AFE*plus* XL
User's Manual
Firmware Version 80.31

Manual Code: MW02101E00 V_0.1

SUMMARY

1 INTRODUCTION

To help the customer during the configuration of the power converter, 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 refer, 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 with a serial line or fieldbus and represent the factor which to divide the value stored to obtain the real value set, as following indicated:

$$Value = \frac{Internal\ Representation}{Scale}$$

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 values that are displayed as a number within a set range. The parameters are split up into free, reserved and TDE MACNO reserved parameters.
The following rules apply:

Free parameters (black text in OPDExplorer): may be changed without having to open any key, even when running;

Reserved parameters (blu text in OPDExplorer): may be changed only at a standstill after having opened the reserved parameter key in P60 or the TDE MACNO reserved parameters key in P99;

TDE MACNO reserved parameters (violet text in OPDExplorer): may be changed only at a standstill after having opened the TDE MACNO reserved parameters key in P99. While the key for these parameters is closed, they will not be shown on 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 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 DESCRIPTION AND START-UP

The Regenerative AC-DC Converter (Active Front End) 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 ex-changed 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.

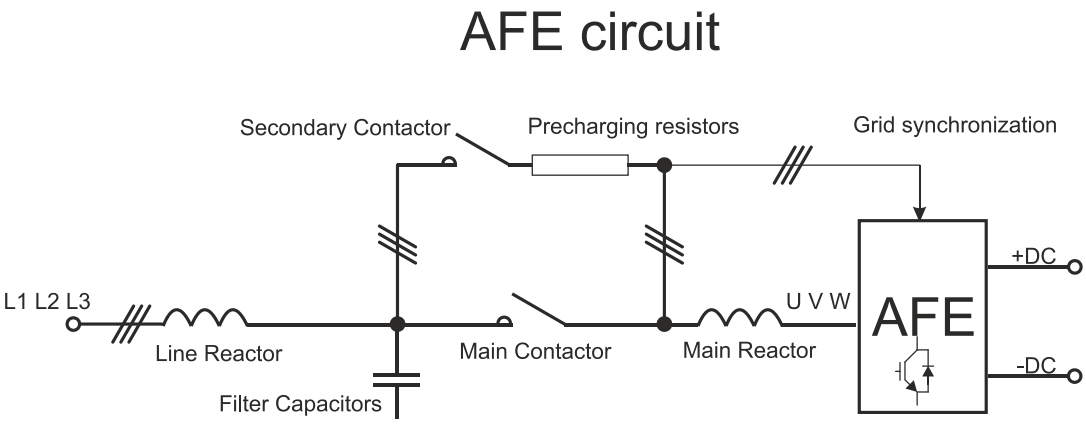


Figure 1 AFE Circuit

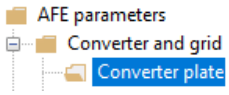
NOTE: AFE is part of OPDE family. This manual is intended to describe the AFE Parameters and Settings. For further in-formation about the hardware of the OPDE family and functionality please refer to OPDE AFE INSTALLATION manuals.

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).

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			
		4	Disable zero seq. injection			
I_OVR_LOAD_SEL	C56 - Current overload	Range		1		1
		0	120%x30			
		1	150%x30			
		2	200%x30			
		3	200%x30+155%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).

C27 parameter allows to configure PWM modulation type:

C27	Description	Details
0	SPWM-1	Space Vector Modulation
1	DPWM-1	Discontinuos Modulation
2	SPWM-2	Near State / Space Vector Modulation
3	DPWM-2	Near State / Discontinuos Modulation
0	Disable zero seq. injection	Space Vector Modulation without 3rd harmonic injection

2.1.1.1 New current overload function

With connection **C94 "DRV_TH_MODEL" = 2 (New Th_model)** is possible to enable a new current overload management.

2.1.1.2 Converter Current Overload Selection

Four types of drive overload can be set on **C56**

C56	Overload type for rated drive 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

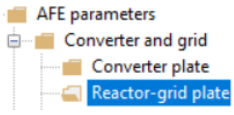
The choice also changes the rated converter current as shown by the tables in the installation manual (chapter "**3.5-TECHNICAL DATA**") and the correct value is always displayed in ampere rms in **P53**.

The delivered current is also used to calculate the operating temperature reached by the power component junctions with the converter presumed to be working with standard ventilation at the maximum ambient temperature permitted.
If this temperature reaches the maximum value permitted for the junctions (see **D06-Drive inner connection limit**), the delivered power limit is restricted to a value that is just over the rated drive current, i.e. the system's effective thermal current. Now the power converter will only overload if the temperature drops below the rated value, which will only occur after a period of operation at currents below the rated current.

The overload time is bound to the power converter output current before the overload request and how long this current is delivered for. Reducing this time (so increasing the frequency of overload request) the available overload time will decrease.
If the average delivered current is lower than the rated reactor current before the overload request, then the overload time will increase. So the overload will be available for a longer or identical time to the ones shown.

Note that, if the overload current is equal to the converter thermal current, it may be delivered for an unlimited time.

*For more details please consult chapter "**3.5-TECHNICAL DATA**" of Installation Manual of the OPDE PLUS.*



2.1.2 REACTOR-GRID PLATE

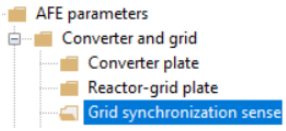
Name	Description	Min	Max	Default	UM	Scale
IN_LINE_REACT	P61 - Rated current of the Reactor	10.0	100.0	100	% I_CONV_NOM	10
V_GRID_NOM	P62 - Nominal Grid Voltage	30.0	1000.0	400	V	
GRID_FREQ_NOM	P63 - Rated grid frequency	5.0	100.0	50.0	Hz	
REACT_TF_THERM	P71 - Main reactor thermal time constant	30	2400	600	s	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
GRID_F	D04 - Measured grid frequency			0	Hz	16
GRID_SEL	D14 - 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

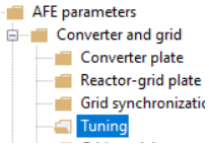
P61 is calculated as follows:

P61 = Rated current of the Inductor as percentage of I_CONV_NOM (i.e. % I_CONV_NOM)



2.1.3 GRID SYNCHRONIZATION SENSE

Name	Description	Min	Max	Default	UM	Scale
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



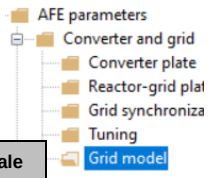
2.1.4 TUNING

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:

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

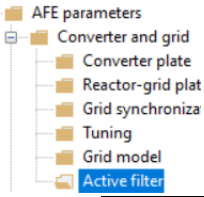
Example:

$I_{\_CONV\_NOM}$= 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

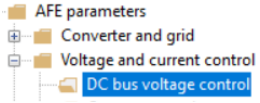


2.1.6 ACTIVE FILTER

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.

2.2 VOLTAGE AND CURRENT CONTROL



2.2.1 DC BUS VOLTAGE CONTROL

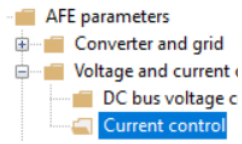
Name	Description	Min	Max	Default	UM	Scale
DC_BUS_REF	P08 - DC Bus Voltage Reference	300.0	1200.0	650.0	V	10
V_REG_KP	P31 - KpV voltage regulator proportional gain	0.1	400.0	6		10
V_REG_TI	P32 - TiV voltage regulator lead time constant	0.1	3000.0	30	ms	10
V_REG_TF	P33 - TfV voltage regulator filter time 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_ZERO_KP_COEFF	P124 - Corrective coeff. estimated Kp for zero current loop	0.1	200.0	50	%	40.96
PRC_I_ZERO_TI_COEFF	P125 - Corrective coeff. estimated Ti for zero current loop	0.1	200.0	10	%	40.96
PRC_I_REG_KP_COEFF	P126 - KpI Corrective coeff. estimated Kp for current loops	0.0	200.0	50	%	40.96

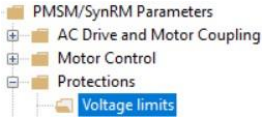
Name	Description	Min	Max	Default	UM	Scale
PRC_I_DECOUP	P158 - Corrective coefficient for decoupling terms	0.0	200.0	0	%	40.96
PI_AC_TI	P181 - TiPIac PI_AC regulator lead time constant	0.0	1000.0	50.0	ms	10
DIS_I_DECOUP	C59 - Disable dynamic decoupling + feedforward	0	1	0		1
I_CTRL_SEL	C80 - Current control type selection	Range		0		1
		0	dq control			
		1	ac control PR			
		2	ac control P			
3PH_CTRL_EN	C86 - Enable control on V phase	Range		0		1
		0	No			
		1	Yes			
ACTV_POW	D01 - Active power delivered			0	kW	16
PRC_IQ_REF	D07 - Request of active current Iq rif	-100	100	0	% I_NOM	40.96
PRC_ID_REF	D08 - Request of reactive current Id rif	-100	100	0	% I_NOM	40.96
REACT_I	D11 - Current module			0	A rms	16
PRC_IQ	D15 - Active current Iq	-100	100	0	% I_NOM	40.96
PRC_ID	D16 - Reactive current Id	-100	100	0	% I_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
PRC_APP_T_MAX	D32 - Maximum current limit by application	-400	400	0	% I_NOM	40.96
PRC_APP_T_MIN	D48 - Minimum current limit by application	-400	400	0	% I_NOM	40.96

The AFE current control allows to compensate external reactive power (e.g. 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).

C86 configures the number of current controllers that are running into AFE: with C86 = 0, two degrees of freedom are compensated by current controller (made of 2 PID controllers); while with C86 = 1, three degrees of freedom are compensated by current controller (made of 3 PID controllers).
When C80 = 0, current control is based on *dq0* controllers: with C86 = 0, only *dq* current controllers are running, while with C86 = 1, all three *dq0* controllers are running. With other words, C86 = 1 enables the zero-component current controller in *dq0* state space.
If C80 is equal to 1 or 2, AC current controllers are running on the *abc* or *uvw* state spaces: this means that if C86 = 0, only two current controllers are running on *u* and *w* phases (while *v* quantities are derived assuming that the current are balanced), while with C86 = 1, three independent current controllers are running (*u*, *v*, and *w* phases).
So setting C86 = 1 enables the reading of the current on *v* phase, while with C86 = 0 this reading is not exploited by the current controller.

When C86 = 1 and C80 = 0, parameters P124 and P125 can be used to tune the current regulator of zero current component: they can introduce into the parameters of the PI controller two scaling factors starting from the PI parameters of the *dq* component regulators.

2.3 PROTECTIONS

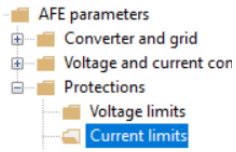


2.3.1 VOLTAGE LIMITS

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
K_V_GRID_EXT	P54 - Corrective Factor for AC Grid Voltage of external grid	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
GRID_SEL	C70 - Grid type selection	Range		0		1
		0	THREE PHASE (U-V-W)			
		1	SINGLE PHASE (U-V)			
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	Inverso			
		1	Diretto			

2.3.1.1 DC Bus Ripple Alarm

This function prevents the drive from rectifier bridge problems, unbalanced mains and main phase loses.
Using a 100Hz pass band filter, the DC Bus ripple is measured and shown in “DC_BUS_RIPPLE”.
With a DC Bus Ripple over 100V the drive goes in alarm A13.2 in 100ms.
With a DC Bus Ripple from 60 to 100V the drive goes in alarm A13.2 in 5 seconds.
Connection C31 can be used to disable the DC Bus Ripple alarm.

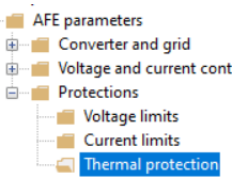


2.3.2 CURRENT LIMITS

Name	Description	Min	Max	Default	UM	Scale
PRC_CONV_I_PEAK	P40 - Current limit	0.0	250.0	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 5 PT1000		0		1
REACT_TEMP_MAX	P91 - Maximum reactor temperature (if read with PT100)	0.0	150.0	130	°C	10
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
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
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

Name	Description	Min	Max	Default	UM	Scale
REACT_THERM_CURV_SEL	C33 - Choice of reactor thermal curve	Range		0		1
		0	No reduction			
		1	-limitative			
		2	Self-ventilated			
		3	+limitative			
KP_CARD_THERM_PRB	P138 - Corrective factor for card thermal sensor	0.0	200.0	100	%	168.84
CONV_TEMP	D25 - Heat sink temperature reading			0	°C	16
REACT_TEMP	D26 - Reactor temperature			0	°C	16
REG_CARD_TEMP	D40 - Regulation card temperature			0	°C	16
REACT_PRB_RES	D41 - Thermal probe resistance			0	kOhm	16
PRC_DRV_I_THERM	D28 - Reactor thermal current	-100	100	0	% soglia All	40.96
IGBT_J_TEMP	D45 - IGBT junction temperature			0	°C	16
IGBT_J_TEMP_MARGIN	D46 - IGBT junction temperature margin with its limit			0	°C	16
DRV_I_CONN_TH_MODEL	D06 - Drive inner connection limit			0	% DRV_I_CONN_ MAX	163.84

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:

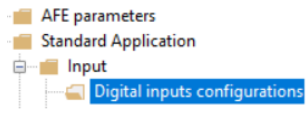
C32 = 0 (default value) the thermal alarm will cut in and reduce the current limit to match the line reactor thermal current.

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.

3 STANDARD APPLICATION

3.1 INPUT



3.1.1 DIGITAL INPUTS CONFIGURATIONS

The control requires up to 8 optically insulated digital inputs (L.I.1 … L.I.8.) whose logic functions can be configured by means of connection **C1** ÷ **C8**.

Name	Description	Min	Max	Default	UM	Scale
LI1_SEL	C01 - Meaning of logic input 1	-1	31	8		1
LI2_SEL	C02 - Meaning of logic input 2	-1	31	2		1
LI3_SEL	C03 - Meaning of logic input 3	-1	31	3		1
LI4_SEL	C04 - Meaning of logic input 4	-1	31	0		1
LI5_SEL	C05 - Meaning of logic input 5	-1	31	4		1
LI6_SEL	C06 - Meaning of logic input 6	-1	31	12		1
LI7_SEL	C07 - Meaning of logic input 7	-1	31	5		1
LI8_SEL	C08 - Meaning of logic input 8	-1	31	22		1
TF_LI6-7-8	P15 - I06, 07, 08 logical inputs digital filter	0.0	20.0	2.2	ms	10
EN_NOT_LI	C79 - Enable negative logic for digital inputs	0	255	0		1

The following table shows the logic functions managed by standard application:

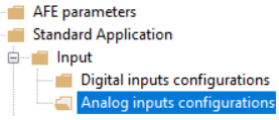
		NAME	INPUT LOGIC FUNCTIONS	DEFAULT INPUT	DEFAULT STATUS
I	00	ID_RUN	Run command	P.I.4	L
I	02	ID_EN_EXT	External enable	P.I.2	H
I	03	ID_SWAP_ISL_EN	Swap to Island Enable	P.I.3	L
I	07	ID_UGRID_CONT_STS	Microgrid external contactor status		L
I	08	ID_RESET_ALR	Alarms reset	P.I.1	L
I	09	ID_UGRID_RESYNC_REQ	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

NB: pay particular attention to the fact that it is absolutely not possible to assign the same logic function to two different logic inputs: after changing the connection value that sets a determined input, check that the value has been accepted, if not check that another has not already been allocated to that input. In order to disable a logic input it's necessary to assign to it the logic function -1: this is the only value that can be assigned to more than one inputs.

3.1.1.1 Input Logic Functions Set in Other Ways

In reality the input logic functions can also be set by serial connection and by fieldbus, with the following logic:

- **I00** Run: stands alone, it has to be confirmed by terminal board inputs, by the serial and by the fieldbus, though in the case of the latter the default is active and so, if unaltered, controls only the terminal board input.
- **I01÷ I31**: is the parallel of the corresponding functions that can be set at the terminal board, the serial or the fieldbus

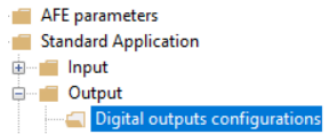


3.1.2 ANALOG INPUTS CONFIGURATIONS

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

If the user wants to give references in current (4÷20 mA signals), it is necessary to set correctly the dip-switch sw1 in the display card (see installation manual 5.2.17). After that, for every analog input it is possible to enable, with connections C95÷C97, the correct software management of these inputs. When the 4÷20 mA function is enabled, automatically KP_Ax=125% and OFFSET_Aix=-25% are set, in this way with 4 mA the reference is 0 and with 20 mA the reference is 100%. Furthermore, there is a software lower limitation to 0%, so with current reference lower than 4 mA, the real reference is 0. It's possible to enable separately all references using connections or logic input functions.

3.2 OUTPUT



3.2.1 DIGITAL OUTPUT CONFIGURATIONS

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

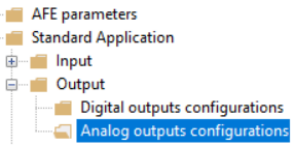
The control can have up to 4 optically insulated digital outputs (L.O.1 … L.O.4) whose logic functions can be configured as active high (H) by means of connection **C10** ÷ **C13**.

The following table shows the logic functions managed by standard application:

		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	07	OD_LIM_I_BASE	Converter in current limit (thermal + P40)	
O	08	OD_LIM_I_ALL	Converter in current limit (all)	
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	15	OD_KT_DRV	Heat sink overheating (higher than P120 threshold)	
O	16	OD_IDC_OVERCURR	Idc overcurrent	
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	

If you wish to have the logic outputs active at the low level (L) you need just configure the connection corresponding to the chosen logic function but with the value denied: for example, if you want to associate the function “Grid fault” to logic output 1 active low, you have to program connection 10 with the number -12 (C10=-12).

Note: if you want to configure Output logic 0 to active low you have to set the desired connection to value -32



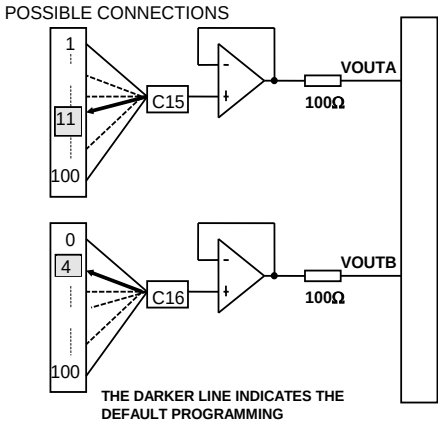
3.2.2 ANALOG OUTPUTS CONFIGURATIONS

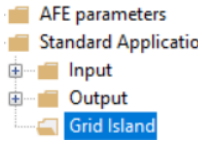
Name	Description	Min	Max	Default	UM	Scale
AO1_SEL	C15 - Meaning of programmable analog output 1	-99	100	11		1
AO2_SEL	C16 - Meaning of programmable analog output 2	-99	100	4		1
PRC_AO1_10V	P57 - % value of 10V for analog output A	100.0	400.0	200	%	10
PRC_AO2_10V	P58 - % value of 10V for analog output 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	02	Zero sequence of current	
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	30	Max active current limit	
o	32	Internal value: outputs (MONITOR only)	
o	31	Zero sequence of phase voltage duty-cycle	
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	43	Max active current limit by app	
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	64	Min active current limit by app	
o	67	I_Beta_Rif (abc Control)	

There can be a maximum of two analog outputs, VOUTA and VOUTB ± 10 V, 2mA.
An internally regulated variable (selected from the list below) can be associated to each of the two outputs; the allocation is made by programming the connection corresponding to the output concerned, **C15** for VOUTA and **C16** for VOUTB, with the number given in the table below corresponding to the relative quantities. By means of the parameters **P57** (for VOUTA) and **P58** (for VOUTB) it is also possible to set the percentage of the variables selected to correspond to the maximum output voltage (default values are P57=P58=200% so 10V in output correspond to 200% of selected variable).
It is also possible to have the absolute internal variable value desired: to do this it is simply necessary to program the connection corresponding to the denied desired number.
It is also possible to have an analog output fixed to +10V: to do this it is simply necessary to program the connection corresponding to 100.



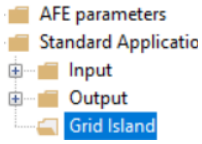


3.3 GRID ISLAND

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
K_V_GRID_EXT	P54 - Corrective Factor for AC Grid Voltage of external grid	25.0	200.0	100.0	%	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
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
I_CTRL_SEL	C80 - Current control type selection	0	1	0		1

Name	Description	Min	Max	Default	UM	Scale
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 more details regarding these parameters please refer to AFE Energy Microgrid manual.



3.4 LVFRT

The Low-Voltage Fault Ride Through (LVFRT) function gives the possibility to comply with the LVFRT requirements depicted in the Italian standard CEI 0-21.
To enable the LVFRT support use parameter C74–EN_LVFRT_MANAGE.
The voltage versus time characteristic can be set using parameters P50–MIN_V_GRID, P145–LVFRT_T_MAX as described hereafter.
This rectangular settable voltage-time characteristic is suitable to comply with a lot of different characteristics specified in the national standards.

By default, this function is not active, therefore in case of a grid voltage drop the inverter will automatically disconnect from the grid by opening the grid main contactor. The disconnection is done because the grid voltage decreases under the threshold P50–MIN_V_GRID.

When the function is activated (C74=Yes), if there is a grid voltage drop with:

- Vgrid < P50–MIN_V_GRID;
- voltage drop duration < P145–LVFRT_T_MAX;

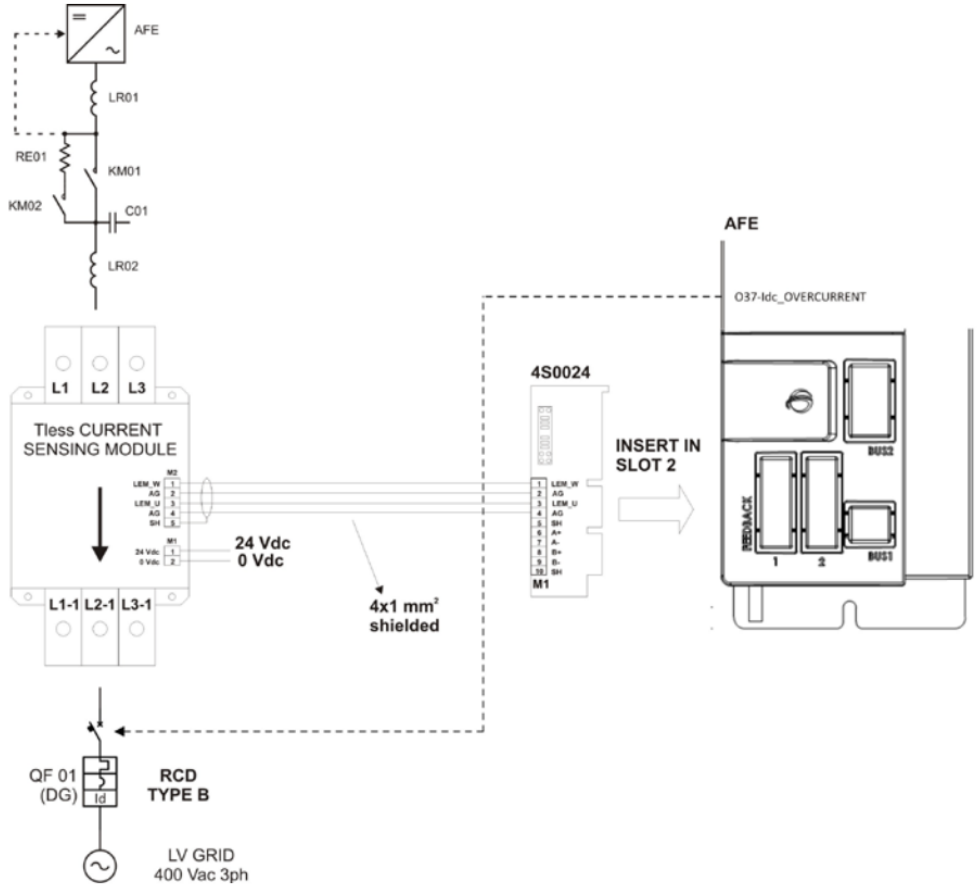
then the inverter stops to supply power into the grid but does not disconnect from the grid, i.e. the grid contactor does not open and the inverter gives alarm A02.1.

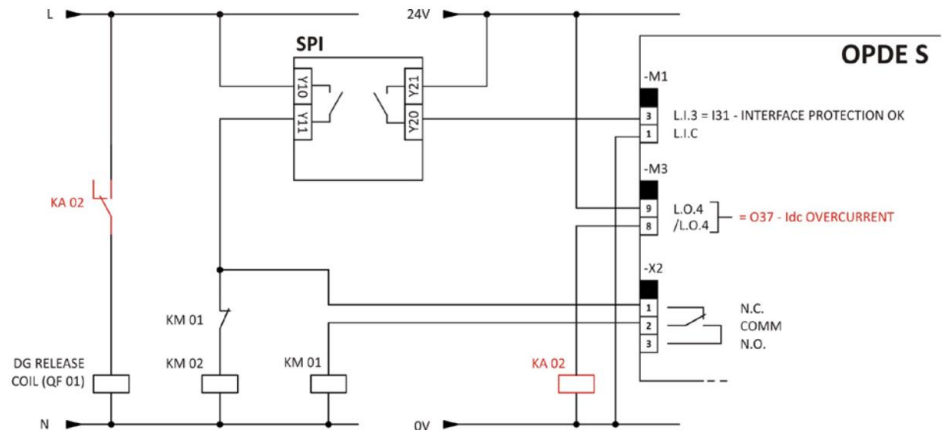
If within the maximum waiting time set in P145 there is a voltage grid restoration, then the inverter automatically resets and start again power delivery after the waiting time set in P65–WaitAfeReady.
If within the maximum waiting time set in P145 there is not a voltage grid restoration, then at the end of the waiting time the inverter disconnects from the grid by opening the grid main contactor and i alarm A02.0 appears.

Name	Description	Min	Max	Default	UM	Scale
LVFRT_T_MAX	P145 - LVFRT maximum duration	0.10	5.00	3.00	s	100
GRID_UNB_MAX	P146 - Maximum grid voltage unbalance for enabling run	0.1	100.0	10.0	% V_GRID _NOM	10
V_GRID_MAX_UNB	P147 - Maximum grid voltage with unbalanced grid for enabling run	0.0	200.0	115.0	% V_GRID _NOM	10
V_GRID_MIN_UNB	P148 - Minimum grid voltage with unbalanced grid for enabling run	0.0	200.0	80.0	% V_GRID _NOM	10
EN_LVFRT_MANAGE	C74 - Enable LVFRT manage	0	1	0		1

3.5 TRANSFORMERLESS

The transformerless function (AFE Tless) limits the DC current injected toward the grid and can be used instead of the insulation transformer when the grid code requires to limit the DC current.
A current sensing module and an optional card 4S0024 must be connected according to the following figure.





The transformer must be replaced with a secondary inductance (refer to AFE Energy installation manual).
Logic output O16-Idc overcurrent is used to open the grid circuit breaker (DG) when the DC current on phase U, V, or W exceeds one of these thresholds:
- P319 - TLESS_IDC_THRa with Idc filter time constant E237-TLESS_LPF2a_TF, or
- P320 - TLESS_IDC_THRb with Idc filter time constant E238-TLESS_LPF2b_TF.

During the Idc overcurrent event the alarm A12.4 – Idc overcurrent is generated. The status of O16 is equal to the status of alarm A12.4, therefore O16 stays at high logic level until alarm A12.4 is reset.
Derivative filters on the active and reactive currents of the inverter are used to recognize the AFE load transients, and another derivative filter on the grid frequency measurement is used to recognize

transients that happens on the grid that are not coming from the AFE. These derivative filters are used to disable the Idc overcurrent recognition during transient events.
To enable the AFE Tless function select C72-EN_TLESS=1, then execute the Rgrid tuning as described hereafter:

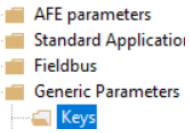
Rgrid tuning
The Rgrid tuning function measures the resistance that the AFE sees toward the grid, this data is used to regulate automatically the proportional gain of the Tless function. During the tuning a reactive current must be injected into the grid, P68 is used to set temporarily this value, at the end of the tuning P68 must be restored at the original value.

- Connect the AFE to the grid and verify that it's in stop with no alarm. Set C73-EN_R_GRID_TUNING=1 and P68=30%.
- Drag and drop P335-PRC_DELTA_VRG, D400-TLESS_IDC_U in the monitor window on OPD Explorer.
- Give run, after 5s the AFE will generate a DC ramping voltage on phase U that generates a DC current on phase U. The DC voltage ramp will stop when:
  - the DC current on phase U reaches the +100% value, or
  - the DC voltage reaches the maximum value equal to E227*5.
- After 5s the DC voltage go back to zero and the Rgrid measured value is written in P335.

During the test the value displayed in D400 will increase. The test is finished when D400 decreases back to approximately zero and P335 changes its value.
At this moment is possible to remove the run command, C73 will automatically restore to 0.

Name	Description	Min	Max	Default	UM	Scale
EN_TLESS	C72 - Enable Transformerless	0	3	0		1
EN_R_GRID_TUNING	C73 - Enable Rgrid tuning	0	1	0		1
TLESS_DER_F_TD	P312 - Tless frequency derivative time constant	0.1	3000.0	200.0	ms	10
TLESS_DER_F_TF	P313 - Tless frequency derivative filter time constant	0	3000.0	10.0	ms	10
TLESS_DER_F_THR	P314 - Tless frequency derivative threshold	0.0	100.0	10.0	%	10
TLESS_DER_I_TD	P315 - Tless current derivative time constant	0.1	3000.0	20.0	ms	10
TLESS_DER_I_TF	P316 - Tless current derivative filter time constant	0	3000.0	10.0	ms	10
TLESS_DER_I_THR	P317 - Tless current derivative threshold	0.0	100.0	10.0	%	10
TLESS_IDC_NOM	P318 - Tless Idc rated current	0.001	32.767	0	A	1000
TLESS_IDC_THRa	P319 - Tless Idc threshold a	0.1	100.0	0.5	% I_NOM	10
TLESS_IDC_THRb	P320 - Tless Idc threshold b	0.1	100.0	1.0	A	10
TLESS_LPF2_DMP	P321 - Tless LPF2a and LPF2b damping factor	0.01	1.00	0.90		100
TLESS_LPF2a_TF	P322 - Tless LPF2a filter time constant	0.1	3000.0	200.0	ms	10
TLESS_LPF2b_TF	P323 - Tless LPF2b filter time constant	0.1	3000.0	25.0	ms	10
TLESS_NOTCH_DMP	P324 - Tless Notch filter damping factor	0.0	100.0	0.0	%	10
TLESS_NOTCH_F0	P325 - Tless Notch Filter natural frequency	0.0	100.0	50.0	Hz	10
TLESS_NOTCH_FB	P326 - Tless Notch Filter bandwidth	0.0	100.0	25.0	Hz	10
TLESS_OFF_MAX	P327 - Tless maximum voltage offset	0.1	5.0	2.0	% V_NOM	10
TLESS_REG_KP	P328 - Kp Tless regulator gain	0.01	100.00	3.5		100
TLESS_REG_MAX	P329 - Tless regulator maximum output	0	400	200	%	1
TLESS_REG_TF	P330 - Tf Tless regulator filter time constant	0.0	3000.0	0.0	ms	10
TLESS_REG_TI	P331 - Ti Tless regulator lead time constant	0.1	3000.0	50	ms	10
TLESS_U_KP	P332 - Tless U amplitude compensation	0.0	200.0	100.0	%	10
TLESS_W_KP	P333 - Tless W amplitude compensation	0.0	200.0	100.0	%	10
KT	P334 - Multiplier	1.0	100.0	1.0	p.u.	10
PRC_DELTA_VRG	P335 - Voltage drop due to total resistor toward the grid	0.01	100.00	10.0	%	100
TLESS_IDC_U	D400 - Tless Idc U current	0	32.767	0	A	1000
TLESS_IDC_W	D401 - Tless Idc W current	0	32.767	0	A	1000

4 GENERIC PARAMETERS

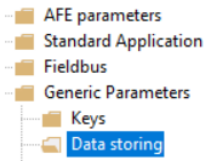


4.1 KEYS

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 off access key to reserved parameters	0	19999	95		1

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

- If the value of P60 is the same of the key is possible to modify the reserved parameters
- If the value of P99 is the same of the key is possible to modify the TDE parameters

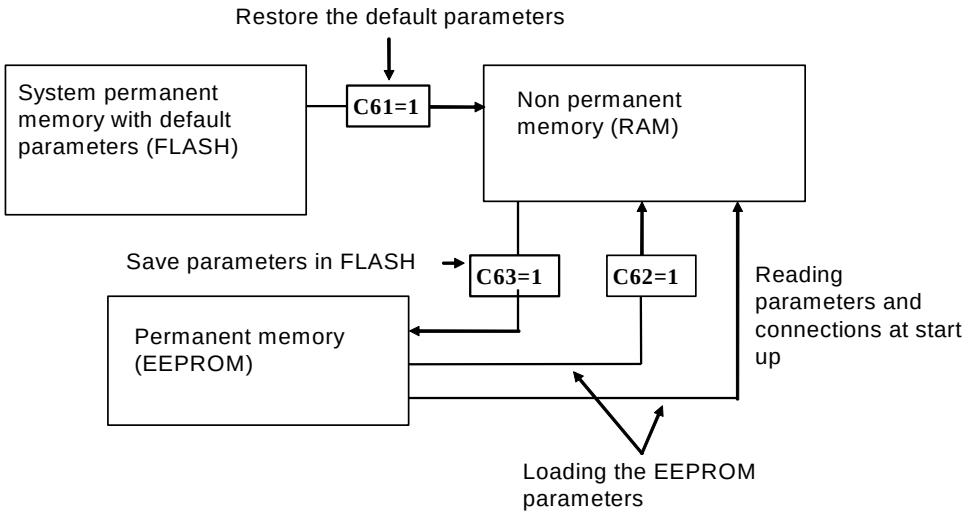


4.2 DATA STORING

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	Range		0		1
		0	No			
		1	All Parameters			
		2	Only App Parameters			
EEPROM_PAR_RD	C62 - Read parameters from EEPROM	Range			1	
		0	No			
		1	Yes			
		2	Restore factory par			
EEPROM_PAR_WR	C63 - Save parameters in EEPROM	0	1	0		1
ALL_COUNT_RESET	C44 - Reset alarms counters	0	4	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

4.2.1 STORAGE AND RECALL OF THE WORKING PARAMETERS

The drive has three types of memory:
The non permanent work memory (RAM), where the parameters become used for operation and modified parameters become stored; such parameters become lost due to the lack of feeding regulation.
The permanent work memory (EEPROM), where the actual working parameters become stored to be used in sequence (C63=1, Save Parameters on EEPROM).
The permanent system memory where the default parameters are contained.
When switched on, the drive transfers the permanent memory parameters on to the working memory in order to work. If the modifications carry out on the parameters, they become stored in the work memory and therefore become lost in the break of feeding 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 EEPROM Parameter C62=1).
If for some reason the parameters in EEPROM 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 drive switched on/RUN, while the loading may only be affected aside with drive switched off/STOP, after having opened the key to reserved parameters.
During permanent memory writing (C63=1) the data are immediately read after its writing. If any inconsistency is detecting, alarm A1.2 appears.
In this case resets the alarm and try again to store the data.

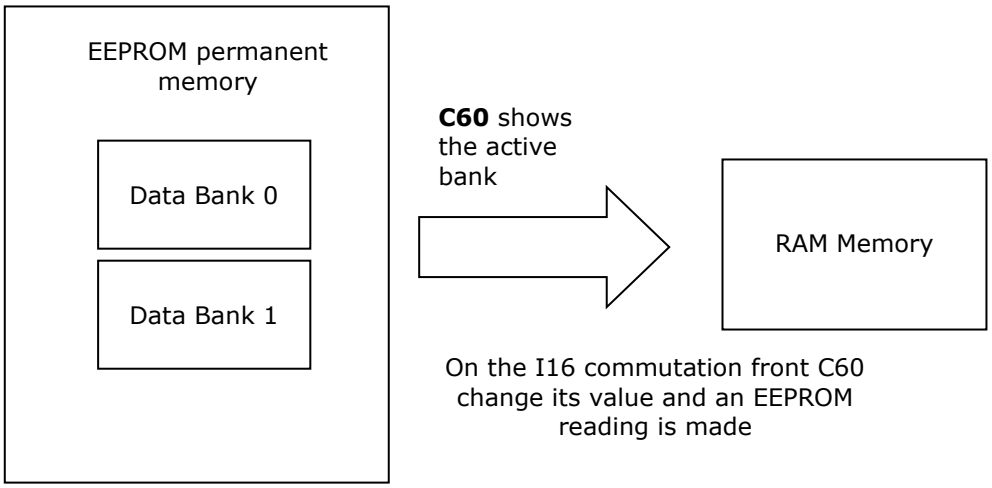


Because the default parameters are standard to be different than those that are personalized, it is correct that after the installation of each drive, there is an accurate copy of permanent memory parameters to be in the position to reproduce them on an eventual drive exchange.

4.2.1.1 Active Bank Parameters

This function allows to switch over the internal sets of parameters and connections between two distinct memory banks (drive must 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

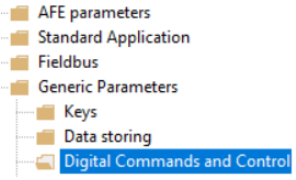
4.2.1.2 Restore Factory Parameters

When the drive goes out from TDE MACNO its data are stored into a permanent memory like factory parameters and firmware revision also.
Subsequently it is possible to restore this data setting C62=2.
When this function is enabled the behavior depends on the actual firmware revision:

- If the current firmware revision is exactly the same of when the drive left TDE MACNO ("FACTORY_FW_REV") all core parameters and connections are reloaded, independently of keys status.

- If the current firmware revision is different, the default core parameters and connections are loaded except some particular parameters (P94, P100÷P120, P154÷P157, P167, P198, P199, C23, C24, C45, C58 and C98).

In every case all application parameters came back to their default values.
Profibus, Anybus, Monitor configuration data came back to their default values.
If the factory data are invalid, alarm A1.1 appears and all default parameters are loaded.



4.3 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	4	0		1
EN_BOOT	C98 - Enable boot mode	0	1	0		1

Name	Description	Min	Max	Default	UM	Scale
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

The “DRV_F_PWM_MAX” is the maximum PWM frequency allowed with the functions enabled.

4.3.1 CONVERTER READY

The Converter Ready condition (**o.L.0=H**) is given by alarms are not active and at the same time both the software and hardware enables:
* The software enable, given by state of the connection **C29**, (C29=1 of 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 drive signal goes into an non-active state o.L.0=L and this state remains until the causes that brought about the alarm conditions 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.

4.3.2 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.

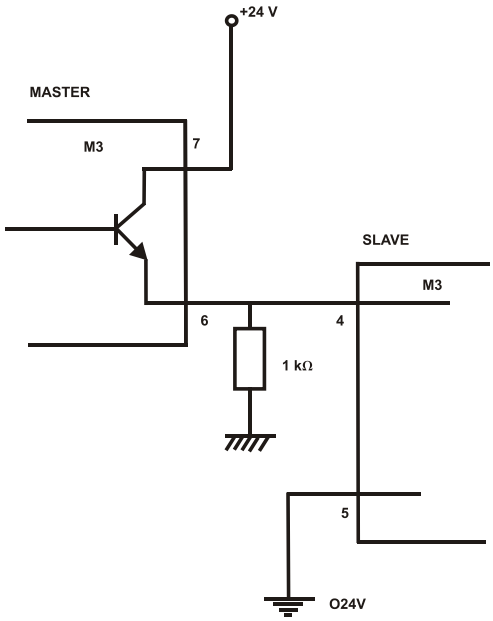
4.4 PWM SYNCHRONIZATION (STANDARD APPLICATION)

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_SYNCHRONIZATION	C23 - Pwm Synchronization	0	10	0		1

With this function it's possible to synchronize two or more OPDE at PWM level.
Some parameters are found in this sub-menu, while other in PWM synchronization menu of Application: please refer also to this menu.

Parameter E87 is used to select the drive function:

1 Master= Every PWM period the third digital output (O3) is configured like PWM synchronization output.
2 Slave= Eight physical input (I08) is used to synchronize the drive.



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.

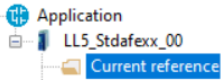
5 CATALOG STANDARD APPLICATIONS

The functions seen in previous chapter refer to the standard application, in the application “catalog” (downloadable from AFE “application” project) these functions can’t be present, so please refer to the application manual itself for more details.
Some functions, however, depend on the core and they are otherwise present both in the standard application and in the catalog application.
Following be repeated all the functions seen previously, noting which ones are always present.

Parameters:
P00-P199 are common to all applications (standard and catalog),
E00-E99 instead depend on the type of application.

Connections:
C00-C99 are common to all applications (standard and catalog),

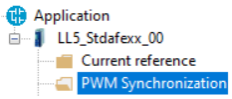
Internal values:
d00-d63 are common to all applications (standard and catalog),
d64-d99 instead depend on the type of application.



5.1 CURRENT REFERENCE

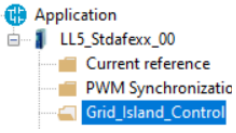
Name	Description	Min	Max	Default	UM	Scale
EN_CURR_REF	E25 - Enable application current reference	0	1	0		1
IQ_REF	E00 - Reference active current Iq	-100	100	0	% I_CONV_NOM	100
ID_REF	E01 - Reference reactive current Id	-100	100	0	% I_CONV_NOM	100

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.



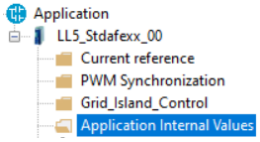
5.2 PWM SYNCHRONIZATION

Name	Description	Min	Max	Default	UM	Scale
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



5.3 GRID ISLAND CONTROL

Name	Description	Min	Max	Default	UM	Scale
I_PV_MAX	E30 - Maximum PV input current	0.0	2000.0	0.0	A	10
Tau_Ipv_filter	E37 - Time constant Ipv filter	10	999	10	Ms	1
Kmult_Ipv	E38 - Kmult_IPV	0	200	100	%	1
VB_MAX	E55 - V Bus Max Limit in CSI	0.0	1200.0	0.0	V	1
VB_MIN	E56 - V Bus Min Limit in CSI	0.0	1200.0	0.0	V	10
KP_VB_LIM	E57 - Kp V Bus limit in CSI	0.0	300.0	1.0		10
TI_VB_LIM	E58 - Ti V Bus Limit in CSI	0.0	3000.	60.0	Ms	10
TF_VB_LIM	E59 - Tf V Bus Limit in CSI	0.0	3000.0	0.0	Ms	10



5.4 APPLICATION INTERNAL VALUES

Name	Description	Min	Max	Default	UM	Scale
Ipv_	D65 - PV current			0	A	32

5.5 DRIVE2DRIVE CAN

This feature is helpful to run 2 or more AFE converters in parallel, when one MASTER node is working with voltage and current closed loops and the others are working with current control only. MASTER note can calculate its own current references thanks to its voltage close loop and it can communicate its current references (active and reactive) to SLAVE AFE converters via CAN bus.

Name	Description	Min	Max	Default	UM	Scale
CAN2_EN	E31 - Current reference via CAN2 config.	Range		0		1
		0	Disable			
		1	Master curr ref			
		2	Slave curr ref			
CAN2_MASTER_NODEID	E32 - CAN2 Master NodeID	0	127	1	hex	1
ID_REF_CAN2	D64 - Id reference from CAN2	-200.0	200.0	0	% I_NOM	40.96
IQ_REF_CAN2	D67 - Iq reference from CAN2	-200.0	200.0	0	% I_NOM	40.96

This function allows to read and write a current reference for the AFE converter via CAN B network (see installation manual for more details).
This feature can be enabled via E31 parameter:

- MASTER node is in charge to write over CAN B network its own active current reference calculated by its voltage loop (i.e. osc51) and reactive current reference
- SLAVE node is in charge to read MASTER node current references on the CAN B network and to apply them as its own current references

E32 parameter allows to specify MASTER node address.
D64 and D67 display the received current references on the SLAVE node.

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 switch 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 switches (alarms) cut in, they are signaled on the displays, which start to flash and to show a cycle of all the alarms triggered (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 cannot 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 indication is divided in 16 categories (A0÷A15) and for each alarm can be present code to identify better the alarm (AXX.YY)

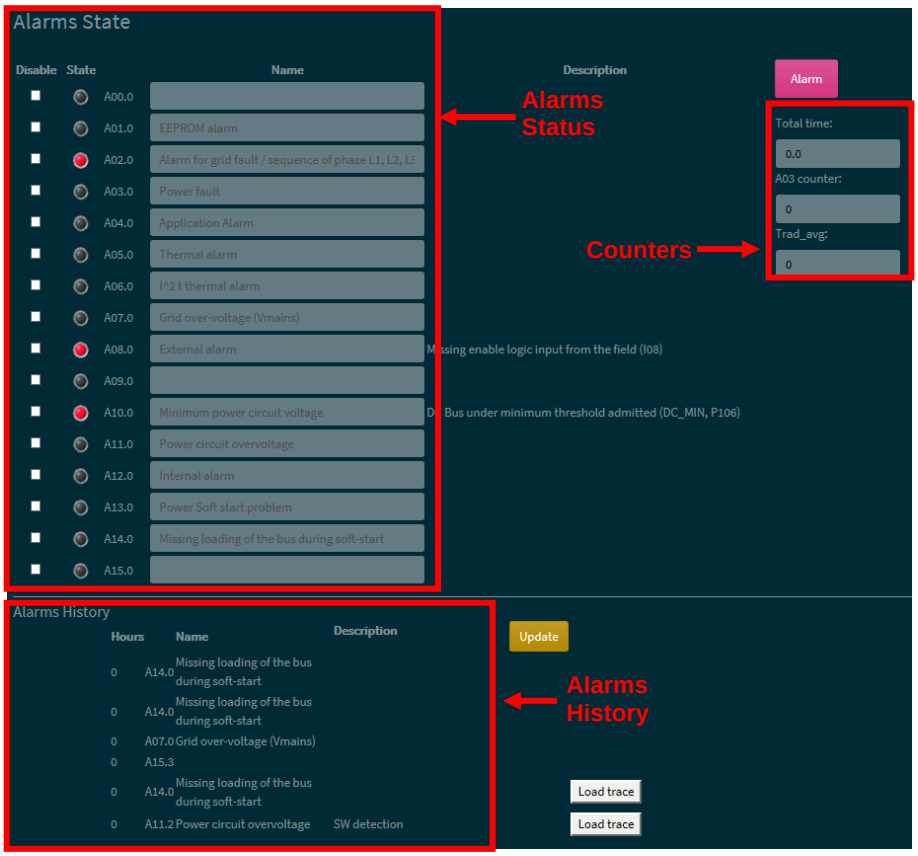
ALARM			DESCRIPTION	CORRECTIVE ACTION
HEX	DEC			
A.1.0.H	A1.0	Loaded default parameters	EEPROM data related to a different core	It's possible to reset this alarm but keep attention: now all parameters have its default value.
A.1.1.H	A1.1	EEPROM Read failure	A Check Sum error occurred while the EEPROM was reading the values. Default values loaded automatically.	Try rereading 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.1.2.H	A1.2	EEPROM 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 rewriting 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.
A.1.3.H	A1.3	EEPROM Read and write failure	Alarms A1.1 and A1.2 appears	There are some problems with EEPROM.
A.1.4.H	A1.4	Data storing not completed	During data storing was switched off the regulation card	It's possible to reset this alarm but keep attention: now all parameters have its default value.
A2.0 H	A 2.0	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.
A2.1h	A 2.1	LVFRT routine has identified a fault	A Low-Voltage Fault transient has been detected	No action The converter is waiting for grid voltage during a low-voltage fault: if the voltage will return within allowed (frequency and voltage module) thresholds, AFE will restart automatically, otherwise a A 2.0 alarm will appear
A.3.0.H	A3.0	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	A4.0	Application alarm	This alarm is application specific. Please refer to specific documentation	
A.5.0.H	A5.0	Thermal alarm. Reactor temperature too high	Connection C46 runs a range of motor heat probes. If C46=1 or 2, a PTC/NTC is being used and its Ohm value (d41) has breached 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.

ALARM			DESCRIPTION	CORRECTIVE ACTION
HEX	DEC			
A.5.1.H	A5.1	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 permit-ted by its technical characteristics. Check parameter P118 is set correctly
A.5.4.H	A5.4	Thermal alarm. Reactor thermal probe not connected	Thermal probe of the reactor not detected	Check the connection of the probe.
A.5.5.H	A5.5	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	A7.0	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.
A.8.0.H	A8.0	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 active state	The external safety switch has cut in disabling drive 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. Authorize or do not assign the function.
A.8.1.H	A8.1	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	A8.2	Fast task LogicLab too long	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	A8.3	Application out of service	There is no valid application running in the drive	Reload the application using OPDExplorer
A.A.0.H	A10.0	Minimum power circuit voltage. DC Bus under minimum threshold admit-ted (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	Software alarm	C29 different from 1	Check and enable connection C29 “Converter software enable”
A.C.1.H	A12.1	Run without power soft start	RUN without Power Soft start	Check why the Power Soft start isn’t enabled
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.C.4.H	A12.4	Transformer-less - Idc overcurrent	Too high DC current injection into the grid detected	Check for faults on external LEM current sensor for transformerless operation or on the cabling. Verify the setting of transformerless parameters (refer to specific paragraph on Transformer-less
A.d.2.H	A13.2	Excessive Ripple on DC Bus	A big variation on DC Bus has been detected	Verify if all three main phases are present on connector L1,L2,L3 and their rms value.

ALARM			DESCRIPTION	CORRECTIVE ACTION
HEX	DEC			
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 converter running are saved into the not volatile memory. This alarm history contains all the alarm events happens during converter's life and it's very useful when converter 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 alarm 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 behavior 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), "▼" (**-** decrease), "▲" (**+** increase) and a four numbers and half display, with the decimal points and the sign "**-**".

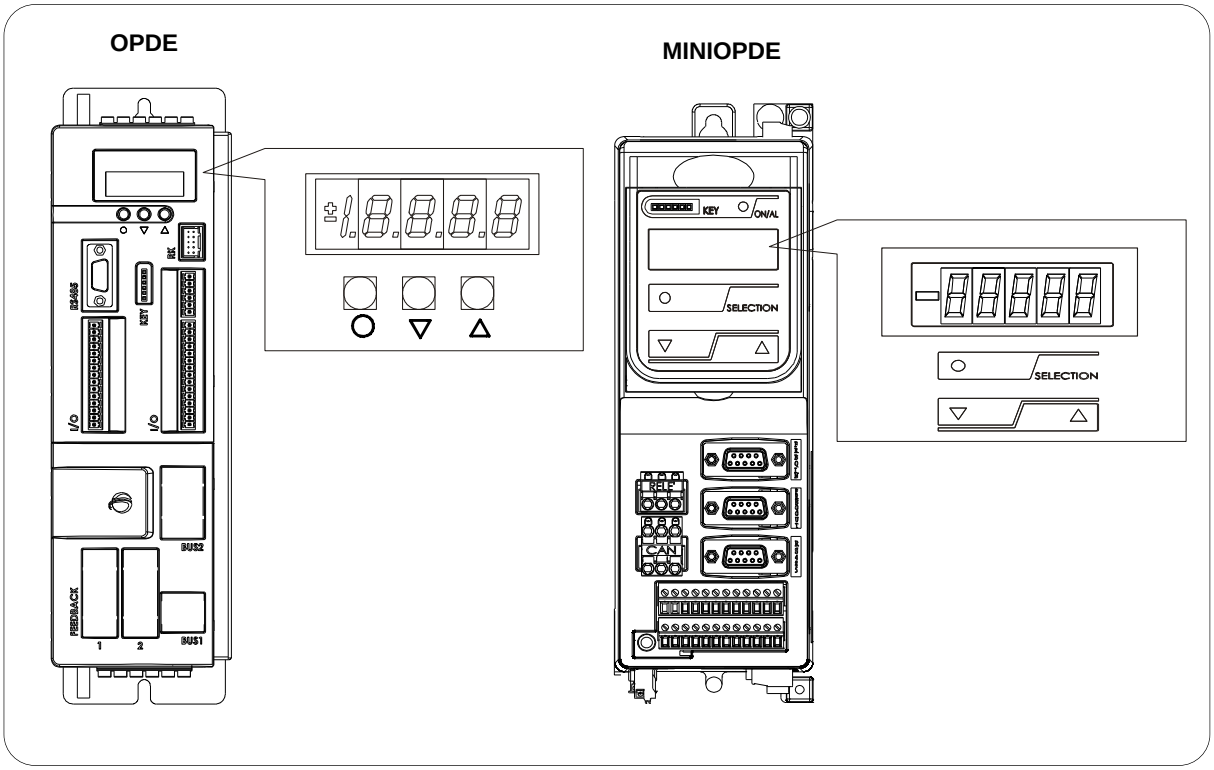


FIG. 1 (Physical disposition)

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 greatnesses have been grouped in the following menu:

- Parameters (**PAR**)
- Application Parameters (**APP**)
- Connections (**CON)**
- Internal values (**INT**)
- Alarms (**ALL**)
- Digital Input (**INP**)
- Digital Output (**OUT**)
- Utilities Commands (**UTL**)
- Fieldbus commands (**FLB**)
- USB port commands (**USB**)

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

7.2.1 PARAMETERS (PAR)

They are definite parameters of variables of setting whose numerical value has an absolute meaning (for example: P63 = nominal frequency motor = 50 Hz) or they are of proportional value to the limit range (for example: P61 = motor nominal current = 100 % of the drive 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:

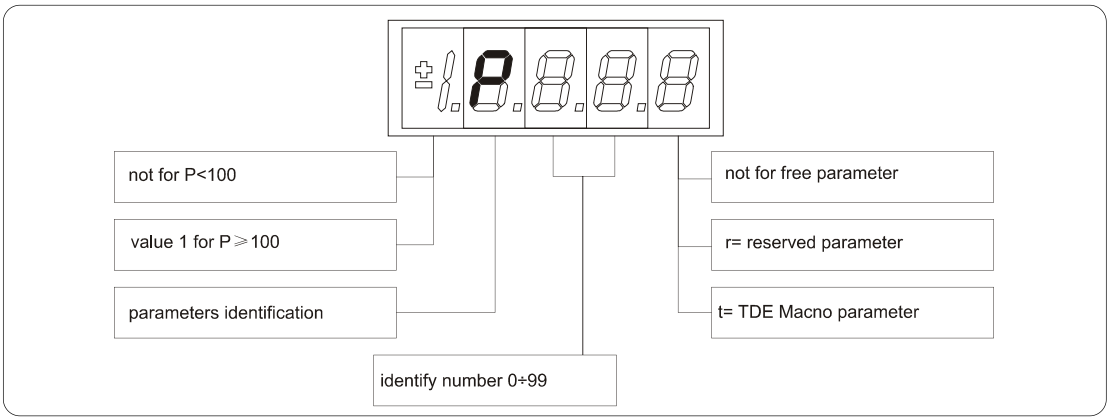


FIG. 2 (Parameters PAR)

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). The characteristics of each parameter are recognizable from the code of identification as below:

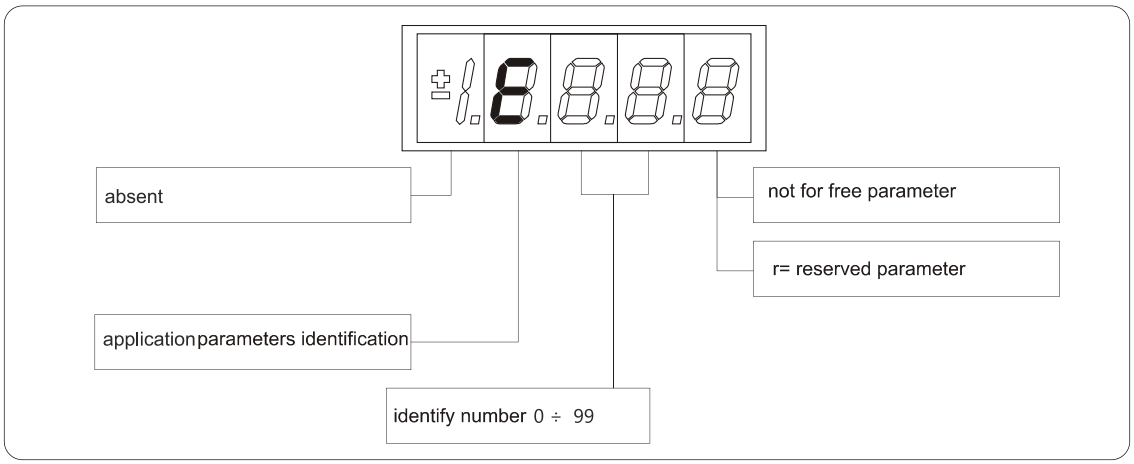


FIG. 3 (Application Parameters PAR)

For example: E03 r = application parameter 03: reserved

7.2.3 CONNECTIONS (CON)

They are certain connections that variables approach that are of numerical value comes connected to a function or a clear command {for example: rounded ramp insertion C27= 1; or no rounded ramp, C27= 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), 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 connection are individually recognizable of **identification code** as under report.

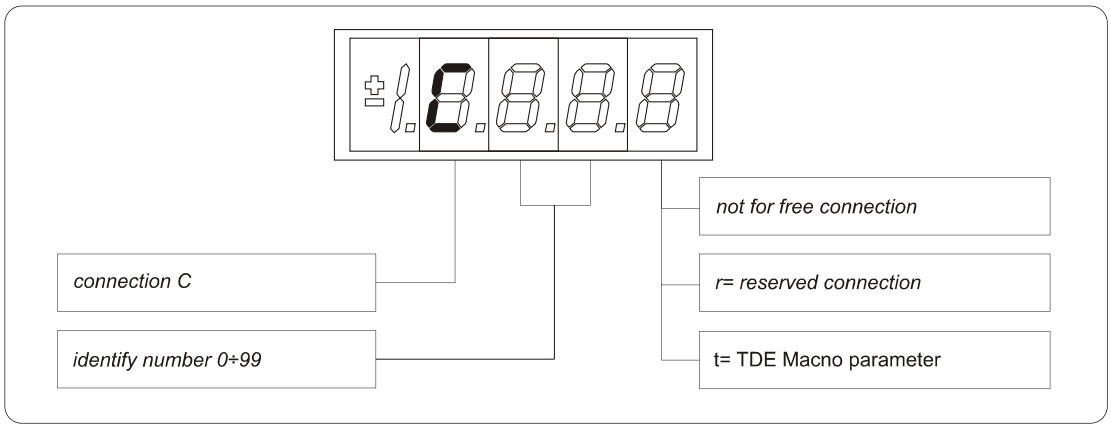


FIG. 4 (Connections CON)

7.2.4 INTERNAL VALUES (INT)

Overall functions of protection of the converter, of the motor or in the application whose status to active alarm or non active alarm it may be visualized in the display. The actived 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:

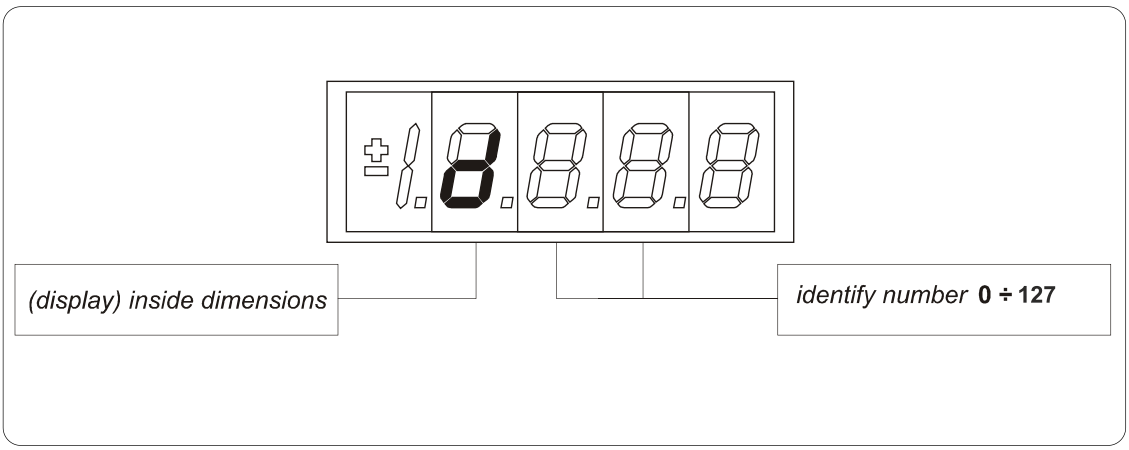


FIG. 5 (Internal Values INT)

7.2.5 ALARMS (ALL)

Overall functions of protection of the converter, of the motor 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).

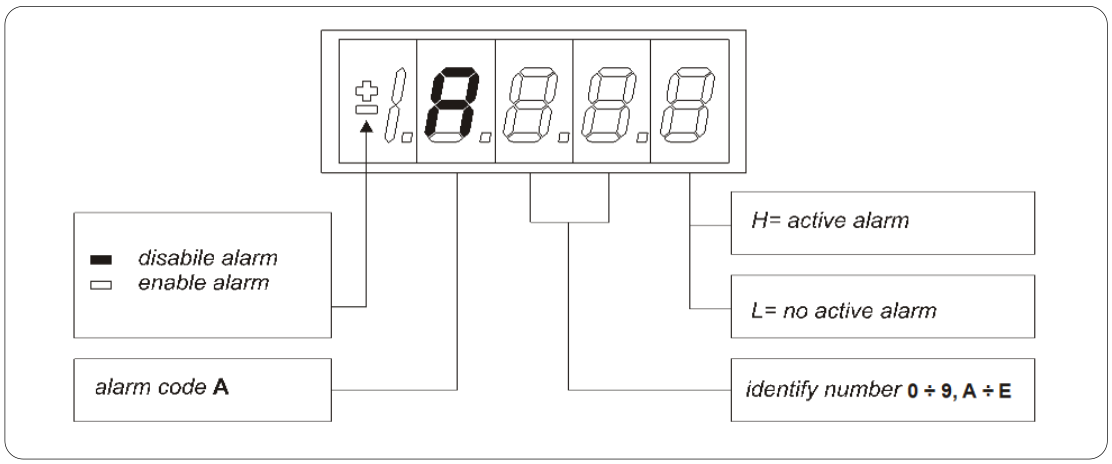


FIG. 6 (Alarms ALL)

7.2.6 LOGIC FUNCTIONS OF INPUT (INP)

The visualization between I00 and I31 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.

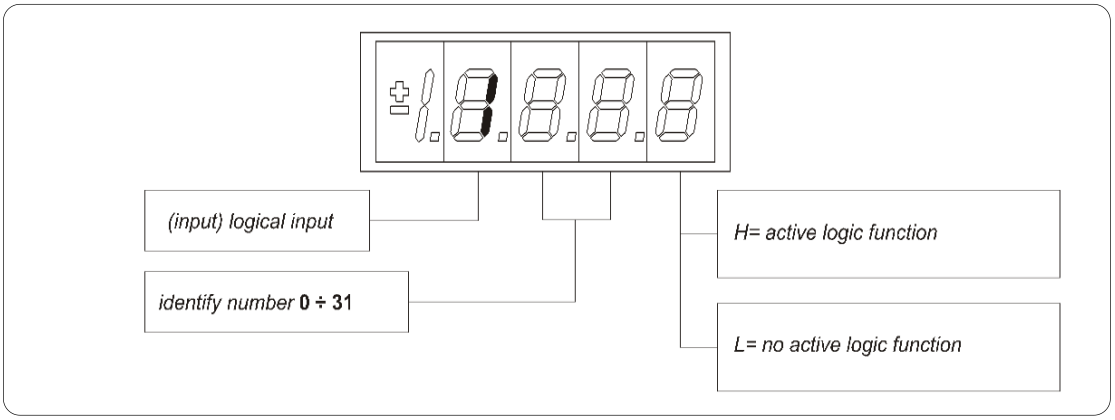


FIG. 7 (Logics functions of input INP)

7.2.7 LOGIC FUNCTIONS OF OUTPUT (OUT)

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

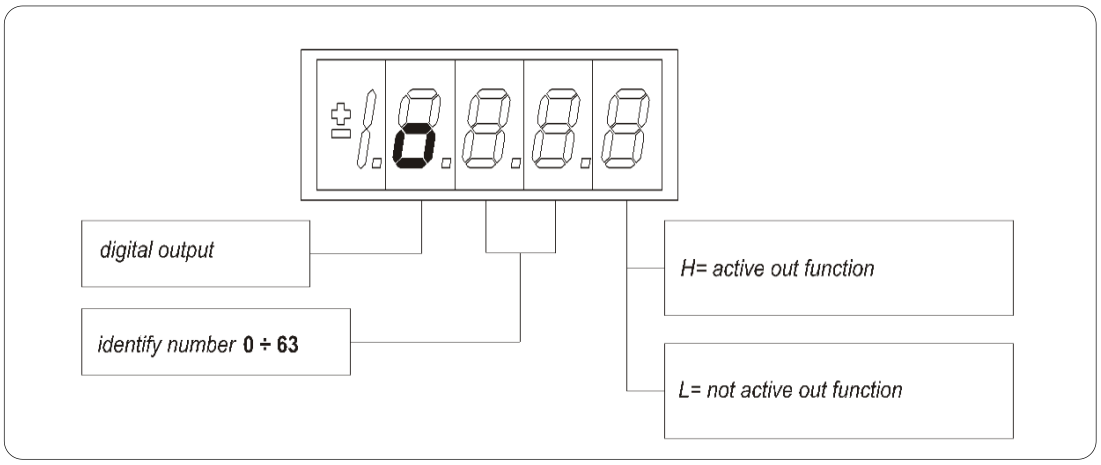


FIG. 8 (Logics functions of output OUT)

7.2.8 UTILITIES COMMANDS (UTL)

They are certain connections that variables 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:

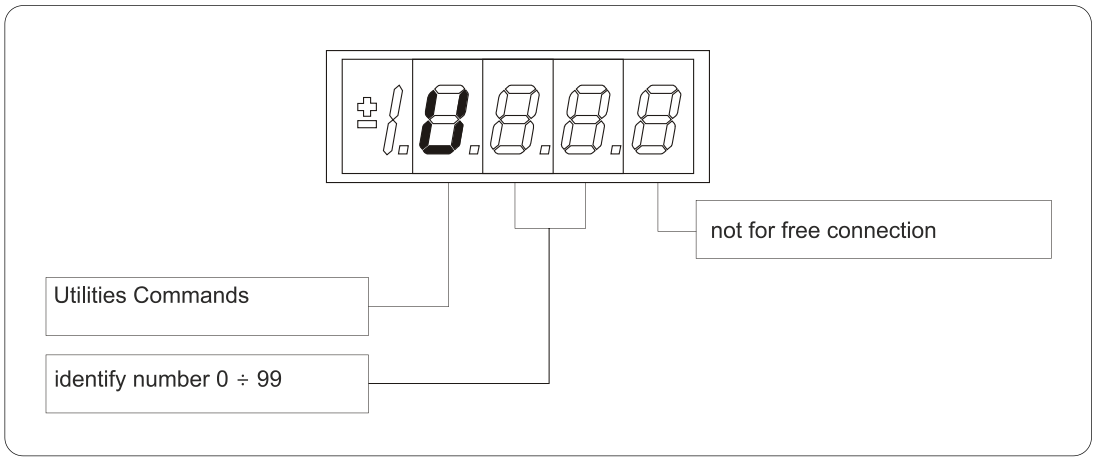


FIG. 9 (Utilities Commands UTL)

7.2.9 FIELDBUS PARAMETERS (FLB)

FLB menu refers to parameters related to Fieldbuses management that was previously accessible only by OPDExplorer 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, as lists in following tables, 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:

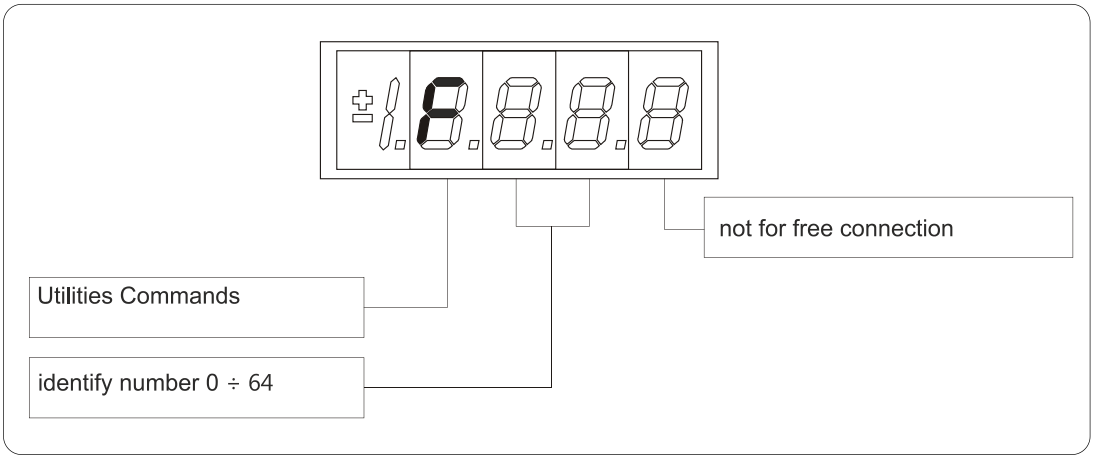


FIG. 10 (Fieldbus Parametrs FLB)

7.2.10 USB PORT COMMANDS (USB)

Now is available a new version of the display/keypad board interface to the drive, in which the programming key has been replaced with an USB port. About this, a new menu USB is been added and it contains all the command that allows data exchange with a pen-drive. With this new functionality is possible to save more than one parameter recipes, firmware and application files in the same pen-drive. For more information look at the specific manual situated in our web site **www.bdfdigital.it** in Product/Download/Manuals/Automation/OPDE family. Code of identification:

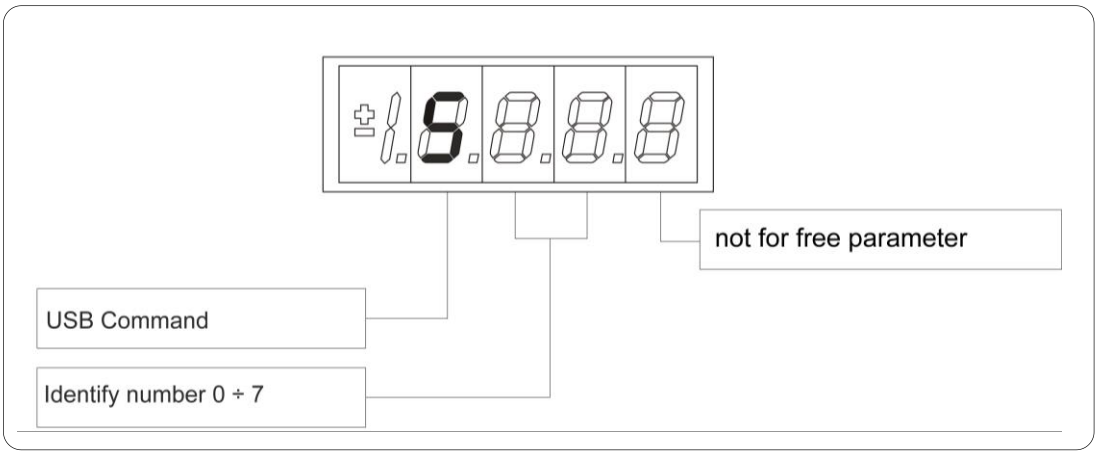


FIG. 11 (USB Commands)

7.3 IDLE STATE

It's 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 idle state, if the converter isn't running, the status "**STOP**" is visualized; if the converter is running the internal values selected with C00 connection or the status "**run**" is visualized. If the converter finds the status alarm, for intervention of one 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 visualizable variables:

- **PAR** = Parameters
- **APP** = Application Parameters
- **CON** = Internal Connections
- **INT** = Internal values
- **ALL**= Alarm
- **INP** = Digital Input
- **OUT** = Digital Output
- **UTL** = Utilities commands
- **FLB** = Fieldbus Parameters
- **USB** = USB commands

To change from a list to another enough is necessary to use the "+" or "-" keys and the passage will happen in the order of figure. 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 status of rest comes instead automatically after 10 (P112) seconds of inactivity is from some sub-menu that goes by the main menu.

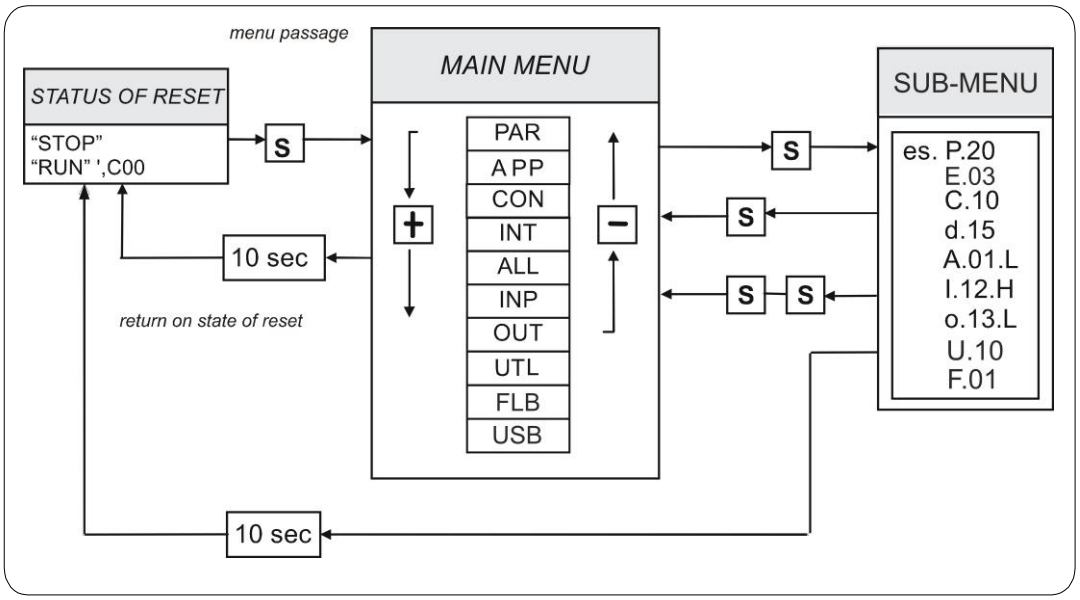


FIG. 12 (Main Menu)

7.4.1 SUB-MENU OF PARAMETERS, APPLICATION PARAMETERS AND CONNECTIONS MANAGEMENT

From "**PAR**", "**APP**" 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 doesn't 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.

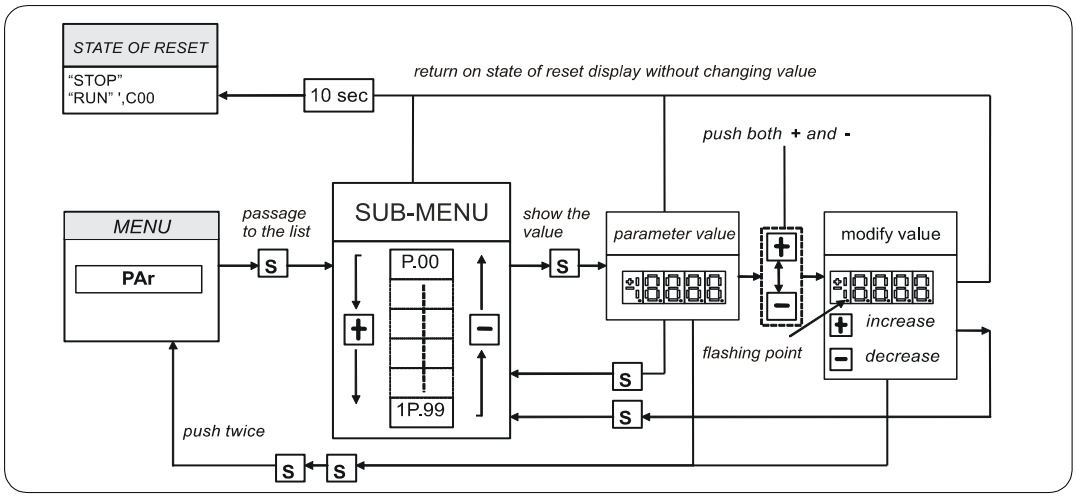


FIG. 13 (Submenu management parameters PAR)

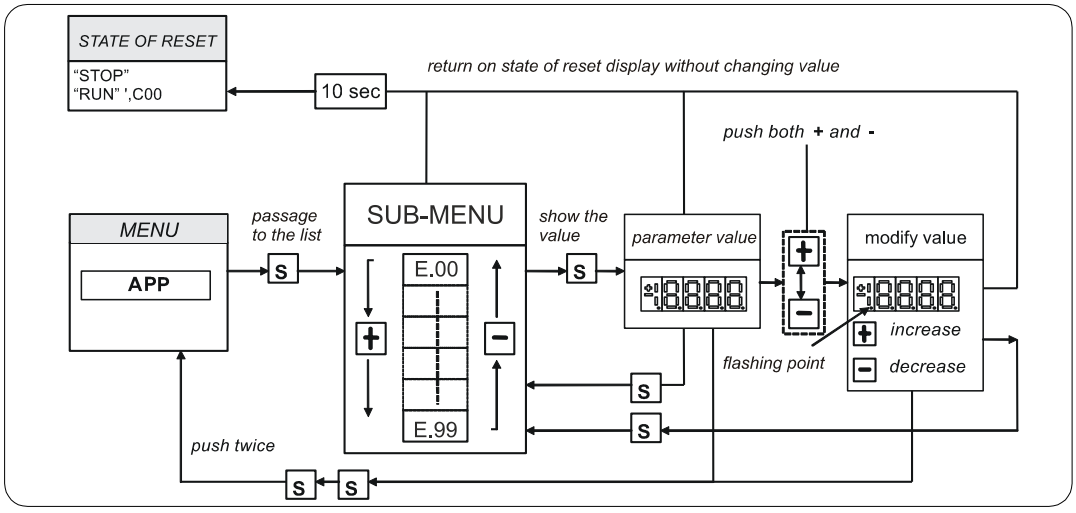


FIG. 14 (Submenu management application parameters APP)

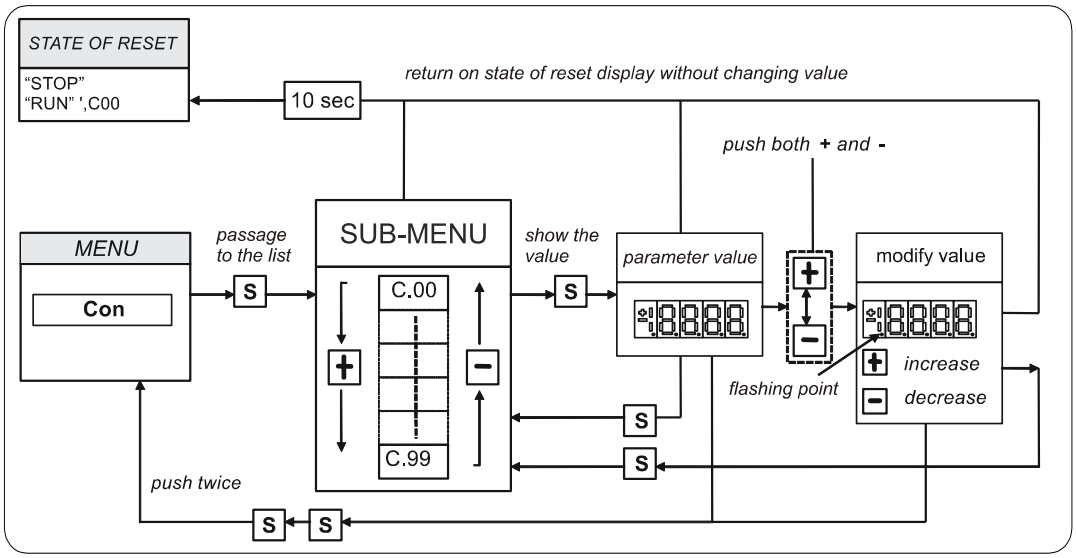


FIG. 15 (Submenu management connections CON)

7.4.2 VISUALIZATION OF THE INTERNAL VALUES (INT)

From "**INT**" you enter into the sub-menu list of internal values pressing "**S**". In the list you are moving with the keys "+" or "–" till that appearing address of dimensions wanted visualize "**dxx**"; 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.

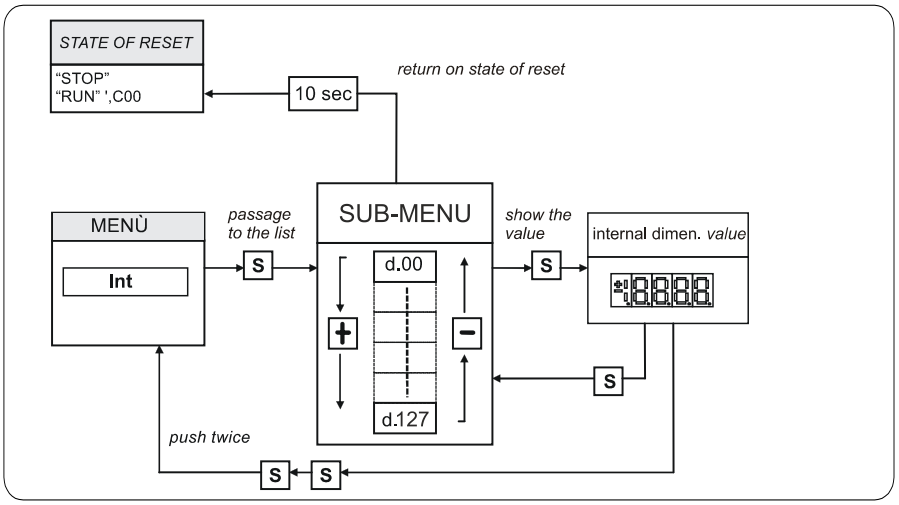


FIG. 16 (Visualization of the internal dimensions INT)

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 submenu You turn automatically to the status of rest after a time closed to 10 seconds.

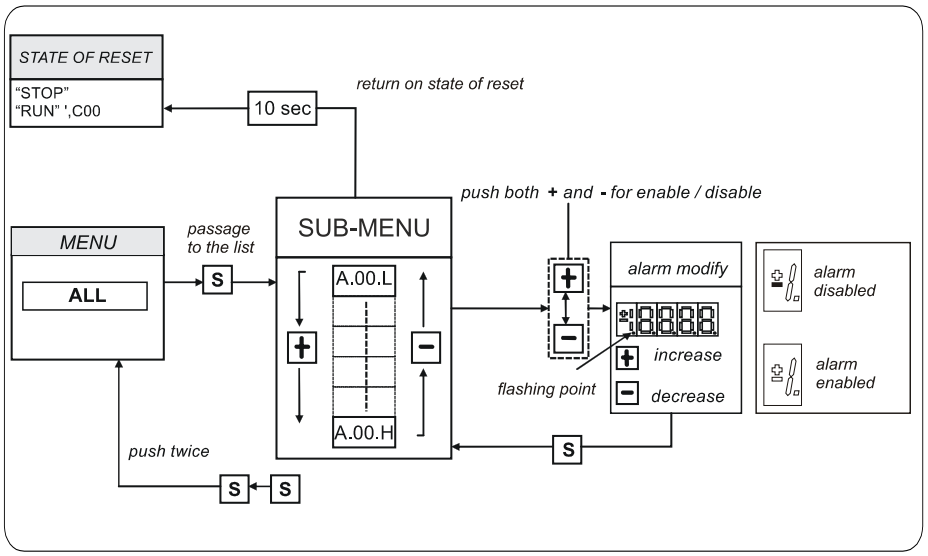


FIG. 17 (Alarms ALL)

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**”.

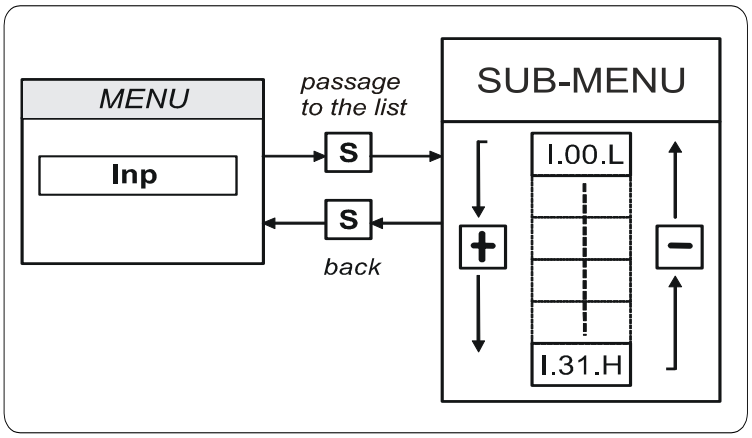


FIG. 18 (Digital input INP)

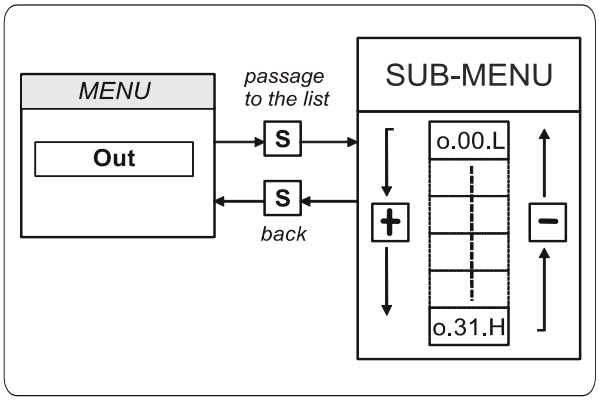


FIG. 19 (Digital output OUT)

7.4.5 SUB-MENU OF USB PORT MANAGEMENT

From "**USB**" you enter into corresponding list of sub-menu pressing "**S**". At the access will be available only "**S.00=0**" command, because USB port is normally disable and can't interact with a pen-drive. In order to enable USB port set **S.00=1**; now a pen-drive will be recognized and in the USB sub-menu all the command will be available (S.01÷S.07). S.00 will come back to 0 (USB port disable) if a pen-drive hasn't been connected within 30 seconds.

Once entered into the list is able look through the commands by pressing the keys "**+**" or "**–**" to move in increase or in decrement; even in this case the list is circular. If You press "**S**" key the value of the command is visualized; 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.

For more information look at the specific manual situated in our web site **www.bdfdigital.it** in Product/Download/Manuals/Automation/OPDE family.

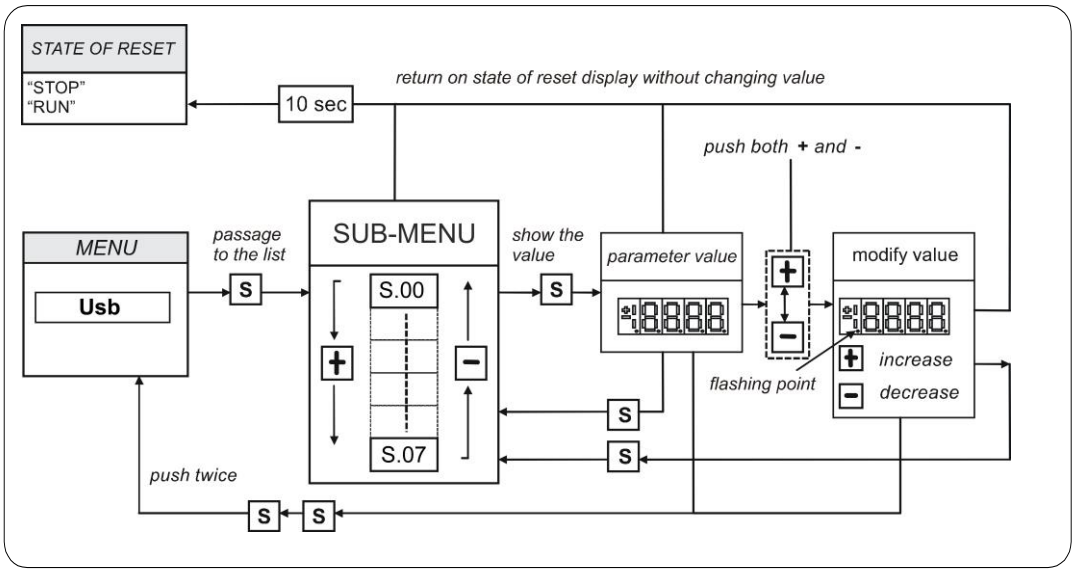


FIG. 20 (USB commands)

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.21 (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. 22

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:

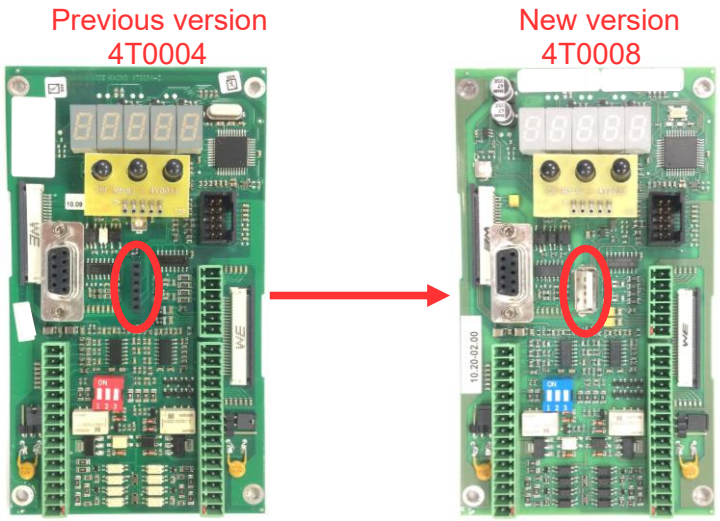
- Insert the key into the suitable slot with the correct way (otherwise it's not read);
- Open the reserved parameter key with **P60=95**;
- Select the "**LoAd**" function with the buttons▼ and ▲ located on the keyboard of the drive and push "●" as confirm;
- Set **C63=1** to save the new parametrization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

FIG.23

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

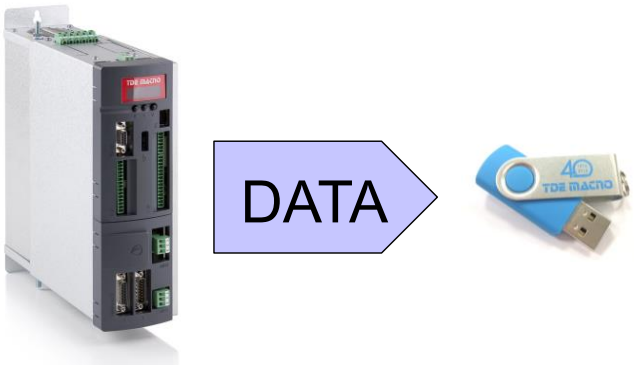
Before connecting a pen-drive in the menù is available only the command **S.00=0** (default).
Set **S.00=1** to enable the USB Host interface: the power supply is applied to the USB connector and then a pen-drive can be connected and recognized by the OPDE; if a MSD Device is not recognized within 30 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 menus, 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).

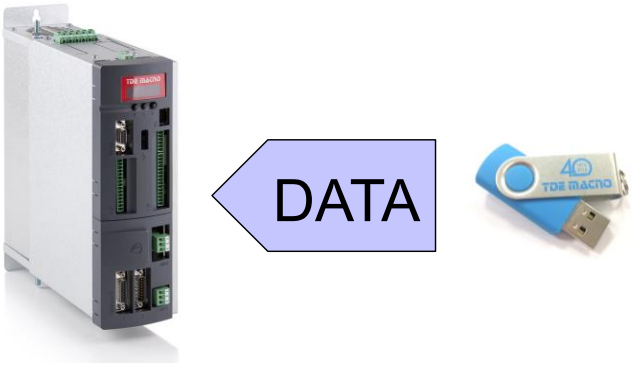
Command **S.01** stores **all the OPDE parameters** to the flash drive; the data are stored into the flash drive working directory in a file named **RCPxx_cc.cc_aa.aa_.MRA** where **xx** is the slot # number choosed by parameter S.01, **cc.cc** is the firmware "core" version and **aa.aa** is the firmware "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).

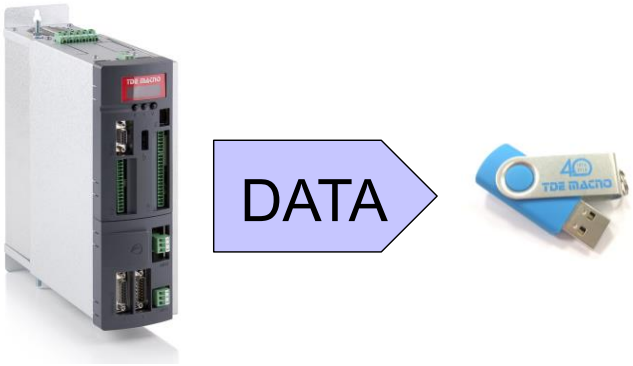
There are a variety of situations and problems that can happen and that prevent a correct execution of the command: in these cases the display will show a message (for 10s) that indicates the cause of failure:

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
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.

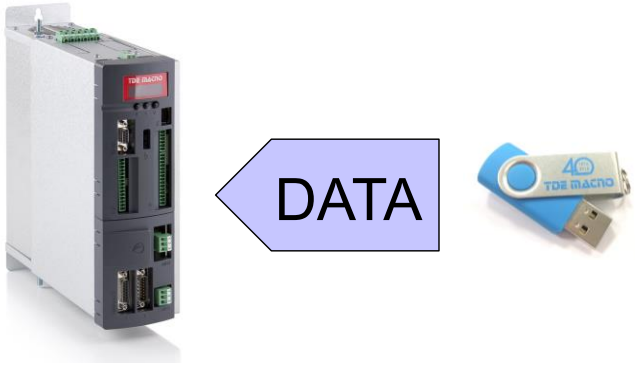
Firmwares (“core” and “app” together) are stored into the flash drive working directory in 2 separated files named **CORExx_cc.cc_.LDR** and **APPxx_aa.aa_.LDR** where **xx** is the slot # number choosed by parameter **S.05**, **cc.cc** is the firmware “core” version and **aa.aa** is the firmware “app” 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

Error code	Description	Action
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
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

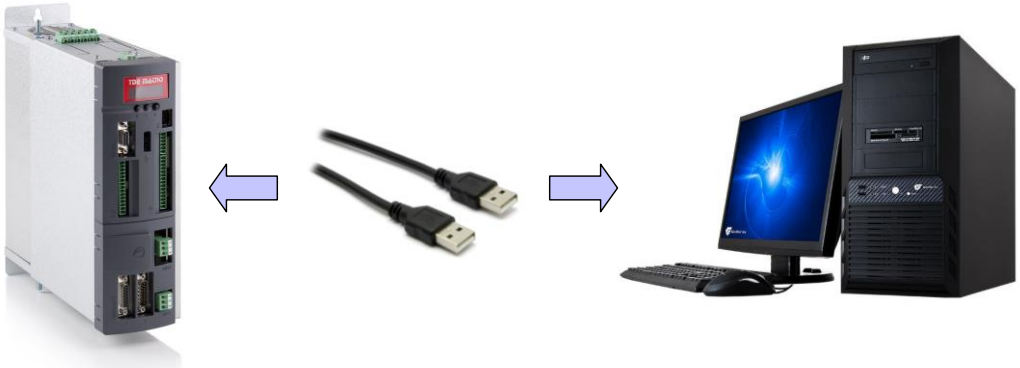
Warning:
Loading the firmware the control board of the OPDE is fully busy, so we suggest to power off the main voltage of the drive before these operations.

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.

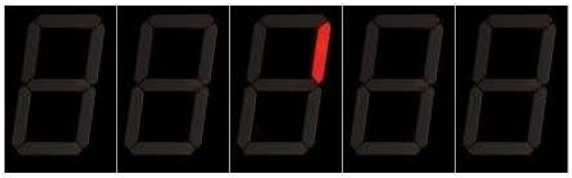


At the first connection the Operative System of the PC will ask for a driver that are powerd by TDE Macno with the .inf file (that's good for both 32 and 64bit Windows OSes) and that can be downloaded by the website www.bdfdigital.it a the voice **PRODUCTS/DOWNLOAD/UTILITY SW**, folder **DRIVER_USB_4T0008.zip**.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

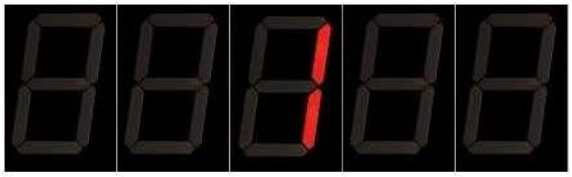
When a PC is directly connected to the OPDE, the Operator Interface is not working as the internal serial link is used exclusively for data communication with the PC.
For the same reason **speed is 38400 bps and Modbus address is 1** (regardless to settings in parameters P92 and P93) and can't be changed.

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_NOM	10
PRC_I_PEAK	P40 - Current limit	0.0	250.0	200	% I_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_NOM	40.96
MAX_ABSORPT_I	P43 - Maximum absorption current	-400	0	-200	% I_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_NOM	10
MAX_V_GRID	P51 - Alarm level for maximum grid voltage	105.0	135.0	130.0	% V_NOM	10
K_V_GRID	P52 - Corrective Factor for AC Grid Voltage	25.0	200.0	100.0	%	10
K_V_GRID_EXT	P54 - Corrective Factor for AC Grid Voltage of external grid	25.0	200.0	100.0	%	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_NOM	327.67
V_NOM	P62 - Nominal Grid Voltage	30.0	1000.0	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_NOM	10
PRC_REAL_VRS	P69 - Voltage drop due to real resistor	0.0	25.0	0.1	% V_NOM	327.67
PRC_REAL_VLS	P70 - Voltage drop due to real inductance	0.0	50.0	3.0	% V_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_NOM	327.67
PRC_VIRTL_VLS	P73 - Voltage drop due to real+virtual inductance	-50.0	50.0	3.0	% V_NOM	327.67
CAPAC_LINE_CURR	P74 - Capacitors Line Current	0.0	20.0	0.0	% I_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_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
TR_ANGLE	P80 - Transformer phase shift (angle at grid side minus angle at AFE side)	-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
GRID_V_TF	P90 - TfGridV Grid voltage filter time constant	0.0	300	30.0	ms	10
LOAD_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
LOAD_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
DCBUS_MIN_GRID_LOST	P97 - Minimum voltage level for forced grid off	100.0	1200.0	425	V	10
SW_PAR_KEY	P99 - Access key to TDE parameters	0	19999	0		1
FACTORY_PAR_KEY	P100 - Value of access key to reserved parameters	0	19999	95		1
F_PWM	P101 - PWM frequency	1000	25000	5000	Hz	1
PRC_DEAD_TIME_CMP	P102 - Dead time compensation	0.0	100.0	0	‰ PRC_V_MAX	32.76
PRC_I_MAX	P103 - Converter limit current	0.0	800.0	200	% I_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
I_PEAK	P113 - Maximum converter current	0.0	3000.0	0	A	10
KP_LOAD_THERM_PRB	P115 - Multiplication factor for reactor PTC/NTC/PT100 analog 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
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
RAD_DO_TEMP_THR	P120 - Heat sink temperature threshold for logic output o.15	0.0	150.0	80	°C	10
FAN_CTRL	P121 - FAN ctrl	0	3	1		1
MOD_INDEX_MAX	P122 - Max. modulation index	0.500	0.995	0.98		1000
PRC_I_ZERO_KP_COEFF	P124 - Corrective coeff. estimated Kp for zero current loop	0.1	200.0	50	%	40.96
PRC_I_ZERO_TI_COEFF	P125 - Corrective coeff. estimated Ti for zero current loop	0.1	200.0	10	%	40.96
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 option)	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 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	2.0	%	81.92
RESYNC_PHASE_THR	P136 - % Phase threshold for microgrid resync	0.0	100.0	0.5	%	81.92
RESYNC_VAL_TIME	P137 - Validation time for microgrid resync	20	2000	200	ms	1
KP_BOARD_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_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
BLACK_START_INIT_VALUE	P144 - Initial boost value for black-start	0.0	100.0	0.0	%	163.84
LVFRT_T_MAX	P145 - LVFRT maximum duration	0.10	5.00	3.00	s	100
GRID_UNB_MAX	P146 - Maximum grid voltage unbalance for enabling run	0.1	100.0	10.0	% V_GRID_NOM	10
V_GRID_MAX_UNB	P147 - Maximum grid voltage with unbalanced grid for enabling run	0.0	200.0	115.0	% V_GRID_NOM	10
V_GRID_MIN_UNB	P148 - Minimum grid voltage with unbalanced grid for enabling run	0.0	200.0	80.0	% V_GRID_NOM	10
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_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
OVR_LOAD_T_ENV	P155 - Ambient temperature reference value during overload	0.0	150.0	40	°C	10
CHR_F_PWM	P156 - PWM frequency for converter definition	1000	16000	5000	Hz	1
DEAD_TIME_SW	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
CHR_V	P167 - Characterization voltage	200.0	690.0	400	V rms	10
PI_AC_TI	P181 - TiPlac PI_AC regulator lead time constant	0.0	1000.0	50.0	ms	10
DRV_K_ALTITUDE	P195 - Drive Derating with altitude	0	200	100	%	163.84
DEAD_TIME_SW_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
CONTROL_SEL	C00 - Control Selection	0	13	0		1
DISPLAY_SEL	C14 - Display selection	0	127	0		1
EN_SLOT_SWAP	C19 - Enable sensor slot swap	0	1	0		1
SW_RUN_CMD	C21 - Run software enable	0	1	1		1
PWM_SYNCHRONIZATION	C23 - Pwm Synchronization	0	10	0		1
DC_BUS_FULL_SCALE	C24 - DC Voltage converter full scale	0	2	0	V	1
PWM_MOD_TYPE_SEL	C27 - PWM Modulation type selection	0	4	0		1
CONV_SW_EN	C29 - Converter software enable	0	1	1		1
ALL_RESET	C30 - Alarms reset	0	1	0		1
DIS_DCBUS_RIPPLE_ALL	C31 - Disable DC Bus Ripple Alarm	0	1	0		1
EN_LOAD_THERM_AL	C32 - Reactor thermal switch 'Block converter?'	0	1	1		1
REACT_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
BOARD_CONF	C40 - Control board mounting options	0	10	1		1
ALL_COUNT_RESET	C44 - Reset alarms counters	0	4	0		1
LOAD_THERM_PRB_SEL	C46 - Enable reactor thermal probe management (PT100/PTC/NTC)	0	5	0		1
CANOPEN_BAUD_SEL	C48 - CAN Baud rate	0	7	0		1
I_OVR_LOAD_SEL	C56 - Current overload	0	3	1		1
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 - Default parameters Read	0	2	0		1
EEPROM_PAR_RD	C62 - Read parameters from EEPROM	0	2	0		1
EEPROM_PAR_WR	C63 - Save parameters in EEPROM	0	1	0		1
EN_FLDBUS	C64 - Enable fieldbus manage	0	7	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
LOAD_PRB_RES_THR_MUL	C71 - Reactor NTC or PTC resistance multiplication factor	0	1	0		1
EN_TLESS	C72 - Enable Transformerless	0	3	0		1
EN_R_GRID_TUNING	C73 - Enable Rgrid tuning	0	1	0		1
EN_LVFRT_MANAGE	C74 - Enable LVFRT manage	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	2	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
3PH_CTRL_EN	C86 - Enable control on V phase	0	2	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
DRV_TH_MODEL	C94 - Drive Thermal Model	0	2	1		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
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
TX9_INDEX	Transmit Object9 Index			0	Hex	1
TX9_SUB_INDEX	Transmit Object9 Sub-Index			0	Hex	1
NODE_SLAVE_ADDR	Slave address			0		1
NODE_BAUD_RATE	Node baud rate	0	255	0		1
DATA_CONSISTENCE	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
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
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
TLESS_DER_F_TD	P312 - Tless frequency derivative time constant	0.1	3000.0	200.0	ms	10
TLESS_DER_F_TF	P313 - Tless frequency derivative filter time constant	0	3000.0	10.0	ms	10
TLESS_DER_F_THR	P314 - Tless frequency derivative threshold	0.0	100.0	10.0	%	10
TLESS_DER_I_TD	P315 - Tless current derivative time constant	0.1	3000.0	20.0	ms	10
TLESS_DER_I_TF	P316 - Tless current derivative filter time constant	0	3000.0	10.0	ms	10
TLESS_DER_I_THR	P317 - Tless current derivative threshold	0.0	100.0	10.0	%	10
TLESS_IDC_NOM	P318 - Tless Idc rated current	0.001	32.767	0	A	1000
TLESS_IDC_THRa	P319 - Tless Idc threshold a	0.1	100.0	0.5	% I_CONV_NOM	10
TLESS_IDC_THRb	P320 - Tless Idc threshold b	0.1	100.0	1.0	A	10
TLESS_LPF2_DMP	P321 - Tless LPF2a and LPF2b damping factor	0.01	1.00	0.90		100
TLESS_LPF2a_TF	P322 - Tless LPF2a filter time constant	0.1	3000.0	200.0	ms	10
TLESS_LPF2b_TF	P323 - Tless LPF2b filter time constant	0.1	3000.0	25.0	ms	10
TLESS_NOTCH_DMP	P324 - Tless Notch filter damping factor	0.0	100.0	0.0	%	10
TLESS_NOTCH_F0	P325 - Tless Notch Filter natural frequency	0.0	100.0	50.0	Hz	10
TLESS_NOTCH_FB	P326 - Tless Notch Filter bandwidth	0.0	100.0	25.0	Hz	10
TLESS_OFF_MAX	P327 - Tless maximum voltage offset	0.1	5.0	2.0	% V_CONV_NOM	10

TLESS_REG_KP	P328 - Kp Tless regulator gain	0.01	100.00	3.5		100
TLESS_REG_MAX	P329 - Tless regulator maximum output	0	400	200	%	1
TLESS_REG_TF	P330 - Tf Tless regulator filter time constant	0.0	3000.0	0.0	ms	10
TLESS_REG_TI	P331 - Ti Tless regulator lead time constant	0.1	3000.0	50	ms	10
TLESS_U_KP	P332 - Tless U amplitude compensation	0.0	200.0	100.0	%	10
TLESS_W_KP	P333 - Tless W amplitude compensation	0.0	200.0	100.0	%	10
KT	P334 - Multiplier	1.0	100.0	1.0	p.u.	10
PRC_DELTA_VRG	P335 - Voltage drop due to total resistor toward the grid	0.01	100.00	10.0	%	100
EN_PWM_VAR	P339 - Enable fPwm variation	0	3	0		1
FPWMSWEEP_INJ_F	P340 - frequency of fPwm sweep (percentage of fPwm)	0	16000	100	Hz	1
FPWMSWEEP_INJ_A	P341 - Amplitude of fPwm sweep (percentage of fPwm)	0	30	10	%	1
I_NOM	P53 - Rated Converter current	0.0	400	0	A	10
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_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	%	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_LOAD_THERM_PRB_TDE	Factory multiplication factor for motor PTC/NTC/KTY84 analog 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
DRV_I_CONN_TH_MODEL	D06 - Drive inner connection limit			0	% DRV_I_CONN_MAX	163.84
PRC_IQ_REF	D07 - Request of active current Iq rif	-100	100	0	% I_NOM	40.96
PRC_ID_REF	D08 - Request of reactive current Id rif	-100	100	0	% I_NOM	40.96
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
GRID_SEL	D14 - Grid type			0		1
PRC_IQ	D15 - Active current Iq	-100	100	0	% I_NOM	40.96
PRC_ID	D16 - Reactive current Id	-100	100	0	% I_NOM	40.96
PRC_V	D18 - Reference voltage module	-100	100	0	% V_NOM	40.96
MOD_INDEX	D19 - Modulation index	-100	100	0		40.96
PRC_VQ_REF	D20 - Vq rif	-100	100	0	% V_NOM	40.96
GRID_V	D21 - Grid AC Voltage			0	V rms	1
PRC_VD_REF	D22 - Vd rif	-100	100	0	% V_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
RAD_TEMP	D25 - Heat sink temperature reading			0	°C	16
LOAD_TEMP	D26 - Reactor temperature			0	°C	16
PRC_REACT_I_THERM	D28 - Reactor thermal current	-100	100	0	% soglia All	40.96
PRC_I_MAX	D29 - Current limit	-100	100	0	% I_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
PRC_APP_I_MAX	D32 - Maximum current limit by application	-400	400	0	% I_NOM	40.96
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
LOAD_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
IGBT_J_TEMP	D45 - IGBT junction temperature			0	°C	16
IGBT_J_TEMP_MARGIN	D46 - IGBT junction temperature margin with its limit			0	°C	16
PRC_APP_I_MIN	D48 - Minimum current limit by application	-400	400	0	% I_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
PLC_REV	D61 - Application Revision			0		163.84
HW_SENSOR2	D62 - Sensor2 presence			0		1
HW_SENSOR1	D63 - Sensor1 presence			0		1
MAP_ERROR_CODE	Mapping Error Code			0		1
MAP_ERROR_OBJ	Mapping Error Object			0	Hex	1
FLDB_ERROR_CODE	Fieldbus error code			0		1
FLDB_STATE	Fieldbus state			0		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
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
TLESS_IDC_U	D400 - Tless Idc U current	0	32.767	0	A	1000
TLESS_IDC_W	D401 - Tless Idc W current	0	32.767	0	A	1000

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