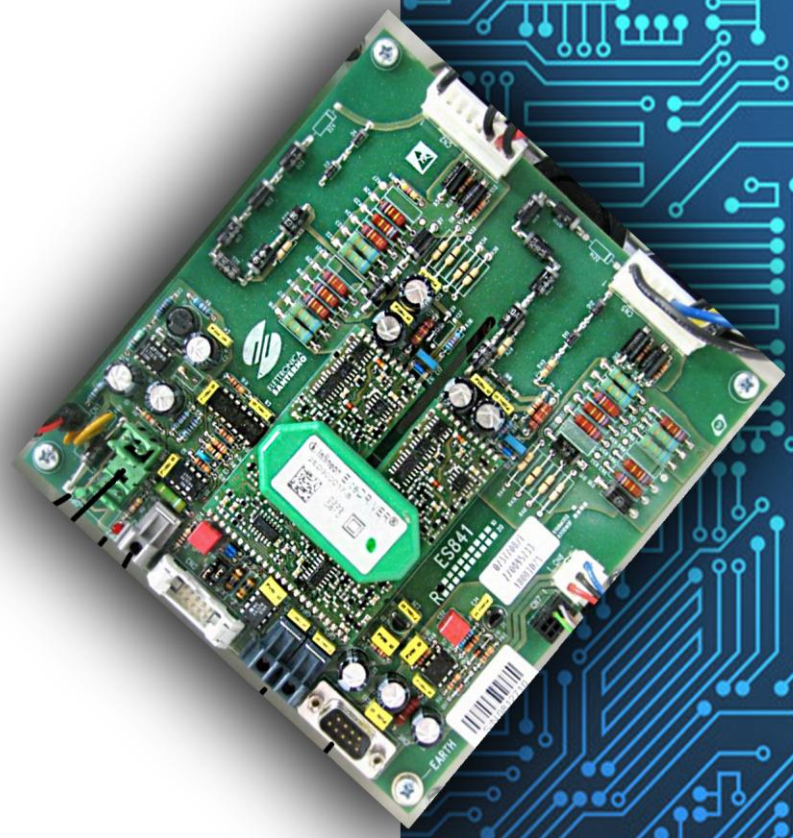
Our structure is composed of real problem solvers who study the customer requirements and orient him towards simple and innovative solutions thanks to the structure of MET product range that gives our highly professional technical engineers a wide area of solutions. MET product range comprises a whole variety of automation, electrical and mechanical equipment such as PLCs, touch screens, SCADA systems, flow meters, density meters, BMS components, inverters, Solar Drives, soft starters, AC/DC motors, Servo systems, gearboxes, clutches and brakes. Distributed Control System (DCS) is the latest product that MET provides to our customers.

A strong presence in the market

Our experienced sales and marketing team is highly technical and customer-oriented. They combine premium customer support with years of industry experience to develop and sustain long-term relationships.

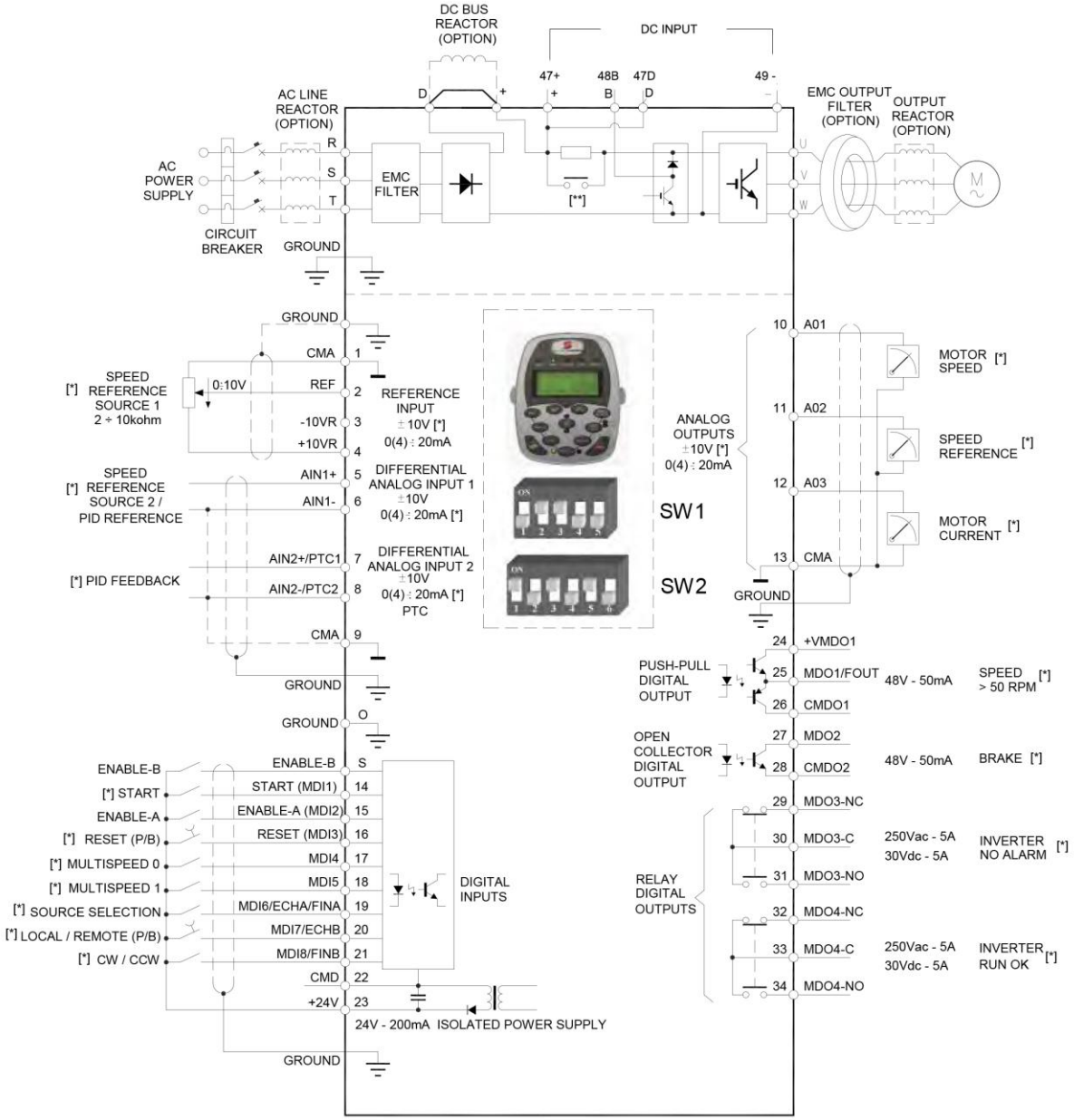
Our team ensures each customer is treated with professionalism and integrity as we work hard to understand our customers' needs and to provide solutions to meet those needs, so we serve a wide variety of market fields such as soup and fats, sugar industries, petroleum and refineries, cement factories, iron and steel mills, pharmaceutics and cosmetics, textiles and dyeing, paints and chemicals, plastics and petrochemicals, food & beverages industries, paper and printing, packing and wrapping, pump & water treatment plants, sewage & water treatment plants and commercial HVAC.

3.Hardware Overview



3.1 Wiring Diagram Sizes
S05 : S60:

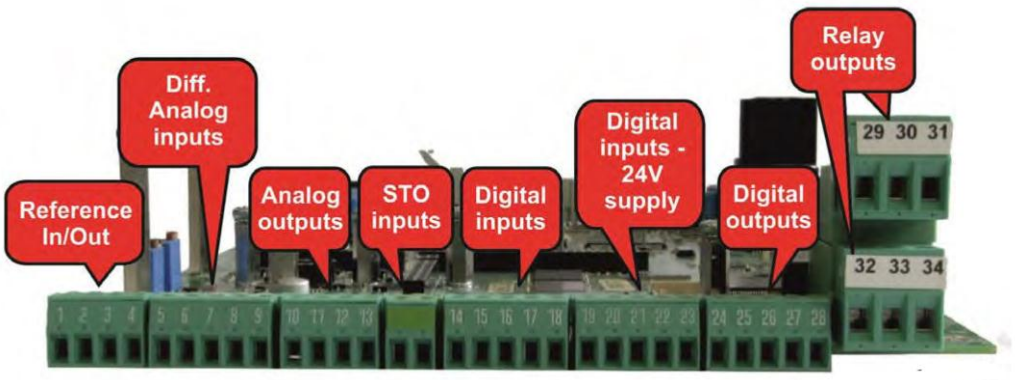
*** Factory defaults**



3.2 Power Terminals For Sizes S05 : S52:

	DESCRIPTION
41/R – 42/S – 43/T	Inputs for three-phase supply (the phase sequence is not important).
44/U – 45/V – 46/W	Three-phase motor outputs.
47/+	Link to the DC voltage positive pole. It can be used for - DC voltage supply; - DC inductors; - the external braking resistor and the external braking unit (for the drive models which are NOT provided with terminal **50/+** dedicated to the external braking resistor) - the external braking unit.
47/D	When fitted, link to the positive pole of the continuous AC rectified voltage. It can be used for the inductor—if no DC inductor is used, terminal 47/D must be short-circuited to terminal **47/+** using a cable/bar having the same cross-section as the cables used for power supply; factory setting).
48/B	When available, it can be used to connect the IGBT brake for braking resistors.
49/–	Link to the negative pole of the DC voltage. It can be used for - DC voltage power supply; - the external braking unit
50/+	When available, it can be used to connect the positive pole of the DC voltage to be used for the external braking resistor only.

3.3 Control Terminals:



Terminals 1 : 13 and S,O:

No.	Name	Description	I/O Features	DIP-switch
1	CMA	0V for main reference (connected to control 0V)	Control board zero volt	
2	REF	Input for single-ended main reference to be configured either as a voltage input or as a current input	Vfs = ± 10 V, Rin = 50kΩ; Resolution: 12 bits	SW1-1: Off (default)
			0 (4) ÷ 20 mA, Rin = 250 Ω; Resolution: 11 bit	SW1-1: On
3	-10VR	Negative reference supply output for external potentiometer	-10V Imax: 10mA	
4	+10VR	Positive reference supply output for external potentiometer	+10V Imax: 10mA	
5	AIN1+	Differential auxiliary analog input 1 to be configured either as a voltage input or as a current input	Vfs = ± 10 V, Rin = 50kΩ; Resolution: 12 bits	SW1-2: Off
6	AIN1-		0 (4) ÷ 20 mA, Rin = 250 Ω; Resolution: 11 bits	SW1-2: On (default)
7	AIN2+/PTC1	Differential auxiliary analog input 2 to be configured either as a voltage input or as a current input, or to be configured as a PTC acquisition input for motor protection	Vfs = ± 10 V, Rin = 50kΩ; Resolution: 12 bits	SW1-3: Off SW1-4,5: Off
8	AIN2-/ PTC2		0 (4) ÷ 20 mA, Rin = 250 Ω; Resolution: 11 bits	SW1-3: On SW1-4,5: Off (default)
			Motor protection PTC reading according to DIN44081/DIN44082	SW1-3: Off SW1-4,5: On
9	CMA	0V for auxiliary inputs (connected to control 0V)	Control board zero volt	
10	AO1	Analog output 1 to be configured either as a voltage output or as a current output	Vout = ± 10 V; Ioutmax = 5 mA; Resolution: 11 bits	SW2-1: On; SW2-2: Off (default)
			0 (4) ÷ 20 mA; Voutmax = 10V Resolution: 10 bits	SW2-1: Off; SW2-2: On
11	AO2	Analog output 2 to be configured either as a voltage output or as a current output	Vout = ±10V; Ioutmax = 5mA Resolution: 11 bits	SW2-3: On; SW2-4: Off (default)
			0 (4) ÷ 20 mA; Voutmax = 10V Resolution: 10 bits	SW2-3: Off; SW2-4: On
12	AO3	Analog output 3 to be configured either as a voltage output or as a current output	Vout = ±10V; Ioutmax = 5mA Resolution: 11 bits	SW2-5: On; SW2-6: Off (default)
			0 (4) ÷ 20 mA; Voutmax = 10V Resolution: 10 bits	SW2-5: Off; SW2-6: On
13	CMA	0V for main reference (connected to control 0V)	Control board zero volt	
S	ENABLE-B	Active input: inverter run enabled. Inactive input: freewheeling regardless of the control mode; converter not commutating. To be enabled/disabled in conjunction with **ENABLE-A**	24Vdc opto-isolated digital input; positive logic (PNP type): active with high signal in respect to CMD (terminal O). Compliant with EN 61131-2 as Type 1 digital inputs with 24Vdc nominal voltage. Max. response time to processor: 500µs	
O	CMD		Control board zero volt	

Terminals 14 : 34:

N.	Name	Description	I/O Features	DIP-switch
14	START (MDI1)	Active input: inverter running. Inactive input: main ref. is reset and the motor stops with a deceleration ramp Multifunction digital input 1	Opto-isolated digital inputs 24 VDC; positive logic (PNP): active with greater signal in respect to CMD (terminal 22). In compliance with EN 61131-2 as type-1 digital inputs with rated voltage equal to 24 VDC. Max. response time to processor: 500 µs	
15	ENABLE-A (MDI2)	Active input: inverter running enabled Inactive input: motor idling regardless of control mode; inverter not switching To be enabled/disabled in conjunction with **ENABLE-B** Multifunction digital input 2		
16	RESET (MDI3)	Alarm reset function Multifunction digital input 3		
17	MDI4	Multifunction digital input 4		
18	MDI5	Multifunction digital input 5		

19	MDI6 / ECHA / FINA	Multifunction digital input 6; Encoder dedicated input, push-pull 24 V single-ended phase A, frequency input A	Opto-isolated digital inputs 24 VDC; positive logic (PNP): active with greater signal in respect to CMD (terminal 22). In compliance with EN 61131-2 as type-1 digital inputs with rated voltage equal to 24 VDC. Max. response time to processor: 600 µs	
20	MDI7 / ECHB	Multifunction digital input 7; Encoder dedicated input, push-pull 24 V single-ended, phase B		
21	MDI8 / FINB	Multifunction digital input 8; Frequency input B		
22	CMD	0V digital input isolated to control 0V	Opto-isolated digital input zero volt	
23	+24V	Auxiliary supply output for opto-isolated multifunction digital inputs	+24V±15% ; Imax: 200mA Protect with resettable fuse	
24	+VMDO1	Supply input for MDO1 output	20 ÷ 48 VDC; IDC = 10 mA + output current (max 60 mA)	

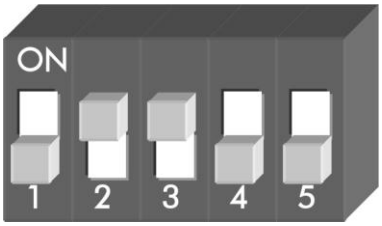
25	MDO1/ FOUT	Multifunction digital output 1; frequency output	Opto-isolated digital output (push-pull); Iomax = 50 mA max; fout max 100 kHz.	
26	CMDO1	0V Multifunction digital output 1	Common for supply and multifunction output 1	
27	MDO2	Multifunction digital output 2	Opto-isolated digital output (open collector); Vomax = 48 V; Iomax = 50mA	
28	CMDO2	Common for multifunction digital output 2	Common for multifunction output 2	

29	MDO3-NC	Multifunction, relay digital output 3 (NC contact)	Change-over contact: with low logic level, common terminal is closed with NC terminal; with high logic level, common terminal is open with NO terminal; Vomax = 250 VAC, Iomax = 5A Vomax = 30 VDC, Iomax = 5A	
30	MDO3-C	Multifunction, relay digital output 3 (common)		
31	MDO3-NO	Multifunction, relay digital output 3 (NO contact)		

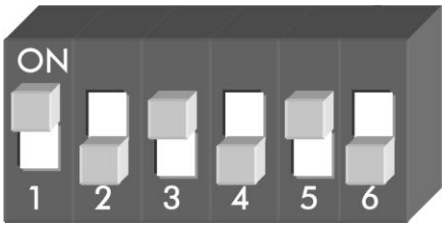
32	MDO4-NC	Multifunction, relay digital output 3 (NC contact)	Change-over contact: with low logic level, common terminal is closed with NC terminal; with high logic level, common terminal is open with NO terminal; Vomax = 250 VAC, Iomax = 5A Vomax = 30 VDC, Iomax = 5A	
33	MDO4-C	Multifunction, relay digital output 4 (common)		
34	MDO4-NO	Multifunction, relay digital output 4 (NO contact).		

3.4 DIP - Switches Configurations

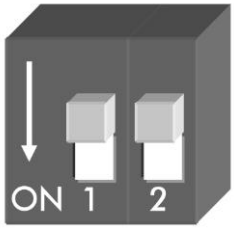
REF Analog Input: Voltage
2 X Analog Output: Current



Analog Output: Voltage

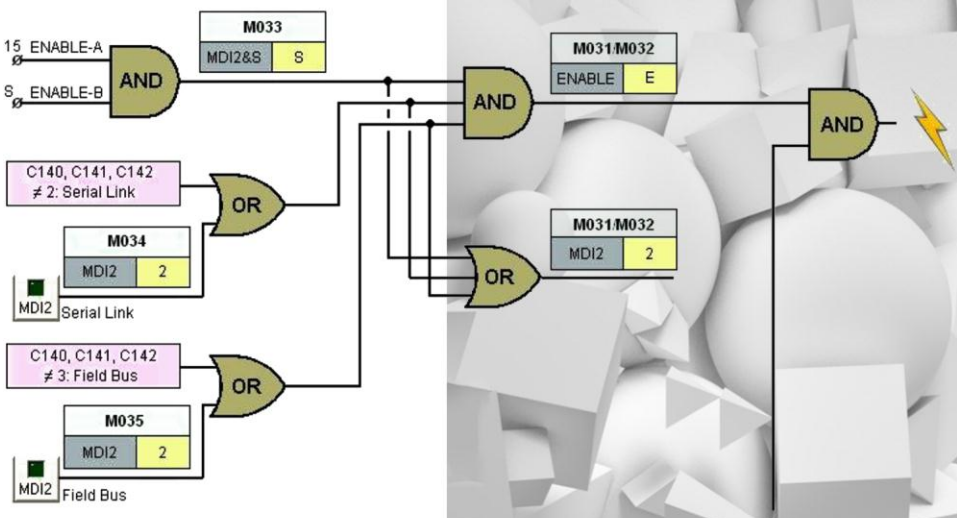


Both OFF: RS485 - Disabled
Both ON: RS485 - Enabled



Notes:

4.Programming Overview



4.1 Keypad Keys Description:

Menu Key:

- Allows going to the next menu.

ESC Key:

- Move up one level in the menu tree.
- Go to the next field when changing a parameter having multiple value fields.
- Quit the editing mode without storing the value to EEPROM.

Reset Key:

- Alarm and Control Board Reset, 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

TX/RX Key:

- Download/Upload from/to the Keypad

LOC/REM Key:

- To enable the Local/Remote operating mode, Remote sources are command and/or reference sources other than the display/keypad.

SAVE/ENTER Key:

- Allows selecting a lower level when navigating within the programming menus. It also allows changing a parameter value.

START-UP Key:

- Goes to the Start Up Menu for the setup of the main parameters of the Solar Drive Plus

START Key:

- Run the Solar Drive Plus

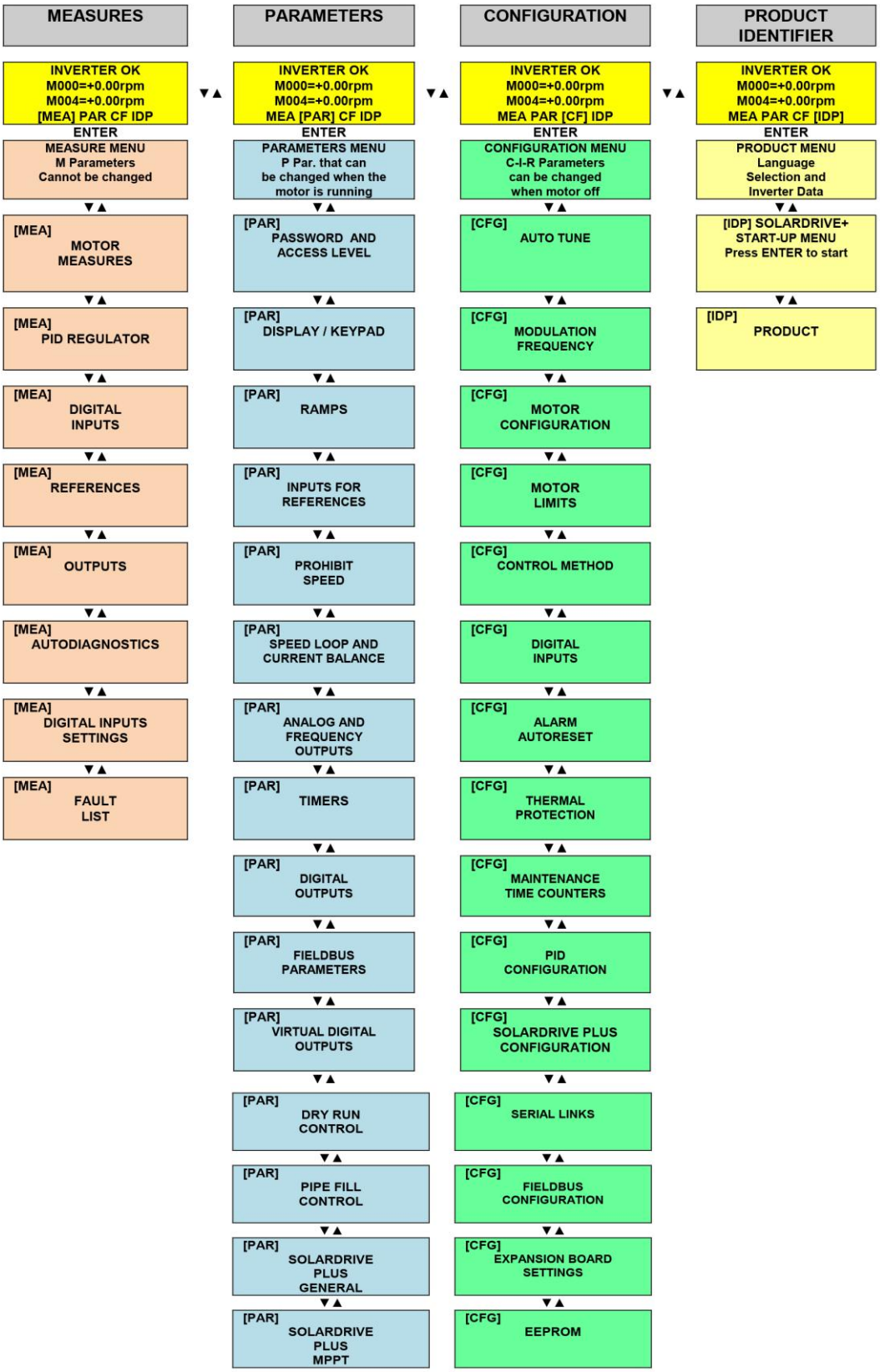
STOP Key:

- STOP the Solar Drive Plus

4.2 Keypad LEDs Description:

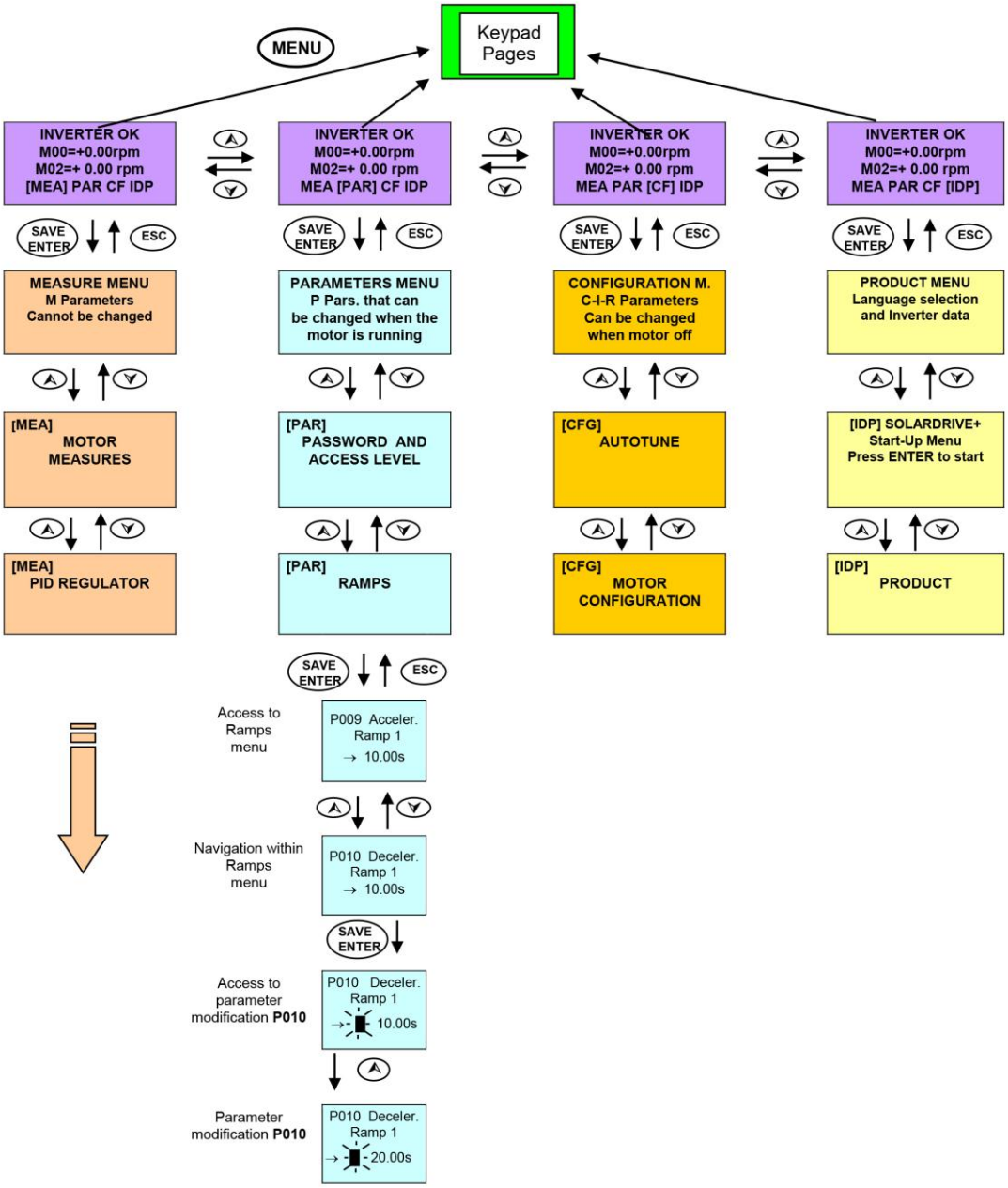
RUN LED – GREEN		
●		Motor not powered
☀		Motor powered, but no torque (idle)
●		Motor powered and running
PV OK LED – GREEN		
●		DC voltage out of required working range
●		DC voltage within working range
ALARM LED – RED		
●		Inverter Ok
●		Alarm tripped
LIMIT LED – YELLOW		
●		No active limit
●		Voltage 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

4.3 Menu Tree Overview:



4.4 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.

4.5 Password and User Level Menu:

The Password and User Level menu allows changing the programming parameters and sets their visibility.

- P000 Enables parameter modification
- P001 Sets the user level
- P002 Allows to change the password set in P000
- P003 Conditions required to change C parameters

P000			
	Range	00000÷32767	00000: [No] ÷32767
	Default	00001	00001
	Level	BASIC	
	Address	Cannot be accessed via serial link. Parameter write via serial link is always enabled.	
	Function	Set the correct value in P000 to enable parameter write. The default password for **P000** is 00001. You can enter a custom password in **P002.**	

P001			
	Range	0÷2	0: Basic 1: Advanced 2: Engineering
	Default	0	0 : Basic
	Level	BASIC	
	Address	514	
	Function	The inverter programming parameters are grouped by access levels based on their functions (more or less complex functions). Some menus, or some parts of menus, are not displayed when a given access level is selected. When the BASIC access level is selected once the inverter parameterization is correct, navigation is easier, as only frequently accessed parameters are displayed. The User Level is stated for each parameter.	

P002			
	Range	00001 ÷ 32767	00001 ÷ 32767
	Default	00001.	
	Level	ENGINEERING	
	Address	510	
	Function	Once write is enabled after entering the correct password in **P000**, you can use parameter P002 to enter a custom password.	

P003			
	Range	0 ÷ 1	0:[Stand-by only] ÷ 1:[StandBy+Fluxing]
	Default	1	1:[StandBy+Fluxing]
	Level	ADVANCED	
	Address	509	
	Function	Factory setting allows **C parameters** to be programmed even when the inverter is enabled. However, the motor must be stopped. If **P003=0: [Stand-by only]**, C parameters can be changed only when the inverter is disabled. This parameter also affects the behaviour of the digital inputs for **LOC/REM** and motor selection: when those inputs change, they produce their effect only when C parameters are allowed to be changed, according to the value in **P003**.	

4.6 Start Up Key Menu:

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

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
C257: Motor thermal time constant

4.7 Solar Application Adjusting Criteria Tips:

Parameters for optimum operation of the Solar Drive Plus:

C800: Minimum Pump Speed

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 behavior is that when the speed value set in C800 is attained, the pump flow rate is low but not zero.

P009, P010, P018, P019: Ramps

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 are stronger when solar radiation is strong. The time set in P009 is the minimum time required to attain the maximum power.

P020: Speed Threshold for Initial and Final Ramps

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: Minimum Solar Radiation Voltage

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.

P801: Minimum Solar Radiation Time

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 and P811: MPPT Minimum and Maximum Voltage

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.

P813: Load Curve Exponent

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: Voltage Regulator Integral Gain

P815: Voltage Regulator Proportional Gain

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:

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).

2. Monitor speed reference of pump M001. If too noisy or oscillatory, decrease gains P814 and P815.

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: MPPT Initial Voltage Gain

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.

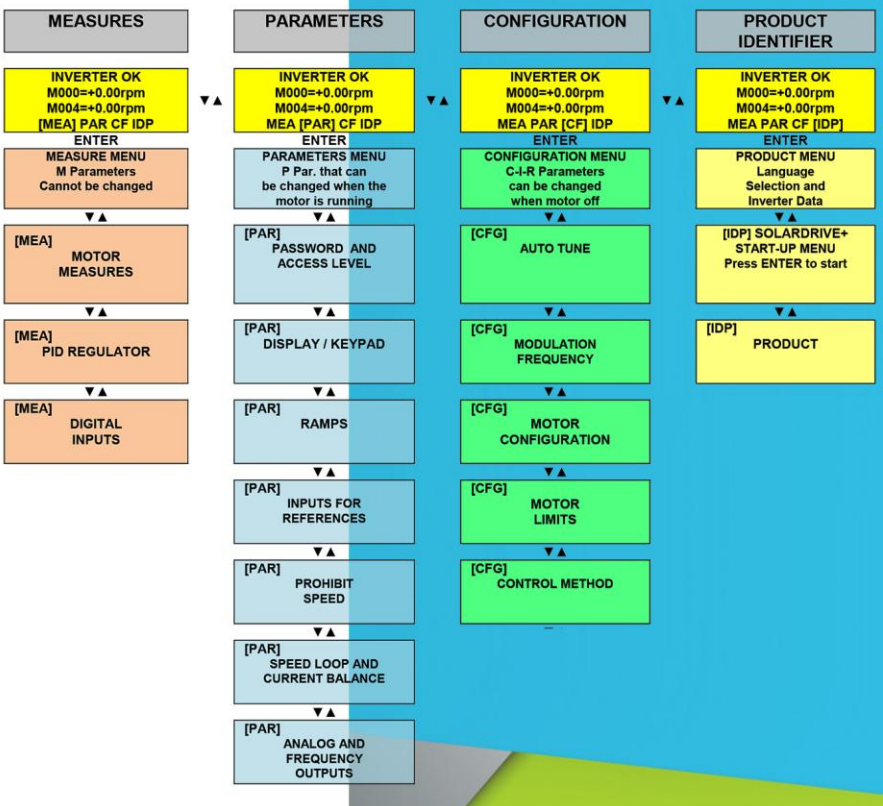
Example: from the datasheet of the PV panel:
Open-circuit voltage: 38.58 V
Voltage at maximum power: 30.90 V
Minimum value for P822 = 30.90/38.58*100 = 80.09%.

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.
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%).

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.

Notes:

5.Frequently Used Menus



5.1 Measure Menu

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

5.1.1 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
Value of the speed reference obtained when the motor rotates at constant speed, once the preset ramp time is over.

M002: Speed Ramp Output
This is the measure of the speed value processed with respect to the ramp time.

M004: Motor Speed
Motor speed value.

M006: Drive Output Frequency
This is the measure of the voltage frequency output of the drive.

M026: Output Current
Measurement of the RMS of the output current.

M026a: Motor Thermal Capacity
Heating of the connected motor. This parameter indicates the current level of the motor heating following I2t pattern set in the Motor Thermal Protection Menu. This value is expressed as a percentage of the allowable asymptotic value.

M027: Output Voltage
Measure of the RMS of the output voltage.

M027a: Power Factor
Estimation of power factor (or Cos φ), i. e. the ratio between active power and apparent power at the drive output.

M028: Output Power
Measure of the active power produced by the drive. A negative value indicates input power (the motor is regenerating energy).

M028a: Energy Consumption

Counter of the drive energy consumption. 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

Measure of the voltage in the drive DC-link.

M029a: DC-Bus Voltage Reference

This is the set point 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

Measure of the RMS value of the drive supply voltage

5.1.2 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

Status of the control terminal board used by the drive. This is the terminal board resulting from the combination of the preset command sources (local terminal board, serial link and fieldbus), where;

- Inputs MDI1 to MDI8 are the result of the OR between the different control sources.
- 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.
- The ENABLE SW (ESW) is the result of the AND of the inputs programmed as ENABLE SW (C152) of all the programmed command sources.

M032: Instant Digital Inputs

Status of the virtual control terminal board before applying the timers to the digital inputs.
(If no timer is applied, it matches with M031).

Coding of Measuring M031 and 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

Status of the digital inputs in the drive physical terminal board. The status of MDI2&S (S) input is the result of logic AND between ENABLE-A and ENABLE-B physical signals.

Coding of Measuring 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

5.1.3 Digital 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

Status of digital outputs MDO1:4 and status of the recharged contactor.

Coding of Measuring M056

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

5.1.4 Auto Diagnostics Menu:

This menu allows the user to check the functioning times and the relevant counters (for maintenance purposes) of the Solar Drive 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 and M054: Functioning Timers

This screen displays the ST (Supply Time) and the OT (Operation Time). The Operation Time is the activation time of the drive IGBTs. Both values are expressed in 32 bits divided into two 16-bit words: the low part and the high part.

M062: Ambient temperature Measure

Ambient temperature measured on the surface of the control board.

M064: IGBT Temperature Measure

If the temperature readout is <–30.0 °C or >150.0 °C, warning W50 NTC Fault appears.

M065: Operation Time Counter

Time elapsed after resetting the operation time counter. The Operation Time is the activation time of the drive IGBTs.

M066: Supply Time Counter

Time elapsed after resetting the supply time counter.

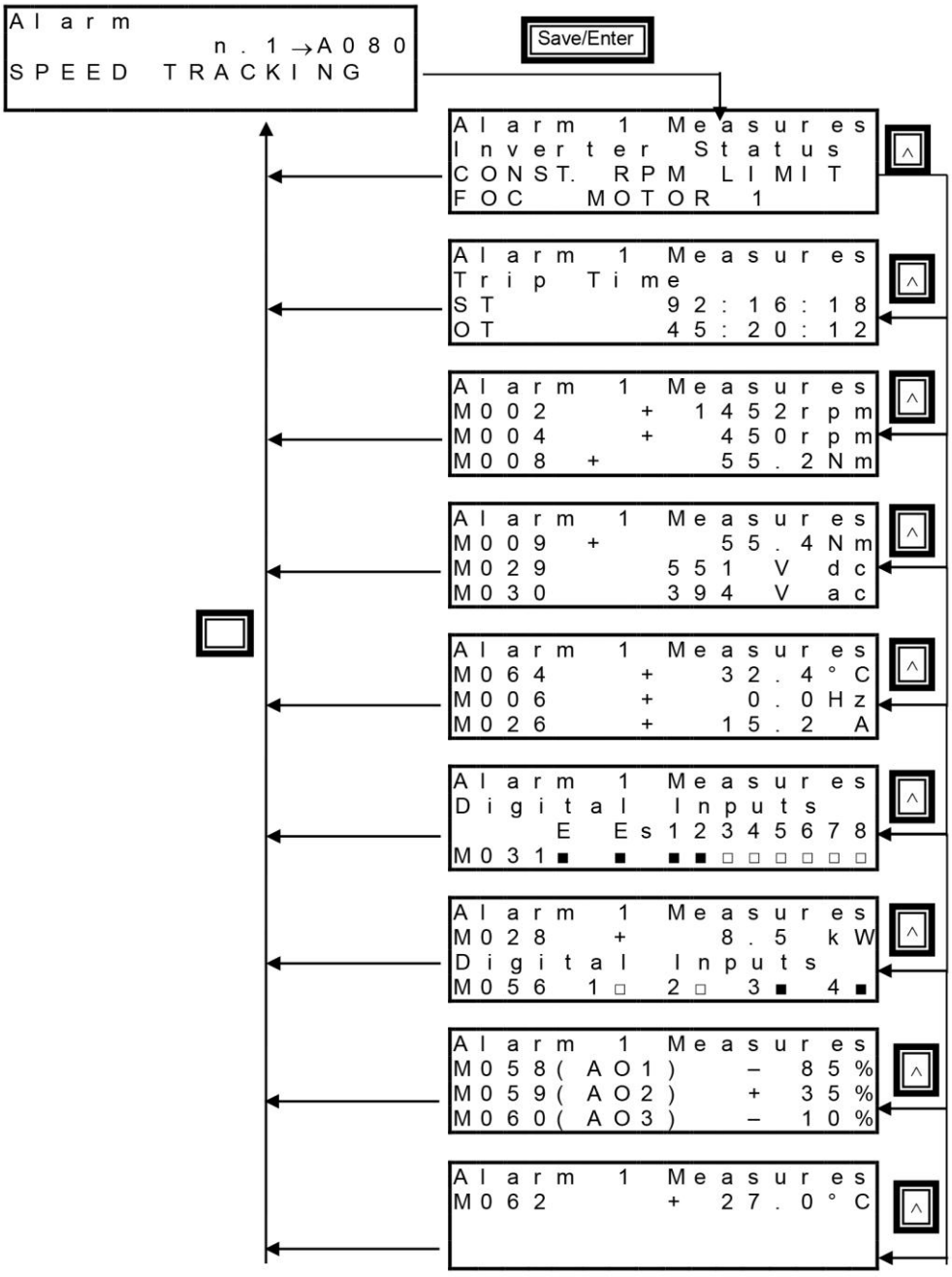
M089: Drive Status

Describes the current condition of the drive.

M090: Active Alarm

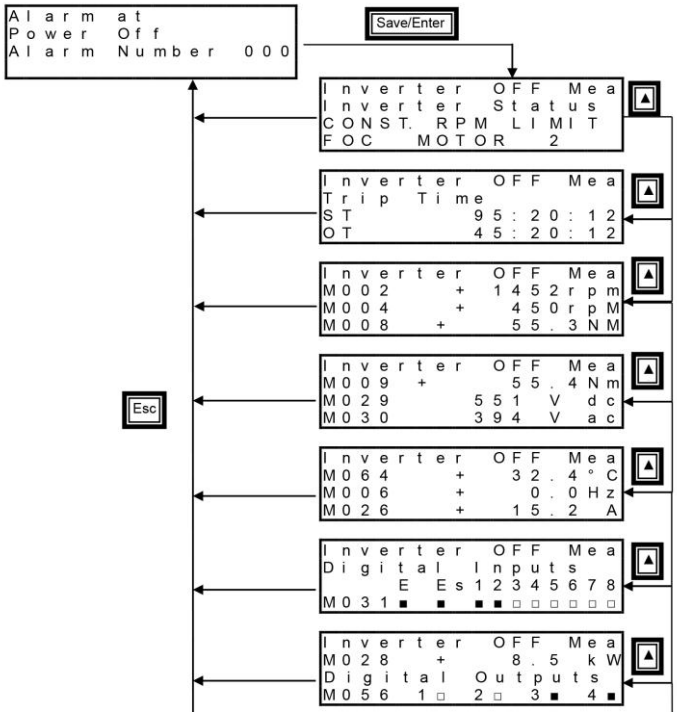
Alarm tripped at the moment.

5.1.5 Fault List Menu: Scroll the Fault List Menu to display the codes of the last eight alarms tripped as the following:



5.1.6 Power Off List Menu:

This menu contains the measures of some characteristic variables detected at the drive power off.



List of the measures in the Fault Lists and in the Power Off List M090 to M062

Measure	Function	Range	Value	Modbus Offset Address
M090	Active Alarm		-	0
M052	Supply Time	See measurement description	-	1: LSW 2: MSW
M054	Operation Time	See measurement description	-	3: LSW 4: MSW
M089	Inverter Status		-	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 1: Mot2 2: Mot3	17
	Selected Control (low byte)	0 ÷ 2	0: IFD 1: VTC 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

This manual covers only the menus and parameters for the solar

5.2 Parameters Menu:

pumping application

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

5.2.1 Ramps Menu:

List of Ramps Menus from 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 : 327,000 Sec.

Ramp for motor start.

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 : 327,000 Sec.

Ramp for motor stop.

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 : 327,000 Sec.

Ramp for motor start 2.

P013: Deceleration Time at Stop 2

Range: 0 : 327,000 Sec.

Ramp for motor stop 2.

For P012 and P013. Values for ramp 2 can be applied to the reference provided that multiramp digital inputs are set up and that ramp 2 is selected.

P014: Unit of Measure for Ramps 1 and 2

Range: 0 : 3

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.

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

Examples:

- P014=1 then P009=100;means P009 = 100 x 0.1 s = 10 s
- P014=0 then P009=100;means P009 = 100 x 0.01 s = 1 s
- P014=3 then P009=100;means P009 = 100 x 10 s = 1000 s

P015: Acceleration Time after Start

Range: 0 : 327,000 Sec.

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). See also parameter P009 (ramp for motor stop).

P016: Deceleration Time after Start

Range: 0 : 327,000 Sec.

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). See also parameter P010 (deceleration ramp time).

P018: Start Acceleration Time

Range: 0 : 327,000 Sec.

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. See also parameter P009 (ramp for motor stop).

P019: End Deceleration Time

Range: 0 : 327,000 Sec.

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. See also parameter P010 (deceleration ramp time).

P020: Speed Threshold for Initial and Final Ramps
Range between 0 to 150.0%
The maximum value depends on C800 and C029. 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:

- Ramp P018 while accelerating.
- Ramp P019 while decelerating.

The maximum value for this parameter is:
C800 / C015 * p * 100
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.

P032: Fire Mode Acceleration Ramp
Range: 0 : 327,000 Sec
This ramp is used to accelerate the motor when in Fire Mode.

P033: Fire Mode Deceleration Ramp
Range: 0 : 327,000 Sec
This ramp is used to decelerate the motor when in Fire Mode.

5.2.2 Dry – Run Control Menu:

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.

Dry-Run Parameter list

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

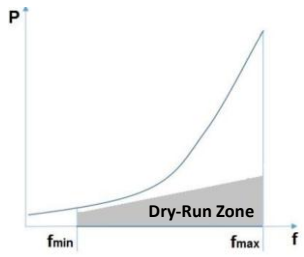
Dry-run detection below a preset operating frequency. The calibration guidelines for two different applications are given below:

- 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.

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.

P710: Quantity for Dry-Run Detection
Range: 0 : 1
0: Electrical Power
1: Power Factor
Defines the measurement for the Dry-run detection.

P710a: Low Frequency for Dry-Run Threshold
Range: 0 : 100%
Speed for the first point defining the Dry-run function. Expressed as a percentage of C015: nominal motor frequency.

P710b: Dry-Run Threshold at Low Frequency
Range: 0 : 100
Value of the Dry-run detection measurement, selected in P710, at first point speed P710a.

P710c: High Frequency for Dry-Run Threshold
Range: 0 : 100%
Speed for the second point defining the Dry-run function. Expressed as a percentage of C015: nominal motor frequency.

P710d: Dry-Run Threshold at High Frequency
Range: 0 : 100
Value of the Dry-run detection measurement, selected in P710, at second point speed P710c.

P711: Minimum Frequency for Dry-Run Enable
Range: 0 : 100
Frequency below which the Dry-run condition detection is kept disabled. Expressed as a percentage of C015: nominal motor frequency.

P712: Dry-Run Trip Time
Range: 0 : 3,200 Sec.
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 : 3,200 Sec.
Timeout for condition reset from the latest Dry-run detection event. 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 : 32,000 msec.
First order filter time constant applied to the reference variable chosen in P710. Useful in case of electric noise affecting the variable.

P715: MDI for Dry-Run Disable
Range: 0 : 24 XMDI8
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
1: Alarm
2: Warning
3: Only MDO

When a Dry-run condition is detected for a time equal to at least the time set in P712, the selected action is executed.

The default setting is “No action, 0: Disable”. 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).

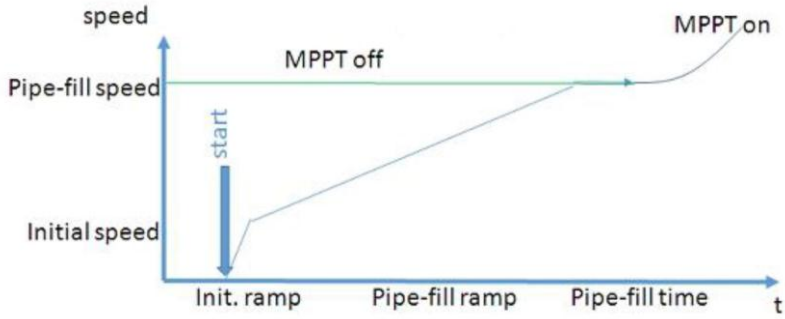
If an MDO for Dry-run detection is allocated to this function from the Digital Outputs Menu, its status will be changed in cases 1, 2 and 3.

Option 3 is required to have only the MDO command without any additional signal.

5.2.3 Pipe Fill Control Menu:

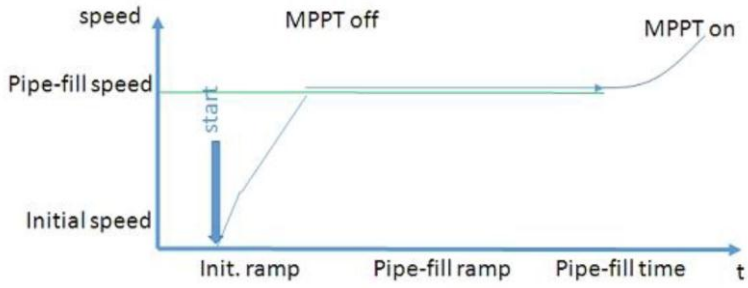
The Pipe Fill function has been developed to smoothly control pipe fill and avoid water hammer phenomena damaging hydraulic outlets (such as irrigation nozzles) by limiting the system filling rate.

- **Pipe Fill Rate over time during the Vertical System**:



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

- **Pipe Fill Rate over time during the Horizontal System**:



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

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.

Pipe Fill Parameter list

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 : 3,200 Sec.

Determines the time taken to go from zero rpm to the value set in P731.

P731: Pipe Fill Rate

Range: 0 : 320%

Determines the pipe fill rate for the reference during the Pipe Fill stage.

P732: Pipe Fill Time

Range: 0 : 32,000 Sec.

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

1: Enabled

0: Disabled

The Pipe Fill function is inactive and the active ramps are implemented.

1: Enabled

The function is active; exiting the Pipe Fill mode is conditioned only when the preset times are over

2: Enabled + PID feedback

The function is active; exiting the Pipe Fill mode is conditioned when the preset times are over or when the PID reference is attained.

5.3 Configuration Menu:

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).

5.3.1 Motor Configuration Menu:

This group of parameters defines the Motor Ratings, the V/f pattern trend of the drive, Torque Boosting, Phase Rotation, Voltage Pre-Boost for IFD Slip Compensation, …etc.

Configuration Menu Parameter list

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

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.**

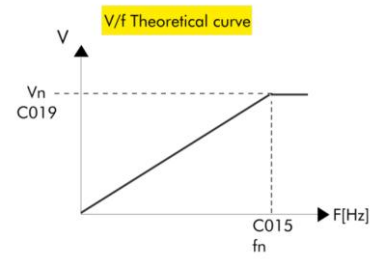
Ranges are:

0: [200 : 240] V	**1**: 2T Regen.	**2**: [380 : 480] V
3: [481 : 500] V	**4**: 4T Regen.	**5**: [500 : 600] V
6: 5T Regen.	**7**: [600 : 690] V	**8**: 6T Regen.

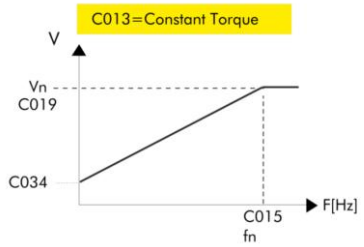
C013: Type of V/F Pattern

Range: 0 : 2

Allows selecting different types of V/f pattern.

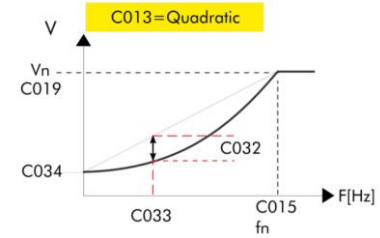


Standard Pattern



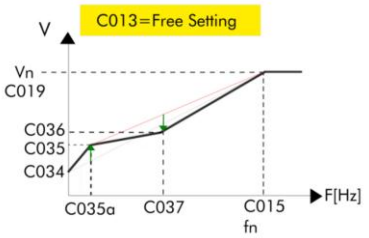
0: Constant Torque

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).



1: Quadratic

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 drops if compared to the relevant constant torque (use C032) and the frequency allowing implementing this torque reduction (use C033).



2: Free Setting

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).

C014: Phase Rotation
Range: 0 : 1
0: [NO]
1: [YES]
Allows reversing the mechanical rotation of the connected motor.

C015: Phase Rotation
Range: 1 : 1000 Hz
This parameter defines the rated motor frequency (nameplate rating).

C016: Rated Motor RPM
Range: 1 : 32,000 rpm
This parameter defines the rated motor rpm (nameplate rating).

C017: Rated Motor Power
Range: 0.1 : 32,000 KW
This parameter defines the rated motor power (nameplate rating).

C018: Rated Motor Current
Range: 0.1 : 32,000 A
This parameter defines the rated motor current (nameplate rating).

C019: Rated Motor Voltage
Range: 5 : 1,200 Volt
This parameter defines the rated motor voltage (nameplate rating).

C020: Motor No-load Power
Range: : 100%
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: : 100%
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 : 32,000 Ω

This parameter defines stator resistance Rs.

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 : 320 mH

This parameter defines the global leakage inductance of the connected motor.

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 : 650 mH

This parameter defines the mutual inductance of the connected motor.

The approximates value of the mutual inductance results from no-load current according to the formula below:

M = (Vmot – Rstat*Io) / (2∏ *fmot* Io)

C026: Time Constant of Bus Voltage Low-pass Filter

Range: : 0 : 3,200 ms

This parameter defines the time constant of the low-pass filter of the bus voltage readout. Changing this value can avoid motor oscillations, especially when no load is connected to the motor.

C028: Min. Motor Speed

Range: : -32,000 : 32,000 rpm

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.

C029: Max. motor speed

Range: : 0 : 32,000 rpm

This parameter defines the maximum speed of the connected motor. This is the reference speed forced when the active speed reference is at its maximum value.

C031: Max. Speed Alarm

Range: : 0 [Disable] : 32,000 rpm

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 : 100%

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.

C033: Rated Revs Referring to Reduction in Quadratic Torque Curve

Range: : 0 : 100%

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.

C034: Voltage Preboost for IFD

Range: : 0 : 5%

Torque compensation at minimum frequency produced by the drive. IFD control: determines the increase of the output voltage at 0Hz.

C035: Voltage Boost 0 at Programmable Frequency

Range: : -100 : 100%

Torque compensation at preset frequency (parameter C035a). 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%

Frequency for the application of the boost preset with parameter C035. It is expressed as a percentage of the nominal motor frequency (C015).

C036: Voltage Boost 1 at Programmable Frequency

Range: : -100 : 400%

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%

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%

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 [Disable]

1: 0 : 200%

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 : 50%

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:

Delta V = (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).

Example:

C040 = 10%	: Voltage drop at rated current
C013 = Constant torque	: Type of V/f pattern
C015 = 50 Hz	: Rated frequency
C019 = 380 V	: Rated voltage
C018 = 50 A	: Rated current

If the drive output frequency is 25 Hz, it should deliver 190V. When the output current is 40A (C018) the voltage actually produced is:

Vout =190+((10/100 * 380) * 40/50 * 25/50) =190+15.2= 205.2 V.

C042: Vout Saturation Percentage

Range: : 10 : 120%

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.

5.3.2 Limits Menu:

The Limits Menu defines the current/torque limits applied to the control functions, for IFD control, current limits are used. Three limit current levels are available, which are expressed as a percentage of the motor rated current:

- Current limit while accelerating
- Current limit at constant rpm
- Current limit while decelerating

Limits Menu Parameter list

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

C046 and C050 are 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).

C043: Current Limit while Accelerating

Range: : 0 : [Disable]

1 : 0 : 400%

This parameter defines the current limit while accelerating; it is expressed as a percentage of the rated current of the motor. No limit is applied if this parameter is set to 0: Disabled.

C044: Current Limit at Constant rpm

Range: : 0 : [Disable]

1 : 0 : 400%

This parameter defines the current limit at constant rpm; it is expressed as a percentage of the rated current of the motor. No limit is applied if this parameter is set to 0: Disabled.

C045: Current Limit while Decelerating

Range: : 0 : [Disable]

1 : 0 : 400%

This parameter defines the current limit while decelerating; it is expressed as a percentage of the rated current of the motor. No limit is applied if this parameter is set to 0: Disabled.

The two special parameters which useful for inertial loads.

C046: Current Limit Decrease in Flux Weakening

Range: : 0 : [Disable]

1 : [Enable]

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:

Limit = current limit being used * (Fmot/ Fout).

C050: Frequency Decrease during Acceleration Limit

Range: : 0 : [Disable]

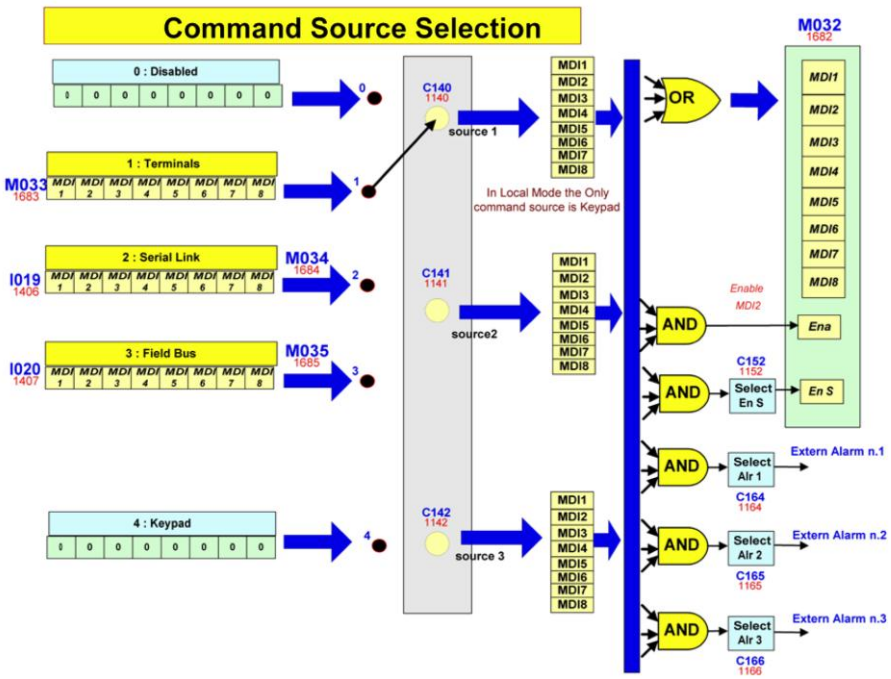
1 : [Enable]

This parameter enables output frequency decrease during acceleration limit.

5.3.3 Control Method Menu:

Command Sources, The drive commands may be sent from the following sources:

0: Disabled
1: Terminal board A
2: Serial link (with MODBUS protocol)
3: Fieldbus (fieldbus on option board)
4: Terminal board B
5: Keypad (remotable display/keypad)



As per factory setting, and for the Solar Drive Plus, 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).

The factory-setting enables only Terminal Board A (C140=1 and C141=1) as a command source.

Control Method Menu Parameter list

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: Selection of Command Source 1, 2, 3
C141:
C142:

Range: : 1 : 5

0: Disabled
1: Terminal board A
2: Serial link (with MODBUS protocol)
3: Fieldbus (fieldbus on option board)
4: Terminal board B
5: Keypad (remotable display/keypad)

Selection of the drive command source.

C143: Selection of Reference when PV

Range: : 0 : 12

0: Disabled
1: REF
2: AIN1
3: AIN2
4: Frequency input
5: Serial Link
6: Fieldbus
7: Keypad
8: Encoder
9: Up Down from MD
10: XAIN4
12: MPPT

This parameter selects the reference source when DC power supply (PV field) is active.

The default is 12: MPPT, so 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.

C144: Selection of Reference when AC

Range: : 0 : 9

0: Disabled
1: REF
2: AIN1
3: AIN2
4: Frequency input
5: Serial Link
6: Fieldbus
7: Keypad
8: Encoder
9: Up Down from MD

This parameter selects the reference source when AC power supply (optional) is active.

The default is 1: REF, so 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

5.3.4 Auto Reset Menu:

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. Under voltage alarms or mains loss alarms can be saved in the fault list in the Autoreset Menu.

Auto Reset Menu Parameter list

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

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.

C255: Autoreset Attempt Number

Range: 0 : 100

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 : 1,000 Sec.

Determines the time that passes from the last alarm tripped to reset the autoreset attempt number.

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]). Under voltage 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].

C257: Alarm Reset at Power On
Range: 0 : [Disabled]
1: [YES]
At power on, this parameter enables the automatic reset of the alarms tripped when the drive is powered off.

C258: Enable Under voltage and Mains Loss Alarms
Range: 0 : [Disabled]
1: [YES]
This parameter saves Under voltage and Mains Loss alarms to the fault list.

The Solar Drive 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.

5.3.5 Motor Thermal Protection Menu:

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).

Motor Thermal Protection Menu Parameter list

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 ^{O}C

This parameter sets the heatsink threshold for the activation of its cooling fans according to the control logic set in C264a. This parameter is active only if C264a=0: Default or 2: By Temperature Only.

The actual temperature of the heatsink can be displayed in measure parameter M064.

C264a: Fan Activation Logic Selector

Range: 0 : 2

0: [Default]

1: [Always On]

2: [By Temperature Only]

This parameter defines the control logic of the heatsink cooling fans.

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.

1: [Always On]: Fans are always on.

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]

1 : [No Derating]

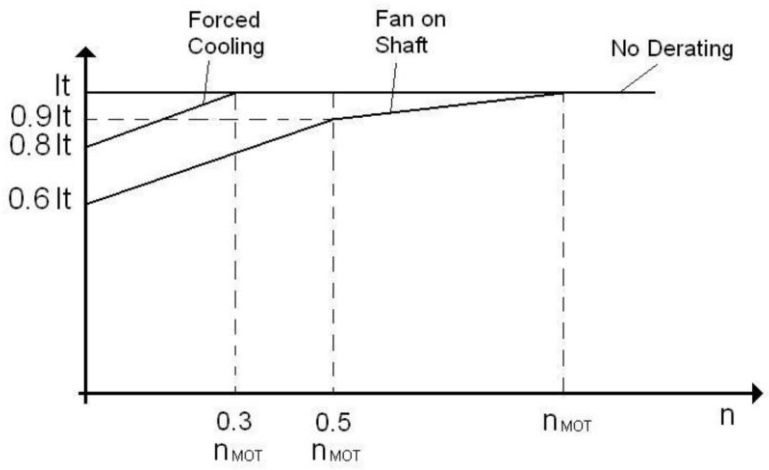
2 : [Forced Cooling]

3: [Fan on Shaft]

This parameter enables the Motor Thermal Protection function. It also selects the type of thermal protection among different trip patterns.

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).

Trip current drop depending on speed values, " trip current I*t drops depending on the generated speed based on the value set in parameter C265 " as shown below.



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 (Io2). 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.
The motor heating can be monitored with measure M026a. This value is expressed as a percentage of the asymptotic value that can be attained.

C266: Pick-Up Current for Motor 1
Range: 1 : min [120%; [(Imax/Imot)*100) %]
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 : 10.800 Sec.
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.

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 : [Disabled]
1: Enabled
This parameter enables the PTC probe (AIN2 analog input).

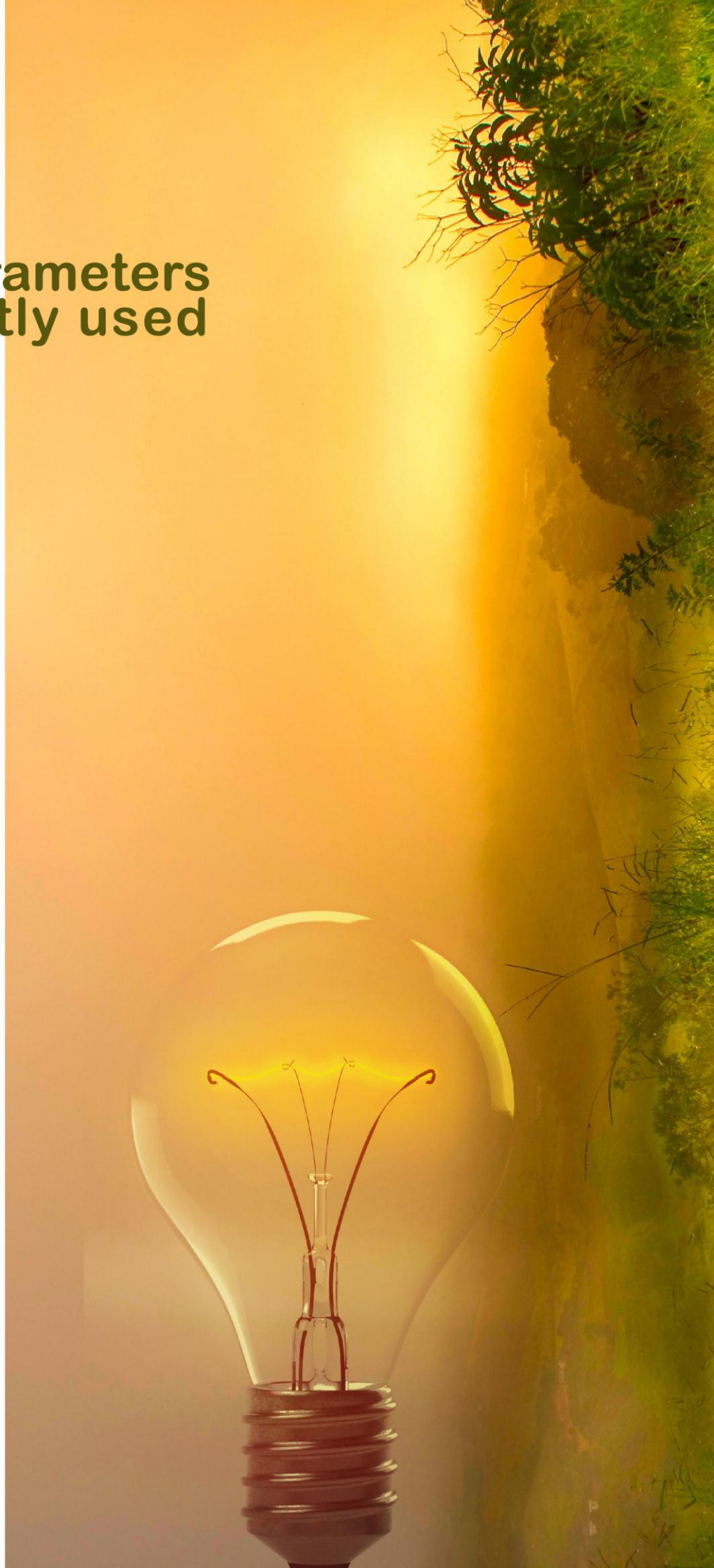
When C274=Enabled, the thermal protection function is implemented from a PTC sensor: the PTC alarm (A055) trips when voltage acquired by AIN2 used as a PTC signal input exceeds a preset threshold value when the characteristic temperature is attained.

Alarm A055 can be reset only if temperature decreases by 5% with respect to the trip temperature.

Notes:

Notes:

6. Solar Parameters Frequently used



6.1 Configuration Parameters Menu:

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.

Configuration Parameters Menu list

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 : 32,000 rpm

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.

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.

C801: MDI Switch PV/AC Supply

Range: 0 : :16 or 24 [when ES847 or ES870 is fitted]

0 : [Inactive]

1 : 8 : [MDI1 : MDI8]

9 : 12: [MPL1 : MPL4]

13: 16:[TFL1 : TFL4]

17: 24:[XMDI1 : XMDI8]

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.

If your Solar Drive 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 : [NO]

1: YES

Set C802 = [1: Yes] to enable A064 Mains Loss alarm. 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.

Digital Inputs

MDI	FUNCTION	DESCRIPTION
MDI1	Motor start command	Full tank sensor
MDI4 (*)	PV Field isolation loss	– Signal from isolation control board – 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

C803: MDI for PV Isolation Loss Detection

Range: 0 : 16 or 24 [when ES847 or ES870 is fitted]

0 : [Inactive]
1 : 8 : [MDI1 : MDI8]
9 : 12: [MPL1 : MPL4]
13: 16:[TFL1 : TFL4]
17: 24:[XMDI1 : XMDI8]

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.
If your Solar Drive Plus does not feature the isolation loss control functionality, set this parameter to **0: Disable.**

C804: Delay for PV Isolation Loss Detection

Range: 0 : 32,000 ms

Delay associated with parameter C803.

C805: PV Isolation Type

Range: 0 : 4

0: No control
1: PV isolation
2: PV isolation + Alarm
3: PV Earthed

This parameter sets the type of isolation control implemented on the PV field:

0: No isolation control

1: Isolated field; isolation control implemented by way of ES942 board. In case of isolation loss, warning W53 appears.

2: Isolated field; isolation control implemented by way of ES942 board. In case of isolation loss, alarm A134 trips.

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 or 24 [when ES847 or ES870 is fitted]

0 : [Inactive]

1 : 8 : [MDI1 : MDI8]

9 : 12: [MPL1 : MPL4]

13: 16:[TFL1 : TFL4]

17: 24:[XMDI1 : XMDI8]

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.

If your Solar Drive 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 : 32,000 ms

Delay associated with parameter C806.

C808: Action Selector for Surge Protection Device Tripped

Range: 0 : 1

0: Warning

1: Alarm

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 : 1

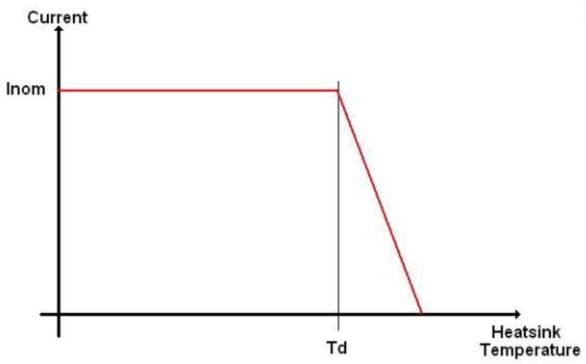
0: Disable

1: 1 : 90 °C

Heatsink temperature for current decrease. If set to "0", this function is disabled.

The current heatsink temperature may be displayed in measure M064. 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.

The typical effect of current decrease is a slower motor speed of rotation.



C810: Current Decrease % for Heatsink Temperature

Range: 0 : 100%

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.

If the motor speed drops below the value set in parameter C800 due to current decrease for over temperature, alarm A074 – Overload trips after a timeout set in parameters P018, P019.

6.2 General Parameters Menu:

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.

General Parameters Menu list

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 V

When minimum voltage MPPT (parameter P810) power is not adequate to keep power over parameter C800 or voltage drops below the value ensuring the drive correct operation, the motor stops.

P801: Minimum Time for Radiation OK

Range: 0 : 3,000 Sec.

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.

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: **P801 = 3600/10 = 360.0 Sec.**

P802: Delay Start after Alarm

Range: 0 : 65,000 Sec.

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.

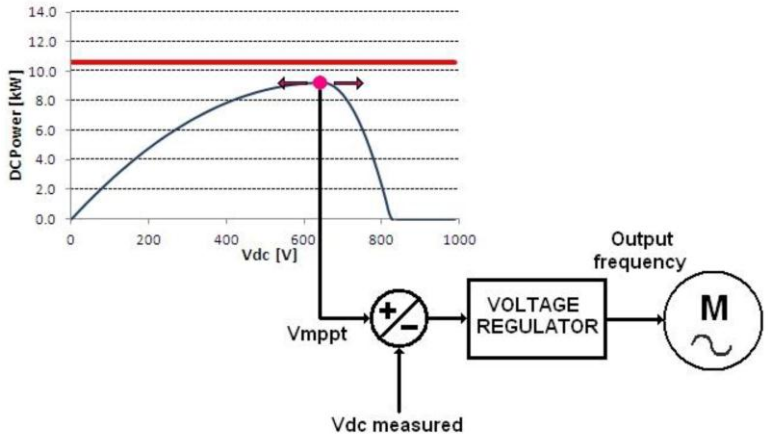
The motor will be restarted also based on parameters P801 and P802.

6.3 MPPT Parameters Menu:

This menu contains the parameters to configure the MPPT algorithm.

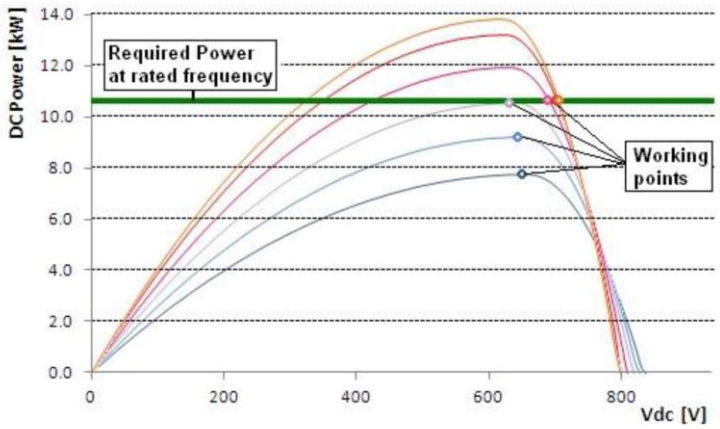
Parameters P810 and P811 set the operating range of the Maximum Power Point Tracking (MPPT) algorithm. Parameter P812 defines when the Maximum Power Point Tracking (MPPT).

This control algorithm acts on the motor speed in order to keep DC voltage at this value. The MPPT control algorithm is given in this Figure.



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. Next Figure shows how the working point varies based on the available power.



MPPT Parameters Menu list

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: 550 : 900 Volt

Minimum output value of the MPPT algorithm. The DC voltage value forced to the PV field is limited to this value. The maximum value that can be set is limited by the value set in P811.

P811: Maximum MPPT Voltage

Range: 550 : 900 Volt

Maximum output value of the MPPT algorithm. The DC voltage value forced to the PV field is limited to this value. The minimum value that can be set is limited by the value set in P810.

P812: MPPT Execution Period

Range: 0.2 : 120 Sec.

Execution time period of the MPPT algorithm.

P813: Load Curve Exponent

Range: 0 : 650

Within the control algorithm, the pump motor load function is as follows:

$P = k * va$

Where P is power, k a constant, v the motor speed of rotation, a an exponent represented by this parameter.

This is worth 3.00 by default, so power is represented as a cubic function of speed.

P814: Voltage Regulator Integral Gain

Range: 0 : 300

Voltage regulator integral constant. This regulator has the voltage value detected by the MMPT algorithm as the set point and the motor supply voltage frequency as the output.

P815: Voltage Regulator Proportional Gain

Range: 0 : 300

Voltage regulator proportional constant. This regulator has the voltage value detected by the MMPT algorithm as the set point and the motor supply voltage frequency as the output.

P816: Vdc Filter Time Constant

Range: 0 : 30,000 ms

Time constant of the low-pass filter applied to the DC voltage measure at the voltage regulator input.

P817: MPPT Manual Voltage Reference

Range: 210 : 1100 Volt

Reference for voltage regulator if manual MPPT has been enabled by setting P818 = Yes.

P818: MPPT in Manual Mode

Range: 0: [NO]

1: [YES]

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: 0.1 : 20 Volt

Maximum variation of the voltage reference between two cycles of the MPPT algorithm.

P820: Minimum MPPT Delta V

Range: 0.1 : 20 Volt

Minimum variation of the voltage reference between two cycles of the MPPT algorithm.

P821: Electric Power Time Constant Filter

Range: 0 : 30,000 ms

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 %

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.

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.

Example: from the datasheet of the PV panel:

Open-circuit voltage: 38.58 V

Voltage at maximum power: 30.90 V

Minimum value for P822 = 30.90/38.58*100 = 80.09%.

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.

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: Under voltage Dynamic Limitation – Delta V

Range: 0 : 1000 Volt

This parameter sets the range disabling the under voltage protection (see parameter P825). It is to be considered as the deviation between the reference voltage and the actual voltage.

P824: Under voltage Dynamic Limitation – Delta Freq

Range: 0 : 100 %

This parameter sets the range disabling the under voltage protection (see parameter P825). It is to be considered as the deviation between the reference frequency and the actual frequency.

P825: Under voltage Protection

Range: 0 : 3

0: Disabled

1: Dynamic Limitation and Vout MPPT

2: Disabled and Smart MPPT

3: Dynamic Lim+Vout MPPT+Smart MPPT

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:

- 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 under voltage protection. It is enabled for values 1 and 3 of the parameter.

- Smart MPPT: An optimized MPPT function is utilized for hydraulic applications. It is enabled for values 2 and 3.

Notes:

Notes:

7. Status, Alarms and Warnings

7.1 Status List:

The state of the Solar Drive Plus appears in the first row of the display on the root page.

STATUS 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; 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 waiting for reference in order to start
32	IFD WAIT START	Drive enabled with IFD control 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.

7.2 Alarms List:

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

7.2.1 What Happens When a Protection Trips:

- 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.

- 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.

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

7.2.2 What To Do When an Alarm Trips:

- 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 slow down, 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.

  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.

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

  1. Enable the RESET signal in MDI3 terminal in the hardware terminal board.

  2. Press the RESET key on the keypad.

  3. To activate the Autoreset function, enable parameter C255; the drive will automatically try to reset the alarms tripped.

THE AUTORESET FUNCTION IS FACTORY SET AS ACTIVE

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)

List of the Possible Alarms

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

- 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.

Warnings List:

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.

- 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: W32 OPEN ENABLE

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. 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. **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.

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