Firmware Tde Macno

User’s manual

AFE - Firmware version 41.31

Cod. MP00101E00 V_2.2

SUMMARY

1 AFE INTRODUCTION

To help the customer during the configuration of the drive, the manual is organized to follow faithfully the structure of the configurator (OPDExplorer) that allows, according to a logical sequence, to set all the sizes needed for the proper functioning of the drive.

In particular, each chapter refers to a specific folder of OPDExplorer which includes all the relative parameters.

Also, at the beginning of each chapter of the manual, is showed the location of the folder in the OPDExplorer tree, which the chapter refers to, and the complete table of sizes of the folder in question.
The control values are divided as follows:

- Parameters
- Connections
- Input logic functions
- Internal values
- Output logic functions

In the tables of the control value, the last column on the right “Scale” shows the internal representation base of the parameters. This value is important if the parameters have to be read or written by a serial line or fieldbus and represents the factor by which to divide the value stored to obtain the real set value, as following indicated:

$$\text{Value} = \frac{\text{Internal representation}}{\text{Scale}}$$

Example1: P62 = Nominal Grid Voltage

Normalization unit	= Volt	
Internal repr.	= 10	
Internal value	= 3800	→ real data = 3800/10 = 380.0 Volt

1.1 PARAMETERS (P)

The parameters are configuration variables of the converter, they are numeric quantities with minimum and maximum admitted values. Their representation is usually in percentage.
The parameters are divided in free, reserved and reserved TDE MACNO.
The following rules are valid:

- **Parameters free**: they can be modified without setting any key, even when converter is running
- **Reserved parameters (r)**: they can be modified only out of running, after setting the reserved parameters key in P60 or the reserved parameters key TDE MACNO in P99
- **Reserved parameters TDE MACNO (t)**: they can be modified only out of running, after setting the reserved parameters key TDE MACNO in P99. Unless the related key is set, these parameters are not shown in the display.

Take careful note of the reference values for each parameter so that they are set correctly.

1.2 CONNECTIONS (C)

The connections are drive configuration values that are displayed as a whole number in the same way as a digital selector. They are split up into free, reserved and TDE MACNO reserved connections, and are changed in the same way as the parameters.
The internal representation base is always as whole number.

1.3 INPUT LOGIC FUNCTIONS (I)

The input logic functions are 32 commands that come from configured terminal board logic inputs, from the serial line, and from the fieldbus. The meaning of this logical functions depends on the application, so please refer to specific documentation.

1.4 INTERNAL VALUES (D)

Internal values are 128 variables within the drive that can be shown on the display or via serial line on the supervisor. They are also available from the fieldbus.
The first 64 values are referred to power converter control part and are always present. The second 64 values are application specific.
Pay close attention to the internal representation base of these values as it is important if readings are made via serial line or fieldbus.

1.5 OUTPUT LOGIC FUNCTIONS (O)

The logic functions are 64, the first 32 display drive status and second 32 are application specific. All output functions can be assigned to one of the 4 logic outputs.

1.6 AFE DECRIPTION AND START-UP

The Regenerative AC-DC Converter (**A**ctive **F**ront **E**nd) acts as an AC-DC rectifier with line input voltages L1, L2, L3 and output being the V_{BUS} DC set by the user. The power exchanged with the mains can be in the two directions (absorption or power regeneration), according to the needs of the load.

The control is made by a voltage loop (V_{BUS} DC) and a current one, that provides sinusoidal current under any condition of load (the part of reactive power can be set by the user). In detail, when setting at zero the part of reactive power exchanged with the mains, only active power is exchanged with the mains (power factor equal to one).

Caution! AFE unit is provided by three-phase IGBT bridge (with anti-parallel diodes). DC Bus can be charged also with the converter in 'stop' and the voltage at DC Bus equals the AC input voltage rectified by the diodes.

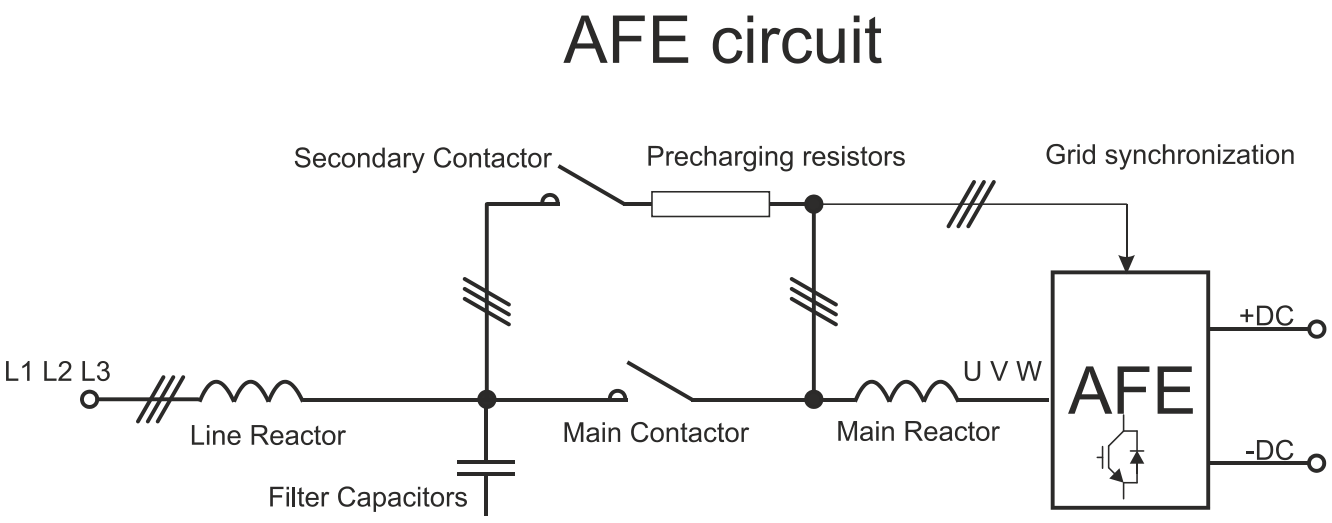


Figure 1: AFE Circuit

NOTE: AFE is part of OPDE family. This manual is intended to describe the AFE Parameters and Settings. For further information about the hardware of the OPDE family and functionality please refer to OPDE AFE INSTALLATION manuals.

The basic 5 steps to set-up the AFE are the following:

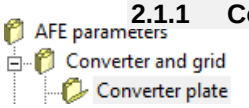
STEP	TITLE	ACTION
1	**Connections set up and verify**	**Power +24 V of the Converter. Do not Power the 400V AC of the Converter.** Verify the connections following the manual (OPDE_AFE_INSTALLATION)**.** Care must be taken in order to verify the feedback synchronism of the Mains.
2	**Set up the Converter/Grid Plate**	Verify the setup of Converter Plate. Verify the setup of the P61 (Rated Reactor Current), P62 (Nominal Grid Voltage), P63 (Rated grid Frequency). Verify the setup of parameters P77 and P78 voltage drop and time constant due to the chosen main reactor.
3	**Verify the DC Precharging**	Verify the DC precharging circuit parameters: P65 (wait after converter ready) and P64 (Filter Time-constant for V_GRID). Verify the connections of the DC precharging circuit (OPDE_AFE_INSTALLATION).
4	**Power the 400V AC of the Converter**	Now it is possible to power the 400V AC of the converter (AFE). The AFE now should finish precharging of the DC Bus to a level that is the AC Grid voltage rectified (e.g. 400*√2 Vdc). Verify the correct value of the AC voltage compared with the one read into D21 (Grid AC Voltage). Verify the correct value of the voltage of the DC BUS compared with the one read into D24 (Bus Voltage)
5	**BUS Control**	Now it is possible to start working with the AFE. Verify the setup of the voltage regulator control (P31, P32, P33). With the converter Run, the Bus Voltage should be kept to the selected value in P08 (DC Bus Voltage Reference).

FIRMWARE VERSION 41.31

2 AFE PARAMETERS

2.1 CONVERTER AND GRID

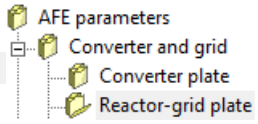
2.1.1 Converter Plate



Name	Description	Min	Max	Default	UM	Scale
CONV_I_NOM	P53 - Rated Converter current	0.0	400	0	A	10
CONV_F_PWM	P101 - PWM frequency	1000	16000	5000	Hz	1
PRC_CONV_I_MAX	P103 - Converter limit current	0.0	800.0	200	% I_CONV_NOM	40.96
T_RAD	P104 - Heat sink time constant	10.0	360.0	80	s	10
CONV_I_PEAK	P113 - Maximum converter current	0.0	3000.0	0	A	10
T_JUNC	P116 - Junction time constant	0.1	10.0	3.5	s	10
OVR_LOAD_T_ENV	P155 - Ambient temperature reference value during overload	0.0	150.0	40.0	C°	10
CONV_F_PWM_CARATT	P156 - PWM frequency for converter definition	1000	16000	5000	Hz	1
DEAD_TIME	P157 - Dead time duration	0.0	20.0	4	µs	10
CONV_E_CARATT	P167 - Characterization voltage	200.0	690.0	400	V rms	10
DEAD_TIME_HW	P198 - Dead time hardware duration	0.0	20.0	0.0	µs	10
MIN_PULSE	P199 - Minimum command pulse duration	0.0	20.0	1.0	µs	10
DC_BUS_FULL_SCALE	C24 - DC Voltage converter full scale	0	2	0	V	1
PWM_MOD_TYPE_SEL	C27 - PWM Modulation type selection	Range		0		1
		0	SPWM-1			
		1	DPWM-1			
		2	SPWM-2			
		3	DPWM-2			
I_OVR_LOAD_SEL	C56 - Current overload	Range		3		1
		0	120%x30			
		1	150%x30			
		2	200%x30+155%x30			
		3	200%x30			
FW_REV	D00 - Software version			0		256

The regenerative AC-DC unit needs an external precharging circuit to limit the bus capacitors currents at the insertion of the mains. To favor the performance of this circuit, a contact-relay (X1_2 ; X1_3) is made available to the customer ; it is closed at the end of the precharge, i.e. when the Bus voltage has exceeded the threshold $V_{BUS} \geq V_{\_GRID\_NOM} \cdot \sqrt{2} \cdot P(39)$ where $V_{\_GRID\_NOM}$ is the rated voltage of the mains (P62) and after a time of 3 RC time constant is elapsed.
P(39) indicates (%) the minimum level of charge of the Bus voltage (referred to the rectified mains voltage).

At the end of the precharge phase, if there are no alarms, the control enables the logic output Converter Ready at a high level and the converter is ready to run. The time between the end of the precharge (contact X1_2 ; X1_3 closed) and the enabling Converter Ready can be set in P65 [ms] and must be set according to the switch on time of the remote contactor (80-300ms).



2.1.2 Reactor-Grid Plate

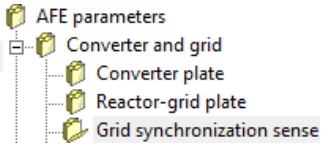
Name	Description	Min	Max	Default	UM	Scale
IN_LINE_REACT	P61 - Rated current of the Reactor	10.0	100.0	100	% I_CONV_NOM	10
V_GRID_NOM	P62 - Nominal Grid Voltage	30.0	690.0	400	V	
GRID_FREQ_NOM	P63 - Rated grid frequency	5.0	100.0	50.0	Hz	
VFilt	P64 - Filter Time Constant for V_GRID	0.0	30.0	0.0	ms	10
WaitAfeReady	P65 - Wait after Converter Ready	20	2000	1000	ms	1
REACT_TF_THERM	P71 - Main reactor thermal time constant	30	2400	600	s	1
GRID_F	D04 - Measured grid frequency			0	Hz	16
GRID_SEL	D06 - Grid type			0		1
GRID_V	D21 - Grid AC Voltage			0	V rms	1
MAIN_GRID_F	D30 - Measured main grid frequency			0	Hz	16
MAIN_GRID_V	D31 - Main grid AC voltage			0	V rms	1

For the correct operation of the converter it is important to set some fundamental parameters. These parameters are:

P61	Rated current of the line reactor in % of the rated current of the converter
P62	Rated voltage of the line in Volts
P63	Rated frequency of line in Hz
P71	Time of thermal constant of the reactor in seconds

P61 is calculated as follows:

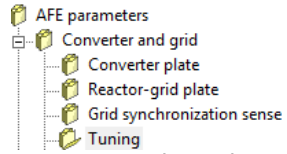
P61 = Rated current of the Inductor (% I_CONV_NOM)



2.1.3 Grid Synchronization Sense

Name	Description	Min	Max	Default	UM	Scale
HW_SENSOR1	D63 - Sensor1 presence			0		1
PLL_ERR_TF	P81 - TfPLLerr PLL error filter time constant	0.0	300.0	5.0	ms	10
GRID_F_TF	P82 - TfGridF Grid frequency filter time constant	0.0	30.0	0.0	ms	10
PLL_KP_STOP	P86 - KpPLL PLL regulator proportional gain at stop	0.1	10.0	1.0		10
PLL_TI_STOP	P87 - TiPLL PLL regulator lead time constant at stop	0.0	300.0	2.5	ms	10
PLL_KP_RUN	P88 - KpPLL PLL regulator proportional gain at run	0.1	10.0	1.0		10
PLL_TI_RUN	P89 - TiPLL PLL regulator lead time constant at run	0.0	300.0	250.0	ms	10
GRID_V_TF	P90 - TfGridV Grid voltage filter time constant	0.0	300.0	30.0	ms	10

2.1.4 Tuning

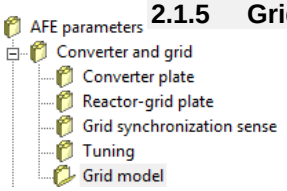


The mains synchronism signals must be appropriately calibrated in terms of offset and amplitude. To do this, an autotuning function is available. This function (that can be enabled by means of C68) has to be performed only once, when the inverter is switched on for the first time, when the connector with the mains synchronisms is properly fed. This function has to be enabled with the converter not in Alarm status (otherwise the function is not carried out). After enabling the function (C68=YES), switch on the converter (RUN). The function is carried out (with a duration of 5 seconds), when the RUN command is disabled the C68 is reset to NO automatically.
This automatic function, while calculating mains-related parameters, evaluates also offsets and amplitude for a second set of synchronism signals. These signals are those used for secondary PLL for microgrid resynchronization (for more details see dedicated microgrid user manual). This second set of signals is stored in P152, P153, and P154.

The calculated values (P164, P165, and P166) must be stored in the EEPROM memory of the converter.

Name	Description	Min	Max	Default	UM	Scale
EN_V_GRID_TUNING	C68 - Enable line voltage tuning	0	1	0		1
V_GRID_AMPL_COEFF_RESYNC	P152 - Line voltage amplitude coefficient (PLL for resync)	0.0	200.0	100	%	163.84
OFFSET_L1_RESYNC	P153 - Line voltage L1 offset (PLL for resync)	-16383	16383	0		1
OFFSET_L2_RESYNC	P154 - Line voltage L2 offset (PLL for resync)	-16383	16383	0		1
V_GRID_AMPL_COEFF	P164 - Line voltage amplitude coefficient	0.0	200.0	100	%	163.84
OFFSET_L1	P165 - Line voltage L1 offset	-16383	16383	0		1
OFFSET_L2	P166 - Line voltage L2 offset	-16383	16383	0		1

2.1.5 Grid Model



Name	Description	Min	Max	Default	UM	Scale
PHASE_ANG	P75 - Grid Phase Shift	-180.0	180.0	0	°	10
PRC_DELTA_VLS	P77 - Voltage drop due to leakage inductance	5.0	100.0	10.0	% V_GRID_NOM	327.67
T_REACT	P78 - Main Reactor time constant Ts	0.0	50.0	50.0	ms	10
PRC_DEAD_TIME_CMP	P102 - Dead time compensation	0.0	100.0	0	‰ PRC_V_MAX	32.76
PRC_DEAD_TIME_CMP_XB	P151 - Xb = cubic coupling zone amplitude	0.0	50.0	12.0	% DRV_I_NOM	10

P77	ΔV LS % Voltage drop on the total line reactor due to the rated line current in % of the rated line voltage
P78	Time constant τ_S in milliseconds

These parameters are very important in order to correctly model the system. To obtain these parameters it is necessary to start from the nameplate data of the line reactor:

Rs = Resistance of the line reactor in Ohms
Ls = inductance of the line reactor in mHenry
I_CONV_NOM = Rated current of the reactor in Amperes
V_GRID_NOM = Line voltage in Volts

It is possible then to calculate:

$$P77 = \frac{2\prod \cdot F_{\_GRID\_NOM} \cdot Ls \cdot I_{\_CONV\_NOM} \cdot \sqrt{3}}{V_{\_CONV\_NOM}} \qquad P78 = \frac{Ls}{Rs} \quad [ms]$$

Example:

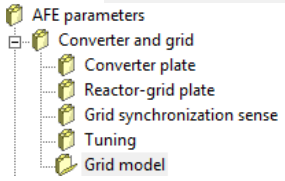
$I_{\_CONV\_NOM}$= 60A
$V_{\_GRID\_NOM}$= 380V
$f_{\_GRID\_NOM}$= 50Hz

Rs = 0,05 Ω
Ls= 1,4mH

Performing the calculations yields:

P77=11,4% P78=28ms

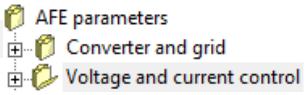
2.1.6 Active Filter



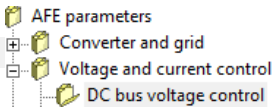
Name	Description	Min	Max	Default	UM	Scale
GRID_CURRENT_OFFSET_U	P55 - Grid current sensor offset U	-100.0	100.0	0.0	%	327.67
GRID_CURRENT_OFFSET_W	P56 - Grid current sensor offset W	-100.0	100.0	0.0	%	327.67
GRID_LEM_I_NOM	P128 - Full-scale RMS current for grid LEM (Active Filter option)	0.0	3000.0	0.0	A	10
EN_HARMONICS_COMP	C69 - Enable Harmonics compensation	Range		0		1
		0	Disabled			
		1	Enable the 5th and 7th Harmonics comp.			
		2	Enable the 5th, 7th, 11th and 13th Harmonics comp.			
GRID_LEM_OFF_COMP_EN	U01 - Enable AT offset compensation for grid LEM (Active Filter)	Range		0		1
		0	No			
		1	Yes			
GRID_LEM_I	D23 - Current module on external sensors (Active filter)				A rms	16

AFE can be operated as Series Active Filter by setting C00 to “3 – Active filter”: in this case, parameters of this section are used to configure the active filter operation, otherwise these parameters are ignored.
Active Filter can compensate distorted current absorption of a non-linear local load in order to improve Total Hormonic Distortion (THD) of line current: for this reason, non-linear load is connected in parallel to the Active Filter and additional external current sensors shall be installed upstream the power converter and the non-linear load. For more details regarding electric connection please refer to installation manual.
At the first run as Active Filter, offset compensation of external current sensors shall be compensated with U01 parameter: before activating this procedure, please disconnect both AFE (and output filter) and local load in order to ensure zero current flow through the current sensor. Once this procedure is completed, compensating offsets are stored in P55 and P56.
C69 parameter allows to choose which harmonics components the Active Filter has to compensate.
P63 parameter shall be set to configure scaling factor for active filter RMS current (it has the same meaning of P113).

2.2 VOLTAGE AND CURRENT CONTROL



2.2.1 Dc Bus Voltage Control



Name	Description	Min	Max	Default	UM	Scale
DC_BUS_REF	P08 - DC Bus Voltage Reference	300.0	1200.0	650.0	V	10
V_REG_KP	P31 - KpV voltage regulator proportional gain	0.1	400.0	6		10
V_REG_TI	P32 - TiV voltage regulator lead time constant	0.1	3000.0	30	ms	10
V_REG_TF	P33 - TfV voltage regulator filter time constant	0.0	25.0	0.4	ms	10
MOD_INDEX_MAX	P122 - Max. modulation index	0.500	0.995	0.98		1000
V_BUS_NORM	D05 - V bus Norm	0	500	0	% VBUS_NOM	163.84
PRC_CONV_V	D18 - Reference voltage module	-100	100	0	% V_GRID_NOM	40.96
MOD_INDEX	D19 - Modulation index	-100	100	0		40.96
DC_BUS	D24 - Bus voltage			0	V	16
VBUS_REF_NORM	D33 - DC Voltage Reference (Norm)	0	100	0	% DC_BUS_NOM	163.84

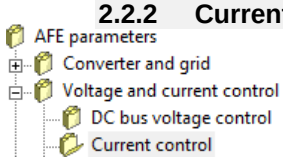
The task of the voltage regulator is to produce the correct current demand thus to keep the voltage of the BUS at the value required by the user (set on P08).

P08 operating range must be set from a minimum equal to 1.1·1.41 (=1.55) times the grid rms voltage (P62) to a maximum limited by the maximum bus voltage (P107) reduced by a control margin.
The minimum DC bus voltage that can be controlled by the AFE is the peak rms value of the grid Voltage (multiplied by 1.1 due to the mains). Lower DC Voltage is not controllable by the AFE due to the effect of the freewheeling diodes of the IGBT bridge.
The constants of the DC voltage regulator are fixed in engineering units by the parameters **P31**, proportional gain Kp, **P32**, lead time constant [ms], Ta equal to the time constant of the integral regulator multiplied by the gain (Ta = Ti·Kp), **P33**, constant of filter Tf of the Ist order in ms on the error.
The total transfer function of the voltage regulator is:

$$Iq\_rif = [Vrif - Vbus\_norm] \cdot Kp \cdot \left[\frac{1}{1+sTf} + \frac{1}{sTa}\right]$$

Vrif = voltage reference (normalized to the rated voltage)
Vbus_norm = voltage of the bus read (normalized to the rated voltage)
Iq_rif = active current request (normalized to the rated line current)
Kp = DC Bus Voltage control Proportional gain (**P31**)
Ta = DC Bus Voltage control Lead time constant (**P32** in ms)
Tf = DC Bus Voltage control Filter time constant (**P33** in ms)

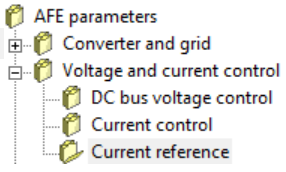
2.2.2 Current Control



Name	Description	Min	Max	Default	UM	Scale
REF_ID	P68 - Reference Reactive Current	-80.0	80.0	0.0	% I_CONV_NOM	10
I_REG_KP	P83 - Kpc current regulator proportional gain	0.1	100.0	1.9		10
I_REG_TI	P84 - Tic current regulator lead time constant	0.0	1000.0	20	ms	10
I_REG_TF	P85 - Tfc current regulator (filter) time constant	0.0	25.0	0	ms	10
PRC_I_REG_KP_COEFF	P126 - KpI Corrective coeff. estimated Kp for current loops	0.0	200.0	50	%	40.96
PRC_I_DECOUP	P158 - Corrective coefficient for decoupling terms	0.0	200.0	0	%	40.96
PI_AC_TI	P181 - TiPIac PI_AC regulator lead time constant	0.0	1000.0	50.0	ms	10
DIS_I_DECOUP	C59 - Disable dynamic decoupling + feedforward	0	1	0		1
I_CTRL_SEL	C80 - Current control type selection	Range		0		1
		0	dq control			
		1	ac control PR			
		2	ac control P			
ACTV_POW	D01 - Active power delivered			0	kW	16
PRC_IQ_REF	D07 - Request of active current Iq rif	-100	100	0	% I_CONV_NOM	40.96
PRC_ID_REF	D08 - Request of reactive current Id rif	-100	100	0	% I_CONV_NOM	40.96
REACT_I	D11 - Current module			0	A rms	16
PRC_IQ	D15 - Active current Iq	-100	100	0	% I_CONV_NOM	40.96
PRC_ID	D16 - Reactive current Id	-100	100	0	% I_CONV_NOM	40.96
PRC_VQ_REF	D20 - Vq rif	-100	100	0	% V_GRID_NOM	40.96
PRC_VD_REF	D22 - Vd rif	-100	100	0	% V_GRID_NOM	40.96

The AFE current control allows to compensate external reactive power (ex. Filters or other reactive loads) whether they are of inductive or capacitive nature. This functionality is obtained by using the parameter **P68** that expresses (in % of the rated current of line) the reactive part of the reference current (Id_rif). Once the value of these reactive currents has been estimated (e.g. the value of the capacitive currents on the line filters), it is possible to compensate them by inserting a reactive current request in P68, equal and opposite in sign. Considering that the sign of the currents is positive if the current outcomes from the converter.
A *positive* value written in P68 means the current produced can compensate inductive loads (**AFE acts as a capacitor**). A *negative* current value set in P68 means the current produced can compensate capacitive loads (**AFE acts as an inductor**). Setting P68=0 (default), the power exchanged with the mains is only active (unity power factor).

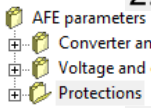
2.2.3 Current Reference



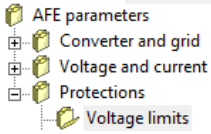
Name	Description	Min	Max	Default	UM	Scale
EN_CURR_REF	E25 - Enable application current reference	0	1	0		1
IQ_REF	E00 - Reference active current Iq	-100	100	0	% I_CONV_NOM	100
ID_REF	E01 - Reference reactive current Id	-100	100	0	% I_CONV_NOM	100

Alternatively, to the DC BUS Voltage Control a *Current Reference Mode* of operation is possible. By setting E25=YES the DC Bus Voltage Control is excluded and the user can work only with Active and/or Reactive current references using parameters E00 and E01.
Note: the current flowing from the Converter to the Grid is considered with a positive value.

2.3 PROTECTIONS

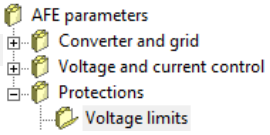


2.3.1 Voltage Limits



Name	Description	Min	Max	Default	UM	Scale
MinVDcSStart	P39 - Min Volt DC for End Soft Start	60	95	80	% V_GRID_NOM	10
TIMER_NO_BYPASS	P44 - Precharge debounce time - remain on bypass	50	1000	200	ms	1
TIMER_AGAIN_BYPASS	P45 - Precharge debounce time - reject bypass	50	1000	500	ms	1
MIN_V_GRID	P50 - Alarm level for minimum grid voltage	5.0	95.0	70.0	% V_GRID_NOM	10
MAX_V_GRID	P51 - Alarm level for maximum grid voltage	105.0	135.0	130.0	% V_GRID_NOM	10
K_V_GRID	P52 - Corrective Factor for AC Grid Voltage	25.0	200.0	100.0	%	10
DCBUS_MIN_GRID_LOST	P97 - Minimum voltage level for forced grid off	100.0	1200.0	425	V	10
KP_DCBUS	P105 - Corrective factor for Bus voltage	80.0	200.0	100	%	10
DCBUS_MIN	P106 - Minimum DC Bus voltage	100.0	1200.0	400	V	10
DCBUS_MAX	P107 - Maximum DC Bus voltage	350.0	1200.0	760	V	10
ALL_RST_ON_GRID	C35 - Automatic alarm reset when grid back on	0	1	0		1
EN_PW_SOFT_START	C37 - Enable soft start	0	1	1		1
EN_PRECH_APP	C38 - Enable Precharge from Application	0	1	0		1
GRID_SEL	C70 - Grid type selection	Range		0		1
		0	THREE PHASE (U-V-W)			
		1	SINGLE PHASE (U-V)			
DIS_MIN_VBUS	C89 - Disable minimum power circuit voltage with converter stopped	0	1	0		1
CONTROL_SEL	D02 - Control Selected	Range				1
		0	AFE standard control			
		1	FFE control			
		2	MicroGrid control			
		3	Active Filter			
GRID_SEQUENCE	D03 - Positive/negative L1, L2, L3 - sequence	Range		0		1
		0	Reverse			
		1	Direct			

2.3.2 Current Limits

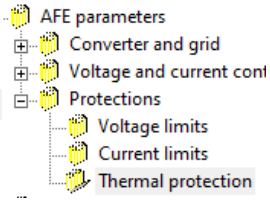


Name	Description	Min	Max	Default	UM	Scale
PRC_CONV_I_PEAK	P40 - Current limit	0.0	200.0	200	% I_CONV_NOM	40.96
MAX_REGEN_I	P42 - Maximum regeneration current	0	400	200	% I_CONV_NOM	40.96
MAX_ABSORPT_I	P43 - Maximum absorption current	-400	0	-200	% I_CONV_NOM	40.96
PRC_CONV_I_MAX	D29 - Current limit	-100	100	0	% I_CONV_NOM	40.96

The converter is designed with a maximum current limiting circuit that cuts in if exceeded, restricting the maximum current delivered to the lowest value between parameter **P40,** the value calculated by the converter thermal image circuit, and the line thermal protection circuit.
P40 is used to program the maximum current limit delivered by the converter from 0% to the maximum value allowed, which depends on the type of overload chosen with the connection **C56**.
It is also possible to limit the active current in different ways using the parameters:

P42: Maximum limit for active current regeneration.
P43: Maximum limit for active current absorption.

2.3.3 Thermal Protection



Name	Description	Min	Max	Default	UM	Scale
REACT_THERM_PRB_SEL	C46 - Enable reactor thermal probe management (PT100/PTC/NTC)	Range 0 No 1 PTC 2 NTC 3 I23 4 KTY84-130		0		1
REACT_TEMP_MAX	P91 - Maximum reactor temperature (if read with PT100)	0.0	150.0	130	°C	10
CONV_THERM_PRB_SEL	C57 - Enable heat sink heat probe management (PTC/NTC)	0	4	1		1
REACT_PRB_RES_THR	P95 - Reactor NTC or PTC resistance value for alarm	0	19999	1500	Ohm	1
PRC_REACT_DO_TEMP_THR	P96 - Reactor thermal logic output 14 cut-in threshold	0.0	200.0	100	% PRC_REACT_I_THERM	40.96
KP_REACT_THERM_PRB	P115 - Multiplication factor for reactor PTC/NTC/PT100 analog reference value	0.00	200.00	100		163.84
KP_DRV_THERM_PRB	P117 - Multiplication factor for heat sink PTC/NTC analog reference value	0.00	200.00	100		163.84
CONV_TEMP_MAX	P118 - Max. temperature permitted by heat sink PTC/NTC	0.0	150.0	90	°C	10
CONV_START_TEMP_MAX	P119 - Max. temperature permitted by heat sink PTC/NTC for start-up	0.0	150.0	75	°C	10
CONV_DO_TEMP_THR	P120 - Heat sink temperature threshold for logic output o.15	0.0	150.0	80	°C	10
EN_REACT_THERMAL_ALL	C32 - Reactor thermal switch “Block converter?”	0	1	1		1
REACT_THERM_CURV_SEL	C33 - Choice of reactor thermal curve	Range 0 No reduction 1 - Limitative 2 Self-ventilated 3 + Limitative		0		1

Name	Description	Min	Max	Default	UM	Scale
KP_CARD_THERM_PRB	P138 - Corrective factor for card thermal sensor	0.0	200.0	100	%	168.84
RE-ACT_PRB_RES_THR_MUL	C26 - Reactor NTC or PTC resistance multiplica-tion factor	0	1	0		1
TEMP_ON_CONV_FANS	E47 - Switch-on tempera-ture of converter fans	30	80	60	°C	
CONV_TEMP	D25 - Heat sink tempera-ture reading			0	°C	16
REACT_TEMP	D26 - Reactor tempera-ture			0	°C	16
REG_CARD_TEMP	D40 - Regulation card temperature			0	°C	16
REACT_PRB_RES	D41 - Thermal probe re-sistance			0	kOhm	16
PRC_REACT_I_THERM	D28 - Reactor thermal current	-100	100	0	% soglia All	40.96

Four types of converter overload can be set on **C56**:

C56	Overload type for rated converter current (P53)
0	120% for 30 seconds
1	150% for 30 seconds
2	200% for 30 seconds
3	200% for 3 seconds and 155% for 30 seconds

NB: the choice also changes the rated converter current as shown by the tables in the installation file and the correct value is always displayed in ampere rms in **P53**.

The delivered current is used to calculate the operating temperature reached by the power device junctions. The converter is supposed to work with standard ventilation at the maximum allowed ambient temperature.
If this junction estimated temperature reaches the maximum allowed value, the delivered power limit is reduced to a value that is just larger than the converter rated current, i.e. the system's effective thermal current (see following table).
In this condition, a converter overload is possible only if the temperature drops below the rated value: this will only occur when the converter operates for a certain period at current levels smaller than the rated ones.

C56	Max. converter current	converter thermal current
0	120% I NOM CONV for 30 seconds	103% I NOM AZ
1	150% I NOM CONV for 30 seconds	108% I NOM AZ
2	200% I NOM CONV for 30 seconds	120% I NOM AZ
3 (*)	200% I NOM CONV for 3 seconds 155% I NOM CONV for 30 seconds	110% I NOM AZ

Note = the overload times are calculated with the converter running continuously at the rated line reactor current. If the average delivered current is lower than the rated line reactor current, then the overload time will increase. This means that the actual overload times can be longer or identical to those shown in the Table.

Note (*) = the 200% overload is available until junction temperatures remain smaller than 95% of the rated value; at the rated value the maximum limit becomes 180%. For repeated work cycles, TDE MACNO is available to estimate the converter's actual overload capacity.

Note = automatic current derating is also provided due to the line Voltage (P62) compared with the converter characteristic voltage (P174) and due to PWM frequency (P101) compared with the converter characteristic frequency (P156). For more details please contact TDEMACNO.

Line reactor nominal current, parameter **P71** (reactor thermal constant in seconds), and the current delivered by the converter are used to estimate the line reactor temperature considering maximum ambient temperature; the losses are evaluated with the square of the absorbed current and filtered with the line reactor thermal constant. When this value exceeds the maximum thermal current, the thermal protection cuts in, enabling logic output **o.L.1** and alarm A06.

The reaction may be programmed via connection **C32** and by enabling alarm **A06**:

If A06 is disabled, no action will be taken.

If A06 is enabled, action will depend on C32:

C32 = 0 (default value) the thermal alarm will cut in and reduce the current limit to match the line reactor thermal current.

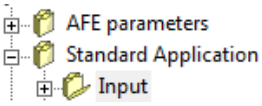
C32 = 1 the thermal alarm cuts in and stops the converter immediately.

Internal value d28 and analog output 28 display a second-by-second reading of the line reactor thermal current as a percentage of the rated line reactor current. When 100% is reached, the line reactor thermal switch cuts in.
P96 can be set with an alarm threshold which, when breached, commutes logic output **o.L.14** to a high level indicating the approximation to the reactor thermal limit.

3 STANDARD APPLICATION

Name	Description	Min	Max	Default	UM	Scale
APPL_REV	D61 - Application Revision			0		163.84

3.1 INPUT



3.1.1 Digital Inputs Configuration

The logic functions of input are commands that may come from the logic inputs of the terminal board (with suitable configuration), from the serial and from the Field bus.

Name	Description	Min	Max	Default	UM	Scale
LI1_SEL	C01 - Meaning of logic input 1	Range				1
		0	Not enabled			
		I00	Run command			
		I02	External enable			
		I03	Swap to island Enable			
		I07	Microgrid external contactor status			
		I08	Reset alarms			
		I09	Microgrid resynch request			
		I10	Enable Restart After OVC (Software detect)			
		I11	Enable Restart After OVC (Hardware detect)			
		I16	Enable second parameters bank			
		I20	Enable CSI (PLL)			
		I21	Enable droop control			
		I31	PWM synchronization input			
LI2_SEL	C02 - Meaning of logic input 2	Range				1
		0	Not enabled			
		I00	Run command			
		I02	External enable			
		I03	Swap to island Enable			
		I07	Microgrid external contactor status			
		I08	Reset alarms			
		I09	Microgrid resynch request			
		I10	Enable Restart After OVC (Software detect)			
		I16	Enable second parameters bank			
		I20	Enable CSI (PLL)			
		I21	Enable droop control			
		I31	PWM synchronization input			
LI3_SEL	C03 - Meaning of logic input 3	Range				1
		0	Not enabled			
		I00	Run command			
		I02	External enable			
		I03	Swap to island Enable			
		I07	Microgrid external contactor status			
		I08	Reset alarms			
		I09	Microgrid resynch request			
		I10	Enable Restart After OVC (Software detect)			
		I16	Enable second parameters bank			
		I20	Enable CSI (PLL)			
		I21	Enable droop control			
		I31	PWM synchronization input			
LI4_SEL	C04 - Meaning of logic input 4	Range				1
		0	Not enabled			
		I00	Run command			
		I02	External enable			
		I03	Swap to island Enable			

Name	Description	Min	Max	Default	UM	Scale
		I07	Microgrid external contactor status			
		I08	Reset alarms			
		I09	Microgrid resynch request			
		I10	Enable Restart After OVC (Software detect)			
		I16	Enable second parameters bank			
		I20	Enable CSI (PLL)			
		I21	Enable droop control			
		I31	PWM synchronization input			
LI5_SEL	C05 - Meaning of logic input5	Range				1
		0	Not enabled			
		I00	Run command			
		I02	External enable			
		I03	Swap to island Enable			
		I07	Microgrid external contactor status			
		I08	Reset alarms			
		I09	Microgrid resynch request			
		I10	Enable Restart After OVC (Software detect)			
		I16	Enable second parameters bank			
		I20	Enable CSI (PLL)			
		I21	Enable droop control			
		I31	PWM synchronization input			
LI6_SEL	C06 - Meaning of logic input 6	Range				1
		0	Not enabled			
		I00	Run command			
		I02	External enable			
		I03	Swap to island Enable			
		I07	Microgrid external contactor status			
		I08	Reset alarms			
		I09	Microgrid resynch request			
		I10	Enable Restart After OVC (Software detect)			
		I16	Enable second parameters bank			
		I20	Enable CSI (PLL)			
		I21	Enable droop control			
		I31	PWM synchronization input			
LI7_SEL	C07 - Meaning of logic input 7	Range				1
		0	Not enabled			
		I00	Run command			
		I02	External enable			
		I03	Swap to island Enable			
		I07	Microgrid external contactor status			
		I08	Reset alarms			
		I09	Microgrid resynch request			
		I10	Enable Restart After OVC (Software detect)			
		I16	Enable second parameters bank			
		I20	Enable CSI (PLL)			
		I21	Enable droop control			
		I31	PWM synchronization input			
LI8_SEL	C08 - Meaning of logic input 8	Range				1
		0	Not enabled			
		I00	Run command			
		I02	External enable			
		I03	Swap to island Enable			
		I07	Microgrid external contactor status			
		I08	Reset alarms			
		I09	Microgrid resynch request			
		I10	Enable Restart After OVC (Software detect)			
		I16	Enable second parameters bank			
		I20	Enable CSI (PLL)			
		I21	Enable droop control			
		I31	PWM synchronization input			
EN_NOT_LI	C79 - Enable negative logic for digital inputs	0	255	0		1
PRC_APP_T_MIN	D48 - Minimum current limit by application	-400	400	0	% I_CONV_NOM	40.96

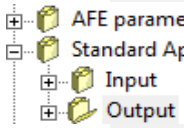
Name	Description	Min	Max	Default	UM	Scale
TF_LI6-7-8	P15 - I06,07,08 logical inputs digital filter	0.0	20.0	2.2	ms	10

		NAME	INPUT LOGIC FUNCTIONS	DEFAULT INPUT	DEFAULT STATUS
I	00	ID_RUN	Run command	P.I.4	L
I	02	ID_EN_EXT	External enable	P.I.2	H
I	03	ID_SWAP_ISL_EN	Swap to Island Enable	P.I.3	L
I	07	ID_UGRID_CONT_STS	Microgrid external contactor status		L
I	08	ID_RESET_ALR	Alarms reset	P.I.1	L
I	09	ID_UGRID_RESYNC_REQ	Microgrid resynch request		L
I	10	ID_EN_REST_OVC_S	Enable Restart After OVC (Software detect)		L
I	16	ID_EN_PAR_DB2	Enable second parameter bank		L
I	20	ID_EN_CSI	Enable PLL on CSI control		L
I	21	ID_EN_DROOP	Enable droop control		L
I	31	ID_PWM_SYNCH	PWM synchronization input		L

3.1.1 Analog Inputs Configurations

Name	Description	Min	Max	Default	UM	Scale
KP_AI1	P01 - Corrective factor for analog reference 1 (AUX1)	-400.0	400.0	100		10
OFFSET_AI1	P02 - Corrective offset for analog reference 1 (AUX1)	-100.0	100.0	0	%	163.84
KP_AI2	P03 - Corrective factor for analog reference 2 (AUX2)	-400.0	400.0	100		10
OFFSET_AI2	P04 - Corrective offset for analog reference 2 (AUX2)	-100.0	100.0	0	%	163.84
KP_AI3	P05 - Corrective factor for analog reference 3 (AUX3)	-400.0	400.0	100		10
OFFSET_AI3	P06 - Corrective offset for analog reference 3 (AUX3)	-100.0	100.0	0	%	163.84
KP_AI16	P13 - Corrective factor for 16 bit analog reference (AUX16)	-400.0	400.0	100		10
OFFSET_AI16	P14 - Corrective offset for 16 bit analog reference (AUX16)	-100.0	100.0	0	%	163.84
EN_AI1_4_20mA	C95 - Enable AI1 4-20mA	0	1	0		1
EN_AI2_4_20mA	C96 - Enable AI1 4-20mA	0	1	0		1
EN_AI3_4_20mA	C97 - Enable AI1 4-20mA	0	1	0		1
AI1	D42 - Analog Input AI1	-100	100	0	%	163.84
AI2	D43 - Analog Input AI2	-100	100	0	%	163.84
AI3	D44 - Analog Input AI3	-100	100	0	%	163.84
AI16	16 bit Analog input (optional)	-100	100	0	%	40.96

3.2 OUTPUT



3.2.1 Digital Outputs Configuration

Name	Description	Min	Max	Default	UM	Scale
LO1_SEL	C10 - Meaning of logic output 1	-64	63	3		1
LO2_SEL	C11 - Meaning of logic output 2	-64	63	0		1
LO3_SEL	C12 - Meaning of logic output 3	-64	63	6		1
LO4_SEL	C13 - Meaning of logic output 4	-64	63	19		1

The logic functions signal the status of the converter and can be assigned to one of the 4 logic outputs.

		NAME	OUTPUT LOGIC FUNCTIONS	DEFAULT OUTPUT
O	00	OD_CONV_READY	Converter ready	P.O.2
O	01	OD_ALR_KT_MOT	Reactor thermal alarm	
O	03	OD_DRV_RUN	Converter running	P.O.1
O	05	OD_K_I_TRQ	Output of the current relay	
O	07	OD_LIM_I	Converter in current limit	
O	10	OD_PREC_OK	Insertion of the active soft-start	
O	12	OD_POW_OFF	Grid fault	
O	13	OD_BUS_RIG	Single Phase Grid	
O	14	OD_IT_OVR	Thermal current exceeds threshold (P96)	
O	15	OD_KT_DRV	Heat sink overheating (higher than P120 threshold)	
O	19	OD_POS_INI_POL	Regulation card supplied and DSP not in reset state	P.O.4
O	20	OD_SNS1_ABS	Power recovery into the Grid (generation)	
O	21	OD_CONV_OK	Converter ready and Power Soft start active	
O	22	OD_LL_ACTV	LogicLab application active	
O	30	OD_UGRID_CONT_CMD	Microgrid external contactor command	
O	31	OD_PWM_SYNCH	PWM synchronization output	
O	32	OD_EN_CONV_FANS	Enable converter fans	

3.2.2 Analog Outputs Configurations

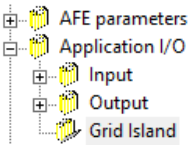
Name	Description	Min	Max	Default	UM	Scale
AO1_SEL	C15 - Meaning of programmable analog output 1	-99	100	11		1
AO2_SEL	C16 - Meaning of programmable analog output 2	-99	100	4		1
PRC_AO1_10V	P57 - % value of 10V for analog output A	100.0	400.0	200	%	10
PRC_AO2_10V	P58 - % value of 10V for analog output B	100.0	400.0	200	%	10
OFFSET_AO1	P110 - Offset A/D 1	-100.0	100.0	0		327.67
OFFSET_AO2	P111 - Offset A/D 2	-100.0	100.0	0	%	327.67

		OUTPUT LOGIC FUNCTIONS	DEFAULT OUTPUT
o	00	Angle read [100%=180°]	
o	01	Delta m [100%=180°]	
o	03	V Bus Ref Norm [100%=Vgrid*1,41]	
o	05	out0 [% I NOM CONV]	
o	06	Internal value: status (MONITOR only)	
o	07	Iq rif [% I NOM CONV]	
o	08	Id rif [% I NOM CONV]	
o	09	Request voltage at maximum rev. [% VNOM MOT]	
o	10	Internal value: alarms (MONITOR only)	
o	11	Current module [% I NOM CONV]	A.O.1
o	13	U phase current reading [% I MAX CONV]	
o	14	Internal value: inputs (MONITOR only)	
o	15	Iq component of current reading [% I NOM CONV]	
o	16	Id component of current reading [% I NOM CONV]	
o	17	U phase voltage duty-cycle	
o	18	Module of the reference voltage [% V NOM CONV]	
o	19	Modulation index [0<->1]	
o	20	Request Q axis voltage (Vq_rif) [% V NOM]	
o	21	Power Delivered [% Nominal Power]	
o	22	Request D axis voltage (Vd_rif) [% VNOM]	
o	24	Bus voltage [100%=900V]	
o	25	Heat sink temperature reading [% 37,6°]	
o	26	Reactor temperature reading [% 80°]	
o	28	Reactor thermal current [% alarm threshold A6]	
o	29	Current limit [% I MAX CONV]	
o	32	Internal value: outputs (MONITOR only)	
o	33	Internal value: inputs_hw (MONITOR only)	
o	34	V phase current reading [% I MAX CONV]	
o	35	W phase current reading [% I MAX CONV]	
o	36	alfa_fi [100%=180°]	
o	37	Analog input A.I.1 [100%=16383]	
o	38	Analog input A.I.2 [100%=16383]	
o	39	Analog input A.I.3 [100%=16383]	
o	40	Grid current module	
o	44	Frequency [% F_GRID_NOM]	
o	46	Grid voltage module filtered [% V NOM CONV]	
o	47	U phase voltage reading Vu1 [100%=16383]	
o	48	V phase voltage reading Vu2 [100%=16383]	
o	49	V Bus Norm %Vgrid*1,41 [100%=16383]	
o	51	out0 (%I NOM CONV)	
o	53	Frequency of main grid [% F_GRID_NOM]	
o	54	Main grid voltage module filtered [% V NOM CONV]	
o	56	Main Grid U phase voltage reading Vg1	
o	57	Main Grid V phase voltage reading Vg2	
o	58	I_Alpha_Rif (abc Control)	

o	61	Grid W phase current reading	
o	62	Grid U phase current reading	
o	67	I_Beta_Rif (abc Control)	

The logic functions signal the status of the converter and can be assigned to one of the 4 logic outputs.

3.3 GRID ISLAND



Name	Description	Min	Max	Default	UM	Scale
GRID_ISL_V_REF	P10 - AC GRID_ISL Voltage Reference	15.0	780.0	230.0	V	10
BLK_START_TM	P21 - Black Start Time	0.01	199.99	1	s	100
FREQ_DROOP	P22 - % Frequency Droop	-100.0	100.0	2.0	%	81.92
VOLT_DROOP	P23 - % Voltage Droop	-100.0	100.0	5.0	%	81.92
DDROOP_GAIN	P24 - % Phase droop gain	-100.0	100.0	20.0	%	81.92
GRID_ISL_KP	P35 - KpV GRID_ISL V Prop Gain	0.01	40.0	0.10		100
GRID_ISL_TI	P36 - TiV GRID_ISL V lead time constant	0.1	3000.0	5.0	ms	10
GRID_ISL_TF	P37 - TfV GRID_ISL filter time constant	0.0	25.0	0.0	ms	10
PRC_DIS_REG_GRID_ISL	P38 - Cross Coupling multiplier for GRID_ISL V ac Control	0.0	200.0	80	%	10
VOLT_REG_FF_FILTER	P41 - Time constant for voltage regulator feed-forward calculation	0.0	500.0	4.5	ms	10
VoltDroopFilt	P59 - Voltage Droop Filter Time const	0.0	200.0	6.0	ms	10
F_GRID_NOM	P63 - Rated grid frequency	5.0	100.0	50.0	Hz	1
DROOP_SIN	P66 - Droop sin (1=inductive 0=resistive)	0.00	1.00	1.00		100
FreqDroopFilt	P67 - Frequency Droop Filter Time const	0.0	200.0	6.0	ms	10
PRC_REAL_VRS	P69 - Voltage drop due to real resistor	0.0	25.0	0.1	% V_GRID_NOM	327.67
PRC_REAL_VLS	P70 - Voltage drop due to real inductance	0.0	50.0	3.0	% V_GRID NOM	327.67
PRC_VIRTL_VRS	P72 - Voltage drop due to real+virtual resistor	-25.0	25.0	0.1	% V_GRID_NOM	327.67
PRC_VIRTL_VLS	P73 - Voltage drop due to real+virtual inductance	-50.0	50.0	3.0	% V_GRID_NOM	327.67
CAPAC_LINE_CURR	P74 - Capacitors Line Current	0.0	20.0	0.0	% I_CONV_NOM	327.67
DDROOP_TF	P79 - Filter time constant for phase droop	0.0	100.0	50	ms	10
DY11_ANG	P80 - Dy11 angle Phase Shift	-180.0	180.0	0	°	10
RESYNC_AMPL_KP	P129 - Voltage regulator Kp for microgrid resync	0.01	80.0	1		100
RESYNC_AMPL_TI	P130 - Voltage regulator TiV lead time constant for microgrid resync	0.1	3000.0	300	ms	10
RESYNC_AMPL_TF	P131 - Voltage error regulator filter Tf time constant for microgrid resync	0.0	500.0	150	ms	10
RESYNC_FREQ_KP	P132 - Freq. regulator Kp for microgrid resync	0.01	80.0	0.1		100
RESYNC_FREQ_TI	P133 - Freq. regulator TiV lead time constant for microgrid resync	0.1	3000.0	300	ms	10
RESYNC_FREQ_TF	P134 - Freq. regulator filter Tf time constant for microgrid resync	0.0	500.0	50.0	ms	10
RESYNC_VOLT_THR	P135 - % Voltage threshold for microgrid resync	0.0	100.0	0.0	%	81.92
RESYNC_PHASE_THR	P136 - % Phase threshold for microgrid resync	0.0	100.0	0.0	%	81.92
RESYNC_VAL_TIME	P137 - Validation time for microgrid resync	20	2000	200	ms	1
TRANSITION_ERR_TIME	P139 - Timeout for microgrid resync	0	15000	500	ms	1
SWAP_VOLT_THR	P140 - Voltage threshold for CSI to VSI swap function	0.0	100.0	10.0	%	163.84
SWAP_FREQ_THR	P141 - Frequency threshold for CSI to VSI swap function	0.0	100.0	5.0	%	163.84
CSIVSI_VOLT_MOD_FILTER	P142 - Time constant for voltage module reference filter for CSI to VSI transition	0.0	1000.0	200	ms	10
BLACK_START_INIT_TIME	P143 - Initial boost time for black-start	0.0	10000.0	0	ms	1

Name	Description	Min	Max	Default	UM	Scale
BLACK_START_INIT_VALUE	P144 - Initial boost value for black-start	0.0	100.0	0.0	%	163.84
CONTROL_SEL	C00 - Control Selection	0	13	0		1
EN_DOUBLE_UPDATE	C67 - Enable double update	0	1	0		1
I_CTRL_SEL	C80 - Current control type selection	0	1	0		1
V_CTRL_SEL	C81 - Voltage control type (GRID-ISLAND)	0	1	0		1
SYNC_CARD_SEL	C82 - Type of Sync Card mounted	0	1	0		1
SWAP_ISL_EN	C83 - Swap to Island function Enable	0	1	0		1
DROOP_EN	C84 - Enable Droop Control	0	1	0		1
OVC_RESTART_SW	C85 - Enable Restart after OVC (SW-caption)	0	1	0		1
DDROOP_SEL	C87 - Enable droop on instantaneous phase reference (Ddroop_f) + use 1st order filter on freq. droop	0	1	0		1
EN_MICROGRID_RESYNC	C88 - Microgrid resync. management enable	0	1	0		1
FREQ_BLACK_START	C90 - Enable frequency black-start	0	1	0		1
GRID_STATUS	D09 - GRID_ISL_status			0		1
MICROGRID_TRANS_STS	D10 - Microgrid Transition State Machine Status			0		1

For details regarding these parameters please refer to AFE Energy Microgrid manual.

4 FIELDBUS

AFE parameters
Standard Application
Fieldbus

Name	Description	Min	Max	Default	UM	Scale
FLD_CARD	D60 - Fieldbus Card			0		1

4.1.1 Modbus Parameters

Name	Description	Min	Max	Default	UM	Scale
MODBUS_ADDR	P92 - Serial identification number	0	255	1		1
MODBUS_BAUD	P93 - Serial baud rate			192	Kbit/s	1

The OPEN converter products line is compatible with the protocol of the serial communication Modbus rtu.
At a physical level, the supported standard is the RS485, see the converter installation manual for information about it. Specifications about the Modbus Protocol are available at the Internet address:

www.**modbus**.org/docs/**Modbus**_Application_Protocol_V1_1b.pdf
www.**modbus**.org/docs/**Modbus**_over_serial_line_V1.pdf

4.1.1.1 Application Configuration

4.1.1.1.1 Node Configuration

The converter configuration as Modbus node requires the correct configuration of the following parameters:

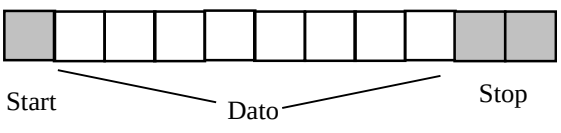
Name	Description	Range	Default
P92	Serial identification number	0÷255	1
P93	Serial baud rate	9,6; 19,2; 38,4; 57,6; 115,2	19,2 Kbit/s

These parameters are taken into account only during converter start-up. Any change will be activated only at the next converter start-up.

Note: the communication mode in broadcast with address = 0 is managed.

4.1.1.2 Managed Services

The converter acts as slave in the communication: this means that it is only able to answer to messages received if its address (settable in P92) corresponds with the one indicated in the message itself. If the address is not correct or there is an error of communication in CRC, the converter will not send any answer, as the protocol requires.
Every word transmitted is composed by 11 bit: 1 bit for start, 8 bit for the data and 1-2 bit for stop. The parity check is not supported.



The Modbus protocol specifies several function implementations, while our application provides a reduced function set: in the following table you can find the implemented functions and their codifications:

Code	Function	Description
1	Read Coil Status	Reading of digital input/output
03	Read Holding Registers	Reading of memorized data
06	Write single register	Writing of memorized data
15	Force Multiple Coils	Writing of digital inputs
16	Preset Multiple Registers	Writing of memorized data

Hereinafter you can find the description of the action and of the related address of each function.

4.1.1.2.1 01 Read Coil Status

This function allows the user to read the status of the digital inputs and outputs.
It is important to underline that the standard management of the digital inputs requires that the RUN enable must be given both via terminal board and via serial line; all the other inputs instead can be commanded by one of the two ways just listed. The default RUN input from the serial line is high while all the others are low: in this way the user who is not using it, can have the total control of digital inputs from the terminal board.
Thanks to Read Coil Status function it is possible to read the status of the digital inputs and related outputs you are interested in, just specifying the correct address written in the following table:

Initial address	Type	Maximum number of registers (DEC)	Type of access Modbus function	Description
0x0300 (HEX) - 768 (DEC)	Boolean	32	Reading (0x01)	Digital input logical functions
0x0320 (HEX) - 800 (DEC)	Boolean	32	Reading (0x01)	Standard digital outputs logical functions
0x0340 (HEX) - 832 (DEC)	Boolean	32	Reading (0x01)	Applicative digital output logical functions

The order number of the inputs and the outputs is the one specified in the related tables (see specific description of the control's core).

4.1.1.2.2 03 Read Holding Register

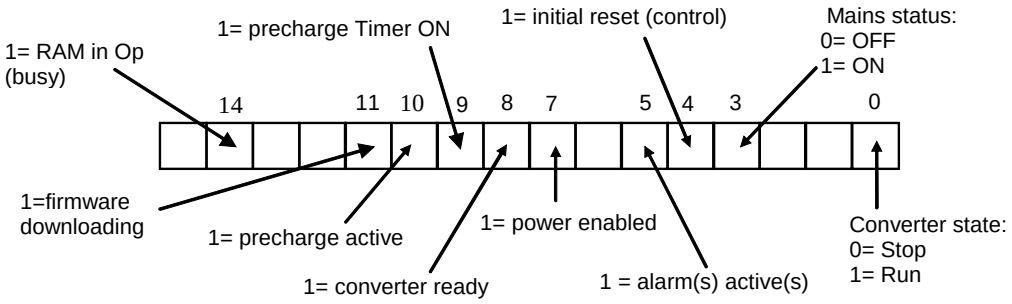
This function allows the user to read the values of all the Parameters, Connections, Internal Sizes and some status variables. Writing the addresses specified in the table below, you can access the related data. Considering the internal representations of different data, as described in whole this document, it is possible to correctly interpret the data of the following table:

HEX - DEC Initial address	Type	Maximum number of registers (DEC)	Type of access Modbus function	Description	Keypad display
0x0000 - 0	INT16	200	Reading (0x03) Writing (0x10 o 0x06)	Table of parameters(P00 - P199)	**PAR (P.)**
0x00C8 - 200	INT16	100	Reading (0x03) Writing (0x10 o 0x06)	Table of connections (C00 - C99)	**CON (C.)**
0x012C - 300	INT16/INT32	100	Reading (0x03) Writing (0x10 o 0x06)	Table of application parameters (E00 - E99)	**APP (E.)**
0x2000 - 8129	INT16/INT32	500	Reading (0x03) Writing (0x10 o 0x06)	Table of expanded application parameters (E100 - E600)	**APP (E.)**
0x0380 - 896	INT16	128	Reading (0x03)	Table of internal values (D00 - D127)	**INT (d.)**
0x0200 - 512	UINT16	1	Reading (0x03)	Converter state	
0x0202 - 514	UINT16	1	Reading (0x03)	Converter alarms	**ALL (A.)**
0x0203 - 515	UINT16	1	Reading (0x03) Writing (0x10 o 0x06)	Alarm enabling	**ALL (A.)**
0x02C3 - 707	UINT32	1	Reading (0x03)	Mechanical position read	

0x0300 - 768	UINT32	2	Reading (0x03)	Logic functions of digital input	**InP (I.)**
0x0360 - 864	UINT32	2	Reading (0x03) Writing (0x10 o 0x06)	Logic functions of digital input from serial c.	
0x0320 - 800	UINT32	2	Reading (0x03)	Logical functions of standard digital outputs	**Out (o.)**
0x0340 - 832	UINT32	2	Reading (0x03)	Logic functions of application digital output	
0x052C - 1324	UINT16	800	Reading (0x03)	Table of parameters formats	
0x084C - 2124	UINT16	400	Reading (0x03)	Table of connections formats	
0x0C00 - 3072	UINT16	128	Reading (0x03)	Table of monitor and analog outputs values	
0x0D00 - 3328	UINT16	500	Reading (0x03)	Table of application parameters formats	
0x09DC - 2524	UINT16	128	Reading (0x03)	Table of internal values formats	

It is not possible to read more than 127 registers at a time due to the memory limits of the buffer.
The order number of the parameters, of the connections and of the internal sizes is the one related to the lists contained in the description of the control's core.
See the specific documentation for data area application.

The status variable is the same for all the implementations; hereinafter you can find the meaning of the most important bits:



Referring to alarms, the bit position into the word corresponds to the number of the alarm itself: e.g. A2 = external enable corresponding to the bit 2 of converter alarm word.

4.1.1.2.3 15 (0F hex) Force Multiple Coils

This function enables to set the value of digital inputs via serial line. As previously said, the digital inputs via serial line are all parallel to the related digital inputs via terminal board except the RUN enable (where the two inputs are in series).

Initial address	Type	Maximum number of registers (DEC)	Type of access Modbus function	Digital inputs
0x0360 (HEX) - 864 (DEC)	Boolean	32	Reading (0x03) Writing (0x0F)	Digital inputs

4.1.1.2.4 16 Present Single Register/16 (10 hex) Present Multiple Registers

This function allows to set the value of the parameters, connections and to enable the alarms even if the corresponding keys are opened.
To correctly set these data the right address is required (see following table) and it is necessary to consider the internal data representation (refer to the specific descriptions of the core in this manual).

Initial address	Type	Maximum number of registers (DEC)	Type of access Modbus functions	Description
0x0000(HEX) - 0(DEC)	INT 16	Reading (0x03) Writing (0x10 o 0x06)	200	Parameters table
0x00C8(HEX) - 200(DEC)	INT 16	Reading (0x03) Writing (0x10 o 0x06)	100	Connections table
0x012C(HEX) - 300(DEC)	INT16/INT32	Reading (0x03) Writing (0x10 o 0x06)	100	Applications data table
0x0203(HEX) - 515(DEC)	UINT16	Reading (0x03) Writing (0x10 o 0x06)	1	Alarms enabling
0x0360(HEX) - 864(DEC)	UINT32	Reading (0x03) Writing (0x10 o 0x06)	1	Digital input

With these functions is also possible to set value of digital inputs writing a double word.

4.1.1.2.5 Exception Responses

The following exception codes are managed as answer:

Code	Name	Description
01	Not managed function	The converter does not manage this Modbus function
02	Wrong data address	The address is not valid
03	Wrong data value	The required data number is too large

4.1.2 CAN Open

Name	Description	Min	Max	Default	UM	Scale
ID_CANOPEN	P162 - CAN BUS node ID	1	127	1		1
CANOPEN_BAUD_SEL	C48 - CAN Baud rate	Range		0		1
		0	1M			
		1	800K			
		2	500K			
		3	250K			
		4	125K			
		5	50K			
		6	20K			
		7	10K			
MAPPING_CONFIG	U03 - Select the mapping configuration	0	32767	0	Hex	1
EN_SYNC_REG	C23 - Enable CANOpen SYNC tracking loop	0	1	0		1
SYNC_DELAY	Delay from SYNC reception to Voltage routine execution			0	us	1
PWM_SYNC_OFFSET	PWM offset for SYNC delay control			0	pulses	1
STATE_SM	Actual states of the State Machine			0		1
CYCLE_TIME	CAN Open: Cycle period in us (Obj 0x1006) - EtherCAT: Sync0 Cycle time in ns			0		1
PDO_MAPPING	PDO mapping - the value is configured with C91			0	Hex	1
BO_CAN_MOD	Bus-off status. If 1 the CAN module is in bus-off status			0		1
REC_CAN_MOD	CAN Receive Error Counter			0		1
TEC_CAN_MOD	CAN Transmit Error Counter			0		1

4.1.2.1 Configuration of the Application

4.1.2.1.1 Configuration of the Node

The converter configuration as CAN node includes the use of the following customer parameters:

Name	Description	Min	Max	Default
ID_CANOPEN	P162 - CAN BUS node ID	1	127	1
CANOPEN_BAUD_SEL	C48 - CAN Baud rate	Range		0
		0	1 M	
		1	800 k	
		2	500 k	
		3	250 k	
		4	125 k	
		5	50 k	
		6	20 k	
		7	10 k	

These parameters must be correctly configured and saved in the permanent memory of the converter (C63=1). At start-up these data are read and become operative.

4.1.2.1.2 Configuration of the Communication Objects

The configuration of communication objects CAN OPEN DS301 can uniquely be done via CAN.
At first switch-on, the converter is a non-configured node which satisfies the “pre-defined connection set” for the identifiers allocation; for this, the following objects are available:

- RX SDO with COB-ID = 600h + ID CAN node (parameter P162)
- TX SDO with COB-ID = 580h + ID CAN node
- an emergency object with COB-ID = 80h + ID CAN node
- NMT objects (Network Management): in broadcast (COB-ID=0) for Module Control services and COB-ID = 700h + ID CAN node for Error Control.
- The SYNC object in broadcast with COB-ID = 80h

With the SDO available, the converter can be totally configured as CAN node and then the communication objects can be saved in the permanent memory using the proper command “store parameters” (1010h)” on the Sub-Index 2.
Also the object “restore default parameters (1011h)” Sub-Index 2 is managed to load all the default communication objects and to save them automatically in the permanent memory (switch-off and then on the converter to make objects operating).

4.1.2.2 Managed Services

4.1.2.2.1 Service Data Object (SDO)

SDO are used to access the objects dictionary. In our implementation a maximum of 4 server SDO can be available and they can be configured with the following objects:

- 1200h - 1st server SDO parameter
- 1201h - 2nd server SDO parameter
- 1202h - 3rd server SDO parameter
- 1203h - 4th server SDO parameter

The transfer mode depends on the length of the data to be transferred: up to 4byte data length, the *expedited* modality is used as it is simple and immediate; for larger size objects the *segmented* and *block* modalities are both supported. See the specific DS301 Communication Profile for more details on the different transmission modes; hereinafter only some peculiarities of our implementation are described:

- a writing access to SDO must indicate the number of significant byte (data set size)
- a writing data by SDO is liable to the same rules (converter state, keys, tolerated range…) seen for the other modalities of parameters modify (serial and keyboard)
- If SDO are structured in more segments, the converter will start writing the data at the indicated address with the first segment, without using a temporary buffer
- A controller is intended to avoid that two SDOs access the same object at the same time
- With the transmission in block modality, the computation of CRC and the “Protocol Switch Threshold” are not supported.

It is possible to set the block size of the SDO Block Download service at the address 2000h of the objects dictionary, in the manufacturer specific section.

4.1.2.2.2 Process Data Object (PDO)

PDO are used for the data exchange in real-time in the objects dictionary that supports this function.

4.1.2.2.3 Transmit PDO

In our implementation up to a maximum of 4 TPDO can be configured with the following objects:

- 1800h - 1st Transmit PDO Communication parameter
- 1801h - 2nd Transmit PDO Communication parameter
- 1802h - 3rd Transmit PDO Communication parameter
- 1803h - 4th Transmit PDO Communication parameter

The 5 Sub-Index related to every type of TPDO are all managed: it is possible to set the transmission type (see the following table), the inhibit time with 100μs resolution and the period of the event timer with 1ms resolution.

Transmission type	PDO transmission
0	Acyclic synchronous: data are transmitted every SYNC received only if its value is changed from previous message.
1-240	Synchronous and cyclical: the number indicates how many SYNC there are in between two following transmissions
241-251	---------- reserved ----------
252	Data are refreshed and sent at the following RTR when the SYNC is received
253	Data are refreshed and sent when the RTR is received (remote transmission request)
254	Event timer: cyclical transmission with a settable time period in ms in the Sub-Index 5
255	Manufacturer specific: it is settable time by time

Note: in the transmission type 255, it is possible to choose on which event the TPDO transmission works. The event choice can be done only during software code compiling.

The TPDO mapping can be dynamically done by correctly configuring the following communication objects:

- 1A00h - 1st Transmit PDO Mapping parameter
- 1A01h - 2nd Transmit PDO Mapping parameter
- 1A02h - 3rd Transmit PDO Mapping parameter
- 1A03h - 4th Transmit PDO Mapping parameter

The PDO mapping must be done in this way:

1. the number of the mapped objects in Sub-Index 0 must be equal to zero
2. the addresses of all mapped objects must be configured
3. the correct number of mapped objects in the Sub-Index 0 must be indicated

4.1.2.2.4 Received PDO

In our implementation a maximum of 4 RPDO can be configured with the following objects:

- 1400h - 1st Receive PDO Communication parameter
- 1401h - 2nd Receive PDO Communication parameter
- 1402h - 3rd Receive PDO Communication parameter
- 1403h - 4th Receive PDO Communication parameter

The first 2 Sub-Index related to each RPDO are managed: in this way it is possible to set the transmission type:

transmission type	PDO receiving
0-240	synchronous: when the following SYNC is received, the received values on the RPDO will be activated.
241-253	---------- reserved ----------
254	Asynchronous: the received values in the RPDO are immediately activated.

The RPDO mapping can be dynamically effectuated by correctly configuring the following communication objects:

- 1600h - 1st Receive PDO Mapping parameter
- 1601h - 2nd Receive PDO Mapping parameter
- 1602h - 3rd Receive PDO Mapping parameter
- 1603h - 4th Receive PDO Mapping parameter

RPDO mapping shall be executed following the next directives as well:

1. Set the number of mapped objects in Sub-Index 0 to be equal to zero
2. Configure the addresses of all mapped objects
3. Indicate the correct number of mapped objects in Sub-Index 0

4.1.2.3 Emergency Object (EMCY)

The emergency object is transmitted by the converter when a new enabled alarm appears or when one or more alarms are reset. The Emergency telegram is made by 8 bytes as shown in the following table:

Byte	0	1	2	3	4	5	6	7
Meaning	Emergency Error Code		Error register	Manufacturer specific alarms LSB –MSB				

In our implementation, only the following two error codes are implemented:

- 00xx = Error Reset or No Error
- 10xx = Generic Error

Speaking of the Error register (object 1001h), the following bits are managed corresponding to the following alarms:

Bit	**Meaning**	**Corresponding alarms**
0	General error	all
1	Current	A3
2	Voltage	A10 - A11 - A13
3	Temperature	A5 - A6

Here the bytes 3 and 4 are assigned to the state of the various alarms of the converter, and byte 5 is the alarm sub-code. Further 2 bytes are available for the transmission of other possible user data.
The management of 1003h “pre-defined error field” object memorizes the chronology of the alarm events (from start-up of the converter) up to maximum 32 elements.
At every new alarm event, 4 bytes are memorized: 2 are mandatory and correspond to the Error Code and the other 2 are Manufacturer specific and they correspond to the state of all the converter alarms.

MSB		**LSB**	
Additional information		**Error code**	
alarms MSB	alarms LSB	Error code MSB	Error code LSB

4.1.2.4 Network Management Objects (NMT)

This function allows the NMT master to check and set the state to every NMT slave.
All the services of Module Control and also the Node Guarding Protocol which uses the COB-ID = 700h + ID CAN node are implemented: this allows the slave to communicate the bootup end and that the pre-operational modality is active, thus the master can interrogate the different slaves with an RTR.
The Life guarding function is implemented as well: the converter (NMT slave) can be set up by the objects:

100Ch **Guard time** in ms
100Dh **Life time factor** (multiplier factor)

} their product yields the **Node life time**
note: node life time is internally saturated
in the period time of 32767/fpwm sec.

Life guarding is enabled only if life time Node is different from zero; in this case the check-up starts after having received the first RTR from the NMT master.
The Communication profile DS301 does not decide which action has to be started if the time constrain of life guarding has not been respected. It is possible to decide how to act, during the firmware compilation step. By default, no action is taken.

4.1.2.5 Objects Dictionary: Communication Profile Area

The following objects of the communication profile are supported:

Index (hex)	Object	Name	Type	Access
1000	VAR	Device type	UNSIGNED32	Reading
1001	VAR	Error register	UNSIGNED8	Reading
1002	VAR	Manufacturer status register	UNSIGNED32	Reading
1003	ARRAY	Pre-defined error field	UNSIGNED32	Reading
1005	VAR	COB-ID SYNC	UNSIGNED32	Reading/writing
1006	VAR	Communication cycle period	UNSIGNED32	Reading/writing
1008	VAR	Manufacturer device name	Vis-String	constant
1009	VAR	Manufacturer hardware version	Vis-String	constant
100A	VAR	Manufacturer software version	Vis-String	constant
100C	VAR	Guard time	UNSIGNED16	Reading/writing
100D	VAR	Life time factor	UNSIGNED8	Reading/writing
1010	ARRAY	Store parameters	UNSIGNED32	Reading/writing
1011	ARRAY	Restore default parameters	UNSIGNED32	Reading/writing
1014	VAR	COB-ID EMCY	UNSIGNED32	Reading/writing
1015	VAR	Inhibit Time EMCY	UNSIGNED16	Reading/writing
1018	RECORD	Identity Object	Identity (23h)	Reading
1200	RECORD	1st Server SDO parameter	SDO parameter	Reading/writing
1201	RECORD	2nd Server SDO parameter	SDO parameter	Reading/writing

4.1.2.6 Objects Dictionary: Manufacturer Specific Profile Area

The words reported in bold type can be mapped in PDO.

Index (hex)	Object	Type	Name	Description	Access
2000	VAR	INTEGER16	Block size	SDO Block size Block Download	Reading/writing
2001	VAR	DOMAIN	Tab_formati	Formats of the 200 parameters (P00…P199)	reading
2002	VAR	DOMAIN	Tab_con_formati	Formats of the 100 connections (C00…C99)	reading
2003	VAR	DOMAIN	Tab_exp_int	Formats of the 128 internal values (D00…D127)	reading
2004	VAR	DOMAIN	Tab_exp_osc	Formats of the 100 monitor's sizes (o00…o99 see in real time graph)	reading
2005	VAR	DOMAIN	Tab_par_def	Values of the default parameters (P00…P199)	reading

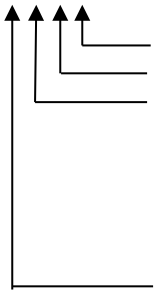
Index (hex)	Object	Type	Name	Description	Access
2006	VAR	DOMAIN	Tab_con_def	Values of the default connections (C00…C99)	reading
200D	ARRAY	INTEGER16	Tab_par [200]	Actual values of the parameters (P00…P199)	reading/writing
200E	ARRAY	INTEGER16	Tab_con [100]	Actual values of the connection (C00…C99)	reading/writing
200F	ARRAY	INTEGER16	Tab_int [128]	Actual values of the internal words (D00…D127)	reading
2010	ARRAY	INTEGER16	Tab_inp_dig[32]	Actual values of the logical input's functions (I00…I31)	reading
2011	ARRAY	INTEGER16	Tab_out_dig[64]	Actual values of the logical output's functions (o00…o63)	reading
2012	ARRAY	INTEGER16	Tab_osc [100]	Actual values of the checked words (o00…o99 see in real time graph)	reading
2013	VAR	UNSIGNED8	Inp_dig_connettore	Logical status of the 8 inputs of the terminal board (physical input status)	reading
2014	VAR	UNSIGNED8	ingressi_hw	Logical status of the 3 inputs from the power	reading
2015	VAR	UNSIGNED8	uscite	Logical status of the 4 digit outputs (physical output status)	reading
2016	VAR	UNSIGNED 32	Out_dig_appl	Reading application outputs	reading
2017	VAR	UNSIGNED16	stato	Variable of the converter's status	reading
2018	VAR	UNSIGNED16	allarmi	Converter alarms' status	reading
2019	VAR	UNSIGNED16	abilitazione_allarmi	Mask for enabling converter's alarms	reading
201E	ARRAY	INTEGER16	Tab_dati_applica-zione [100]	Actual values of the application parameters (E00…E99)	reading/writing
201F	VAR	UNSIGNED32	Inp_dig_field	Logical inputs function by fielbus	reading/writing
2020	VAR	UNSIGNED32	Inp_dig	Actual values of the logical input's functions (I00…I31)	reading
2021	VAR	UNSIGNED32	Out_dig	Actual values of the logical output's functions (o00…o63)	reading
2022	VAR	UNSIGNED16	word_vuota	Unused Word	reading/writing
2023	VAR	UNSIGNED32	double_vuota	Unused Double word	reading/writing
2024	VAR	DOMAIN	Tab_formati_appl	Formats of application parameters (E00...E99)	reading
2025	ARRAY	INTEGER16	Tab_codice_al-larmi[16]	Alarms subcode	reading
2026	VAR	UNSIGNED32	Quota_att	Actual multi-turn position	reading
2028	VAR	UNSIGNED32	letto	Actual position on turn	reading
2029	VAR	UNSIGNED32	letto_senza_top	Actual incremental position on turn	reading
202A	VAR	INTEGER16	letto2	Actual second sensor position on turn	reading
202B	ARRAY	INTEGER16	Tab_extra_int [50]	Actual extra internal values	reading
202C	ARRAY	INTEGER16	Tab_comandi [10]	Utilities commands (U00...U09)	reading/writing

4.1.2.6.1 Format Parameters Table (Tab_formati 2001h)

This table is made by 800 words (200*4); 4 words for each parameter:

1st word: it defines the parameter typology, its internal representation and the number of decimal and integer digits which are shown up on the display. Each nibble has the following meaning:

0x 0 0 0 0 (in hexadecimal)



number of digits visualized in decimal
number of digits visualized in integer
internal representation:

0	Direct value
1	Percent of the base (100/base)
2	Proportional to the base (1/base)
3	Direct value unsigned

Type of parameter:

0	Not managed
1	free (changeable on-line)
2	Reserved (changeable off-line + key P60)
4	TDE (changeable off-line + key P99)

For example:
0x1231 → free parameter, proportional to the base: the real value is equal to internal representation/base (4th word).
2nd word: it defines the min admitted value in the internal representation of the parameter
3rd word: it defines the max admitted value in the internal representation of the parameter
4th word: it defines the representation base of the parameter

example 1: (hexadecimal if leaded by '0x…'):

1st word =	0x1131	
2nd word =	0000	free parameter in percent of the base: the real value is = (internal
3rd word =	8190	representation divided by the base)*100
4th word =	4095	
		if the current value is 1000 → (1000/4095) *100 = 24,4%
		the variation range is included between 0 and 200%

example 2: (hexadecimal if leaded by '0x…'):

1st word =	0x2231	
2nd word =	5	reserved parameter proportional to the base: the real value is
3rd word =	1000	internal representation divided by the base
4th word =	10	
		if the current value is 400 → (400/10) = 40,0%
		the variation range is included between 0,5 and 100%

4.1.2.6.2 Format Connections (Tab_con_formati 2002h)

This table is composed by 400 words (100x4), 4 words for each connection:
1st word: it defines the type of connection, its internal representation and the number of integer and decimal digits that will be shown on the display. Each nibble has the following meaning:

0x 0 0 0 0 (hexadecimal)

- Number of digits visualized in decimal
- Number of digits visualized in integer
- Internal representation:

0	Direct value
1	Percent of the base (100/base)
2	Proportional to the base (1/base)

- Parameter type:

0	Not managed
1	free (changeable on-line)
2	Reserved (change off-line + key P60)
4	TDE (change off-line + key P99)

2nd word: it defines the min admitted value in the internal representation of the connection
3rd word: it defines the max admitted value in the internal representation of the connection
4th word: it defines the base of the representation of the connection (always 1)

The internal representation is always the direct value.

Example (hexadecimal if leaded by '0x…'):

1st word = 0x2020
2nd word = 0 reserved connection: its value is included between 0 and 18
3rd word = 18
4th word = 1

4.1.2.6.3 Format Extra Parameters Table (Tab_formati_appl 2024h)

This table is made by 1000 words (200*5) 5 words for each parameter:
1st word: it defines the parameter typology, its internal representation and the number of decimal and integer digits which are shown up on the display. Each nibble has the following meaning:

0x 0 0 0 0 (in hexadecimal)

- number of digits visualized in decimal
- number of digits visualized in integer
- internal representation:

0	Direct value
1	Percent of the base (100/base)
2	Proportional to the base (1/base)
3	Direct value unsigned

- Type of parameter:

0	Not managed
1	free (changeable on-line)
2	Reserved (changeable off-line + key P60)
4	TDE (changeable off-line + key P99)

For example:

0x1231 → free parameter proportional to the base: the real value is equal to the internal representation/base (4th word).

2nd word: it defines the min admitted value in the internal representation of the parameter
3rd word: it defines the max admitted value in the internal representation of the parameter
4th word: it defines the representation base of the parameter
5th word: it defines the default value of the parameter

example: (hexadecimal if leaded by '0x…'):

1st word =	0x1131	
2nd word =	0000	free parameter in percent of the base: the real value is = (internal
3rd word =	8190	representation divided by the base) *100
4th word =	4095	
5th word =	4095	
		if the current value is 1000→ (1000/4095) *100 = 24,4%
		the variation range is included between 0 and 200%
		the default value is 100%

4.1.2.6.4 Format of Internal Values Table (Tab_Exp_Int 2003h)

This table is composed by 64 words, one word for each internal value:

1st word: it defines the representation of the internal values

0x 0 0 0 0 (hexadecimal)

internal representation:

1	Direct value /2 to the power of…
2	Percent with base 4095
3	Percent with base 32767
4	Percent with base 16383

Example 1 (hexadecimal if leaded by '0x…')
0x0002 internal representation of the value: percent of 4095.
For example, if its value is 2040 → (2040/4095) *100 = 49,8%

Example 2 (hexadecimal if leaded by '0x…')
0x0041 internal representation of the size: direct value divided by 2^4
For example, if its value is 120 → ($120/2^4$) = 7,5

4.1.2.6.5 Format of Monitor Values Table (Tab_Exp_Osc 2004h)

This table is composed by 64 words, one word for each monitor value.
1st word: it defines the representation of internal values:

0x 0 0 0 0 (hexadecimal)

internal representation:

2	Percent with base 4095
3	Percent with base 32767
4	Percent with base 16383

Example 1 (hexadecimal if leaded by '0x…'):
0x0003 internal representation of the internal value: percent of 32767.
For example, if its value is 5000 → (5000/32767) *100 = 15,2%

4.1.2.6.6 Management of Monitor (Objects from 2009h to 200ch + 2012h)

These objects are related to the monitor of the converter internal values.
K_zz (2009h) is the internal counter of the 2000 points circular buffer.
Start_count If ≠ 0 it indicates that the trigger event set with C14 went off.
Tab_monitor_A (200Bh) and **Tab_monitor_B** (200Ch) are circular buffers where the internal selected values by C15 and C16 are stored.
Moreover, parameters P54, P55, and P56 are involved. P54 sets the sample time of the monitor (units = PWM period); P55 sets the post-trigger points; P56 sets the trigger level if this is effectuated on the monitored internal values.
See the product documentation for details regarding the monitored internal values.
The object **Tab_osc** (2012h) is an array of 64 internal values with the most recent values of all the monitoring variables. In this way the single objects can be mapped as PDOs to keep under control the internal values of the converter.

4.1.2.6.7 Input Logic Functions (Object 2010h, 2013h, 2014h, 2016h, 201Fh, 2020h, 2021h, 2022h)

The management of the input logic functions is totally controlled via CAN.
In the variable inputs **(2013h)** it is possible to read the status of the 8 input available in the terminal-box in the less significant bit. The 8 logic inputs are configured by the C1-C8 connections, each one checking a particular input logic function.
Standard input logic functions (I00 ÷ I28)
The status of the 32 input logic functions is available in two different dictionary objects:
the array **Tab_inp_dig (2010h)** in which it's possible to read function by function using sub-index (logic state 0 = low ; 32767 = high) and the 32 bit variable **Ingressi_standard_rd (2021h)** in which every bit is related to the state of corresponding function.
Via CAN it is possible to set the status of the input logic functions: writing function by function with the array **Tab_inp_dig_field (2016h)** (0=low, 32767=high) or setting the state of all 32 logic functions writing the 32bit variable **Ingressi_standard_wr (201Fh).**
The implemented logic provides that:

- The 0 logic input function (converter switch on/off) is given by the logic AND of the different input channels: terminal board, field-bus and serial line
- All the other logic functions can be set high by the logic OR of the different channels.

At start up, Tab_inp_dig_field [0] = high: in this way if this value is never over-written, the converter can be controlled via terminal-board.

Application input logic functions (I29 ÷ I63)
The status of the 32 application input logic functions is available in the 32 bit variable **Ingressi_appl_rd (2022h)** in which every bit is related to the state of corresponding function.
Via CAN it's possible to set the status of all application input logic functions writing the 32bit variable **Ingressi_appl_wr (2020h).**
The implemented logic provides that:

- The 32 application input logic functions can be set via CAN

If one application input logic function is configured to a connector logic input, the physical state imposes the state of corresponding logic function.

4.1.2.6.8 Output Logic Functions (Objects 2011h, 2015h, 2023h)

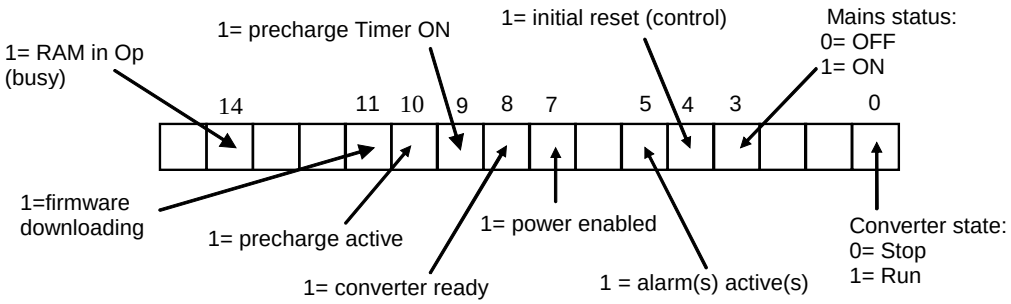
Via CAN bus, it is possible the monitoring the state of:

- the status of the 4 logic outputs in the 4 less significant bits of the variable output (2015h)
- the status of the 32 logic output functions in the array Tab_out_dig (2011h) using the sub-index. Like the inputs, logic levels are: 0=low and 32767=high

the status of all 32 output logic functions in the 32 bit variable Uscite_logiche_rd (2023h) in which every bit is related to the corresponding function.

4.1.2.6.9 Status Words (Objects 2017h, 2018 and 2019h)

The object 2017h is available as status word of the converter with the following meaning:

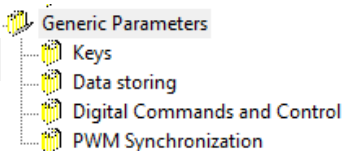


The object 2018h represents the status of the alarms of the converter bit by bit; for example, the status of A8 alarm is shown by the bit n. 8 of the word.
The object 2019h is the alarm enabling mask. Again, the meaning is bit by bit. This variable is available as read only; see parameter P163 for read and write access.

4.1.3 Other fieldbus

For PROFIBUS, ANYBUS and ETHERCAT refer to the relevant manual.

5 GENERIC PARAMETERS



5.1.1 Keys

Name	Description	Min	Max	Default	UM	Scale
RES_PAR_KEY	P60 - Access Key to reserved parameters	0	65535	0		1
TDE_PAR_KEY	P99 - Access key to TDE parameters	0	19999	0		1
RES_PAR_KEY_VAL	P100 - Value of access key to reserved parameters	0	19999	95		1

P60 and P99 are two parameters that allow some reserved parameter (only at a standstill). In particular:

- If the value of P60 is the same of the key, reserved parameters can be modified
- If the value of P99 is the same of the key, TDE parameters can be modified

5.1.2 Data Storing

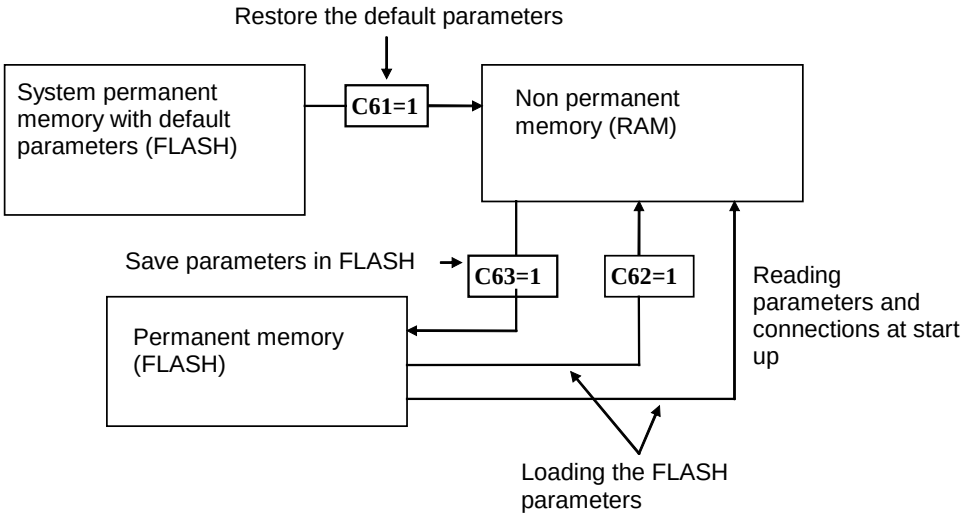
Name	Description	Min	Max	Default	UM	Scale
PAR_ACT_BANK	C60 - Parameter bank active	0	1	0		1
DEF_PAR_RD	C61 - Read default parameters	0	1	0		1
EEPROM_PAR_RD	C62 - Read parameters from EEPROM	0	1	0		1
EEPROM_PAR_WR	C63 - Save parameters in EEPROM	0	1	0		1
ALL_COUNT_RESET	C44 - Reset alarms counters	0	2	0		1
K_V_GRID_TDE	Factory corrective Factor for AC Grid Voltage	25.0	200.0	100.0	%	10
OFFSET_AO1_TDE	Factory corrective offset for A/D 1	-100.0	100.0	0.0	%	327.67
OFFSET_AO2_TDE	Factory corrective offset for A/D 2	-100.0	100.0	0.0	%	327.67
V_GRID_AMPL_COEFF_TDE	Factory corrective factor for Line voltage amplitude coefficient	0.0	200.0	100.0	%	163.84
OFFSET_L1_TDE	Factory corrective offset for line voltage L1	-16383	-16383	0		1
OFFSET_L2_TDE	Factory corrective offset for line voltage L2	-16383	-16383	0		1
OFFSET_AI1_TDE	Factory corrective offset for analog reference 1 (AI1)	-100.0	100.0	0.0	%	163.84
OFFSET_AI2_TDE	Factory corrective offset for analog reference 2 (AI2)	-100.0	100.0	0.0	%	163.84
OFFSET_AI3_TDE	Factory corrective offset for analog reference 3 (AI3)	-100.0	100.0	0.0	%	163.84
KP_DCBUS_TDE	Factory corrective factor for Bus voltage	0.0	200.0	100.0	%	10
KP_REACT_THERM_PRB_TDE	Factory multiplication factor for motor PTC/NTC/KTY84 analog reference value	0.0	200.0	100.0		163.84
KP_CONV_THERM_PRB_TDE	Factory multiplication factor for radiator PTC/NTC analog reference value	0.0	200.0	100.0		163.84

5.1.2.1 Storage and Recall of The Working Parameters

The converter has three types of memory:

1. the non-permanent work memory (RAM), where the parameters become used for operation and modified parameters are stored; such parameters are lost due to the lack of regulation power supply.
2. The permanent work memory (FLASH), where the actual working parameters become stored to be used in sequence (C63=1, Save Parameters on FLASH).
3. The permanent system memory where the default parameters are contained.

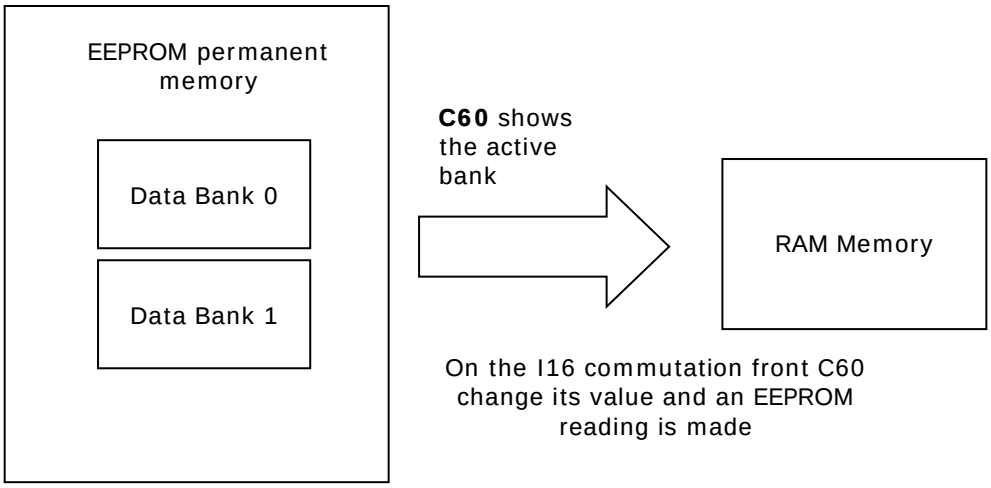
When switched on, the converter transfers the permanent memory parameters onto the work memory. If parameters are modified, they become stored in the work memory and therefore become lost in case of lack of power supply rather than being saved in the permanent memory.
If after the work memory modifications wants to return to the previous security, it is acceptable to load on such a memory, a permanent memory parameter (Load FLASH Parameter C62=1).
If for some reason the parameters in FLASH change, it is necessary to resume the default parameters (C61=1 Load Default Parameters), to make the appropriate corrections and then save them in the permanent working parameter (C63=1).
It is possible to save the data in the permanent memory also at converter switched on/RUN, while the loading may only be affected aside with converter switched off/STOP, after having opened the key to reserved parameters.



Because the default parameters are standard to be different than those that are personalized, it is correct that after the installation of each converter, there is an accurate copy of permanent memory parameters to be in the position to reproduce them on an eventual converter exchange.

5.1.2.1.1 Active Bank Parameters

This function allows to switch over the internal sets of parameters and connections between two distinct memory banks (converter shall be switched off, no RUN).
To activate this function, it is necessary to use the logic input I16, configuring it on a logic input on both banks. The connection C60 indicates the actual data bank in the permanent memory: C60=0 bank 0; C60=1 bank 1. The commutation of the functions logic stage I16 brings an automatic variation of data of C60 and a successive automatic reading of data from the permanent memory.



For initial configuration of the input function I16, follow these steps:

1. Prepare in RAM, the data in bank 0, configuring input function I16 and holding it to a low logic level (make sure C60=0).
2. Save to the permanent memory with C63=1.
3. Always keep I16=L, prepare in RAM the data from bank 1, configuring the same input to the function I16.
4. Set C60=1 and save the data in the permanent memory with C63=1.
5. At this point, changing the state of logic input corresponding to function I16, the bank's commutation will have automatic reading

5.1.3 Digital Commands and Control

Name	Description	Min	Max	Default	UM	Scale
DISP_WAIT_TIME	P112 - Wait time for display stand-by state	3	20	1	s	1
ALL_ENAB	P163 - Alarm enable	-32768	32767	-1	Hex	1
DISPLAY_SEL	C14 - Display selection	0	127	0		1
SW_RUN_CMD	C21 - Run software enable	0	1	1		1
CONV_SW_EN	C29 - Converter software enable	0	1	1		1
ALL_RESET	C30 - Alarms reset	0	1	0		1
ALL_COUNT_RESET	C44 - Reset alarms counters	0	2	0		1
EN_BOOT	C98 - Enable boot mode	0	1	0		1
EN_PF_RES	C99 - Enable Power Fault reset	0	1	0		1
VOLT_ISR	Voltage routine duration			0	us	64
I_ISR	Current routine duration			0	us	64
APP_FAST_ISR	Application fast task duration			0	us	64
APP_AVBLE_FAST_ISR	Application fast task available time			0	us	64
DRV_F_PWM_MAX	Max PWM frequency available			0	Hz	1
WORK_HOURS	D49 - Work Hours			0	hours	1
SERIAL_NUMBER	D59 - Converter Serial Number			0		1
PWM_COUNTER	ISR counter			0		1
SW_RESET_CNT	Software reset occurs			0		1

5.1.3.1 Converter Ready

The Converter Ready condition (**o.L.0=H**) is given when alarms are not active and at the same time both the software and hardware enable:
* The software enable given by state of the connection **C29**, (C29=1 as default).
* The external enable (the function of the input is assigned to the default input L.I.2)

If an enable is missing or an alarm is active, the ready converter signal goes into a non-active state o.L.0=L and this state remains until the causes that brought the alarms are removed and the alarms are reset. An alarm reset can be achieved by activating the function “Alarm reset” that, by default, is assigned to input L.1 (or setting C30=1).
Keep in mind that the “Alarm reset” is achieved by the active front of the signal, not on the active level.

5.1.3.2 Converter Switch On/RUN

When the converter is “Ready to switch on / RUN” o.L.0=H, AFE may start running “Converter switch on/run” o.L.3=H, by activating both the hardware and software switch on enables:
* Function “Logic switch on/RUN input” (default input 4 assigned) RUN=H
* Software switch on/RUN C21 (C21=1) is active by default.

Switch on/RUN disable and enable (from STOP offline, to RUN online) is given by the logic of the following table:

Converter ready o.L.0	Switch on / RUN	C21	ON-LINE
L	X	X	L
H	L	X	L
H	X	0	L
H	H	1	H

It is mentioned that the input function “Switch on/RUN input” can be given also via serial line or field-bus. See for details the Standard Application Manual.

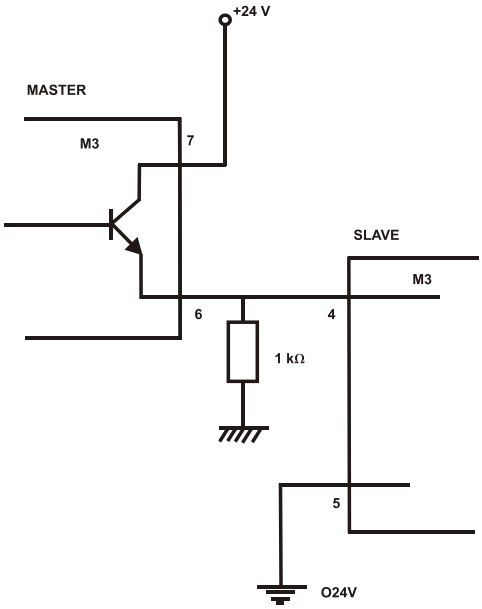
5.1.4 PWM Synchronization

Name	Description	Min	Max	Default	UM	Scale
SYNC_REG_KP	P11 - CanOpen SYNC loop regulator Proportional gain	0	200	5		1
SYNC_REG_TA	P12 - CanOpen SYNC loop regulator lead time constant	0	20000	400		1
PWM_SYNC_OFFSET	PWM offset for SYNC delay control			0	pulses	1
PWM_SYNC_DELAY	D81 - PWM SYNC delay	-400	400	0	us	16
EN_PWM_SYNC	E87 - Enable PWM synchronization	Range		0		1
		0	No			
		1	Master			
		2	Slave			
PWM_SYNC_PHASE	E88 - PWM synchronization phase	-175.0	175.0	0	degrees	10

With this function it is possible to synchronize two or more OPDE at PWM level.
Parameter E87 is used to select the converter function:

1 Master = Every PWM period the third digital output (O3) is configured like PWM synchronization output.

2 Slave = Physical input 8 (I08) is used to synchronize the converter.



In the slave there is a tracking loop with gain Kp (P11) e Ta (P12). It's possible to set also the phase between master and slave with parameter E88.

Note1: Master and slave have to be set with the same PWM frequency (P101)

Note2: If the PWM frequency is great than 5kHz is necessary to use a pull-down 1kΩ resistance 1W.

6 ALARMS

6.1 MAINTENANCE AND CONTROLS

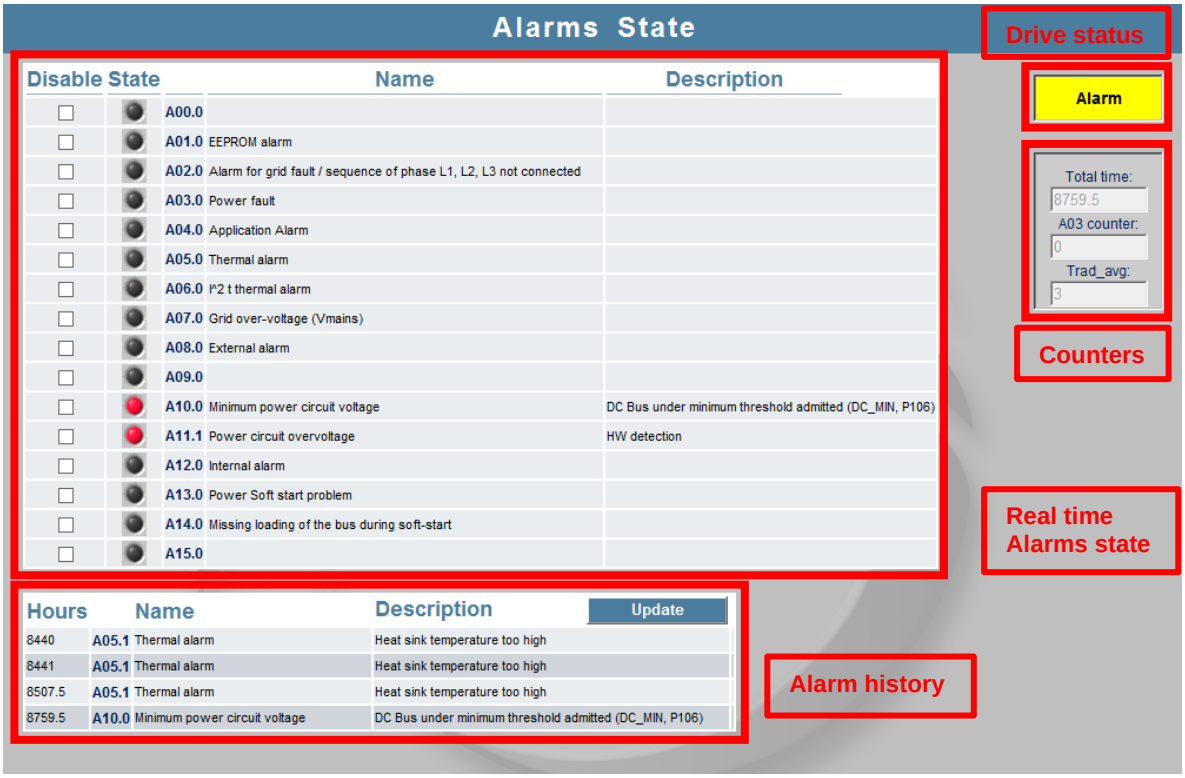
The converter has a range of functions that cut in if there is a fault in order to prevent damage. If a protection function (alarm) cuts in, the converter output phases (U, V, W) are blocked and the DC Bus Voltage is no longer controlled.
If one or more of the protection functions (alarms) cut in, they are signaled on the display, which start to blink and to show a cycle of all the triggered alarms (the 7-segment display shows the alarms that have been set off in hexadecimal).
In case of failure of the converter, or if an alarm is triggered, check the possible causes and act accordingly.
If the causes can not be traced or if parts are found to be faulty, contact TDE MACNO and provide a detailed description of the problem and its circumstances.
The alarm condition indication is divided in 16 categories (A0÷A15) and for each alarm can be presented a code to better identify the alarm condition (AXX.YY)

ALARM			DESCRIPTION	CORRECTIVE ACTION
HEX	DEC			
A.1.0.H	A01.0	EEPROM alarm Read failure	A Check Sum error occurred while the EEPROM was reading the values. Default values loaded automatically.	Try to reread the values with the EEPROM. The reading may have been disturbed in some way. If the problem continues contact TDE as there must a memory malfunction.
A.1.1.H	A01.1	EEPROM alarm Write failure	When data is being written in the EEPROM the required values are always shown afterwards: an alarm triggers if differences are detected.	Try to rewrite the values in the EEPROM. The information may have been disturbed in some way. If the problem continues contact TDE as there must be a memory malfunction.
A2.0 H	A02.0	Alarm for grid fault / sequence of phase L1, L2, L3 not connected	The grid voltage amplitude (D21) read with the synchronization signal is below threshold P50.	If the grid voltage has not been connected to the AFE, this is a normal alarm. Otherwise check the connection on the grid side and the synchronization signals.
A.3.0.H	A03.0	Power fault	The converter output current has reached a level that has set off an alarm; this may be caused by an overcurrent due to leakage in the wires. There may also be a fault on the regulation card or a problem in the synchronization wires.	Check the connection wires on the line side, in particular on the terminals, in order to prevent leakages or short circuits. Check that the connections of the synchronization circuit is correct according to the Installation manual (OPDE_AFE_INSTALLATION).
A.4.0.H	A04.0	Application alarm	This alarm is application specific. Please refer to specific documentation	
A.5.0.H	A05.0	Thermal alarm. Reactor temperature too high	Connection C46 manages a range of heat probes. If C46=1 or 2, a PTC/NTC is being used and its Ohm value (**D41**) has exceeded the safety threshold (**P95).** If C46 = 3 a digital input has been configured to I23 logical input function and this input is in not active state. If C46=4, a KTY84 is being used: the temperature reading (**D26**) must be higher than the maximum temperature (**P91**).	Check the temperature reading in D26 and then check the reactor. With a KTY84, if -273.15 appears the electrical connection towards the reactor heat probe has been interrupted. If the reading is correct and the reactor is overheating, check that the reactor cooling circuit is intact. Check the fan, its power unit, the vents, and the air inlet filters on the cabinet. Replace or clean as necessary. Ensure that the ambient temperature around the reactor is within the limits permitted by its technical characteristics.
A.5.1.H	A05.1	Thermal alarm. Heat sink temperature too high	The heatsink temperature (D25) is higher than the maximum (P118).	Check the temperature read in D25 and then check the heat sink. If -273.15 is displayed, the electrical connection towards the heat sink heat probe has been interrupted. If the reading is correct and the reactor is overheating, check the converter cooling circuit being intact. Check the fan, its power unit, the vents, and the air inlet filters on the cabinet. Replace or clean as necessary. Ensure that the ambient temperature around the converter is within the limits permitted by its technical characteristics. Check parameter P118 is set correctly.
A.5.4.H	A05.4	Thermal alarm. Reactor thermal probe not connected	Thermal probe of the reactor not detected	Check the connection of the probe.
A.5.5.H	A05.5	Thermal alarm. Run with T_heat_sink too high	Run with T_heat_sink > P119	Check the heat sink temperature (D25)
A.7.0.H	A07.0	Grid over-voltage (Vmains)	The grid voltage amplitude (D21) read with the synchronization signal increase over threshold P51.	Grid fault or distribution grid not adequate to the load conditions.

ALARM			DESCRIPTION	CORRECTIVE ACTION
HEX	DEC			
A.8.0.H	A08.0	External alarm. Missing enable logic input from the field (I08)	A digital input has been configured to I02 logical input function and this input is in not at high logic level.	The external safety switch has cut in disabling converter enable. Restore and reset. The connection has been broken. Check and eliminate the fault. Input function has been assigned, but enable has not been given. Authorise or do not assign the function.
A.8.1.H	A08.1	External alarm. Watchdog alarm LogicLab	A LogicLab watchdog alarm on slow cycle appears.	Check if the LogicLab slow task duration is greater than 500 ms and try to reduce this execution time.
A.8.2.H	A08.2	External alarm. Fast task LogicLab too long in execution time	The LogicLab fast task is too long in time	Try to reduce the LogicLab fast task execution time under admitted limit. Please refer to the specific documentation.
A.8.3.H	A08.3	External alarm. Application out of service	There is no valid application running in the converter.	Reload the application using OPDExplorer.
A.A.0.H	A10.0	Minimum power circuit voltage. DC Bus under minimum threshold admitted (DC_MIN, P106)	DC Bus voltage (D24) has dropped below the minimum value (P106).	If the grid voltage has not been connected to the AFE, this is a normal alarm. Otherwise, a grid fault occurred, or the distribution grid is not adequate to the load conditions.
A.B.1.H	A11.1	Power circuit overvoltage. HW detection	DC Bus voltage (D24) has exceeded the HW threshold.	Verify if the parameter P31, P32, P33 are suitable for the application. Check if the power regenerated from the DC Bus to the grid is lower than the maximum regenerating power (P40, P42)
A.B.2.H	A11.2	Power circuit overvoltage. SW detection	DC Bus voltage (D24) has exceeded the threshold P107	
A.B.3.H	A11.3	Power circuit overvoltage. HW + SW detection	A11.0 and A11.1 appears	
A.C.0.H	A12.0	Internal alarm. C29 different from 1	C29 different from 1	Check and enable connection C29 “Converter software enable”
A.C.1.H	A12.1	Internal alarm. Run without power soft start	RUN without Power Soft start	Check why the Power Soft start did not charge the bus
A.C.2.H	A12.2	Run in VSI mode with microgrid external contactor not open	Run in VSI mode with microgrid external contactor not open for microgrid resynchronization	Check that digital signal that switches between CSI and VSI mode via i20 is connected also to i09 (at list in a logical AND) so that when the microgrid is force to work in standalone mode, a request of contractor opening arises to I09
A.C.3.H	A12.3	Mismatch of microgrid external contactor command (O30) versus status (I07)	Mismatch of microgrid external contactor command (O30) versus status (I07) for microgrid resynchronization	Check cablings from converter to external contactor used for microgrid connection to main grid (both for coils and for state contacts); check for possible damage on the external contactor or on the driving stage of the converter
A.E.0.H	A14.0	Missing loading of the bus during precharge	The grid voltage amplitude (D21) read with the synchronization signals is within the allowable range, but the DC Bus has not been precharge.	Check the power connections towards the grid.

6.1.1 Alarm History

The alarms switched on during the normal drive running are saved into the not volatile memory. This alarm history contains all the alarm events happens during drive's life and it's very useful when drive needs a check up after a fault or a malfunction.
These info are available only by supervisor OPDExplorer (click in "Alarms" section). In a typical case it shows:



In the "Real time alarm state" are indicated the actual active alarms and, if they're present, the "Drive status" moves to "Alarm" and lights on in yellow. Every alarm has a description that help to know the cause of it.
Clicking in "Disable" the corresponding alarm is hide and it never switch on again; pay attention that disable an alarm doesn't mean that its cause is fixed.

Every time the drive goes in alarm status the event is reported and saved in the alarms history with its description and the hour of working in which the alarm signal is switch on. There is the possibility to load a trace in the "Real-time graph" in order to plot the main tracks behaviour in the moment of alarm activation. To load these traces move to "Real-time graph", press the "Read Config" icon, back in "Alarms" and click in "Load trace"; now in "Real-time graph" click "download".

In the counters window are saved:

- Number of working hours;
- Number of times A.03 alarm is switched on;
- The average temperature of cooling radiator when drive running.

7 DISPLAY

7.1 PHYSICAL DISPOSITION

The keypad has three buttons, "**S**" (selection), "**+**" (increase), "**-**" (reduce) and a four numbers and half display, with the decimal points and the sign "**-**".

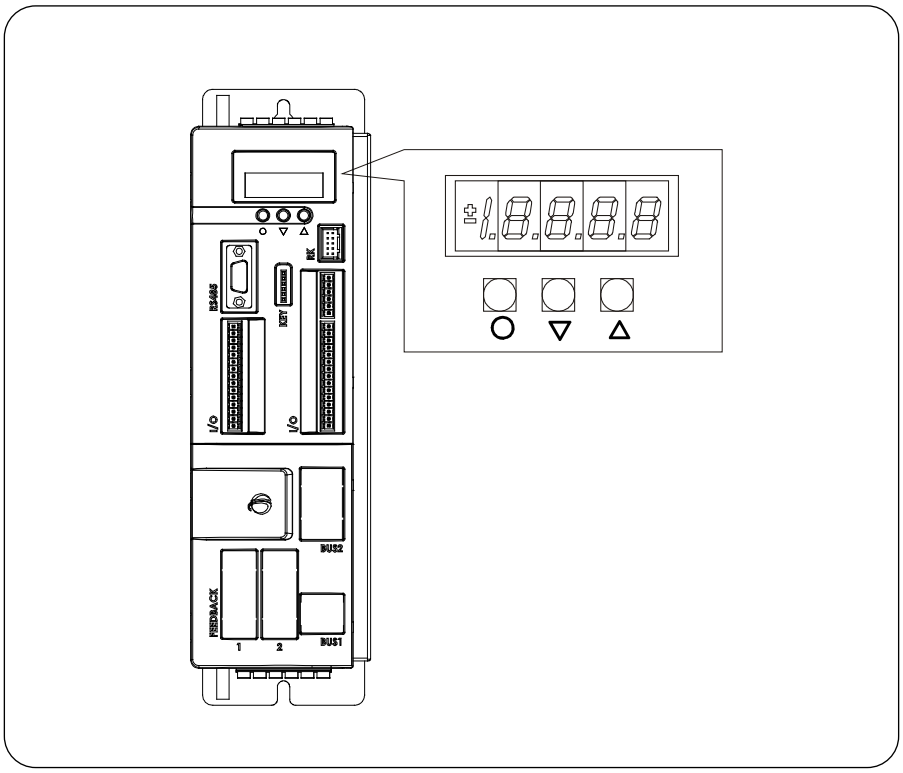


FIG. 1 (Physical disposition)

7.2 LAYOUT OF THE INTERNAL VARIABLES

The converter is a full digital, then other hardware settings are not necessary, if not made in factory, and the setups, settings and visualizations, all digital, they go effect through the keypad and the display, or by serial line or by fieldbus. For easy access of formulations and mnemonics all the accessible variables have been grouped in the following menu:

- Parameters (**PAR**)
- Application Parameters (**APP**)
- Connections (**CON)**
- Internal values (**INT**)
- Alarms (**ALL**)
- Digital Inputs (**INP**)
- Digital Outputs (**OUT**)
- Utilities Commands (**UTL**)
- Fieldbus Commands (**FLB**)

In each group the variables are orderly in progressive order and only those that are actually used.

7.2.1 Parameters (PAR)

They are definite parameters of variables of setting whose numerical value has an absolute meaning (for example: P63 = nominal grid frequency= 50 Hz) or they are of proportional value to the limit range (for example: P61 = reactor nominal current = 100 % of the converter nominal current). They are distinguished in **free** parameters, some modifiable always (Online), other only to converter not in run (offline), **reserved**, modifiable only offline and after access code to the reserved parameters (P60), or **reserved for the TDE MACNO**, visible after having written the access code TDE MACNO parameters (P99) and modifiable only offline. The characteristics of each parameter are recognizable from the **code of identification** as below:

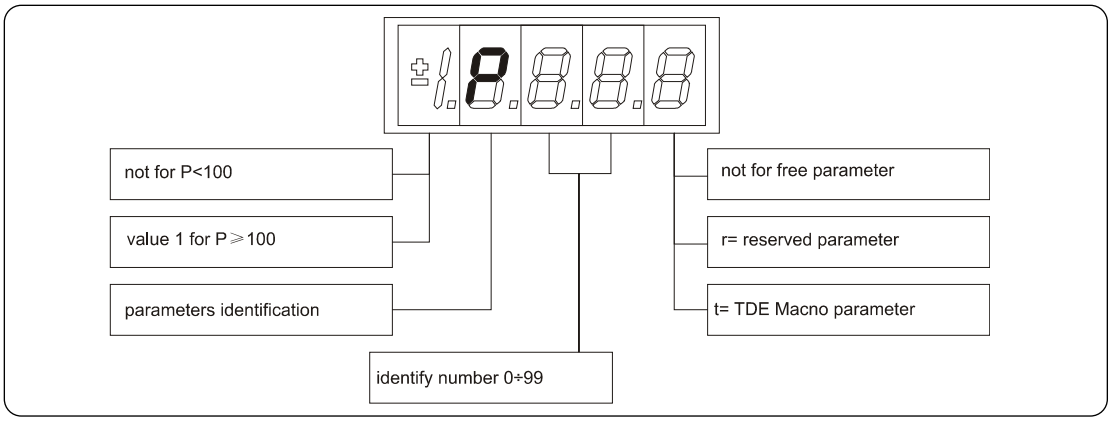


FIG. 2 (Parameters PAR)

For example: P60 r = parameter 60: reserved
1P00 t = parameter 100 TDE MACNO reserved

7.2.2 Application Parameters (APP)

For their definition refer to the description of the parameters. They are distinguished in free parameters, some modifiable always (Online), other only to converter not in run (offline), reserved, modifiable only offline and after access code to the reserved parameters (P60), or reserved for the TDE MACNO, visible after having written the access code TDE MACNO parameters (P99) and modifiable only offline. The characteristics of each parameter are recognizable from the code of identification as below:

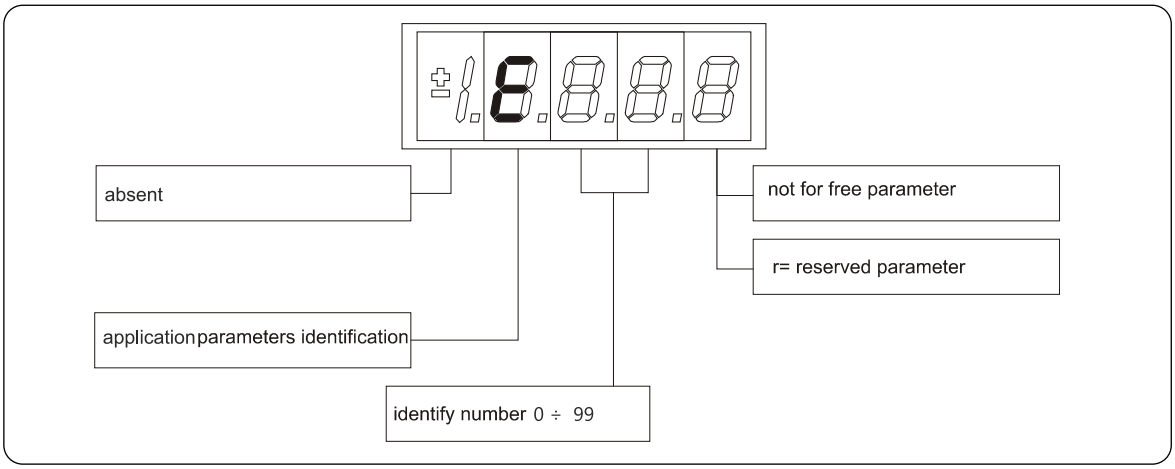


FIG. 3 (Application Parameters PAR)

For example: P60 r = parameter 60: reserved
1P00 t = parameter 100 TDE MACNO: reserved.

7.2.3 Connections (CON)

They are certain connections that dimensions approach that are of numerical value comes connected to a function or a clear command (for example: ramp insertion, C26 = 1; or no ramp, C26 = 0; or save parameters on EEPROM memory, C63 = 1). They are in **free** connections, some of the like modifiable always (Online), other with converter in stop (offline) and **reserved**, modifiable only offline and after access code to the reserved parameters (P60). The characteristics of each connection are individually recognizable of **identification code** as below report.

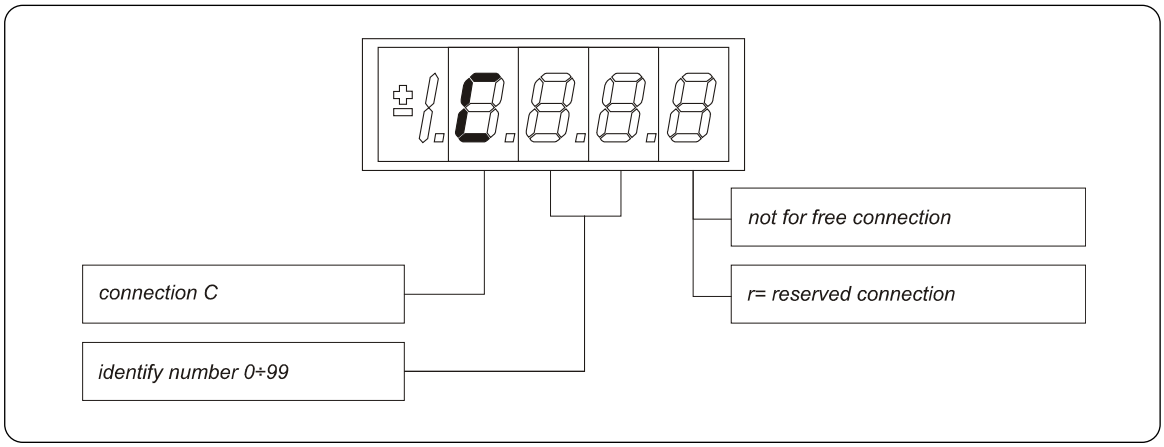


FIG. 4 (Connections CON)

7.2.4 Alarms (ALL)

Overall functions of protection of the converter or in the application whose status to **active alarm** or **non active alarm** it may be visualized in the display. The active protection, stops the converter and does flash the display, excepted if it is disabled. With a single visualization is possible have all the indications with the following:

For ex. **A03.L = power fault doesn't activate**

The alarms are all memorized and so they remain till that is not missing the cause of the alarm and have been resetted (input of resetting alarms activate) or (C30 = 1).

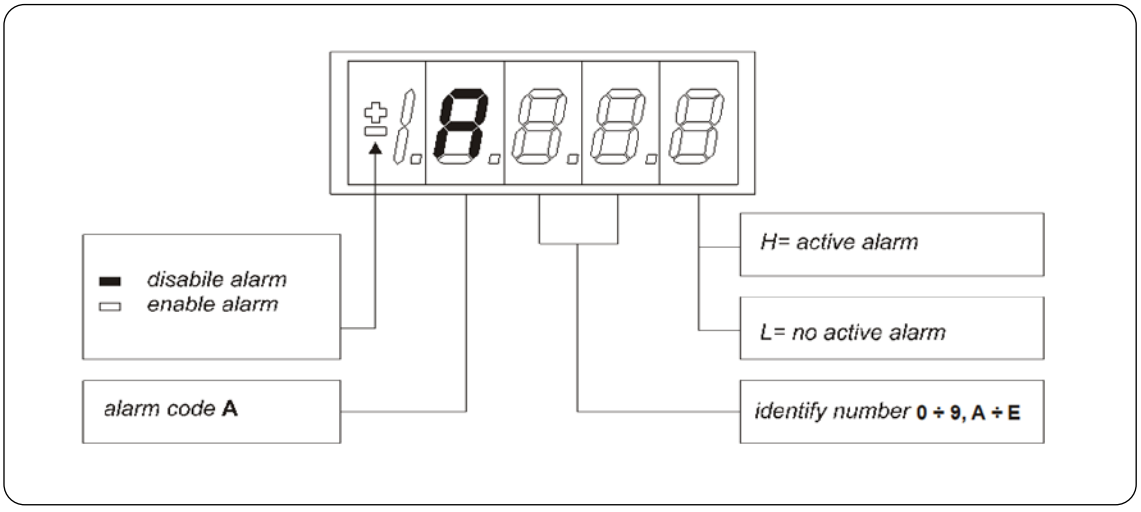


FIG. 5 (Alarms ALL)

7.2.5 Internal Values (INT)

Overall functions of protection of the converter or in the application whose status to active alarm or non-active alarm it may be visualized in the display. The active protection, stops the converter and does flash the display, excepted if it is disabled. With a single visualization is possible have all the indications with the following:

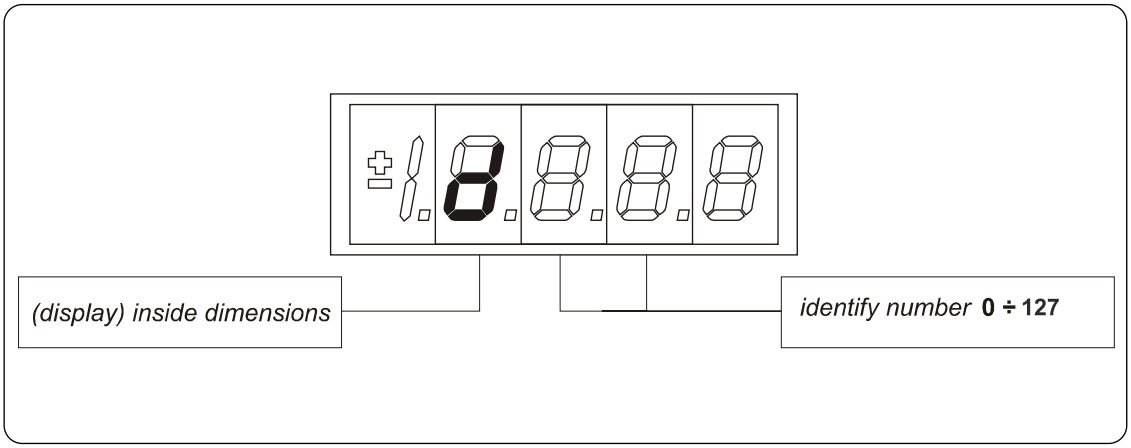


FIG. 6 (Internal Values INT)

7.2.6 Logic Functions of Input (INP)

The visualization between I00 and I28 is the status of the logical functions of sequence or protection that is assigned in the all digital input of the regulation. From I29 to I31 is the visualization of the status of the input from the power. Code of identification (input) logical input.

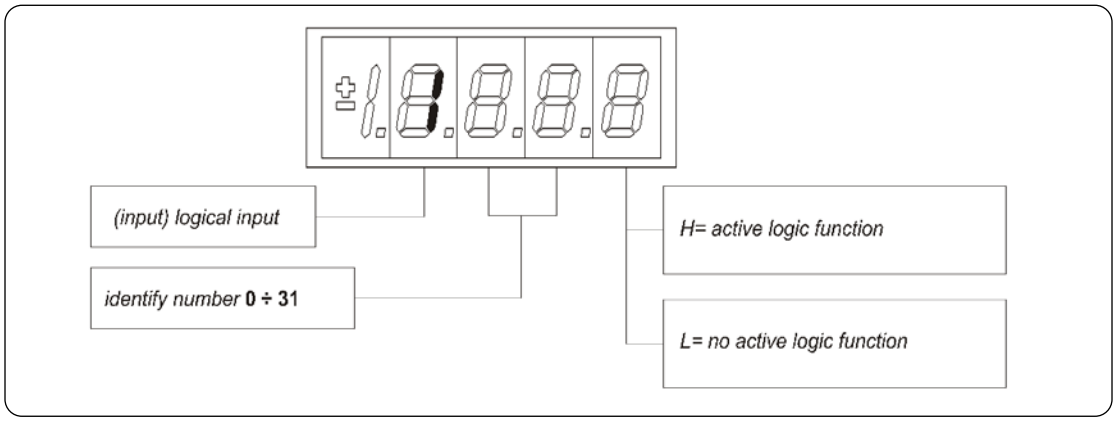


FIG. 7 (Logics functions of input INP)

7.2.7 Logic Functions of Output (OUT)

Visualization of the status, of the logical functions, of protection or sequence (for example: converter ready, converter in run) scheduled in the control, that may or may not be assigned of predicted digital output. Code of identification:

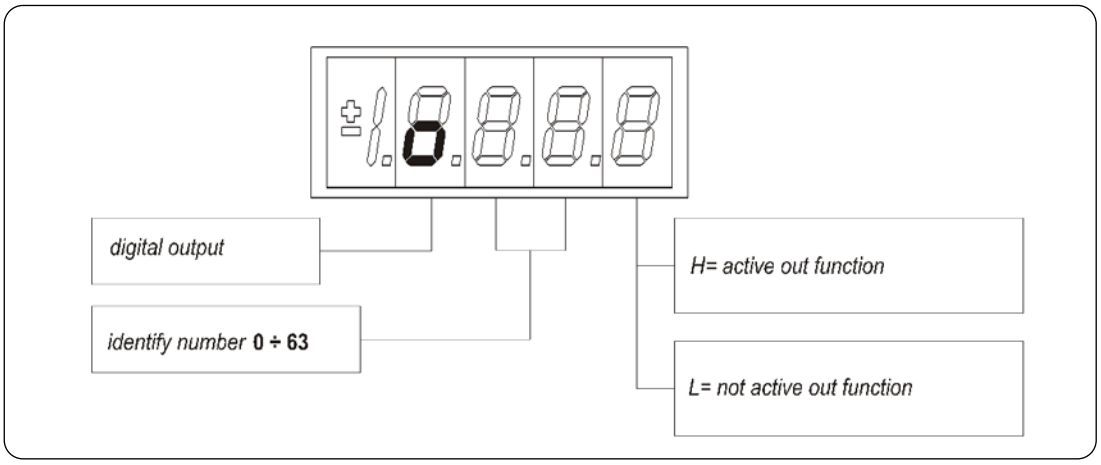


FIG. 8 (Logics functions of output OUT)

7.2.8 Utilities Commands (UTL)

They are certain connections that dimensions approach that are of numerical value comes connected to a function or a clear command. They are only in **free** connections. The characteristics of each connection are individually recognizable of **identification code** as under report:

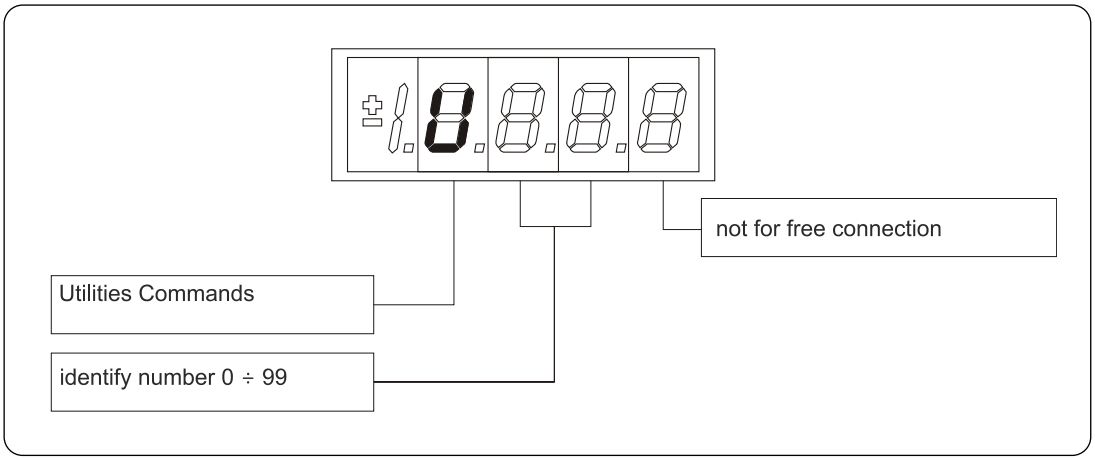
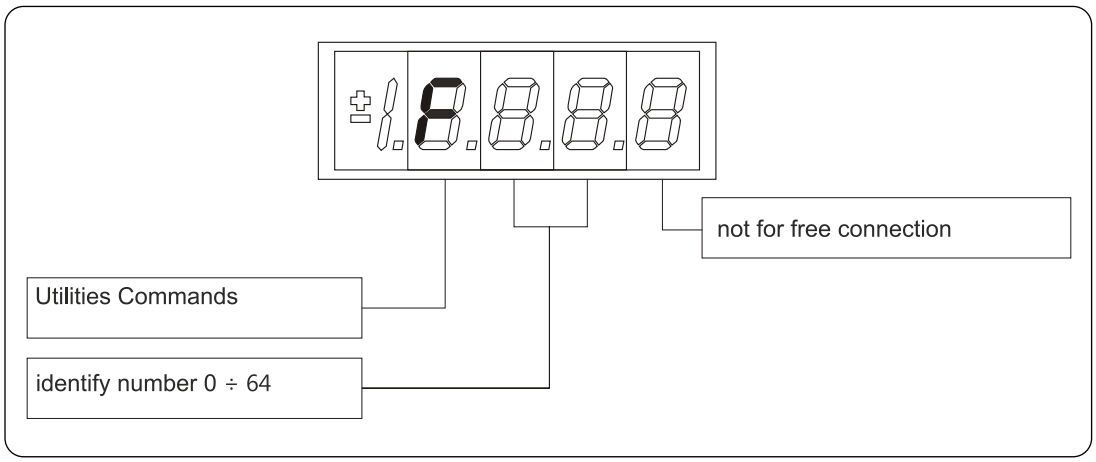


FIG. 9 (Utilities Commands UTL)

7.2.9 Fieldbus Parameters (flb)

FLB menu refers to parameters related to Fieldbuses management that was previously accessible only by OPD Explorer as they weren't associated to any “standard” parameter, connection or extra parameter and so not accessible by keypad. Now they are grouped in this new menu and so they can be viewed and changed (if not read-only) by keypad.

Notice that all parameters in FLB menu are not protected by any key nor by run status so they can be changed at any time. Code of identification:



.

FIG.10 (Fieldbus Parameters)

7.3 IDLE STATE

It is the status that the display assumes right after the lighting or when none is programming (P112 seconds, 10 of default, after the last movement, except that is not is visualizing an internal variables, or an input, or a digital output). When the keypad is on tat the status rest, if the converter is not in run comes visualized “STOP”; if the converter is in run comes visualized the internal variables selected with C00 connection or the status “run”. If the converter finds the status alarm, for intervention of an or more protections, the written on the keypad start to flash and they come visualized all the active alarms (one by one).

7.4 MAIN MENU

Leaving from the status of rest pressing the “S” key the principal menu is gone into of circular type that contains the indication of the type of displayable variables:

PAR = parameters
APP = application parameters
CON = internal connections
INT= internal values
ALL= alarms
INP = digital inputs
OUT = digital outputs
FLB = fieldbus parameters

To change from a list to another, is necessary to use the “+” or “-” buttons and the menu change as depicted in FIG.10. Once select the list you pass on the relative sub-menu pressing “S”; the reentry to the main menu from the following visualizations will be able future through the pressure of the key “S” simple or double in brief succession (less in a second), like showed after. The return to the idle state comes instead automatically after 10 (P112) seconds of inactivity is from some sub-menu that goes by the ain menu.

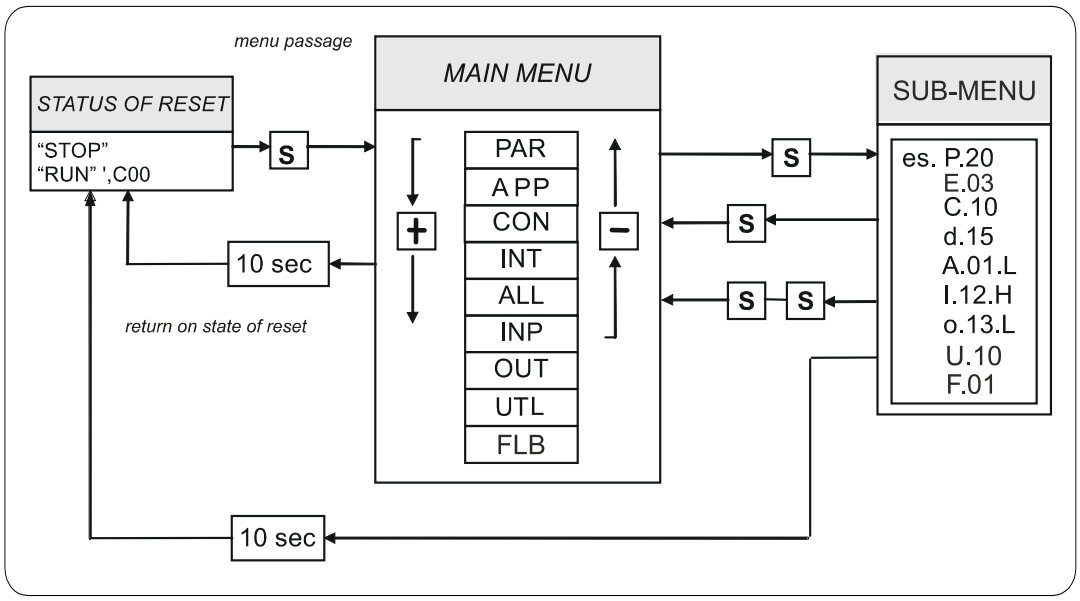


FIG. 10 (Main Menu)

7.4.1 Sub-Menu of Parameters, Application Parameters and Connections Management (PAR, APP and CON)

From "**PAR**" or "**CON**" you enter into the sub-menu list pressing "S"; once entered into the list is able look through the parameters or the existing connections by pressing the keys "**+**" or "**–**" to move in increase or in decrement; even in this case the list is circular. At the number corresponding to the various parameters or connections appear the letter "**r**" if they are reserved, "**t**" if reserved in the TDE MACNO and the letter "**n**" if it modification requires that the converter in not in run (offline); all the reserved parameters are of type "**n**" modifiable only by stop (offline). If You pressed the key "**S**" comes visualized the value of the parameter or of the connection that may be read; at this point repress "**S**" once You return to the sub-menu list, press twice "**S**" in fast succession (less 1 seconds), return to the main menu. The system returns automatically to the status of rest and after 10 seconds of have past inactivity. To modify the value of the parameter or of connection once entered into visualization it necessary press both keys "**+**" and "**–**"; in that moment it starts to flash the decimal point of the first figure to the left warning that from that moment the movement of the keys and "**+**" modifies the value; the change of value may only by stop if the parameter is of kind "**n**" and only after having set up the code of access P60, if the parameter is of the kind "**r**", only after having set up the code of P99 (access for the reserved parameters TDE MACNO), kind "**t**". The parameters and the reserved connections TDE MACNO does not appear in the list if doesn't call the code of P99. Once the value is corrected You press the key "**S**" return to the sub-menu list making operational the parameter or the corrected connection; if after correct the value want go out without change the values wait 10 seconds; if the value is no touched for the exit press again the "**S**" key (it is operative the same original value). About parameters and connections, the return to the status of rest display is in automatically way after 10 seconds from any kind of visualization.

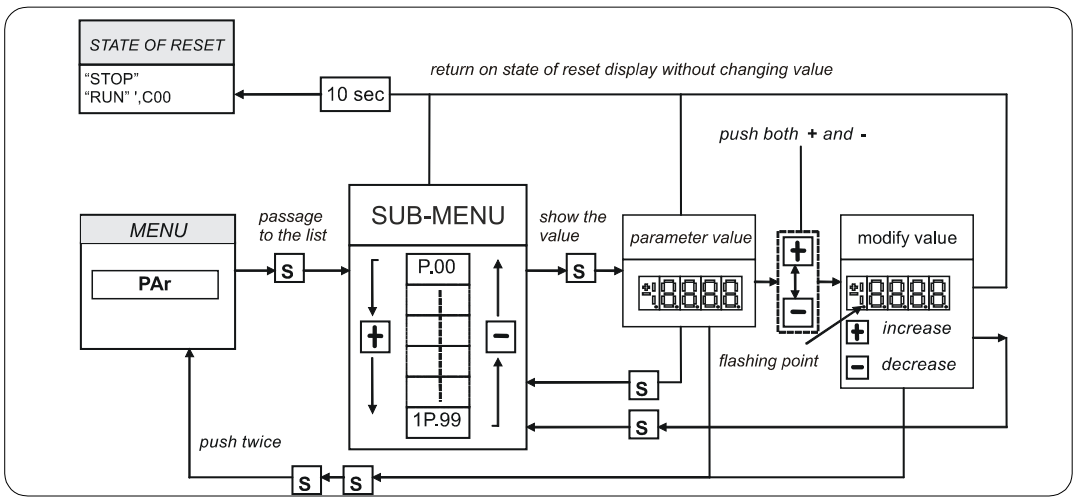


FIG. 11 (Submenu management parameters PAR)

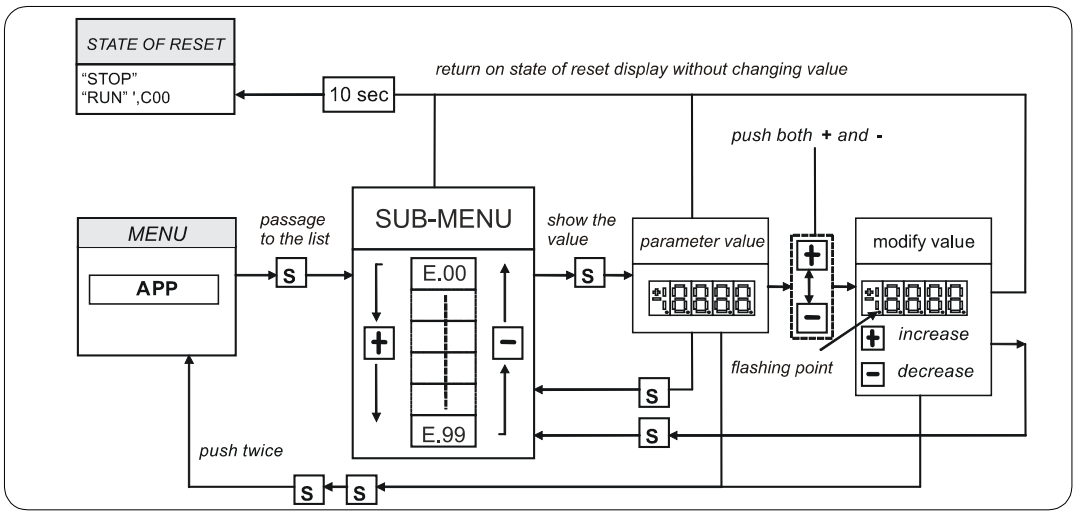


FIG. 12 (Submenu management application parameters APP)

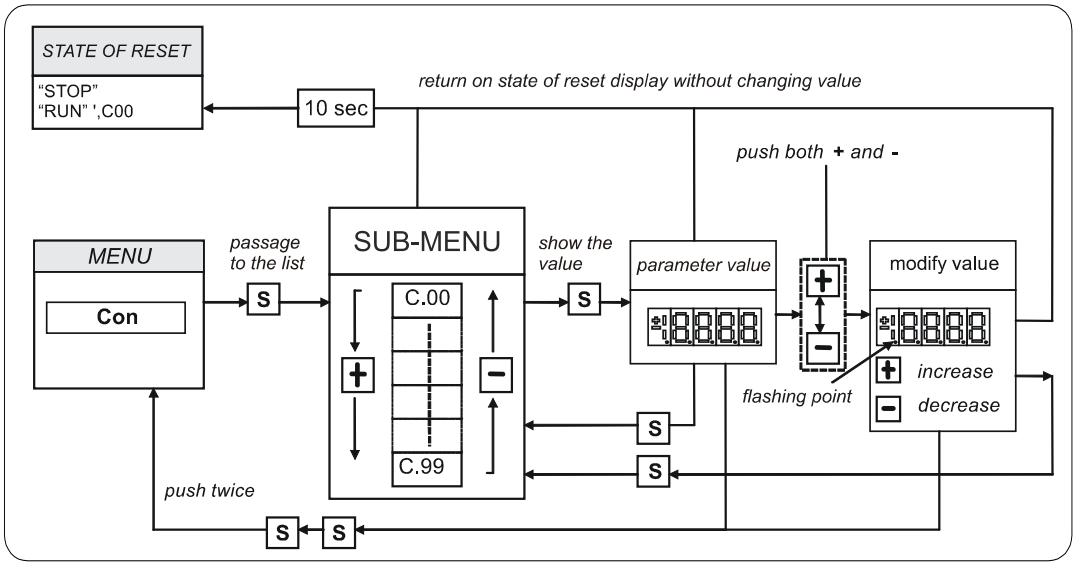


FIG. 13 (Submenu management connections CON)

7.4.2 Visualization of the Internal Values (INT)

From INT You enter into the list of sub-menu of the internal dimensions pressing "S". In the list you are moving with the keys "+" or "–" till that appearing address of dimensions wanted visualize "d x x"; pressing "S" disappears the address and appear the value of the dimension. From this status you go back to sub-menu list, repressing "S", and go again to the main menu repressing "S" twice in fast succession; from the menu and from the sub-menu. You return automatically to the status of rest after a time of 10 seconds.

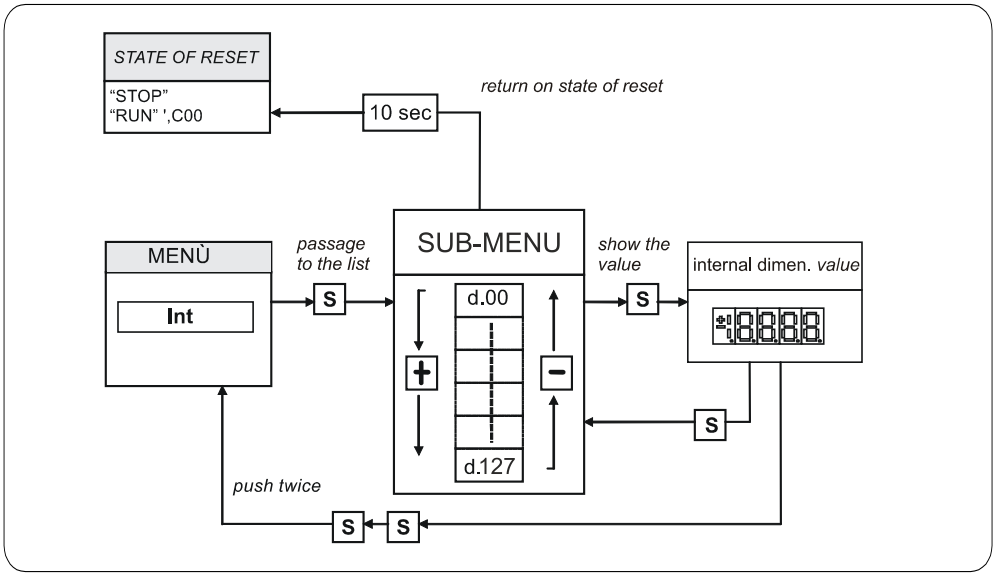


FIG. 14 (Visualization of the internal values INT)

7.4.3 Alarms (ALL)

From ALL you enter into of sub-menu list of the alarms pressing "S". From the corresponding sub-menu with the keys "+" and "–" move all addresses desired for the alarms; with this, in the box to the right, appears the status of the alarm "H" if active, "L" if don't. If the alarm has been disabled; in this case too with the active status doesn't appear any stop of the regulation, the address of the alarm is preceded by the sign "–".

To exclude the event of an alarm You must enter into the menu to modify both the keys "+" and "–" and when the flashing point appears of the first number You can enable or disable the alarm with the keys "+" or "–"; if the alarm is disabled appears the sign the "–" to the left of the writing "A.XX.Y".

From the status of modification returns to the list of sub-menu and You return operative the select made pressing "S", from the menu and from the sub-menu You turn automatically to the status of rest after a time closed to 10 seconds.

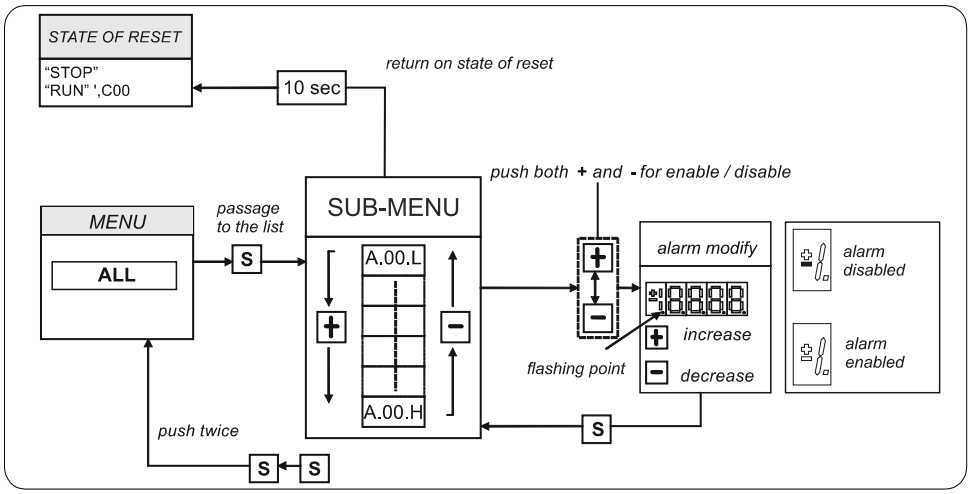


FIG. 15 (Alarms ALL)

7.4.4 Visualization of the Input and Output (Inp and Out)

From the INP or from the OUT You enter into corresponding list of sub-menu pressing "**S**". From the corresponding list of sub-menu with the keys "**+**" and "**–**" move to the address desired for the digital input (i) and the output (o); together to this, in the box, appear the status: "**H**" if activate, "**L**" if not active. From this status You returns to the main menu pressing "**S**".

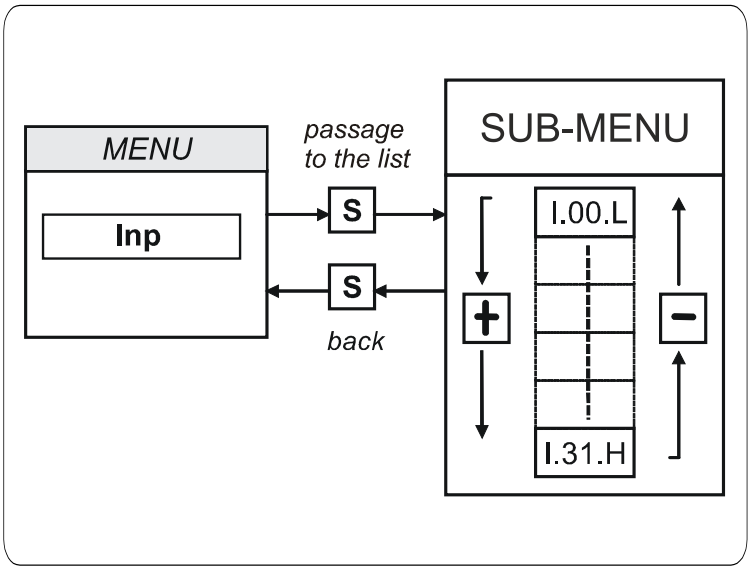


FIG. 16 (Digital input INP)

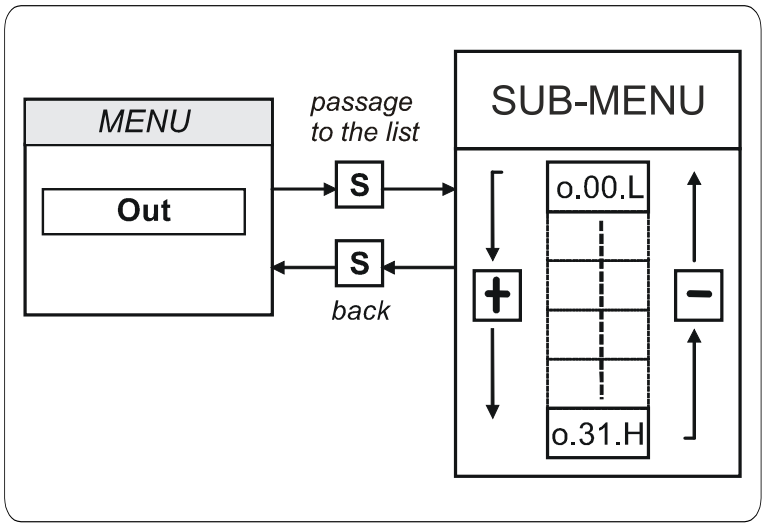


FIG. 17 (Digital output OUT)

7.5 PROGRAMMING KEY

7.5.1 Classic Key

The programming key I2C device allows to back up **all the parameters** of a drive (both Core and Application parameters), in order to upload into others drives or the same if data have been compromises. The data are stored in a EPROM type memory, so **battery backup is not necessary**. In this device is possible to save **only one parameters recipe at a time**, so a second saving data leads an overwriting of previous parameters; the switch put on the key upper front side allows to protect the stored data against possible writing procedures.

FIG.18 (key)

Use method

Parameters transmission from drive to key:

- Insert the key into the suitable slot with the correct way (otherwise it's not read);
- Select the "**SAvE**" function with the buttons ▼ and ▲ located on the keyboard of the drive and push "●" as confirm.

FIG. 19

If the security switch is in " 🔒 " position the command is stopped and the warning "**Prot**" is displayed for 4s.
Otherwise all the parameters is transferred and the "**runn**" notice is displayed, then the message "**donE**" will be shown for 2s as memorization confirm.

Parameters transmission from key to drive:

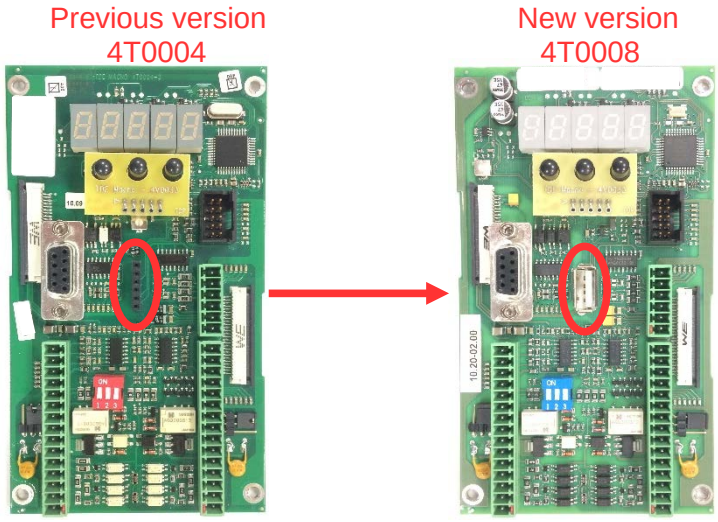
- Insert the key into the suitable slot with the correct way (otherwise it's not read);
- Open the reserved parameter key with **P60=95**;
- Select the "**LoAd**" function with the buttons▼ and ▲ located on the keyboard of the drive and push "●" as confirm;
- Set **C63=1** to save the new parametrization permanently, switch off and switch on the regulation supply to make it operative.

FIG.20

During the data transfer the message "**runn**" is displayed, then the "**donE**" notice will be shown for 2s as memorization confirm.
If the programming key contains not compatible parameters with Core and Application firmware of the drive the warning "n.CPt" will be displayed for 4s; instead, if they are invalid the warning "Err" will be shown for 4s. Both this cases have as effect the load of the factory preset parameters.

7.5.2 USB Key

The **274T0008** is the **new display/keypad + I/O board** for OPDE drives, that replaces previous 274T0004. As before, the display/keypad board of OPDE has its own micro-controller and firmware, that manages the operator interface and implements a ModBus master to communicate with the OPDE control board by a internal serial line.
The main difference to the previous boards is related to "parameters key" interface. The old boards support only the TDE MACNO, custom made, Parameters Key that was based on EEprom type non-volatile memory and I2C interface bus.
The new board supports **USB 2.0** flash drive that's based on Flash type non-volatile memory and USB interface bus.
When USB key is enabled, OPDE acts like an USB Host for **MSD** (Mass Storage Device).



Using a standard USB flash drive carries to some great advantages:

- ❒ they are manufactured by multiple suppliers nor only by TDE MACNO, so they are widely available, all over the world;
- ❒ they are cheap;
- ❒ they are based on consolidated, reliable memory storage technology and they use the USB (Universal Serial Bus) that's also a standard, well known interface, already present in every Personal Computer build in the last 20 years;
- ❒ they are familiar and commonly used by all people that already use a PC;
- ❒ they are available in a wide range of memory capacity, from few MBs to several GBs;
- ❒ they use standard data organizations ("File Systems" like FAT16 and FAT32) to store data in form of tree structured folders and data files;
- ❒ they allow to store into one pen-drive until to 10 parameter recipes, 10 core firmware and 10 application firmware;
- ❒ they allow to have a full back up of a drive (firmware + parameters);
- ❒ the USB port is available even if the internal connection with the drive control board is missing and also if the drive control board is in "**boot**" state due to a previously aborted/incomplete firmware download;
- ❒ they allow to have a direct connection to a PC without any specific interface converter; with a HUB USB it's also possible connect more than one drive in the same time (it's not possible connect more than one pen-drive).

A brand new menù "**USb**" (not available remotely via OPDExplorer) is provided to enable and manage all the functionalities related to the USB key interface. The USB menu is not available only during the upload/download of the core/application firmware started from another source (like OPDExplorer and RS485 serial interface).

7.5.2.1 SPECIFICATION

Following specifications are only related to the new USB interface, as all other are equal to the previous board.

Connector	USB Type-A receptacle
Power supply voltage	5 Vdc ± 5% (supplied only when USB interface is enabled)
Power supply current	limited to 390 mA ± 10%

Interface communications	USB 2.0-compliant, Low Speed (1.5 MBps) and Full Speed (12 MBps)
Supported profiles	MSD Host, CDC Device(1)
Supported file systems	FAT12, FAT16, FAT32

USB key functions	store parameters to key (up to 10 "slots") load parameters from key load only core parameters from key load only application parameters from key upload core and application firmware to key (up to 10 "slots") download core and application firmware from key download only core firmware from key

7.5.2.2 OPERATIONS

The USB bus is physically 1 to 1, where a "downstream" USB port of an apparatus is connected directly or through a cable to the "upstream" USB port of another apparatus; among other relevant differences, downstream port also carries power supply while upstream port can drain that power supply (or not if the apparatus is self-powered).
USB apparatus are distinct into "**Hosts**" (with downstream USB port) and "**Devices**" (with upstream USB port).
A single USB Host can be connected to multiple USB Devices using one or more USB Hubs, without a violation of the 1 to 1 rule, because the HUB USB has the main function to routing the messages flowing through his upstream port to the appropriate downstream port, allowing a star-like connected bus.

The USB interface implemented into OPDE is called **"Dual Role"** interface as it can act both like a Host or a Device:

- ❒ it's a **Host** when connected to a USB flash drive: its downstream port supplies power to the flash drive and sends commands to it in order to access to the data stored into the flash memory.
  The simplified Host implemented is **limited to management of just only 1 MSD Device**: USB Hub connection is not supported, so attach an USB flash drive directly.
  Connection of USB Hosts or Devices other than MSD class was not fully tested and then can lead to unexpected results: please avoid them.

- it's a **Device** when connected to a PC: its upstream port receives commands from the PC in order to exchange communication data.
  As the downstream port from the PC also carries power supply, please **be sure that the OPDE USB Host interface is not enabled (S.00=0) prior to connect to PC**; if not, short circuits can happens between the 5V USB power supply of both interfaces resulting in damage of the USB port of the PC or the OPDE or both.
  As a Device, it can be connected to the downstream port of an USB Hub (one PC connected with more than one drive).

7.5.2.3 MENU USB

"**USb**" menu contains the commands related to the USB interface.

Name	Description	Min	Max	Default	Notes
S.00	enable USB Host interface	0	1	0(2)	when enabled, the 5V power supply is present on USB connector
S.01(1)	store core and application parameters to key slot #	0	10	0(3)	valid slot # are 1 up to 10 0 will abort the command
S.02(1)	load core and application parameters from key slot #	0	10	0(3)	valid slot # are 1 up to 10 0 will abort the command
S.03(1)	load only core parameters from key slot #	0	10	0(3)	valid slot # are 1 up to 10 0 will abort the command
S.04(1)	load only application parameters from key slot #	0	10	0(3)	valid slot # are 1 up to 10 0 will abort the command
S.05(1)	upload core and application firmware to key slot #	0	10	0(3)	valid slot # are 1 up to 10 0 will abort the command
S.06(1)	download core and application firmware from key slot #	0	10	0(3)	valid slot # are 1 up to 10 0 will abort the command
S.07(1)	download only core firmware from key slot #	0	10	0(3)	valid slot # are 1 up to 10 0 will abort the command

Notes: (1) command is available only when a compatible MSD device is connected to the USB Host interface.
(2) cammand value auto reverts to 0 if a compatible MSD device is missing for longer than 30 s.
(3) command value auto reverts to 0 after execution.

Remember that "**USb**" menù is not available remotely via OPDExplorer and during the upload/download of the core/application firmware started from another source (like OPDExplorer and RS485 serial interface).

7.5.2.3.1 ENABLING USB HOST INTERFACE – CONNECTION OF A PEN-DRIVE

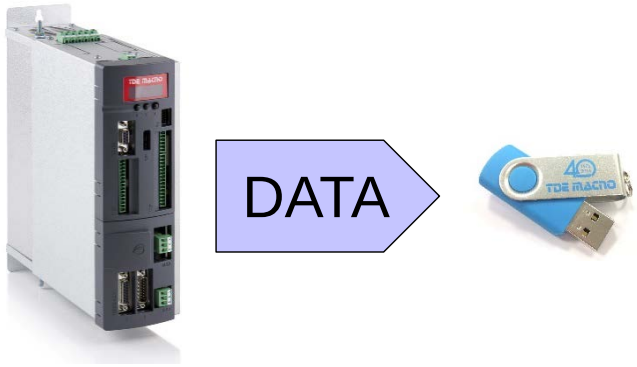
Before connecting a pen-drive in the menù is available only the command **S.00=0** (default).
Set **S.00=1** to enable the USB Host interface: the power supply is applied to the USB connector and then a pen-drive can be connected and recognized by the OPDE; if a MSD Device is not recognized within 30 seconds from the enabling or after removing another already recognized MSD Device, the command S.00 is automatically reverted to 0, disabling USB Host interface and switching off the power supply on USB connector. This is done for avoiding USB power supply to be present on USB connector when not necessary, preventing possible power supply short circuit in case of direct connection with a PC.

A connected Device is correctly recognized only if it's a MSD class device formatted using the File System **FAT 32** bit version (recommended choice). At the first connection of a pen-drive the OPDE create the path **\TDEMACNO\OPDE** that's used as **working directory**; this operation can last for several seconds during which the Operator Interface is freezed.

Only after all is ready the USB menu is populated with the other commands **S.01÷S.07** and they will be **disable when the pen-drive will be remove or will be set S.00=0**.
It's possible store until to 10 files for type (firmwares, applications, parameters) appointed by a number (slot #); chosing a different value for the commands S.01÷S.07 (value from 1 to 10) it's possible decide from what slot # take the file, saved into **\TDEMACNO\OPDE** directory, to complete the selected operation.
Setting the value 0 will abort the command.

7.5.2.3.2 STORE “CORE” AND “APP” PARAMETERS

Name	Description	Min	Max	Default	Notes
S.01(1)	store core and application parameters to key slot #	0	10	0(3)	valid slot # are 1 up to 10 0 will abort the command



OPDE parameters are divided into 2 sets: “core” parameters and “application” parameters; “core” parameter are those contained into PAR, CON and FLB menues, while “application” parameters are those into APP menu (“base” application parameters from E00 up to E99 and “extended” application parameters from E100 up to E599).

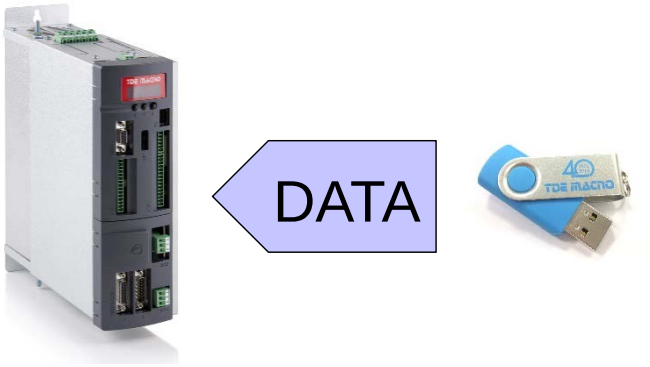
Command **S.01** stores **all the OPDE parameters** to the flash drive; the data are stored into the flash drive working directory in a file named **RCPxx_cc.cc_aa.aa_.MRA** where **xx** is the slot # number choosed by parameter S.01, **cc.cc** is the firmware “core” version and **aa.aa** is the firmware “app” version. The **MRA** file name extension identifies the custom file format (Modbus Register Ascii) used for storing the parameters recipe and the version of core and application firmware was added for better identification of the recipe when the file is accessed by a PC.
The user can further personalize the file name adding a comment before the final .MRA extension:
example: RCP01_**E13358**.MRA.
The only rule to respect is that the “RCPxx_” radix and the latest “.MRA” extension must be maintained in order to let the keypad correctly manage the file.

Each slot # can contains only one file, so it’s possible create until to 10 file of this kind: from **RCP01_cc.cc_aa.aa_.MRA** to **RCP10_cc.cc_aa.aa_.MRA**.

Warning: if to store a recipe the slot # selected is already used by an other file, the last one will be overwrite and the data that this file contains will be lost.

7.5.2.3.3 LOAD “CORE” AND “APP” PARAMETERS

Name	Description	Min	Max	Default	Notes
S.02(1)	load core and application parameters from key slot #	0	10	0(3)	valid slot # are 1 up to 10 0 will abort the command
S.03(1)	load only core parameters from key slot #	0	10	0(3)	valid slot # are 1 up to 10 0 will abort the command
S.04(1)	load only application parameters from key slot #	0	10	0(3)	valid slot # are 1 up to 10 0 will abort the command



Parameters recipe can be loaded from the flash drive into the OPDE by using commands **S.02÷S.04**: the value setted will choose the recipe slot # to load from (choosing slot “0” will result in no operation). The difference between the commands is related to the kind of parameters loaded: S.02 loads both core and application parameters, S.03 loads only core parameters while S.04 loads only application parametes.

Recommanded sequence of operation to load parameters:

- unlock suitable keys **P60=95** (access to reserved parameters) and/or **P99** (access to TDEMacno reserved parameters);
- load parameters recipe (core, application or both) by **S.02÷S.04**;
- save parameters to non volatile memory by **C63=1**;
- switch off 24V power supply of OPDE and wait till it turn off, then switch it on.

During the execution of these commands the display will show **«runn»** and if succesfully executed, the display will show **«donE»** for 10s (after the completion of command, the command value is automatically reverted to 0).

There are a variety of situations and problems that can happen and that prevent a correct execution of the command: in these cases the display will show a message (for 10s) that indicates the cause of failure:

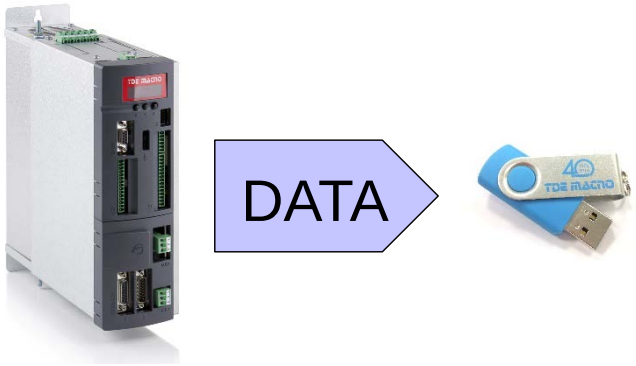
Error code	Description	Action
Prot	trying to store parameters recipe on flash drive that is write protected (“wp” file found in working directory)	use another flash drive / remove “wp” file from working directory
E.0.1.0	generic error during flash drive presence checking or write protection checking	retry / check the flash drive integrity / use another flash drive
E.3.3.3	OPD EXP control board modbus address not found	retry / retry after power cycle
E.5.4.1	communication error retrieving OPD EXP parameters map	retry
E.4.4.1	communication timeout retrieving OPD EXP parameters map	retry
E.1.5.0	error reading recipe file from flash drive (include file system errors, recipe file not found, recipe file format error)	retry / check the flash drive / check the recipe file
n.C.C	Not Compatible Core version between OPD EXP and recipe file to load	use a recipe file, created with a compatible core / change the firmware core to a compatile one
n.C.A	Not Compatible Application version between OPD EXP and recipe file to load	use a recipe file, created with a compatible application / change the firmware application to a compatile one
E.6.5.3	communication error setting OPD EXP parameters (C1-C8 reset)	retry
E.4.5.3	communication timeout setting OPD EXP parameters (C1-C8 reset)	retry

Error code	Description	Action
E.6.5.5	communication error setting OPD EXP parameters (PAR, CON, APP base)	retry
E.4.5.5	communication timeout setting OPD EXP parameters (PAR, CON, APP base)	retry
E.6.5.6	communication error setting OPD EXP parameters (FLB, APP extended)	retry
E.4.5.6	communication timeout setting OPD EXP parameters (FLB, APP extended)	retry
E.5.6.1	communication error retrieving OPD EXP parameters (PAR, CON, APP base)	retry
E.4.6.1	communication timeout retrieving OPD EXP parameters (PAR, CON, APP base)	retry
E.5.6.2	communication error retrieving OPD EXP parameters (FLB, APP extended)	retry
E.4.6.2	communication timeout retrieving OPD EXP parameters (FLB, APP extended)	retry
E.2.6.5	error writing recipe file to flash drive (file system errors, including errors in deleting existing recipes with same RCPxx_ radix)	retry / check the flash drive integrity / use another flash drive

Supervisor OPDExplorer allow to import/export **MRA** files into a pen-drive.
For example, after loaded a parameters recipe into a pen-drive, then connected the pen-drive to the PC, it's possible import the recipe in OPDExplorer ("**Parameters/Import from MRA file**") and print a file **.txt** ("**Parameters/Export to text file**") or save a **.TCN** file.
On the contrary starting from a **.TCN** file with the OPDExplorer is possible to export a **.MRA** file ("**Parameters/Export to MRA file**") **paying attention to save it with a valid name** into the working directory **\TDEMACNO\OPDE**.

7.5.2.3.4 STORE "CORE" AND "APP" FIRMWARE

Name	Description	Min	Max	Default	Notes
S.05(1)	upload core and application firmware to key slot #	0	10	0(3)	valid slot # are 1 up to 10 0 will abort the command



OPDE firmware is divided in 3 parts: the "bootloader", the "core" and the "application".
The bootloader is a part of firmware that's always present (and that can't be changed/updated by the user) into the internal flash memory of the OPDE control board: it allows the download and upload of the other 2 parts of firmware using a serial interface.

An new bootloader version was developed and released to strongly enhance performances: when used with 274T0008 the uploading and downloading execution time will be greatly reduced and also an additional data integrity check will be done on the downloaded firmwares.

Firmwares ("core" and "app" together) are stored into the flash drive working directory in 2 separated files named **CORExx_cc.cc_.LDR** and **APPxx_aa.aa_.LDR** where **xx** is the slot # number choosed by parameter **S.05**, **cc.cc** is the firmware "core" version and **aa.aa** is the firmware "app" version. The **LDR** file name extension identifies the hystorical file format (LoaDeR file) used by TDE MACNO for storing the firmware.
The user can further personalize the file name adding a comment before the final .LDR extension:
example: CORE01_12.22_**E13358**.LDR and APP01_00.26_**E13358**.LDR.
The only rule to respect is that the "CORExx_" or "APPxx_" radix and the latest ".LDR" extension must be maintained in order to let the keypad correctly manage the file.

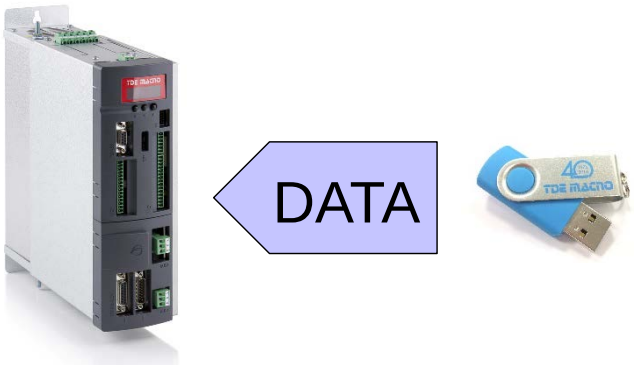
Each slot # can contains only one file, so it's possible create until to 10 file of this kind: from **CORE01_cc.cc_.LDR** to **CORE10_cc.cc_.LDR** and from **APP01_aa.aa_.LDR** to **APP10_aa.aa_.LDR**.

Warning: if to store a recipe the slot # selected is already used by an other file, the last one will be overwrite and the data that this file contains will be lost.

7.5.2.3.5 LOAD "CORE" AND "APP" FIRMWARE

Name	Description	Min	Max	Default	Notes
S.06(1)	download core and application firmware from key slot #	0	10	0(3)	valid slot # are 1 up to 10 0 will abort the command
S.07(1)	download only core firmware from key slot #	0	10	0(3)	valid slot # are 1 up to 10 0 will abort the command

Firmware can be downloaded from the flash drive into the OPDE by using commands **S.06** or **S.07**: the value setted will



choose the firmware slot # to load from (choosing slot "0" will result in no operation). The difference between the commands is related to the kind of firmware downloaded: S.06 downloads both core and application firmware, S.07 downloads only core firmware.
Please notice that LogicLab compiles applications to be used with a specific version of core firmware (in order to grant the matching of internal variables and resources) so you can think that an application firmware executable is really bound to a specific version of core firmware. That's why we suggest to download both core and application in a single operation.

During the execution of these commands the display will initially show "**runn**" and then (as execution takes several seconds) a progression index like:

- "**uP.nn**" where **nn** goes from 00 up to 99 for upload;
- "**dL.nn**" where **nn** goes from 00 up to 99 for download.

If successfully executed, the display will show "**donE**" for 10s and after the completion of command, the command value is automatically reverted to 0.

There are a variety of situations and problems that can happen and that prevent a correct execution of the command: in these cases the display will show a message (for 10s) that indicates the cause of failure:

Error code	Description	Action
Prot	trying to upload firmware on flash drive that is write protected (“wp” file found in working directory)	use another flash drive / remove “wp” file from working directory
E.9.7.x	unable to activate OPD EXP boot mode	retry / retry after power cycle
E.5.7.x	communication error retrieving OPD EXP parameters during boot mode activation	retry / retry after power cycle
E.6.7.x	communication error setting OPD EXP parameters during boot mode activation	retry / retry after power cycle
E.4.7.x	communication timeout during boot mode activation	retry / retry after power cycle
E.2.8.2	error accessing or writing application firmware file to flash drive (file system errors, including errors in deleting existing files with same APPxx_ radix)	retry / check the flash drive integrity / use another flash drive
E.2.8.5	error accessing or writing core firmware file to flash drive (file system errors, including errors in deleting existing files with same CORExx_ radix)	retry / check the flash drive integrity / use another flash drive
E.C.8.0	OPD EXP refuses firmware uploading	
E.2.8.8	error writing firmware file to flash drive (file system errors)	retry / check the flash drive integrity / use another flash drive
E.5.8.x	communication error reading bootloader registers during firmware uploading	retry
E.6.8.x	communication error writing bootloader registers during firmware uploading	retry
E.4.8.x	communication timeout during firmware uploading	retry
E.7.9.1	error opening firmware file (file system errors)	retry / check the flash drive integrity / check firmware file / use another flash drive
E.7.9.2 **E.7.9.5**	error reading data block from firmware file (include file system errors, format errors)	retry / check the flash drive integrity / check firmware file / use another flash drive
E.7.9.3	firmware file format error: unsupported starting address	check firmware file
E.7.9.4	firmware file format error: no data at starting address	check firmware file
E.7.9.6	firmware file format error: data present at unsupported address	check firmware file
E.7.9.7	firmware file format error: CRC in file doesn't match	check firmware file
E.1.9.4	error opening application firmware file (file system errors, including file not found)	retry / check the flash drive integrity / check application firmware file / use another flash drive
E.1.9.6	error reading data block from application firmware file (include file system errors, format errors)	retry / check the flash drive integrity / check application firmware file / use another flash drive
E.1.9.9	error opening core firmware file (file system errors, including file not found)	retry / check the flash drive integrity / check core firmware file / use another flash drive
E.1.9.B	error reading data block from core firmware file (include file system errors, format errors)	retry / check the flash drive integrity / check core firmware file / use another flash drive
E.B.x.y	bootloader error register code xy (hex) during firmware downloading	retry
E.5.9.x	communication error reading bootloader registers during firmware downloading	retry
E.6.9.x	communication error writing bootloader registers during firmware downloading	retry

Error code	Description	Action
E.4.9.x	communication timeout during firmware downloading	retry
E.A.A.5	unable to exit OPD EXP boot mode	power cycle
E.5.A.x	communication error reading bootloader registers quitting boot mode	power cycle
E.6.A.x	communication error writing bootloader registers quitting boot mode	power cycle
E.4.A.x	communication timeout quitting boot mode	power cycle

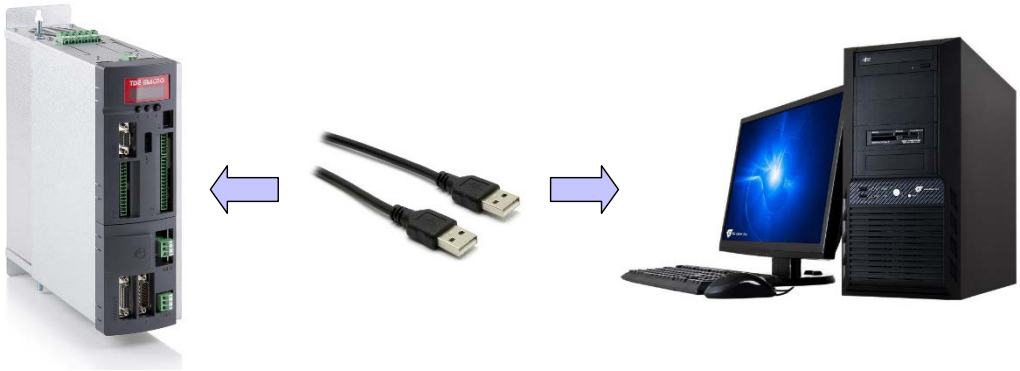
Warning:
Loading the firmware the control board of the OPDE is fully busy, so we suggest to power off the main voltage of the drive before these operations.

Warning: currently is not possible view what is saved into the slot # by the OPDE display, so, in order to avoid error, **we suggest to have a note of what and where has been saved into the pen-drive** or **verify it by the PC before these operations**.

7.5.2.4 CONNECTION TO PC

OPDE can be directly connected to a PC using an “A to A” type USB cable without any specific interface converter like OPDExplorer and RS485 serial interface. In this case the OPDE acts like an USB Device with **CDC** (Communication Device Class) profile, emulating an UART (Universal IM Receiver/Transmitter) that's seen as a virtual COM port on the PC.

Warning: for safety, before doing the connection please check that the OPDE USB Host interface is disabled (**S.00=0**) because, if not, short circuits can happens between the 5V USB power supply of both interfaces resulting in damage of the USB port of the PC or the OPDE or both.

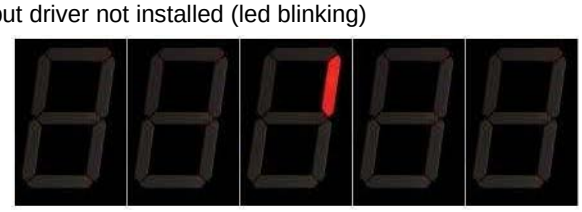


At the first connection the Operative System of the PC will ask for a driver that are powerd by TDE Macno with the .inf file (that's good for both 32 and 64bit Windows OSes) and that can be downloaded by the website www.bdfdigital.it a the voice **PRODUCTS/DOWNLOAD/UTILITY SW**, folder **DRIVER_USB_4T0008.zip**.
When driver has been installed the OPDE will be seen as a new COM port.

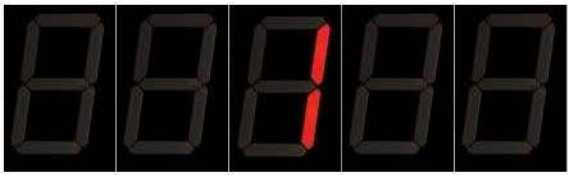
When a PC is directly connected to the OPDE, the Operator Interface is not working as the internal serial link is used exclusively for data communication with the PC.
For the same reason **speed is 38400 bps and Modbus address is 1** (regardless to settings in parameters P92 and P93) and can't be changed.

Here below are illustrated the only messages that the display can show:

- OPDE connected to PC but driver not installed (led blinking)



- Driver installed and OPDE connected to PC (led blinking)



- During the data transfer the two led on the left blinking more slowly than the two on the right

8 LIST OF PARAMETERS

Name	Description	Min	Max	Default	UM	Scale
KP_AI1	P01 - Corrective factor for analog reference 1 (AUX1)	-400.0	400.0	100		10
OFFSET_AI1	P02 - Corrective offset for analog reference 1 (AUX1)	-100.0	100.0	0	%	163.84
KP_AI2	P03 - Corrective factor for analog reference 2 (AUX2)	-400.0	400.0	100		10
OFFSET_AI2	P04 - Corrective offset for analog reference 2 (AUX2)	-100.0	100.0	0	%	163.84
KP_AI3	P05 - Corrective factor for analog reference 3 (AUX3)	-400.0	400.0	100		10
OFFSET_AI3	P06 - Corrective offset for analog reference 3 (AUX3)	-100.0	100.0	0	%	163.84
DC_BUS_REF	P08 - DC Bus Voltage Reference	30.0	1200.0	650.0	V	10
GRID_ISL_V_REF	P10 - AC GRID_ISL Voltage Reference	15.0	780.0	230.0	V	10
SYNC_REG_KP	P11 - CanOpen SYNC loop regulator Proportional gain	0	200	5		1
SYNC_REG_TA	P12 - CanOpen SYNC loop regulator lead time constant	0	20000	400		1
KP_AI16	P13 - Corrective factor for 16 bit analog reference (AUX16)	-400	400	100	%	10
OFFSET_AI16	P14 - Corrective offset for 16 bit analog reference (AUX16)	-100	100	0	%	163.84
TF_LI6-7-8	P15 - I06,07,08 logical inputs digital filter	0.0	20.0	2.2	ms	10
BLK_START_TM	P21 - Black Start Time	0.01	199.99	1	s	100
FREQ_DROOP	P22 - % Frequency Droop	-100.0	100.0	2.0	%	81.92
VOLT_DROOP	P23 - % Voltage Droop	-100.0	100.0	5.0	%	81.92
DDROOP_GAIN	P24 - % Phase droop gain	-100.0	100.0	20.0	%	81.92
V_REG_KP	P31 - KpV voltage regulator proportional gain	0.1	400.0	6		10
V_REG_TI	P32 - TiV voltage regulator lead time constant	0.1	3000.0	30	ms	10
V_REG_TF	P33 - TfV voltage regulator filter time constant	0.0	25.0	0.4	ms	10
GRID_ISL_KP	P35 - KpV GRID_ISL V Prop Gain	0.01	40.0	0.10		100
GRID_ISL_TI	P36 - TiV GRID_ISL V lead time constant	0.1	3000.0	5.0	ms	10
GRID_ISL_TF	P37 - TfV GRID_ISL filter time constant	0.0	25.0	0.0	ms	10
PRC_DIS_REG_GRID_ISL	P38 - Cross Coupling multiplier for GRID_ISL V ac Control	0.0	200.0	80	%	10
MinVDcSStart	P39 - Min Volt DC for End Soft Start	60	95	80	% V_GRID_NOM	10
PRC_CONV_I_PEAK	P40 - Current limit	0.0	200.0	200	% I_CONV_NOM	40.96
VOLT_REG_FF_FILTER	P41 - Time constant for voltage regulator feed-forward calculation	0.0	500.0	4.5	ms	10
MAX_REGEN_I	P42 - Maximum regeneration current	0	400	200	% I_CONV_NOM	40.96
MAX_ABSORPT_I	P43 - Maximum absorption current	-400	0	-200	% I_CONV_NOM	40.96
TIMER_NO_BYPASS	P44 - Precharge debounce time - remain on bypass	50	1000	200	ms	1
TIMER_AGAIN_BYPASS	P45 - Precharge debounce time - reject bypass	50	1000	500	ms	1
MIN_V_GRID	P50 - Alarm level for minimum grid voltage	5.0	95.0	70.0	% V_GRID_NOM	10
MAX_V_GRID	P51 - Alarm level for maximum grid voltage	105.0	135.0	130.0	% V_GRID_NOM	10
K_V_GRID	P52 - Corrective Factor for AC Grid Voltage	25.0	200.0	100.0	%	10
I_CONV_NOM	P53 - Rated Converter current	0.0	400	0	A	10
GRID_CURRENT_OFFSET_U	P55 - Grid current sensor offset U	-100.0	100.0	0	%	327.67
GRID_CURRENT_OFFSET_W	P56 - Grid current sensor offset W	-100.0	100.0	0	%	327.67
PRC_AO1_10V	P57 - % value of 10V for analog output A	100.0	400.0	200	%	10
PRC_AO2_10V	P58 - % value of 10V for analog output B	100.0	400.0	200	%	10
VoltDroopFilt	P59 - Voltage Droop Filter Time const	0.0	200.0	6.0	ms	10
RES_PAR_KEY	P60 - Access Key to reserved parameters	0	65535	0		1
IN_LINE_REACT	P61 - Rated current of the Reactor	10.0	100.0	100	% I_CONV_NOM	327.67
V_GRID_NOM	P62 - Nominal Grid Voltage	30.0	690.0	400	V	10
F_GRID_NOM	P63 - Rated grid frequency	5.0	100.0	50.0	Hz	1
VFilt	P64 - Filter Time Constant for V_GRID	0.0	30.0	0.0	ms	10
WaitAfeReady	P65 - Wait after Converter Ready	20	2000	1000	ms	1
DROOP_SIN	P66 - Droop sin (1=inductive 0=resistive)	0.00	1.00	1.00		100
FreqDroopFilt	P67 - Frequency Droop Filter Time const	0.0	200.0	6.0	ms	10
REF_ID	P68 - Reference Reactive Current	-80.0	80.0	0.0	% I_CONV_NOM	10
PRC_REAL_VRS	P69 - Voltage drop due to real resistor	0.0	25.0	0.1	% V_GRID_NOM	327.67
PRC_REAL_VLS	P70 - Voltage drop due to real inductance	0.0	50.0	3.0	% V_GRID_NOM	327.67
REACT_TF_THERM	P71 - Main reactor thermal time constant	30	2400	600	s	1
PRC_VIRTL_VRS	P72 - Voltage drop due to real+virtual resistor	-25.0	25.0	0.1	% V_GRID_NOM	327.67
PRC_VIRTL_VLS	P73 - Voltage drop due to real+virtual inductance	-50.0	50.0	3.0	% V_GRID_NOM	327.67
CAPAC_LINE_CURR	P74 - Capacitors Line Current	0.0	20.0	0.0	% I_CONV_NOM	327.67
PHASE_ANG	P75 - Grid Phase Shift	-180.0	180.0	0	°	10
PRC_DELTA_VLS	P77 - Voltage drop due to leakage inductance	5.0	100.0	10.0	% V_GRID_NOM	327.67
T_REACT	P78 - Main Reactor time constant Ts	0.0	50.0	50	ms	10
DDROOP_TF	P79 - Filter time constant for phase droop	0.0	100.0	50	ms	10
DY11_ANG	P80 - Dy11 angle Phase Shift	-180.0	180.0	0	°	10
PLL_ERR_TF	P81 - TfPLLerr PLL error filter time constant	0.0	300.0	5.0	ms	10
GRID_F_TF	P82 - TfGridF Grid frequency filter time constant	0.0	30.0	0.0	ms	10
I_REG_KP	P83 - Kpc current regulator proportional gain	0.1	100.0	1.9		10
I_REG_TI	P84 - Tic current regulator lead time constant	0.0	1000.0	20	ms	10
I_REG_TF	P85 - Tfc current regulator (filter) time constant	0.0	25.0	0	ms	10
PLL_KP_STOP	P86 - KpPLL PLL regulator proportional gain at stop	0.1	10.0	1.0		10
PLL_TI_STOP	P87 - TiPLL PLL regulator lead time constant at stop	0.0	300.0	2.5	ms	10
PLL_KP_RUN	P88 - KpPLL PLL regulator proportional gain at run	0.1	10.0	1.0		10
PLL_TI_RUN	P89 - TiPLL PLL regulator lead time constant at run	0.0	300	250.0	ms	10

Name	Description	Min	Max	Default	UM	Scale
GRID_V_TF	P90 - TfGridV Grid voltage filter time constant	0.0	300	30.0	ms	10
REACT_TEMP_MAX	P91 - Maximum reactor temperature (if read with PT100)	0.0	150.0	130	°C	10
MODBUS_ADDR	P92 - Serial identification number	0	255	1		1
MODBUS_BAUD	P93 - Serial baud rate			192	Kbit/s	1
REACT_PRB_RES_THR	P95 - Reactor NTC or PTC resistance value for alarm	0	19999	1500	Ohm	1
PRC_REACT_DO_TEMP_THR	P96 - Reactor thermal logic output 14 cut-in threshold	0.0	200.0	100	% PRC_RE-ACT_I_THERM	40.96
DCBUS_MIN_GRID_LOST	P97 - Minimum voltage level for forced grid off	100.0	1200.0	425	V	10
TDE_PAR_KEY	P99 - Access key to TDE parameters	0	19999	0		1
RES_PAR_KEY_VAL	P100 - Value of access key to reserved parameters	0	19999	95		1
CONV_F_PWM	P101 - PWM frequency	1000	16000	5000	Hz	1
PRC_DEAD_TIME_CMP	P102 - Dead time compensation	0.0	100.0	0	% PRC_V_MAX	32.76
PRC_CONV_I_MAX	P103 - Converter limit current	0.0	800.0	200	% I_CONV_NOM	40.96
T_RAD	P104 - Heat sink time constant	10.0	360.0	80	s	10
KP_DCBUS	P105 - Corrective factor for Bus voltage	80.0	200.0	100	%	10
DCBUS_MIN	P106 - Minimum DC Bus voltage	100.0	1200.0	400	V	10
DCBUS_MAX	P107 - Maximum DC Bus voltage	350.0	1200.0	760	V	10
OFFSET_AO1	P110 - Offset A/D 1	-100.0	100.0	0		327.67
OFFSET_AO2	P111 - Offset A/D 2	-100.0	100.0	0	%	327.67
DISP_WAIT_TIME	P112 - Wait time for display stand-by state	3	20	10	s	1
CONV_I_PEAK	P113 - Maximum converter current	0.0	3000.0	0	A	10
KP_REACT_THERM_PRB	P115 - Multiplication factor for reactor PTC/NTC/PT100 ana-log reference value	0.00	200.00	100		163.84
T_JUNC	P116 - Junction time constant	0.1	10.0	3.5	s	10
KP_DRV_THERM_PRB	P117 - Multiplication factor for heat sink PTC/NTC analog reference value	0.00	200.00	100		163.84
CONV_TEMP_MAX	P118 - Max. temperature permitted by heat sink PTC/NTC	0.0	150.0	90	°C	10
CONV_START_TEMP_MAX	P119 - Max. temperature permitted by heat sink PTC/NTC for start-up	0.0	150.0	75	°C	10
CONV_DO_TEMP_THR	P120 - Heat sink temperature threshold for logic output o.15	0.0	150.0	80	°C	10
MOD_INDEX_MAX	P122 - Max. modulation index	0.500	0.995	0.98		1000
PRC_V_REF_DCBUS	P125 - Voltage reference function of DC bus	0.0	100.0	96.005 13	%	327.67
PRC_I_REG_KP_COEFF	P126 - KpI Corrective coeff. estimated Kp for current loops	0.0	200.0	50	%	40.96
GRID_LEM_I_NOM	P128 - Full-scale RMS current for grid LEM (Active Filter op-tion)	0.0	3000.0	0.0	A	10
RESYNC_AMPL_KP	P129 - Voltage regulator Kp for microgrid resync	0.01	80.0	1		100
RESYNC_AMPL_TI	P130 - Voltage regulator TiV lead time constant for microgrid resync	0.1	3000.0	300	ms	10
RESYNC_AMPL_TF	P131 - Voltage error regulator filter Tf time constant for mi-crogrid resync	0.0	500.0	150	ms	10
RESYNC_FREQ_KP	P132 - Freq. regulator Kp for microgrid resync	0.01	80.0	0.1		100
RESYNC_FREQ_TI	P133 - Freq. regulator TiV lead time constant for microgrid resync	0.1	3000.0	300	ms	10
RESYNC_FREQ_TF	P134 - Freq. regulator filter Tf time constant for microgrid re-sync	0.0	500.0	50.0	ms	10
RESYNC_VOLT_THR	P135 - % Voltage threshold for microgrid resync	0.0	100.0	0.0	%	81.92
RESYNC_PHASE_THR	P136 - % Phase threshold for microgrid resync	0.0	100.0	0.0	%	81.92
RESYNC_VAL_TIME	P137 - Validation time for microgrid resync	20	2000	200	ms	1
KP_CARD_THERM_PRB	P138 - Corrective factor for card thermal sensor	0.00	200.00	100	%	163.84
TRANSITION_ERR_TIME	P139 - Timeout for microgrid resync	0	15000	500	ms	1
SWAP_VOLT_THR	P140 - Voltage threshold for CSI to VSI swap function	0.0	100.0	10.0	%	163.84
SWAP_FREQ_THR	P141 - Frequency threshold for CSI to VSI swap function	0.0	100.0	5.0	%	163.84
CSIVSI_VOLT_MOD_FIL-TER	P142 - Time constant for voltage module reference filter for CSI to VSI transition	0.0	1000.0	200	ms	10
BLACK_START_INIT_TIME	P143 - Initial boost time for black-start	0.0	10000. 0	0	ms	1
BLACK_START_INIT_VALU E	P144 - Initial boost value for black-start	0.0	100.0	0.0	%	163.84
PRC_DEAD_TIME_CMP_XB	P151 - Xb = cubic coupling zone amplitude	0.0	50.0	12.0	% DRV_I_NOM	163.84
V_GRID_AMPL_CO-EFF_RESYNC	P152 - Line voltage amplitude coefficient (PLL for resync)	0.0	200.0	100	%	163.84
OFFSET_L1_RESYNC	P153 - Line voltage L1 offset (PLL for resync)	-16383	16383	0		1
OFFSET_L2_RESYNC	P154 - Line voltage L2 offset (PLL for resync)	-16383	16383	0		1
OVR_LOAD_T_ENV	P155 - Ambient temperature reference value during overload	0.0	150.0	40	°C	10
CONV_F_PWM_CARATT	P156 - PWM frequency for converter definition	1000	16000	5000	Hz	1
DEAD_TIME	P157 - Dead time duration	0.0	20.0	4	µs	10
PRC_I_DECOUP	P158 - Corrective coefficient for decoupling terms	0.0	200.0	0	%	40.96
ID_CANOPEN	P162 - CAN BUS node ID	1	127	1		1
ALL_ENAB	P163 - Alarm enable	-32768	32767	-1	Hex	1
V_GRID_AMPL_COEFF	P164 - Line voltage amplitude coefficient	0.0	200.0	100	%	163.84
OFFSET_L1	P165 - Line voltage L1 offset	-16383	16383	0		1
OFFSET_L2	P166 - Line voltage L2 offset	-16383	16383	0		1
CONV_E_CARATT	P167 - Characterization voltage	200.0	690.0	400	V rms	10
PI_AC_TI	P181 - TiPIac PI_AC regulator lead time constant	0.0	1000.0	50.0	ms	10
DEAD_TIME_HW	P198 - Dead time hardware duration	0.0	20.0	0.0	µs	10
MIN_PULSE	P199 - Minimum command pulse duration	0.0	20.0	1.0	µs	10

Name	Description	Min	Max	Default	UM	Scale
CONTROL_SEL	C00 - Control Selection	0	13	0		1
DISPLAY_SEL	C14 - Display selection	0	127	0		1
SW_RUN_CMD	C21 - Run software enable	0	1	1		1
EN_SYNC_REG	C23 - Enable CANOpen SYNC tracking loop	0	1	0		1
DC_BUS_FULL_SCALE	C24 - DC Voltage converter full scale	0	2	0	V	1
RE-ACT_PRB_RES_THR_MUL	C26 - Reactor NTC or PTC resistance multiplication factor	0	1	0		1
PWM_MOD_TYPE_SEL	C27 - PWM Modulation type selection	0	3	0		1
CONV_SW_EN	C29 - Converter software enable	0	1	1		1
ALL_RESET	C30 - Alarms reset	0	1	0		1
EN_REACT_THERMAL_ALL	C32 - Reactor thermal switch "Block converter?"	0	1	1		1
RE-ACT_THERM_CURV_SEL	C33 - Choice of reactor thermal curve	0	3	0		1
ALL_RST_ON_GRID	C35 - Automatic alarm reset when grid back on	0	1	0		1
EN_PW_SOFT_START	C37 - Enable soft start	0	1	1		1
EN_PRECH_APP	C38 - Enable Precharge from Application	0	1	0		1
ALL_COUNT_RESET	C44 - Reset alarms counters	0	2	0		1
REACT_THERM_PRB_SEL	C46 - Enable reactor thermal probe management (PT100/PTC/NTC)	0	4	0		1
CANOPEN_BAUD_SEL	C48 - CAN Baud rate	0	7	0		1
I_RELAY_SEL	C55 - Current relay output	0	2	0		1
I_OVR_LOAD_SEL	C56 - Current overload	0	3	3		1
CONV_THERM_PRB_SEL	C57 - Enable heat sink heat probe management (PTC/NTC)	0	4	1		1
DIS_I_DECOUP	C59 - Disable dynamic decoupling + feedforward	0	1	0		1
PAR_ACT_BANK	C60 - Parameter bank active	0	1	0		1
DEF_PAR_RD	C61 - Read default parameters	0	1	0		1
EEPROM_PAR_RD	C62 - Read parameters from EEPROM	0	1	0		1
EEPROM_PAR_WR	C63 - Save parameters in EEPROM	0	2	0		1
EN_FLDBUS	C64 - Enable fieldbus manage	0	5	0		1
EN_DOUBLE_UPDATE	C67 - Enable double update	0	1	0		1
EN_V_GRID_TUNING	C68 - Enable line voltage tuning	0	1	0		1
EN_HARMONICS_COMP	C69 - Enable Harmonics compensation	0	3	0		1
GRID_SEL	C70 - Grid type selection	0	1	0		1
EN_NOT_LI	C79 - Enable negative logic for digital inputs	0	255	0		1
I_CTRL_SEL	C80 - Current control type selection	0	1	0		1
V_CTRL_SEL	C81 - Voltage control type (GRID-ISLAND)	0	1	0		1
SYNC_CARD_SEL	C82 - Type of Sync Card mounted	0	1	0		1
SWAP_ISL_EN	C83 - Swap to Island function Enable	0	1	0		1
DROOP_EN	C84 - Enable Droop Control	0	1	0		1
OVC_RESTART_SW	C85 - Enable Restart after OVC (SW-caption)	0	1	0		1
DDROOP_SEL	C87 - Enable droop on instantaneous phase reference (Ddroop_f) + use 1st order filter on freq. droop	0	1	0		1
EN_MICROGRID_RESYNC	C88 - Microgrid resync. management enable	0	1	0		1
DIS_MIN_VBUS	C89 - Disable minimum power circuit voltage with converter stopped	0	1	0		1
FREQ_BLACK_START	C90 - Enable frequency black-start	0	1	0		1
EN_AI1_4_20mA	C95 - Enable AI1 4-20mA	0	1	0		1
EN_AI2_4_20mA	C96 - Enable AI2 4-20mA	0	1	0		1
EN_AI3_4_20mA	C97 - Enable AI3 4-20mA	0	1	0		1
EN_BOOT	C98 - Enable boot mode	0	1	0		1
EN_PF_RES	C99 - Enable Power Fault reset	0	1	0		1
K_V_GRID_TDE	Factory corrective Factor for AC Grid Voltage	25.0	200.00	100.0	%	10
OFFSET_AO1_TDE	Factory corrective offset for A/D 1	-100.0	100.0	0	%	327.67
OFFSET_AO2_TDE	Factory corrective offset for A/D 2	-100.0	100.0	0	%	327.67
V_GRID_AMPL_CO-EFF_TDE	Factory corrective factor for Line voltage amplitude coeffi-cient	0.0	200.0	100.0	%	163.84
OFFSET_L1_TDE	Factory corrective offset for line voltage L1	-16383	16383	0		1
OFFSET_L2_TDE	Factory corrective offset for line voltage L2	-16383	16383	0		1
OFFSET_AI1_TDE	Factory corrective offset for analog reference 1 (AI1)	-100.0	100.0	0	%	163.84
OFFSET_AI2_TDE	Factory corrective offset for analog reference 2 (AI2)	-100.0	100.0	0	%	163.84
OFFSET_AI3_TDE	Factory corrective offset for analog reference 3 (AI3)	-100.0	100.0	0	%	163.84
KP_DCBUS_TDE	Factory corrective factor for Bus voltage	0.0	200.0	100	%	10
KP_RE-ACT_THERM_PRB_TDE	Factory multiplication factor for motor PTC/NTC/KTY84 ana-log reference value	0.00	200.00	100		163.84
KP_CONV_THERM_PRB_TDE	Factory multiplication factor for radiator PTC/NTC analog reference value	0.00	200.00	100		163.84
FW_REV	D00 - Software version			0		256
ACTV_POW	D01 - Active power delivered			0	kW	16
CONTROL_SEL	D02 - Control Selected			0	0:AFE Std 1:FFE 2:MGrid	1
GRID_SEQUENCE	D03 - Positive/negative L1, L2, L3 - sequence			0	1:Positive 0:Negative	1
GRID_F	D04 - Measured grid frequency			0	Hz	16
V_BUS_NORM	D05 - V bus Norm	0	500	0	% VBUS_NOM	163.84
GRID_SEL	D06 - Grid type			0		1
PRC_IQ_REF	D07 - Request of active current Iq rif	-100	100	0	% I_CONV_NOM	40.96
PRC_ID_REF	D08 - Request of reactive current Id rif	-100	100	0	% I_CONV_NOM	40.96

Name	Description	Min	Max	Default	UM	Scale
GRID_STATUS	D09 - GRID_ISL_status			0		1
MICROGRID_TRANS_STS	D10 - Microgrid Transition State Machine Status			0		1
REACT_I	D11 - Current module			0	A rms	16
PRC_IQ	D15 - Active current Iq	-100	100	0	% I_CONV_NOM	40.96
PRC_ID	D16 - Reactive current Id	-100	100	0	% I_CONV_NOM	40.96
PRC_CONV_V	D18 - Reference voltage module	-100	100	0	% V_GRID_NOM	40.96
MOD_INDEX	D19 - Modulation index	-100	100	0		40.96
PRC_VQ_REF	D20 - Vq rif	-100	100	0	% V_GRID_NOM	40.96
GRID_V	D21 - Grid AC Voltage			0	V rms	1
PRC_VD_REF	D22 - Vd rif	-100	100	0	% V_GRID_NOM	40.96
GRID_LEM_I	D23 - Current module on external sensors (Active filter)			0	A rms	16
DC_BUS	D24 - Bus voltage			0	V	16
CONV_TEMP	D25 - Heat sink temperature reading			0	Â°C	16
REACT_TEMP	D26 - Reactor temperature			0	Â°C	16
PRC_REACT_I_THERM	D28 - Reactor thermal current	-100	100	0	% soglia All	40.96
PRC_CONV_I_MAX	D29 - Current limit	-100	100	0	% I_CONV_NOM	40.96
MAIN_GRID_F	D30 - Measured main grid frequency			0	Hz	16
MAIN_GRID_V	D31 - Main grid AC Voltage			0	V rms	1
VBUS_REF_NORM	D33 - DC Voltage Reference (Norm)	0	100	0	% DC_BUS_NOM	163.84
REG_CARD_TEMP	D40 - Regulation card temperature			0	°C	16
REACT_PRB_RES	D41 - Thermal probe resistance			0	kOhm	16
AI1	D42 - Analog Input AI1	-100	100	0	%	40.96
AI2	D43 - Analog Input AI2	-100	100	0	%	40.96
AI3	D44 - Analog Input AI3	-100	100	0	%	40.96
CPLD_FW_REV	D47 - CPLD software version			0		1
PRC_APP_T_MIN	D48 - Minimum current limit by application	-400	400	0	% I_CONV_NOM	40.96
WORK_HOURS	D49 - Work Hours			0	hours	1
SERIAL_NUMBER	D59 - Converter Serial Number			0		1
FLD_CARD	D60 - Fieldbus Card			0		1
APPL_REV	D61 - Application Revision			0		163.84
HW_SENSOR2	D62 - Sensor2 presence			0		1
HW_SENSOR1	D63 - Sensor1 presence			0		1
GRID_LEM_OFF_COMP_EN	U01 - Enable AT offset compensation for grid LEM (Active Filter)	0	1	0		1
MAPPING_CONFIG	U03 - Select the mapping configuration	0	32767	0	Hex	1
EN_I_VECTOR	U10 - Enable Current Vector for Power Part Test	0	1	0		1
I_VECTOR_FREQ	U11 - Current Vector frequency for Power Part Test	0	200	50	Hz	1
RX0_INDEX	Receive Object0 Index			0	Hex	1
RX0_SUB_INDEX	Receive Object0 Sub-Index			0	Hex	1
RX1_INDEX	Receive Object1 Index			0	Hex	1
RX1_SUB_INDEX	Receive Object1 Sub-Index			0	Hex	1
RX2_INDEX	Receive Object2 Index			0	Hex	1
RX2_SUB_INDEX	Receive Object2 Sub-Index			0	Hex	1
RX3_INDEX	Receive Object3 Index			0	Hex	1
RX3_SUB_INDEX	Receive Object3 Sub-Index			0	Hex	1
RX4_INDEX	Receive Object4 Index			0	Hex	1
RX4_SUB_INDEX	Receive Object4 Sub-Index			0	Hex	1
RX5_INDEX	Receive Object5 Index			0	Hex	1
RX5_SUB_INDEX	Receive Object5 Sub-Index			0	Hex	1
RX6_INDEX	Receive Object6 Index			0	Hex	1
RX6_SUB_INDEX	Receive Object6 Sub-Index			0	Hex	1
RX7_INDEX	Receive Object7 Index			0	Hex	1
RX7_SUB_INDEX	Receive Object7 Sub-Index			0	Hex	1
RX8_INDEX	Receive Object8 Index			0	Hex	1
RX8_SUB_INDEX	Receive Object8 Sub-Index			0	Hex	1
RX9_INDEX	Receive Object9 Index			0	Hex	1
RX9_SUB_INDEX	Receive Object9 Sub-Index			0	Hex	1
TX0_INDEX	Transmit Object0 Index			0	Hex	1
TX0_SUB_INDEX	Transmit Object0 Sub-Index			0	Hex	1
TX1_INDEX	Transmit Object1 Index			0	Hex	1
TX1_SUB_INDEX	Transmit Object1 Sub-Index			0	Hex	1
TX2_INDEX	Transmit Object2 Index			0	Hex	1
TX2_SUB_INDEX	Transmit Object2 Sub-Index			0	Hex	1
TX3_INDEX	Transmit Object3 Index			0	Hex	1
TX3_SUB_INDEX	Transmit Object3 Sub-Index			0	Hex	1
TX4_INDEX	Transmit Object4 Index			0	Hex	1
TX4_SUB_INDEX	Transmit Object4 Sub-Index			0	Hex	1
TX5_INDEX	Transmit Object5 Index			0	Hex	1
TX5_SUB_INDEX	Transmit Object5 Sub-Index			0	Hex	1
TX6_INDEX	Transmit Object6 Index			0	Hex	1
TX6_SUB_INDEX	Transmit Object6 Sub-Index			0	Hex	1
TX7_INDEX	Transmit Object7 Index			0	Hex	1
TX7_SUB_INDEX	Transmit Object7 Sub-Index			0	Hex	1
TX8_INDEX	Transmit Object8 Index			0	Hex	1
TX8_SUB_INDEX	Transmit Object8 Sub-Index			0	Hex	1

Name	Description	Min	Max	Default	UM	Scale
TX9_INDEX	Transmit Object9 Index			0	Hex	1
TX9_SUB_INDEX	Transmit Object9 Sub-Index			0	Hex	1
MAP_ERROR_CODE	Mapping Error Code			0		1
MAP_ERROR_OBJ	Mapping Error Object			0	Hex	1
NODE_SLAVE_ADDR	Slave address			0		1
NODE_BAUD_RATE	Node baud rate	0	255	0		1
DATA_CONSISTANCE	Data consistence			0		1
EN_ACYCLIC_DATA	Enable acyclic data			0		1
EN_BIG_ENDIAN	Most significant bytes in multi-byte data types			0		1
PDP_SETUP_DATA	Old Profibus DP setup data			0		1
FLDB_ERROR_CODE	Fieldbus error code			0		1
FLDB_STATE	Fieldbus state			0		1
PRC_RX_WORD0	Process Data Read word 0			0	Hex	1
PRC_RX_WORD1	Process Data Read word 1			0	Hex	1
PRC_RX_WORD2	Process Data Read word 2			0	Hex	1
PRC_RX_WORD3	Process Data Read word 3			0	Hex	1
PRC_RX_WORD4	Process Data Read word 4			0	Hex	1
PRC_RX_WORD5	Process Data Read word 5			0	Hex	1
PRC_RX_WORD6	Process Data Read word 6			0	Hex	1
PRC_RX_WORD7	Process Data Read word 7			0	Hex	1
PRC_RX_WORD8	Process Data Read word 8			0	Hex	1
PRC_RX_WORD9	Process Data Read word 9			0	Hex	1
PRC_TX_WORD0	Process Data Write word 0			0	Hex	1
PRC_TX_WORD1	Process Data Write word 1			0	Hex	1
PRC_TX_WORD2	Process Data Write word 2			0	Hex	1
PRC_TX_WORD3	Process Data Write word 3			0	Hex	1
PRC_TX_WORD4	Process Data Write word 4			0	Hex	1
PRC_TX_WORD5	Process Data Write word 5			0	Hex	1
PRC_TX_WORD6	Process Data Write word 6			0	Hex	1
PRC_TX_WORD7	Process Data Write word 7			0	Hex	1
PRC_TX_WORD8	Process Data Write word 8			0	Hex	1
PRC_TX_WORD9	Process Data Write word 9			0	Hex	1
IP_ADDR_00	Anybus IP Address 00	0	255	0		1
IP_ADDR_01	Anybus IP Address 01	0	255	0		1
IP_ADDR_02	Anybus IP Address 02	0	255	0		1
IP_ADDR_03	Anybus IP Address 03	0	255	0		1
SUBNET_MASK_00	Anybus Subnet Mask 00	0	255	0		1
SUBNET_MASK_01	Anybus Subnet Mask 01	0	255	0		1
SUBNET_MASK_02	Anybus Subnet Mask 02	0	255	0		1
SUBNET_MASK_03	Anybus Subnet Mask 03	0	255	0		1
GATEWAY_00	Anybus Gateway 00	0	255	0		1
GATEWAY_01	Anybus Gateway 01	0	255	0		1
GATEWAY_02	Anybus Gateway 02	0	255	0		1
GATEWAY_03	Anybus Gateway 03	0	255	0		1
DHCP	Anybus DHCP	0	1	0		1
ESC_REG_ADDR	Select ESC register address	0	65535	65535	Hex	1
DISPLAY_FW_REV	Display Firmware revision			0		1
AI16	16 bit Analog input (optional)	-100	100	0	%	40.96
ANYBUS_EN	Anybus module enabled			0		1
FLDBUS_STATE	Anybus/Profinet module state			0		1
SW_RESET_CNT	Software reset occurs			0		1
BO_CAN_MOD	Bus-off status. If 1 the CAN module is in bus-off status			0		1
REC_CAN_MOD	CAN Receive Error Counter			0		1
TEC_CAN_MOD	CAN Transmit Error Counter			0		1
STATE_SM	Actual states of the State Machine			0		1
CYCLE_TIME	CAN Open: Cycle period in us (Obj 0x1006) - EtherCAT: Sync0 Cycle time in ns			0		1
PDO_MAPPING	PDO mapping - the value is configured with C91			0	Hex	1
EN_PDO	COE: PDO enabled			0	Bin	1
EN_SM_ASSIGN	COE: Sync Manager PDO assigned			0	Bin	1
ESC_DL_STATUS	ESC Data Link Status			0	Bin	1
RD_ESC_REGISTER0	Read ESC registers 0			0	Hex	1
RD_ESC_REGISTER1	Read ESC registers 1			0	Hex	1
I_LOOP_BAND	Current loop bandwidth			0	Hz	1
SYNC_DELAY	Delay from SYNC reception to routine execution			0	us	1
PWM_SYNC_OFFSET	PWM offset for SYNC delay control			0	pulses	1
PWM_COUNTER	ISR counter			0.0		1
V_ISR	Voltage routine duration			0	us	64
I_ISR	Current routine duration			0	us	64
APP_FAST_ISR	Application fast task duration			0	us	64
APP_AVBLE_FAST_ISR	Application fast task available time			0	us	64
DRV_F_PWM_MAX	Max PWM frequency available			0	Hz	1
BOOTLOADER_REV	Bootloader revision					1
PN_LED_STATUS	Profinet Led Status					1

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