DC-DC*plus*
User's Manual
Firmware Version 90.00

Manual Code: MW02301E00 V_0.0

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 relevant quantities for the proper functioning of the power converter.

In particular, each chapter refers to a specific folder of OPDExplorer project 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 to, and the complete table of its parameters.

The control values are divided as follows:

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

In the tables of the control parameters, the last column "Scale" on the right shows the internal representation base of the parameters. This value is important to read and write the parameters with a serial line or fieldbus and it represents the factor that the value stored has to be divided to in order to obtain the actual set value, that is:

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

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 configuration values that are displayed as an integer 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 integer 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 DC/DC DESCRIPTION AND START-UP

The DC/DC Converter can operate as synchronous buck or synchronous boost power converter.
The converter has a multiphase or interleaved topology: it is made of the parallel connection of three legs. This kind of topology allows bidirectional current flow and so bidirectional power flow.
The DC/DC operating mode is set with C.81 (FW 90.01): for more detail see hereafter.

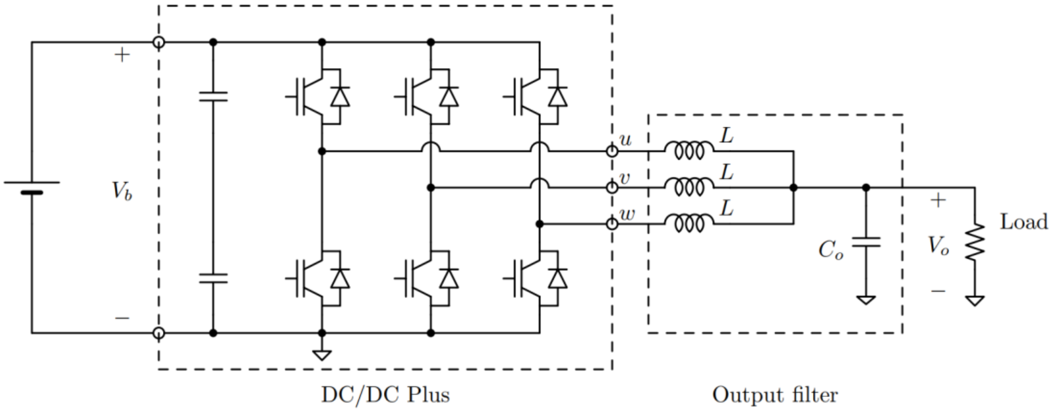


Figure 1 DC/DC Circuit – step-down mode

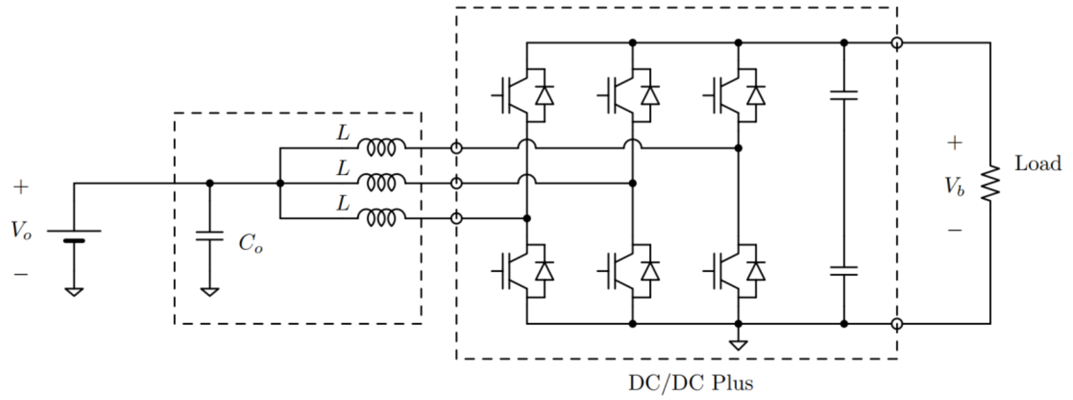


Figure 2 DC/DC Circuit – step-up mode

The DC/DC can be powered from Vb side or from Vo side: in the first case, the power converter operates as buck converter, in the second case as boost converter.
Buck converter is a step-down power converter, while boost converter is a step-up topology. Please consider that buck-boost (or step-up and step-down) modes are not available at the same time and so converter can not work in step-up / step-down mode at the same time.

In this document, buck mode and step-down mode terms will be used to refer to the converter configuration powered at Vb side. On the other hand, boost mode and step-up mode terms will be used to refer to the converter configuration powered at Vo side.

The close loop control is made by an outer voltage loop (Vb or Vo voltage control) and an inner current one: voltage loop can be disabled by the user.

Caution! DC/DC unit is provided by three-phase IGBT bridge (with anti-parallel diodes) and so Vb bus voltage can be charged also with the converter in 'stop' and a voltage presence at Vo side.

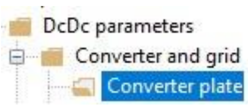
NOTE: DC/DC Plus is part of OPDE Plus family. This manual is intended to describe the DC/DC Parameters and Settings. For further information about the hardware of the OPDE Plus family and functionality please refer to OPDE Plus DC/DC INSTALLATION manual.

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

STEP	TITLE	ACTION
1	**Connections set up and verify**	**Power +24 V of the Converter. Do not Power Vo or Vb sides of the Converter.** Verify the electrical connections following the manual (DCDC_PLUS_INSTALLATION). Care must be taken in order to verify the Vo voltage feedback board.
2	**Set up the Converter**	Verify the setup of Converter Plate. Verify the setup of the P61 (Rated Reactor Current) and P62 (Nominal Grid Voltage. Verify Vo reading full-scale value (P09) and its analog input (C18). Configure DC/DC operating mode (C81). Verify the setup of parameters P22 and P23 that specifies output filter inductance and capacitor values. In step-up mode, perform automatic detection of LEM current offset (U01).
3	**Verify the Precharging (if present)**	Verify the precharging circuit parameters: C45, P154 and P65.
4	**Power the input stage of the Converter**	Now it is possible to power the input stage of the converter (Vo or Vb side). Verify the correct value of the input voltage compared with the one read into D22 or D24.
5	**Vo or Vb control**	Now it is possible to start working with the DC/DC. Verify the setup of the voltage regulator control (P27, P28, P33). With the converter Run, the Bus Voltage or the Output voltage should be kept to the selected value in P08 or in P10 (based on the connection time and on the C81 configuration).

2 DCDC PARAMETERS

2.1 CONVERTER AND GRID



2.1.1 CONVERTER PLATE

Name	Description	Min	Max	Default	UM	Scale
LEM_CURRENT_OFFSET_U	P46 - LEM current sensor offset U	-100.0	100.0	0	%	327.67
LEM_CURRENT_OFFSET_W	P47 - LEM current sensor offset W	-100.0	100.0	0	%	327.67
LEM_CURRENT_OFFSET_V	P48 - LEM current sensor offset V	-100.0	100.0	0	%	327.67
F_PWM	P101 - PWM frequency	1000	25000	10000	Hz	1
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
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
FAN_CTRL	P121 - FAN ctrl	Range 0	 No fan ctrl 1 Fan ctrl On/Off 2 thermostatic fan ctrl	1		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	10000	Hz	1
DEAD_TIME	P157 - Dead time duration	0.0	20.0	4	µs	10
CHR_V	P167 - Characterization voltage	200.0	690.0	460	V rms	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
DC_BUS_FULL_SCALE	C24 - DC Voltage converter full scale	0	2	0	V	1
RECT_BRIDGE_SEL	C45 - Rectification bridge	Range 0 Diode 1 Half-controlled		0		1
I_OVR_LOAD_SEL	C56 - Current overload	Range 0 120% x 30 1 150% x 30 2 200% x 30 3 200% x 3 + 155% x 30		0		1
LEM_OFF_COMP_EN	U01 - Enable AT offset compensation for LEM (step-up mode)	Range 0 No 1 Yes		0		1
I_NOM	P53 - Rated Converter current	0.0	400	0	A	10
FW_REV	D00 - Software version			0		256
HW_SENSOR2	D62 - Sensor2 presence			0		1
HW_SENSOR1	D63 - Sensor1 presence			0		1

The time between the end of the precharge and the enabling Converter Ready can be set in P65 [ms].

2.1.1.1 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 **P53**.

The delivered current is also used to calculate the operating temperature reached by the power component junctions with the converter assumed 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.

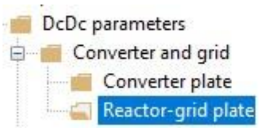
The overload time is bound to the power converter output current before the overload request and how long this current is delivered for. Reducing this time (so increasing the frequency of overload request) the available overload time will decrease.
If the average delivered current is lower than the rated 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.*

2.1.1.2 LEM current offset compensation

While converter is operated in step-down mode, LEM current offset is automatically calculated and compensated: in particular, offset is measured while converter is not running.
On the other side, when converter is operated in step-up mode, current offset can not be easily evaluated: the main reason is that current can flow into the IGBT legs even if the converter is not running due to device body diodes.
In order to compensate LEM current offset in step-up mode, user shall ensure that no current is flowing (for instance disconnecting all the loads) and then start offset measurement with U01. Once offsets are evaluated U01 procedure stops automatically and parameters P46, P47 and P48 are written with new offset values. After this, it is possible to save the parameters on the non-volatile memory.



2.1.2 REACTOR-GRID PLATE

Name	Description	Min	Max	Default	UM	Scale
INDUC_CURR_RIPPLE	P22 - Current ripple on leg-inductance (Vbus = V_GRID_NOM)	1.0	100.0	10.0	% CONV_I_PEAK	10
CAP_CHARGE_TIME	P23 - Capacitor charging time at CONV_I_PEAK at V_GRID_NOM	0.1	250.0	10.00	ms	100
IN_LINE_REACT	P61 - Rated current of the Reactor	10.0	100.0	100	% I_NOM	327.67
V_NOM	P62 - Nominal Grid Voltage	15.0	780.0	400	V	10
REACT_TF_THERM	P71 - Main reactor thermal time constant	30	2400	600	s	1

P22 and P23 are used to define the values of the leg inductance (L in the previous figures) and of the output capacitance Co.
In particular the inductance L is defined with P22 as the peak to peak current ripple of a single phase inductance current:

P22 = (P62 * sqrt(2)) /(4*L* P113 * P156);

The output capacitance Co value is defined with P23 as the rise time of the capacitance voltage under constant current charging transient:

P23 = Co * (P62 * sqrt(2)) / P113;

P61 is calculated as follows:

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

2.2 VOLTAGE AND CURRENT CONTROL

2.2.1 CURRENT CONTROL

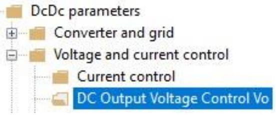
Name	Description	Min	Max	Default	UM	Scale
CURR_PM	P24 - Current loop phase margin	30	80	60	deg	10
CURR_BANDWIDTH_RATIO	P25 - Bandwidth over maximum bandwidth ratio for current loop	10.0	100.0	85.0	%	10
DC_DC_I_TF	P37 - TfV DcDc Curr Control Tf	0.0	25.0	0.0	ms	10
LEM_CURRENT_OFFSET_U	P46 - LEM current sensor offset U	-100.0	100.0	0	%	327.67
LEM_CURRENT_OFFSET_W	P47 - LEM current sensor offset W	-100.0	100.0	0	%	327.67
LEM_CURRENT_OFFSET_V	P48 - LEM current sensor offset V	-100.0	100.0	0	%	327.67
DC_DC Control	C81 - DcDc Control Mode	Range 0 Current Control (step-down) 1 Vo Control (step-down) 2 VDC Bus Control (step-up) 3 Current Control (step-up)		0		1
EN_VCTRL_EXT_IQ_REF	C82 - Enable external Iq reference during voltage control	Range 0 No 1 Yes		0		1
CURR_BANDWIDTH	P26 - Current loop cross-over frequency	0	16000	0	Hz	1
DC_DC_I_KP	P35 - KpV DcDc Curr Control Kp	0.1	400.0	2.0		10
DC_DC_I_TI	P36 - TiV DcDc Curr Control Ti	0.1	3000.0	30.0	ms	10
REACT_I	D11 - Current module			0	A rms	16
CURR_U	D13 - U current			0	A rms	16
DC_BUS	D24 - Bus voltage Vb			0	V	16
PRC_APP_I_MAX	D32 - Maximum current limit by application	-400	400	0	% I_NOM	40.96
CURR_V	D34 - V current			0	A rms	16
CURR_W	D35 - W current			0	A rms	16
PRC_APP_I_MIN	D48 - Minimum current limit by application	-400	400	0	% I_NOM	40.96

The DC/DC current control allows to regulate the 3 leg currents in order to be all equal to a set-point that can be given by the user or by a voltage regulator. This holds both for step-up and step-down operating modes.
C81 allows to configurate DC/DC operating modes:

C81	Step-up / Step-down	Control type
0	Step-down	Current control
1	Step-down	Voltage + current control
2	Step-up	Voltage + current control
3	Step-up	Current control

C82 allows to override current reference from voltage loop (even if it is still running) with a user defined current reference coming from PLC application.

Performances of current closed loop can be set with P24, P25 and P37 (bandwidth, phase margin and additional low-pass filter), and its details are given by P26, P35, and P36.

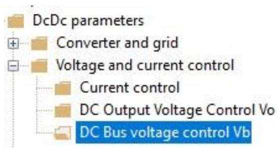


2.2.2 DC OUTPUT VOLTAGE CONTROL VO

Name	Description	Min	Max	Default	UM	Scale
Vo_READ	P09 - Vo READING fs	30.0	1200.0	550.0	V	10
VOLT_PM	P27 - Voltage loop phase margin	30	85	70	deg	10
VOLT_BANDWIDTH_RATIO	P28 - Bandwidth over maximum bandwidth ratio for voltage loop	10.0	100.0	80.0	%	10
V_REG_TF	P33 - TfV voltage regulator filter time constant	0.0	25.0	0.4	ms	10
K_V_VO	P52 - Corrective Factor for Vo Voltage	5.0	2000.0	100.0	%	10
AI_VOLT_READ	C18 - Analog input for external voltage reading board	Range 0	AI 1 1	AI 2 2	AI 3 3	AI 16		0		1
DC_DC Control	C81 - DcDc Control Mode	Range 0	Current Control (step-down) 1	Vo Control (step-down) 2	VDC Bus Control (step-up) 3	Current Control (step-up)		0		1
VOLT_BANDWIDTH	P29 - Voltage loop cross-over frequency	0	16000	0	Hz	1
V_REG_KP	P31 - KpV voltage regulator proportional gain	0.1	400.0	2.0		10
V_REG_TI	P32 - TiV voltage regulator lead time constant	0.1	3000.0	30.0	ms	10
Vo	D23 - Output DC Voltage Vo			0	V	16
DC_BUS	D24 - Bus voltage Vb			0	V	16

The task of the voltage regulator is to produce the correct current demand in order to keep the output voltage at the required value set by the user: based on C81 selection the DC/DC can regulate Vo voltage with P10 set-point or Vb voltage with P8 set-point.
In step-down mode, P10 shall be set at values smaller than Vb voltage.
In step-up mode, P8 shall be set at values greater than Vo voltage.
Voltage loop configuration is done with P27, P28 and P33 (phase margin, closed loop bandwidth and first order filter time constant), while the results of voltage loop design are shown in P29, P31 and P32.

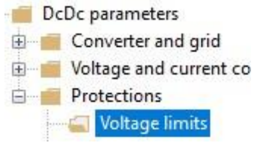
2.2.3 DC BUS VOLTAGE CONTROL VB



Name	Description	Min	Max	Default	UM	Scale
DC_BUS_REF	P08 - DC Bus Nominal Voltage / Reference	30.0	1200.0	650.0	V	10
Vo_REF	P10 - DC Output Voltage Reference	10.0	1200.0	30.0	V	10
VOLT_PM	P27 - Voltage loop phase margin	30	85	70	deg	10
VOLT_BANDWIDTH _RATIO	P28 - Bandwidth over maximum bandwidth ratio for voltage loop	10.0	100.0	80.0	%	10
V_REG_TF	P33 - TfV voltage regulator filter time constant	0.0	25.0	0.4	ms	10
DC_DC Control	C81 - DcDc Control Mode	Range 0 Current Control (step-down) 1 Vo Control (step-down) 2 VDC Bus Control (step-up) 3 Current Control (step-up)		0		1
VOLT_BANDWIDTH	P29 - Voltage loop cross-over frequency	0	16000	0	Hz	1
V_REG_KP	P31 - KpV voltage regulator proportional gain	0.1	400.0	2.0		10
V_REG_TI	P32 - TiV voltage regulator lead time constant	0.1	3000.0	30.0	ms	10
VBUS_REF_NORM	D33 - DC Voltage Reference (Norm)	0	100	0	% V_GRID_NOM	163.84

The task of the voltage regulator is to produce the correct current demand in order to keep the output voltage at the required value set by the user: based on C81 selection the DC/DC can regulate Vo voltage with P10 set-point or Vb voltage with P8 set-point.
In step-down mode, P10 shall be set at values smaller than Vb voltage.
In step-up mode, P8 shall be set at values greater than Vo voltage.
Voltage loop configuration is done with P27, P28 and P33 (phase margin, closed loop bandwidth and first order filter time constant), while the results of voltage loop design are shown in P29, P31 and P32.

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_NOM	10
K_V_VO	P52 - Corrective Factor for Vo Voltage	5.0	2000.0	100.0	%	10
LimitDuty	P64 - Limit Duty Cycle (upper limit in step-down mode, lower limit in step-up mode)	10.0	100.0	100.0	%	163.84
DCBUS_MIN_GRID_LOST	P97 - Minimum voltage level for forced grid off	20.0	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	20.0	1200.0	400	V	10
DCBUS_MAX	P107 - Maximum DC Bus voltage	350.0	1200.0	760	V	10
OUTVOLT_MAX	P109 - Maximum output voltage on external feedback	0.0	1200.0	760	V	10
OVR_LOAD_T_ENV	P155 - Ambient temperature reference value during overload	0.0	150.0	40	Â°C	10
ALL_RST_ON_GRID	C35 - Automatic alarm reset when grid back on	Range 0 No 1 Yes		0		1
EN_PW_SOFT_START	C37 - Enable soft start	Range 0 0 1 1				1

P52 can be used to correct linear error on Vo voltage reading: it introduces a multiplication corrective factor on the reading of Vo voltage.
P109 can be used to set an alarm when Vo voltage exceeds P109 value while working in step-down operating mode. When the alarm trips, converter is switched off automatically.
P64 can be used to limit maximum allowed converter duty-cycle in step-down mode: since voltage conversion ratio is equal to the duty cycle, for a fixed input voltage, this limitation leads to a maximum output voltage limitation.
P64 can be used to limit minimum allowed duty-cycle in step-up mode: since voltage conversion ratio is equal to 1/(1-d) where d is the duty-cycle, this limitation leads to a maximum output voltage limitation for a fixed input voltage.

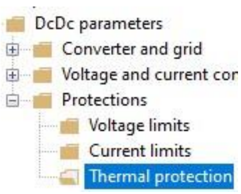
2.3.2 CURRENT LIMITS

Name	Description	Min	Max	Default	UM	Scale
PRC_I_PEAK	P40 - Current limit	0.0	250.0	200	% I_NOM	40.96
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
PRC_I_MAX	D29 - Current limit	-100	100	0	% I_NOM	40.96
PRC_APP_I_MAX	D32 - Maximum current limit by application	-400	400	0	% I_NOM	40.96
PRC_APP_I_MIN	D48 - Minimum current limit by application	-400	400	0	% I_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 current generation.
P43: Maximum limit for current absorption.

D29, D32 and D48 shows applied current limit: the first is from the converter, the second and the third are from the PLC application.



2.3.3 THERMAL PROTECTION

Name	Description	Min	Max	Default	UM	Scale
LOAD_TEMP_MAX	P91 - Maximum reactor temperature (if read with PT100)	0.0	150.0	130	°C	10
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
KP_LOAD_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
TEMP_MAX	P118 - Max. temperature permitted by heat sink PTC/NTC	0.0	150.0	90	Â°C	10
CONV_START_TEMP_MAX	P119 - Max. temperature permitted by heat sink PTC/NTC for start-up	0.0	150.0	75	Â°C	10
RAD_DO_TEMP_THR	P120 - Heat sink temperature threshold for logic output o.15	0.0	150.0	80	Â°C	10
KP_BOARD_THERM_PRB	P138 - Corrective factor for card thermal sensor	0.00	200.00	100	%	163.84
EN_LOAD_THERM_AL	C32 - Reactor thermal switch 'Block converter?'	Range 0 1	 No Yes	1		1
REACT_THERM_CURV_SEL	C33 - Choice of reactor thermal curve	Range 0 1 2 3	 No reduction -limitative Self-ventilated +limitative	0		1
REACT_THERM_PRB_SEL	C46 - Enable reactor thermal probe management (PT100/PTC/NTC)	Range 0 1 2 3 4 5	 No PTC NTC I23 KTY84-130 PT1000	0		1
THERM_PRB_SEL	C57 - Enable heat sink heat probe management (PTC/NTC)	Range 0 1	 No Yes	1		1
DRV_I_CONN_TH_MODEL	D06 - Drive inner connection limit			0	% DRV_I_CONN_MAX	163.84
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
REG_CARD_TEMP	D40 - Regulation card temperature			0	°C	16
LOAD_PRB_RES	D41 - Thermal probe resistance			0	kOhm	16
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

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 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.

Reactor nominal current, parameter **P71** (reactor thermal constant in seconds), and the current delivered by the converter are used to estimate the 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:

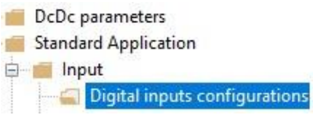
C32 = 0 (default value) the thermal alarm will cut in and reduce the current limit to match the reactor thermal current.

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 reactor thermal current as a percentage of the rated reactor current. When 100% is reached, the 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	04	ID_EN_AI2	Enable AI2	P.I.5	
I	08	ID_RESET_ALR	Alarms reset	P.I.1	L
I	14	ID_EN_FLDBUS_REF	Enable FIELD-BUS reference values		L
I	15	ID_EN_REF_PID	Enable PID ref		L
I	18	ID_FRZ_COM_I	Freeze Integral part of PID		L
I	19	ID_EN_OVR_LMN_I	Enable Override Integral part of PID		L
I	20	ID_EN_AI16	Enable analog reference value AI16		L
I	23	ID_TC_SWT_EXT	External thermal switch		L
I	31	ID_PWM_SYNCH	PWM synchronization input		L

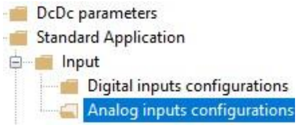
NB: pay particular attention to the fact that it is absolutely not possible to assign the same logic function to two different logic inputs: after changing the connection value that sets a determined input, check that the value has been accepted, if not check that another has not already been allocated 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

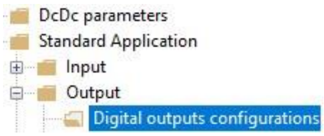


3.1.2 ANALOG INPUTS CONFIGURATIONS

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

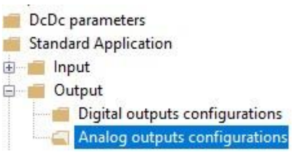
The control can have up to 4 optically insulated digital outputs (L.O.1 … L.O.4) whose logic functions can be configured as active high (H) by means of connection **C10** ÷ **C13**.

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	10	OD_PREC_OK	Insertion of the active soft-start	
O	12	OD_POW_OFF	Grid fault	
O	14	OD_THERM_EXC	Thermal current exceeds threshold (P96)	
O	15	OD_KT_DRV	Heat sink overheating (higher than P120 threshold)	
O	19	OD_POS_INI_POL	Regulation card supplied and DSP not in reset state	P.O.4
O	21	OD_CONV_OK	Converter ready and Power Soft start active	
O	22	OD_LL_ACTV	LogicLab application active	
O	31	OD_PWM_SYNCH	PWM synchronization output	
O	32	OD_EN_CONV_FANS	Enable converter fans	
O	33	OD_AI_RUN_CMD	Analog input run command	
O	34	OD_V_LIM	Converter in voltage limitation	
O	44	OD_VBUS_RANGE	V Bus into the range VB_MAX VB_MIN	

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).

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



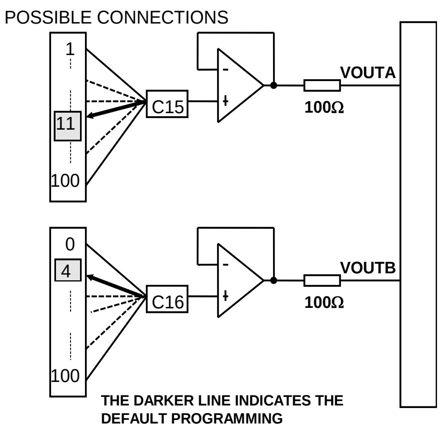
3.2.2 ANALOG OUTPUTS CONFIGURATIONS

Name	Description	Min	Max	Default	UM	Scale
AO1_SEL	C15 - Meaning of programmable analog output 1	0	100	11		1
AO2_SEL	C16 - Meaning of programmable analog output 2	0	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

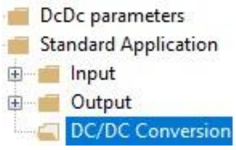
There can be a maximum of two analog outputs, VOUTA and VOUTB ± 10 V, 2mA.

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.

		OUTPUT LOGIC FUNCTIONS	DEFAULT OUTPUT
o	03	V Bus Ref Norm [100%=Vgrid*1,41]	
o	06	Internal value: status (MONITOR only)	
o	09	Internal value: DcDc control mode (MONITOR only)	
o	10	Internal value: alarms (MONITOR only)	
o	11	Current module	A.O.1
o	12	U phase current reference	
o	13	U phase current reading	
o	14	Internal value: inputs (MONITOR only)	
o	16	V phase duty-cycle	
o	17	U phase duty-cycle	
o	18	W phase duty-cycle	
o	21	Power Output (Vo)	
o	22	V Output Ref [100%=P.8]	
o	23	V Output Norm [100%=P.8]	
o	24	Bus voltage	
o	25	Heat sink temperature reading	
o	26	Reactor temperature reading	
o	27	DC current reference	
o	28	Reactor thermal current	
o	29	Current limit	
o	32	Internal value: outputs (MONITOR only)	
o	33	Internal value: inputs_hw (MONITOR only)	
o	34	V phase current reading	
o	35	W phase current reading	
o	36	Output current	
o	37	Analog input A.I.1	
o	38	Analog input A.I.2	
o	39	Analog input A.I.3	
o	43	Max active current limit by app	
o	51	Output current reference	
o	55	End Initial reset	
o	56	PTM motor thermal probe	
o	57	PTR radiator thermal probe	
o	63	SYNC delay measured	
o	64	Min active current limit by app	
o	65	Analog input A.I.16	
o	66	IGBT junction temperature	


POSSIBLE CONNECTIONS
1
11
100
C15
VOUTA
100Ω
0
4
100
C16
VOUTB
100Ω
THE DARKER LINE INDICATES THE
DEFAULT PROGRAMMING

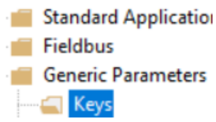
3.3 DC/DC Conversion



Name	Description	Min	Max	Default	UM	Scale
DC_BUS_REF	P08 - DC Bus Nominal Voltage / Reference	30.0	1200.0	650.0	V	10
Vo_READ	P09 - Vo READING fs	30.0	1200.0	550.0	V	10
Vo_REF	P10 - DC Output Voltage Reference	10.0	1200.0	30.0	V	10
VOLT_REF_RAMP	P16 - Voltage reference ramp time	0.0	10000	0	ms	1
K_V_VO	P52 - Corrective Factor for Vo Voltage	5.0	2000.0	100.0	%	10
V_NOM	P62 - Nominal Grid Voltage	15.0	780.0	400	V	10
LimitDuty	P64 - Limit Duty Cycle (upper limit in step-down mode, lower limit in step-up mode)	10.0	100.0	100.0	%	163.84
F_PWM	P101 - PWM frequency	1000	25000	10000	Hz	1
I_PEAK	P113 - Maximum converter current	0.0	3000.0	0	A	10
AI_VOLT_READ	C18 - Analog input for external voltage reading board	Range 0 1 2 3	 AI 1 AI 2 AI 3 AI 16	0		1
DC_DC Control	C81 - DcDc Control Mode	Range 0 1 2 3	 Current Control (step-down) Vo Control (step-down) VDC Bus Control (step-up) Current Control (step-up)	0		1
ACTV_POW	D01 - Delivered output power (Vo)			0	kW	16
DCDC_STATUS	D09 - DcDc_status			0		1
P_CONV_NOM	D14 - Nominal power			0	kW	16
VOUT_REF_NORM	D22 - DC Output voltage Reference (Norm)				% DC_BUS_REF	40.96
Vo	D23 - Output DC Voltage Vo			0	V	16

P16 parameter can be used to set a rate-limiter on voltage reference: this will let the user to automatically change voltage set-point with ramps.

4 GENERIC PARAMETERS

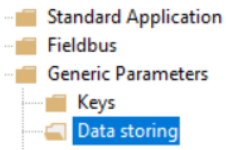


4.1 KEYS

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



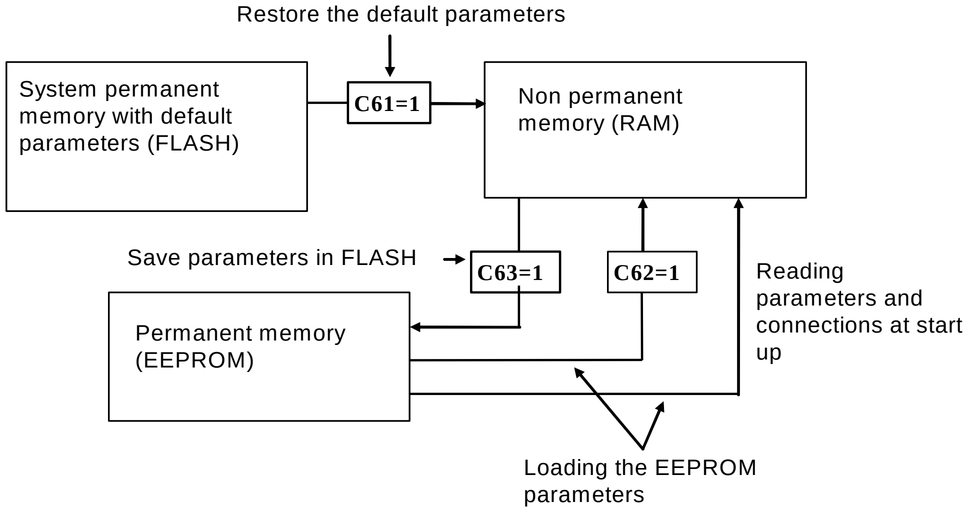
4.2 DATA STORING

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
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_LOAD_THERM_PRB_TDE	Factory multiplication factor for load 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.

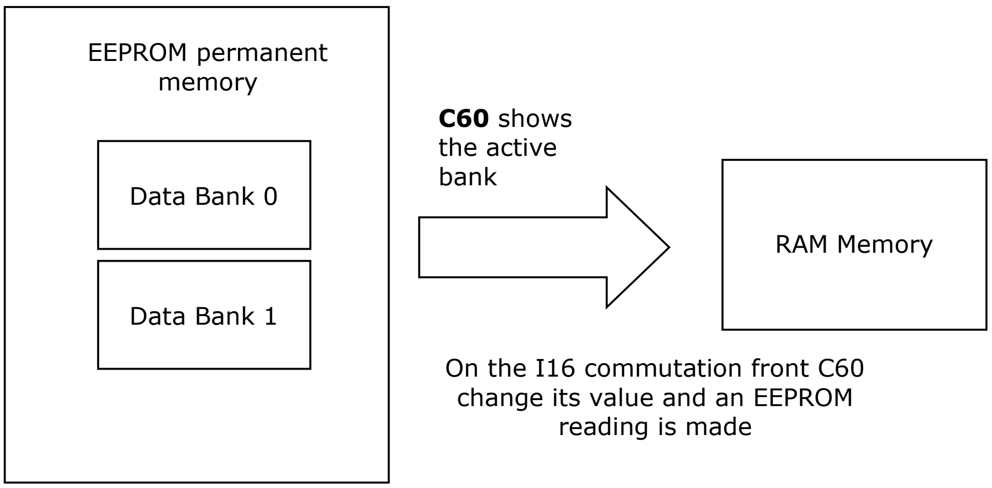
When switched on, the drive transfers the permanent memory parameters on to the working memory in order to work. If the modifications carry out on the parameters, they become stored in the work memory and therefore become lost in the break of feeding rather than being saved in the permanent memory.
If 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

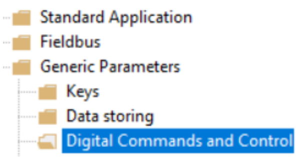
4.2.1.2 Restore Factory Parameters

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
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
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).
<u>Keep in mind that the “Alarm reset” is achieved by the active front of the signal, not on the active level.</u>

4.3.2 CONVERTER SWITCH ON / RUN

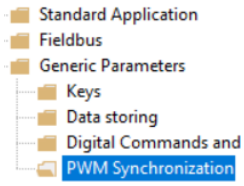
When the converter is “Ready to switch on / RUN” o.L.0=H, power converter may start running “Converter switch on/run” o.L.3=H, by activating both the hardware and software switch on enables:

* 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.



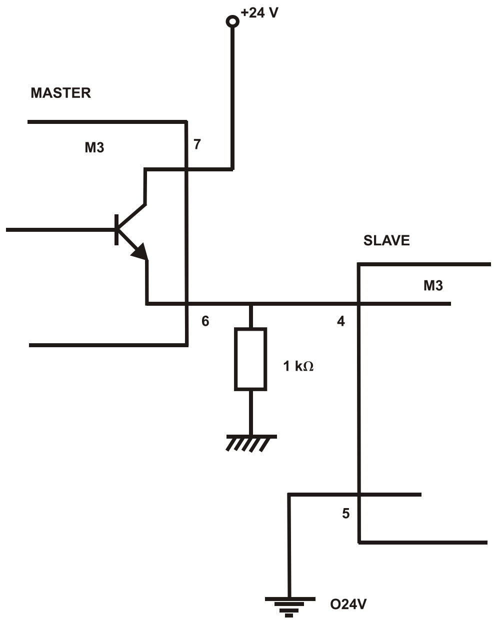
4.4 PWM SYNCHRONIZATION (STANDARD APPLICATION)

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_SYNCHRONIZATION	C23 - Pwm Synchronization	0	10	0		1
PWM_SYNC_OFFSET	PWM offset for SYNC delay control			0	pulses	1

With this function it’s possible to synchronize two or more OPDE Plus 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 APPLICATION

The functions seen in previous chapters refer to the base FW functionalities and they are always present in a DC/DC application.
Further functionalities can be added to the DC/DC via PLC applications that can be selected and included in the OPDExplorer DC/DC project. Among these PLC applications, some common features are always included: they are present in standard DC/DC Application.

These features are detailed in this paragraph.

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 INPUT

This function allows to override the current reference for DC/DC converter with the analog input coming from input 2. Here below the relevant parameters:

Name	Description	Min	Max	Default	UM	Scale
EN_AI2	E01 - Enable analog reference value A.I.2			0		1
AI2_SEL	E04 - Meaning of analog reference value A.I.2			1		1
EN_AI16	E07 - Enable analog reference value A.I.16			0		1

E01 enables the feature, while E04 let the user to give a precise meaning to A.I.2.
E07 is not used yet.

5.2 CURRENT REFERENCE

Converter can be operated with only current close loop by giving a current reference:

Name	Description	Min	Max	Default	UM	Scale
IL_REF	E00 - Reference DC Current IL	-100	100	0	% I_NOM	100

By setting C81=0 or C81=3 or C82=1voltage control is excluded and the user can work only with current references using parameters E00.
Note: the current flowing from Vb towards Vo sides of the Converter is considered to be positive.

5.3 VOLTAGE LIMITATION

This function can introduce a voltage limitation on output voltage (Vo for step-down mode and Vb for step-up mode): it works saturating the current reference when the voltage reading approaches upper or lower voltage bounds.
Here the parameter used for its configuration:

<table>
<tr><th>Name</th><th>Description</th><th>Min</th><th>Max</th><th>Default</th><th>UM</th><th>Scale</th></tr>
<tr><td rowspan="4">V_LIMIT_SEL</td><td rowspan="4">E25 - Selection of terminal for voltage limitation</td><td colspan="2">Range</td><td rowspan="4">0</td><td rowspan="4"></td><td rowspan="4">1</td></tr>
<tr><td>0</td><td>Disabled</td></tr>
<tr><td>1</td><td>Enabled on Vo</td></tr>
<tr><td>2</td><td>Enabled on DC Bus</td></tr>
<tr><td>V_LIMIT_MAX</td><td>E55 - Vrange Max limit</td><td>0.0</td><td>1200.0</td><td>0.0</td><td>V</td><td>10</td></tr>
<tr><td>V_LIMIT_MIN</td><td>E56 - Vrange Min Limit</td><td>0.0</td><td>1200.0</td><td>0.0</td><td>V</td><td>10</td></tr>
<tr><td>KP_V_LIMIT</td><td>E57 - Kp Vrange Limit</td><td>0.0</td><td>300.0</td><td>1.0</td><td></td><td>10</td></tr>
<tr><td>TI_V_LIMIT</td><td>E58 - Ti Vrange Limit</td><td>0.0</td><td>3000.0</td><td>60.0</td><td>ms</td><td>10</td></tr>
<tr><td>TF_V_LIMIT</td><td>E59 - Tf Vrange Limit</td><td>0.0</td><td>3000.0</td><td>0.0</td><td>ms</td><td>10</td></tr>
</table>

It is enabled with E25 selection, while voltage limits are given by E55 and E56. The remaining parameters are used to tune the regulator this function is based on.

5.4 PID CONTROLLER

Name	Description	Min	Max	Default	UM	Scale
EN_PID	E71 - Enabling PID Control	0	2	0		1
DGT_SP_PID	E72 - Digital Setpoin PID	-200.00	199.99	0.00	%	163.84
SEL_SP_PID	E73 - PID Setpoint selection	0	2	0		1
SEL_PV_PID	E74 - PID Process value selection	0	2	0		1
KP_PID	E75 - KP proportional gain	-200.00	199.99	1.0		163.84
TF_PID_ERROR	E76 - Filter time constant ERROR PID [ms/10]	0	20	0.4	ms	10
TI_PID	E77 - TI Integral time	0	19999	0	ms	1
TD_PID	E78 - TD Derivative time	0	19999	0	ms	1
LMN_MIN_OUT_PID	E79 - Limit Min value of output PID	-200.00	199.99	-100	%	163.84
LMN_MAX_OUT_PID	E80 - Limit Max value of output PID	-200.00	199.99	100	%	163.84
EN_REF_PID	E81 - Enabling PID Reference			0		1
SEL_OUT_PID	E82 - PID Output selection			0		1
OVR_LMN_I	E83 - Override Integral Part of PID	-200.00	199.99	0	%	163.84
ERR_DZ_PID	E84 - PID Error dead zone amplitude	0.00	100.00	0		163.84
LMN_MIN_ERR_PID	E85 - Limit Min value of error PID	-200.00	199.99	-100.00	%	163.84
LMN_MAX_ERR_PID	E86 - Limit Max value of error PID	-200.00	199.99	100.00	%	163.84
ACT_SP_PID	D83 - Actual Setpoint PID			0		163.84
ACT_PV_PID	D84 - Actual Feed-back PID			0		163.84
ACT_COM_P_PID	D85 - Actual Component P of PID			0		163.84
ACT_COM_I_PID	D86 - Actual Component I of PID			0		163.84
ACT_COM_D_PID	D87 - Actual Component D of PID			0		163.84
ACT_ERR_PID	D88 - Actual Error SP-PV of PID			0		163.84
ACT_OUT_PID	D89 - Actual Output PUD			0		163.84

5.5 AI RUN COMMAND

Name	Description	Min	Max	Default	UM	Scale
AI_RUN_CMD	E26 - Analog input run command			0		1
THR_AI_RUN_CMD	E70 - Threshold for analog input run command	-200.00	199.99	0	%	163.84

This function allows to connect a run command to an analog input (AI1, AI2 and AI3): once enabled with E26, the function detects if the input voltage is greater than a specified threshold with E70 to give the run command to the converter.

5.6 AUTOMATIC RESET

Name	Description	Min	Max	Default	UM	Scale
RES_BLOCK_AL	E90 - Reset block alarm	0	16	0		1
RES_REP_TIME	E92 - Reset repetition time	0	199.9	0	min	10

This function allows to automatically reset the alarms every time period specified in E92. A particular alarm code can be chosen to block this function via E90: if the alarm set with E90 is active automatic reset will produce no effect.

5.7 THERMAL PROTECTION

Name	Description	Min	Max	Default	UM	Scale
TEMP_ON_CONV_FANS	E47 - Switch-on temperature of converter fans	30	80	60	°C	1

This parameter allows to control switch on temperature for external fans controlled with logical digital output 32.

5.8 FIELDBUS REFERENCE AND LIMIT

Exchanging commands and status between Converter and external control is possible by configuring Fieldbus objects.

Index	Description	Val Def	Val Min	Val Max	Scale	[UM]
2100 h	Vo_Ovd (Fieldbus)	100.0			16384	[%P.9]
2101 h	Io_Ref (Fieldbus)	0.00	-100	100	16384	[%I_CONV]
2103 h	MaxIo (Fieldbus)	200.0	0	200	16384	[%I_CONV]
2104 h	Vb_Ovd (Fieldbus)	100.0	0	200	16384	[%V_GRID_ISL]
2106 h	VoLimMaxOvd (Fieldbus)	100.0	0	100	16384	[%E.55]
2107 h	VoLimMinOvd (Fieldbus)	100.0	0	100	16384	[%E.56]

The following parameters are available on OPDExplorer:

Name	Description	Min	Max	Default	UM	Scale
EN_FLDBUS_REF	E27 - Enable FIELD-BUS reference values			0		1
PRC_DC_BUS_REF_FLDBUS	D90 - Fieldbus DC-Bus Reference			100	% DC_BUS_REF	163.84
IQ_REF_FLDBUS	D91 - Fieldbus Iq active current reference	-100.00	100.00	0	% I_NOM	163.84
PRC_CONV_I_PEAK_FLDBUS	D93 - Fieldbus current limit	0	200.0	200.0	% I_NOM	163.84
Vo_OVD_FIELDBUS	D94 - Fieldbus Vo override reference	0	200.00	100.00	% Vo_REF	163.84

To enable reference from Fieldbus, the EN_FLDBUS_REF (E.27) or ID_EN_FLDBUS_REF (Enable FIELD-BUS reference values I.14) must be enabled. This can be done using a Digital Input of the converter configured as I.14, or using the FieldBus EN_FLDBUS_REF from the field. In case no one of the Enable switch is set to ON, the objects assume the default values.
D90-D94 shows the reference received by the power converter via fieldbus

5.9 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

DC/DC power converter can by synchronized with other OPDE Plus devices at the PWM switching period level. On the slave device, E87 shall be set to 2.
See other details regarding PWM synchronization on the related paragraph, within core features description (see before).

5.10 MPPT

DC/DC power converter application includes the possibility of controlling a PhotoVoltaic (PV) plant featuring Maximum Power Point Tracking (MPPT) algorithms.
This feature is controlled with the following parameters and it is based on a Finite State Machine (FSM):

Name	Description	Min	Max	Default	UM	Scale
PV_SWEEP_SAMPLES	E24 - Number of samples for PV sweep	10	50	10		1
I_DCLEM_MAX	E30 - Maximum DC LEM current	0.0	2000.0	0.0	A	10
PV_SWEEP_TIME_STEP	E33 - PV sweep time step	1	2000	200	ms	1
PV_SWEEP_REP_PERIOD	E34 - PV sweep repetition period	1	180	60	min	1
DELTA_V	E35 - Voltage step MPPT algorithm	0	20	3	V	1
TIME_STEP	E36 - Time step MPPT algorithm	0	5000	1000	ms	1
Tau_Ipv_filter	E37 - Time constant Ipv filter	10	999	10	ms	1
Kmult_IdcLEM	E38 - Kmult_IdcLEM	0	200.0	100.0	%	10
K_MANUAL_MPPT	E39 - MPP in % respect Voc measured	70	100	80	% V_OC	1
P_START_MIN	E41 - Minimum power for starting sequence	3	100	5	% Ppv_NORM_COEFF	1
DIS_IdcLEM_filter	E42 - Disable filter for offset calculation on DC Bus current LEM			0		1
V_PV_START	E43 - PV Voltage for starting sequence	50	780	200	V	1
TMAX_PMIN	E44 - Maximum repetition time minimum power measurement	0.1	30.0	5.0	min	10
V_MPPT_MIN	E51 - Minimum MPPT voltage reachable	50	700	360	V	1
V_MPPT_MAX	E52 - Maximum MPPT voltage reachable	200	900	780	V	1
V_LIMIT_MAX	E55 - Vrange Max limit	0.0	1200.0	0.0	V	10
V_LIMIT_MIN	E56 - Vrange Min Limit	0.0	1200.0	0.0	V	10
EN_PV_SWEEP	E89 - Enable PV sweep			0		1
APPL_SEL	E95 - Application selection			0		1
EN_MPPT	E99 - Enable MPPT Algorithm			0		1
I_DC_LEM	D65 - Current of DC bus LEM			0	A	32
I_DC_LEM_MAX	D67 - Scaling factor of Current of DC bus LEM			0	A	16
Ppv_NORM_COEFF_	D68 - Ppv normalization coefficient			0	kW	16
MPPT_STATUS	D69 - MPPT state machine status			0		1
V_OC	D71 - Last measured Open Circuit PV voltage			0	V	10

Here below there is a simplified graphical representation of the FSM, while later on the states are described.

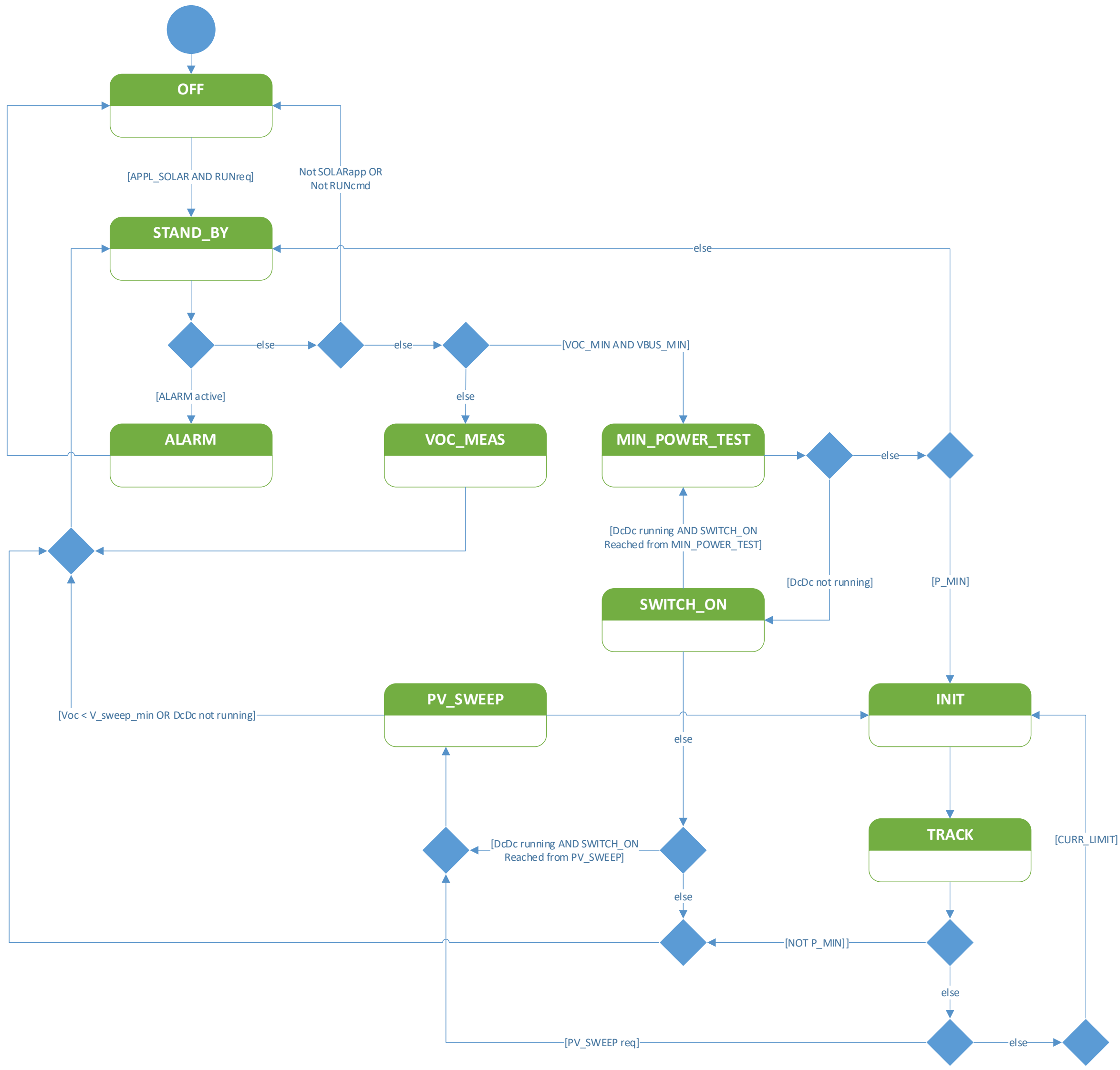


Figure FSM graphical representation. Note that some preliminary state jumps from PV_SWEEP state are not depicted in the figure just for sake of clarity (they are described in the corresponding state description).

OFF: This is the initial state for the FSM and it is active when Solar Application is not enabled (E95) or when MPPT FSM is not capable of putting the converter into RUN state (for instance when run command is prevented by fieldbus or via C21). This state performs no action, and it waits for E95 enable and ability of putting converter into RUN state: once these two conditions are validated, FSM machine moves into STAND_BY state.

STAND_BY: FSM prevents converter switch-on and continues reading PV plant Open-Circuit Voltage (VOC) by jumping into VOC_MEAS state. If measured VOC reaches a minimum value (specified with E43), FSM moves into minimum power verification state, called MIN_POWER_TEST. Before moving into MIN_POWER_TEST, however, a DC bus connection verification is performed by checking that DC bus voltage is greater than a certain threshold (E56). In STAND_BY state, if an alarm arises, previous jumps are bypassed and FSM moves into ALARM state. If solar application is disabled or if FSM has no control on run command, executions return back into OFF state.

VOC_MEAS: FSM switches converter off in this state and performs a VOC measurement. After VOC is measured, FSM jumps back to previous state.

SWITCH_ON: Here, converter is switched on at the last measured VOC level as voltage reference. If DC/DC starts running, FSM jumps back into previous state, otherwise FSM returns into STAND_BY state.

MIN_POWER_TEST: If converter is not running, FSM jumps into SWITCH_ON state for handling converter switch-on. Once converter is running, the voltage reference is set to E39 value to perform a power measurement from PV system. If measured power is greater than a minimum threshold (E41) for more than a certain time, FSM jumps into INIT state. If minimum power test is not passed, FSM jumps into STAND_BY state.

INIT: Here MPPT algorithms are initialized to start from a certain voltage-power starting point (measured in the previous state). Once, this is done, FSM jumps into TRACK.

TRACK: In this State, MPPT algorithm is enabled according with E99 choice: 0 to disable MPPT, 1 Incremental Conductance, 2 Extremum Seeking Control and 3 for manual operating point selection via E39. In this state, PV voltage sweep requests are managed according with E89 and so, TRACK state handles jumps into SWEEP state. If converter is running with saturated current reference (e.g. for bus voltage limitation), TRACK state turns off MPPT algorithm and continues to jump into INIT to maintain aligned MPPT algorithms to actual voltage-power operating point. If PV output power falls below a certain threshold (derived from E41 with a certain hysteresis), FSM returns back into STAND_BY state.

SWEEP: This state performs a sweep of voltage reference in order to create the voltage to power characteristic of PV system and then to move MPPT algorithm or converter voltage-power operating point into the Maximum Power Point (MPP) just discovered. PV voltage sweep starts from the minimum between the last measured VOC and the maximum MPPT voltage set with E52 and goes down to the minimum MPPT voltage set with E51. PV voltage sweep is then parametrized by the number of voltage steps in the previously described voltage range (E24) and how often the voltage set-point is changed from one point to the other (E33).
If DC/DC converter is switched off during PV voltage sweep procedure, FSM jumps back into STAND_BY state. At the end of PV voltage sweep procedure, DC/DC operation is brought to MPP that has been identified and FSM returns back to TRACK.

ALARM: FSM is brought into this state when an alarm appear and here MPPT algorithm is disabled and converter is switched off. In this state, FSM waits for alarm reset before jumping back into OFF state.

5.11 DRIVE2DRIVE CAN

This feature is helpful to run 2 or more DC/DC 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 reference thanks to its voltage close loop and it can communicate this current reference to SLAVE DC/DC converters via CAN bus.

<table>
<tr><th>Name</th><th>Description</th><th>Min</th><th>Max</th><th>Default</th><th>UM</th><th>Scale</th></tr>
<tr><td rowspan="4">CAN2_EN</td><td rowspan="4">E31 - Current reference via CAN2 config.</td><td colspan="2">Range</td><td rowspan="4">0</td><td rowspan="4"></td><td rowspan="4">1</td></tr>
<tr><td>0</td><td>Disable</td></tr>
<tr><td>1</td><td>Master curr ref</td></tr>
<tr><td>2</td><td>Slave curr ref</td></tr>
<tr><td>CAN2_MASTER_NODEID</td><td>E32 - CAN2 Master NodeID</td><td>0</td><td>127</td><td>1</td><td>hex</td><td>1</td></tr>
<tr><td>IQ_REF_CAN2</td><td>D66 - Iq reference from CAN2</td><td>-200.0</td><td>200.0</td><td>0</td><td>% I_NOM</td><td>40.96</td></tr>
</table>

This function allows to read and write a current reference for the DC/DC 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 current reference calculated by its voltage loop (i.e. osc51)
- SLAVE node is in charge to read MASTER node current reference on the CAN B network and to apply it as its own current reference

E32 parameter allows to specify MASTER node address.
D66 displays the received current reference on the SLAVE node.

6 ALARMS

6.1 MAINTENANCE AND CONTROLS

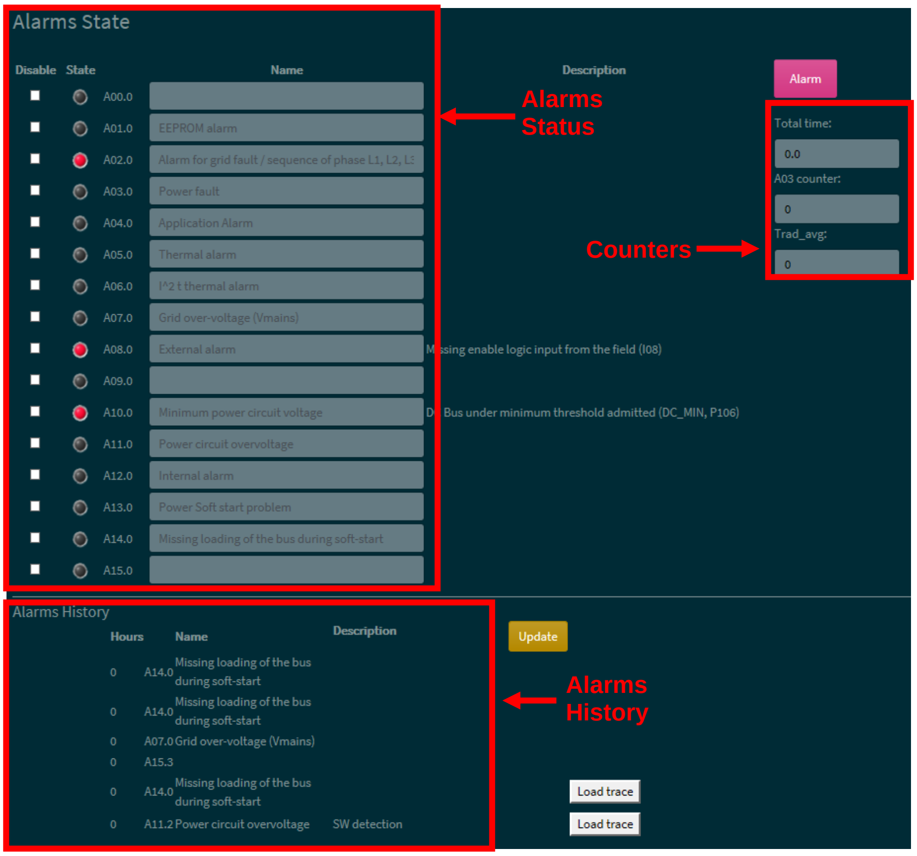
The converter has some functionalities that are blocked if there is a fault in order to prevent damage. If a protection trips, the converter outputs (IGBT commands) are switched off and the output voltage is no longer controlled.
If one or more alarms appear, they are signaled on the display, which starts to flash and to show a cycle of all the triggered alarms (the 7-segment display shows the alarms that have been set off in hexadecimal).
In case of failure of the converter, or if an alarm is triggered, check the possible causes and act accordingly.
If the causes 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.
A.3.0.H	A3.0	Power fault	The converter output current has reached a level that has set 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.	Check the connection wires, in particular on the terminals, in order to prevent leakages or short circuits.
A.4.0.H	A4.0	Application alarm	This alarm is application specific. Please refer to specific documentation	Problem on filedbus used by application: see specific documentation
A.4.1.H	A4.1	Application alarm	This alarm is application specific. Please refer to specific documentation	If application use CAN B network for drive-to-drive communication, this means that there are errors on the SLAVE node, that is the one that is reading data on the network. Check CAN B electrical connection and configuration.
A.4.2.H	A4.2	Application alarm	This alarm is application specific. Please refer to specific documentation	If application use CAN B network for drive-to-drive communication, this means that there are errors on the MASTER node, that is the one that is writing data on the network. Check CAN B electrical connection and configuration.
A.5.0.H	A5.0	Thermal alarm. Reactor temperature too high	Connection C46 runs a range of 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	Over-voltage on DC/DC output	The output voltage Vo for step-down configuration (D24) has exceed P109 threshold.	Fault on the load side or load is regenerating a too large power for the DC/DC.
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	Voltage Vb voltage under minimum threshold admit-ted (DC_MIN, P106)	Vb voltage (D24) has dropped below the minimum value (P106).	Fault on the power source feeding the DC/DC converter. If the DC/DC converter is not powered, this is a normal alarm. Otherwise, input power may not be adequate to the load conditions.
A.B.1.H	A11.1	Power circuit overvoltage. HW detection	Vb voltage (D24) has exceeded the HW threshold.	Verify voltage level of power source connected to Vb side. Check if the power generated by the power source connected at the Vb side is lower than the maximum generating power (P40, P42). Look for possible fault on the power source that is feeding the DC/DC.
A.B.2.H	A11.2	Power circuit overvoltage. SW detection	Vb voltage (D24) has exceeded the threshold P107	Verify if voltage level of power source connected to Vb side is compatible with P107. Check if the power generated by the power source connected at the Vb side is lower than the maximum generating power (P40, P42). Look for possible fault on the power source that is feeding the DC/DC.
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	Timing overrun on current loop	Current loop function timing has exceeded one third of PWM period	Reduce PWM frequency P101
A.D.0.H	A13.0	Rectifier bridge problem	The bridge that enables the line by gradually loading the DC bus capacitors has not managed to load the intermediate drive circuit sufficiently within the time set (P154).	Check the voltage of the three input phases. Try switching off and then back on, measuring the DC Bus level (with the monitor or tester). If the problem repeats, contact TDE as there must be a soft start circuit malfunction.
A.D.2.H	A13.2	Excessive Ripple on DC Bus	A big variation on DC Bus has detected	Verify if all three main phases are present on connector L1, L2, L3 and their rms value.

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; <u>pay attention that disable an alarm doesn't mean that its cause is fixed</u>.

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 “**-**“.

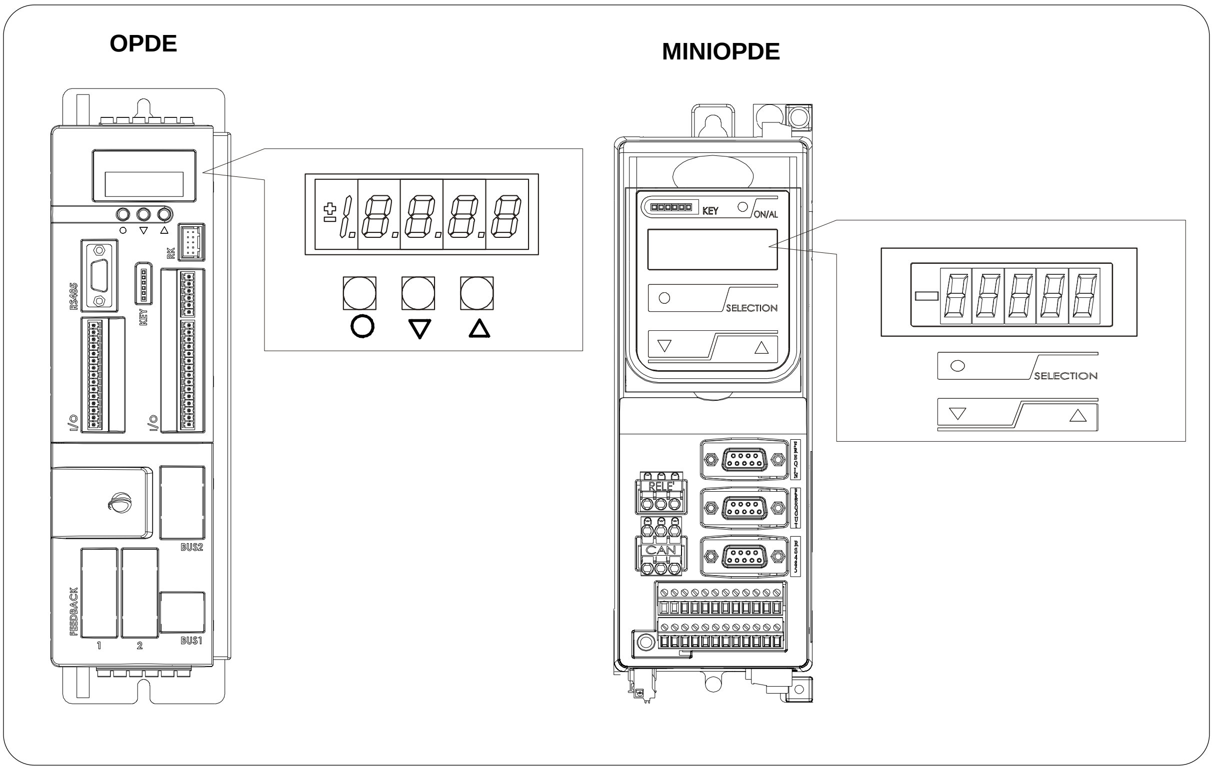


FIG. 1 (Physical disposition)

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:

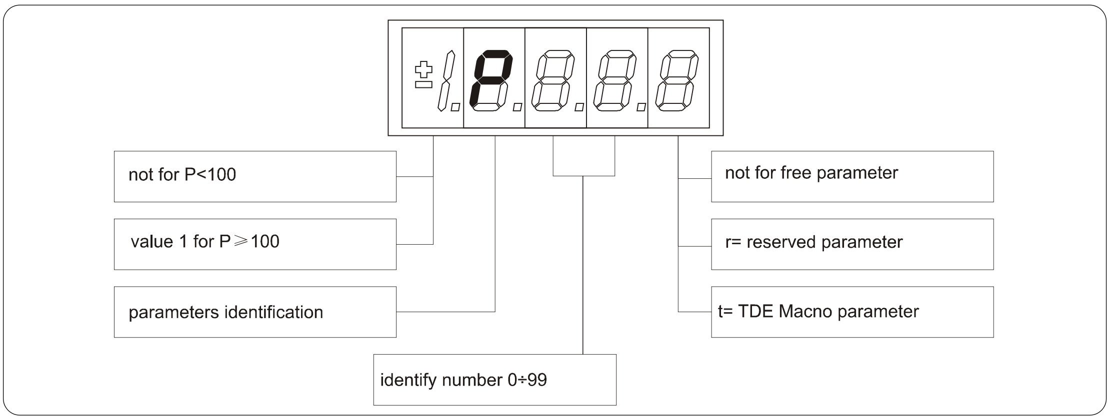


FIG. 2 (Parameters PAR)

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:

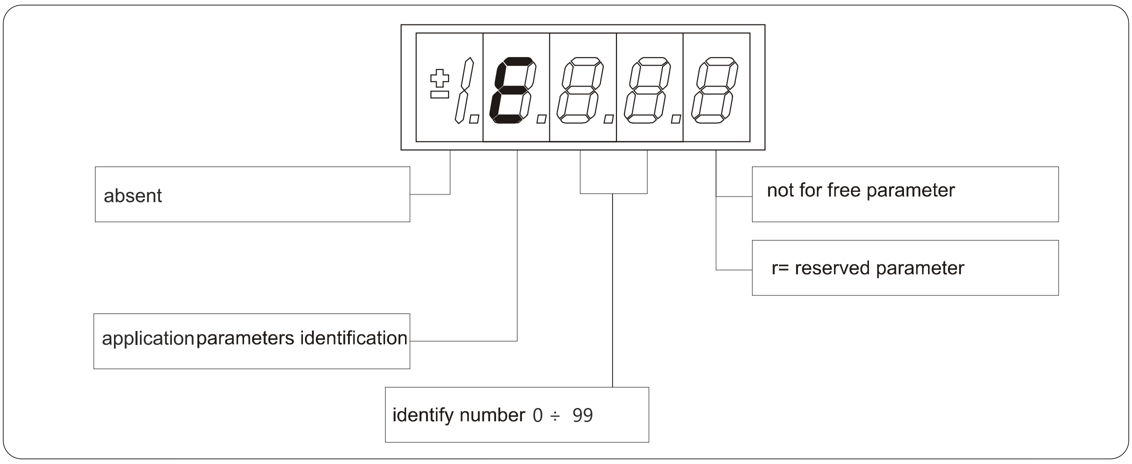


FIG. 3 (Application Parameters PAR)

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.

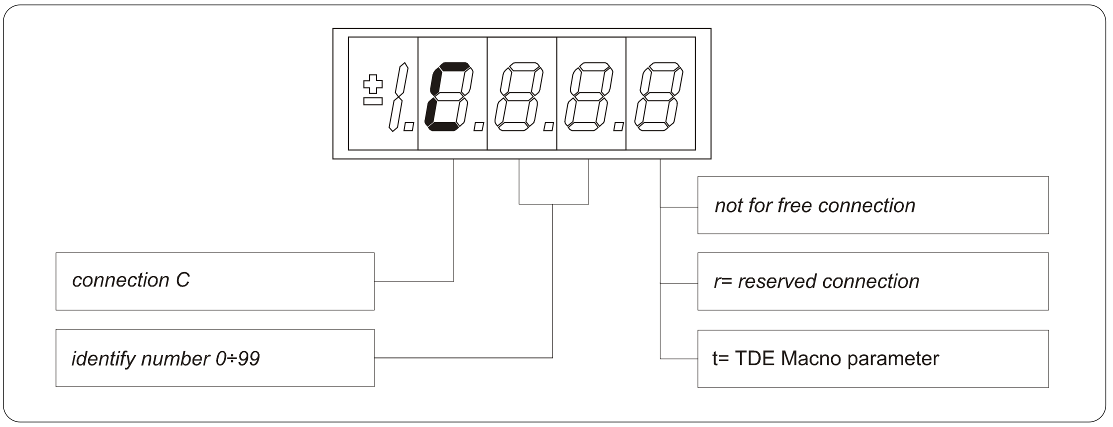


FIG. 4 (Connections CON)

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:

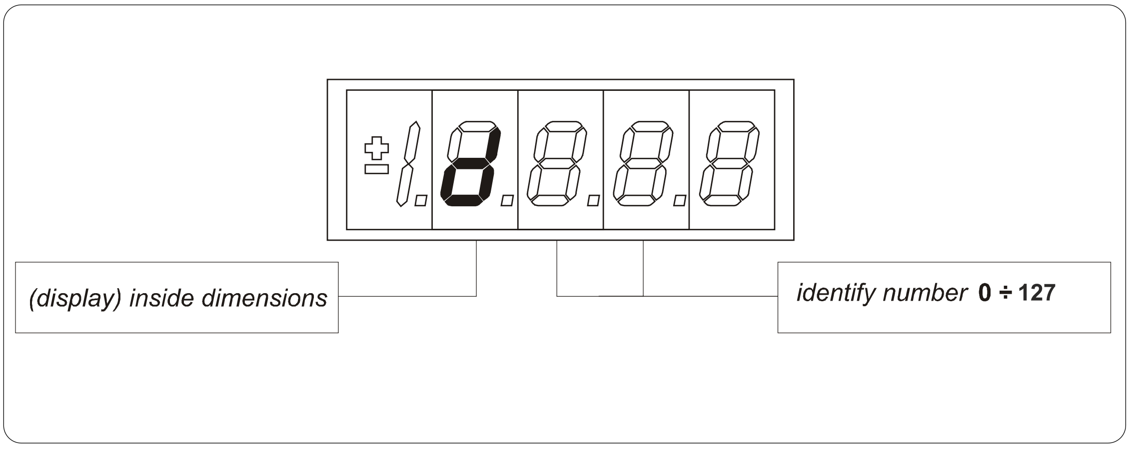


FIG. 5 (Internal Values INT)

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).

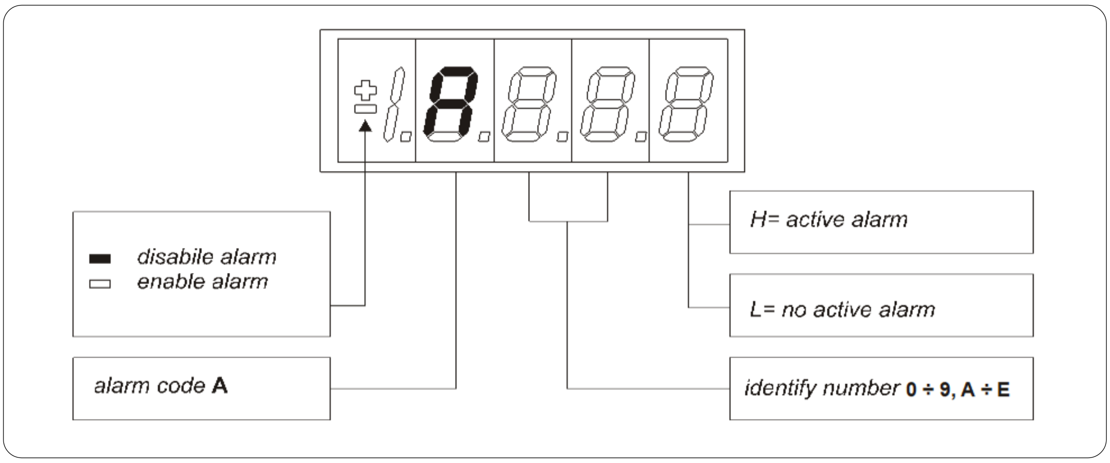


FIG. 6 (Alarms ALL)

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.

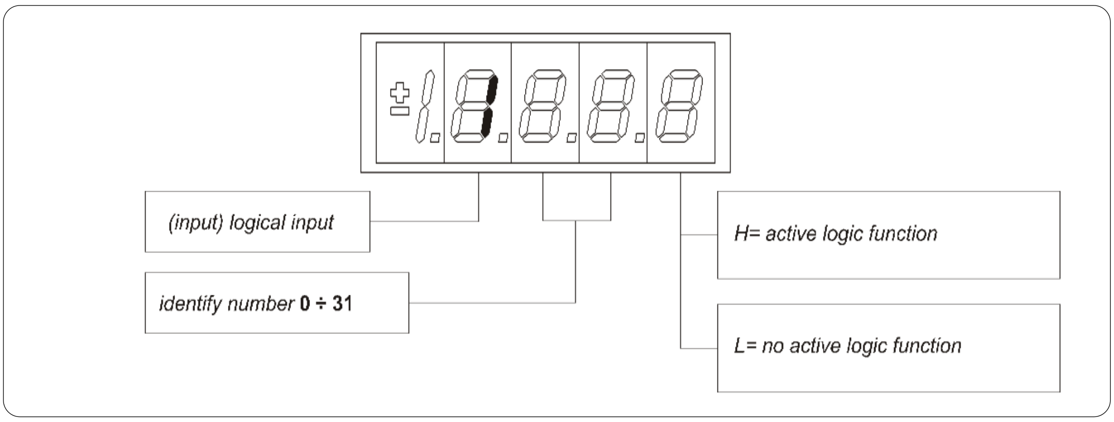


FIG. 7 (Logics functions of input INP)

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:

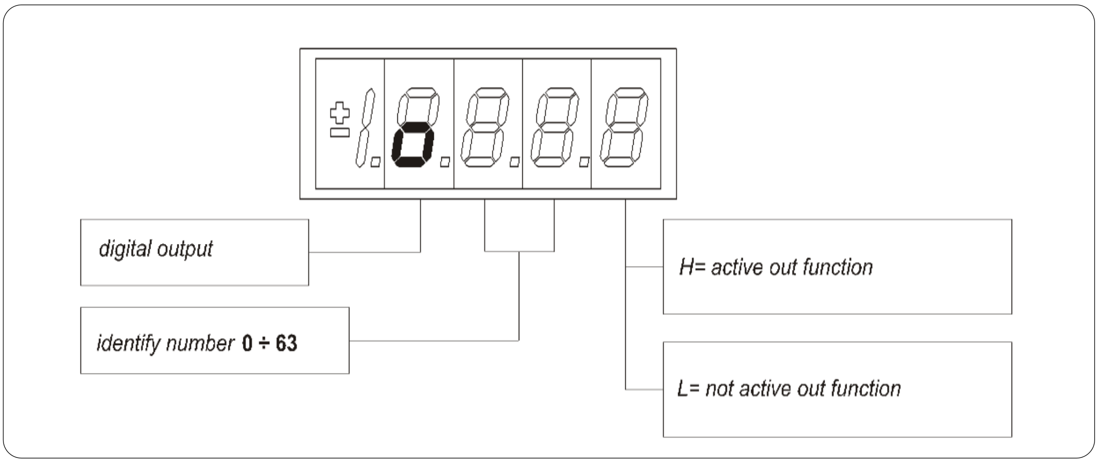


FIG. 8 (Logics functions of output OUT)

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:

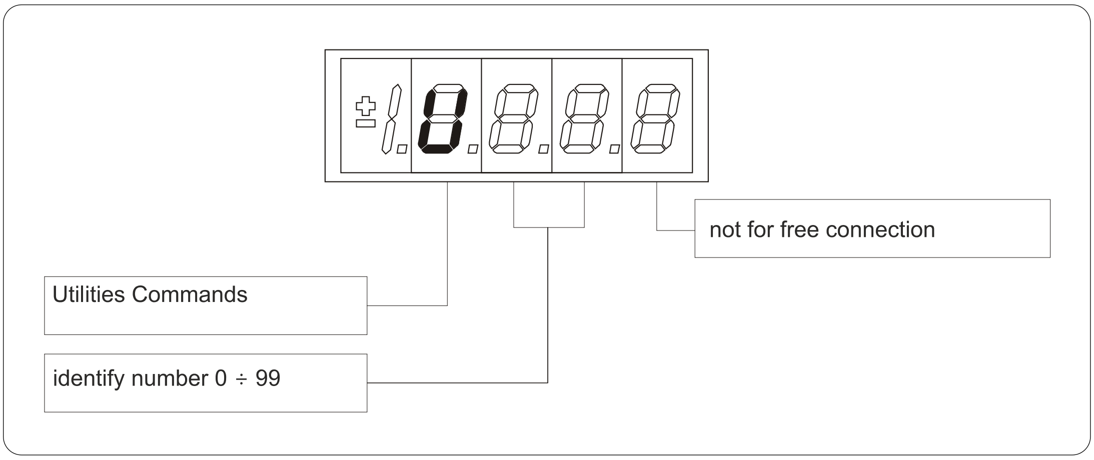


FIG. 9 (Utilities Commands UTL)

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:

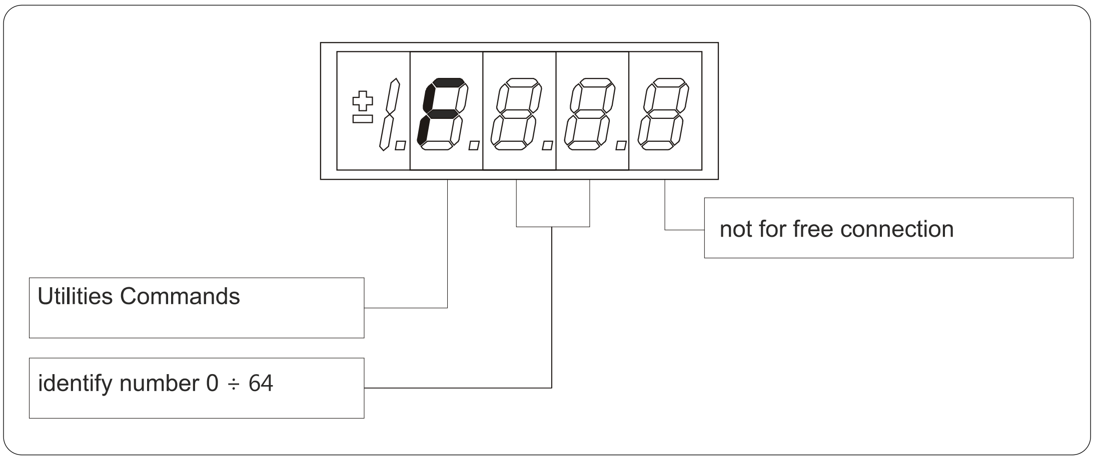


FIG. 10 (Fieldbus Parametrs FLB)

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:

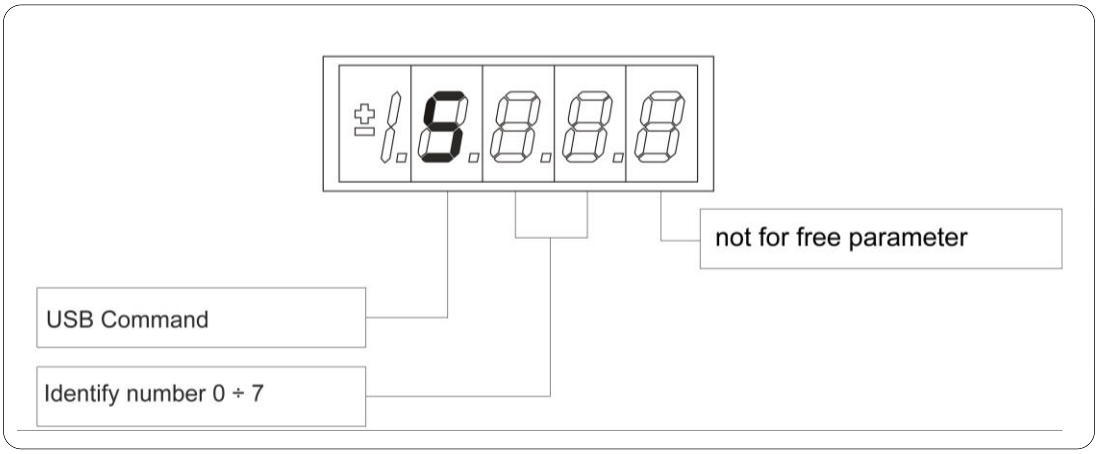


FIG. 11 (USB Commands)

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.

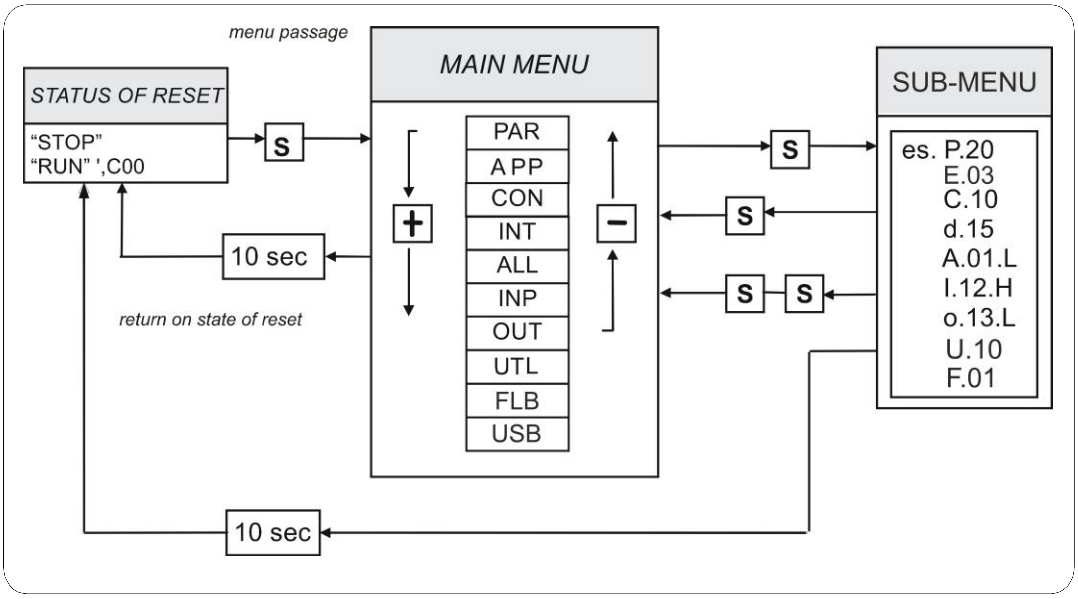


FIG. 12 (Main Menu)

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.

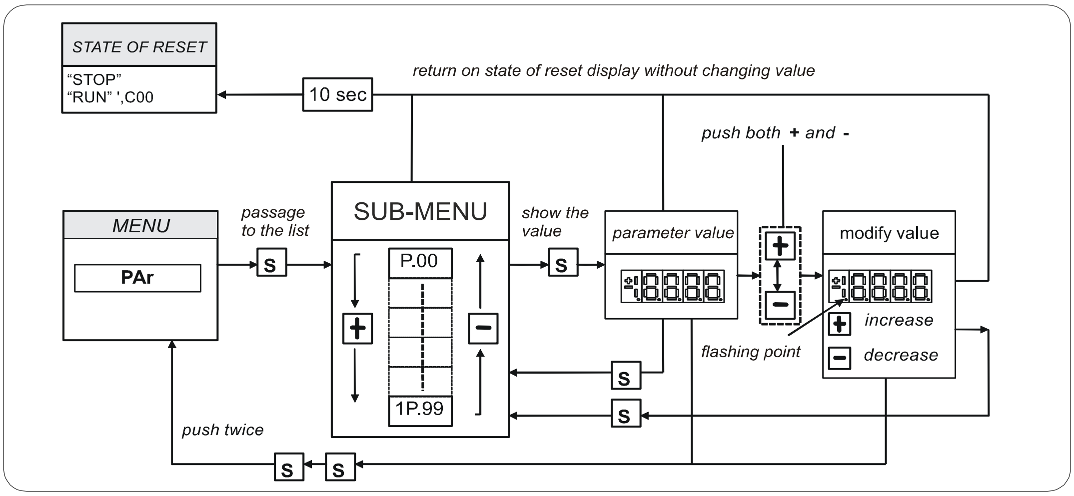


FIG. 13 (Submenu management parameters PAR)

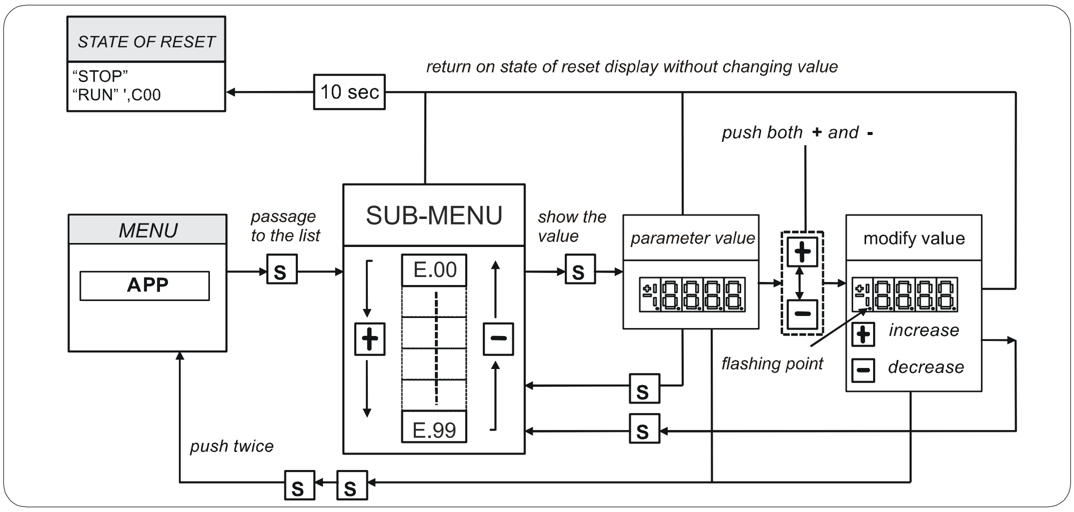


FIG. 14 (Submenu management application parameters APP)

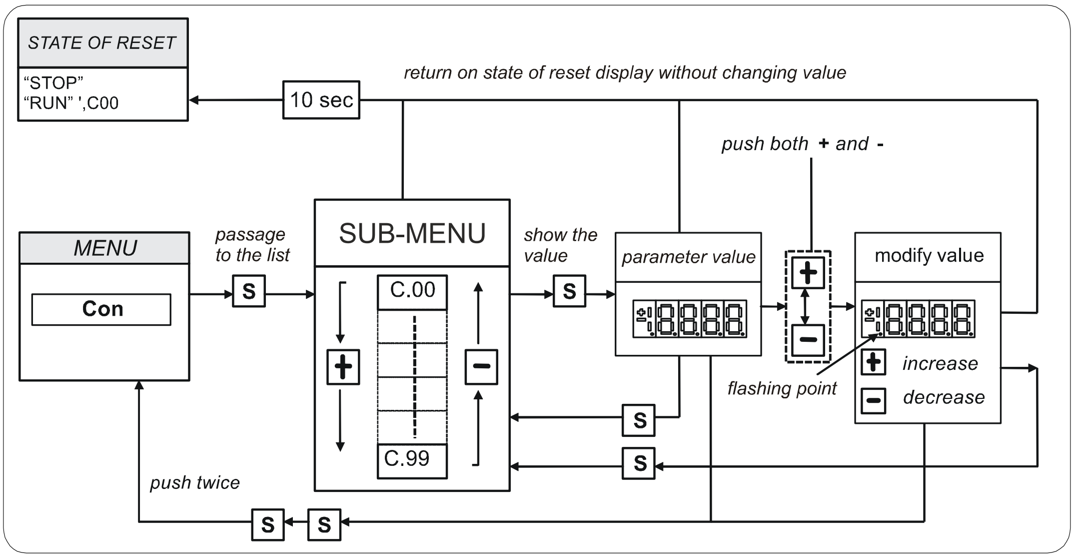


FIG. 15 (Submenu management connections CON)

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.

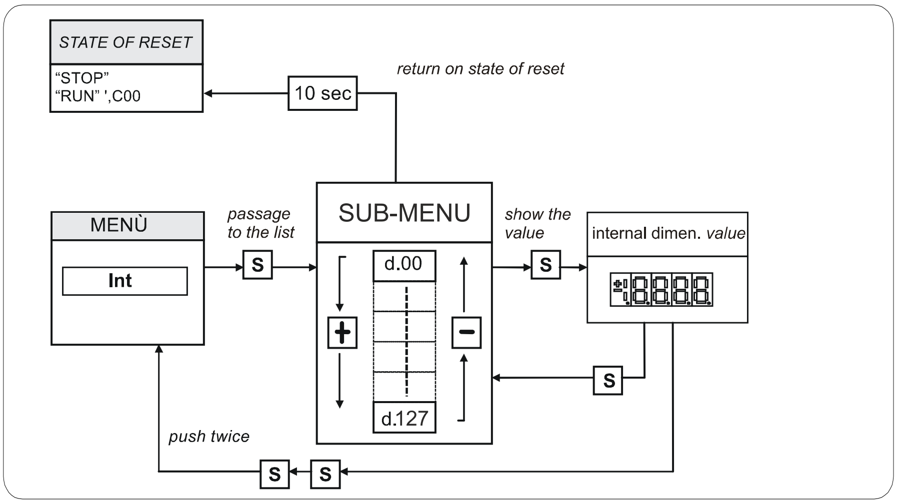


FIG. 16 (Visualization of the internal dimensions INT)

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.

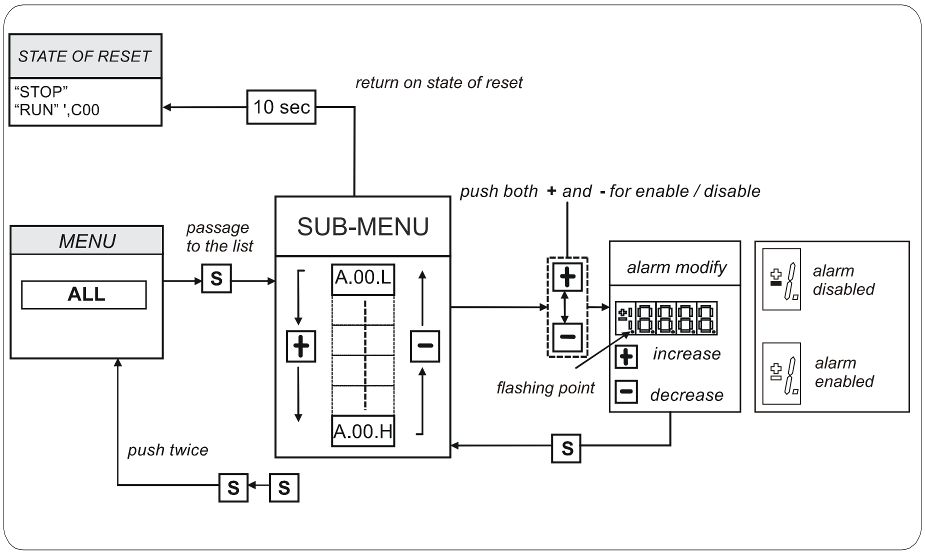


FIG. 17 (Alarms ALL)

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**".

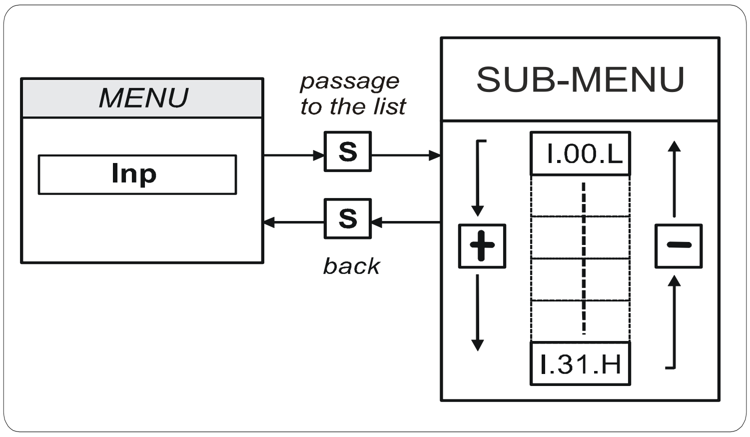


FIG. 18 (Digital input INP)

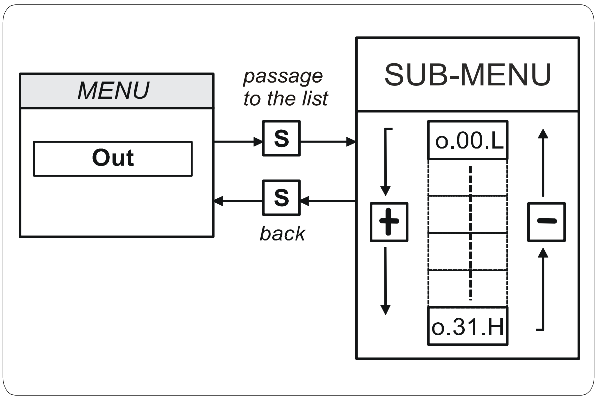


FIG. 19 (Digital output OUT)

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.

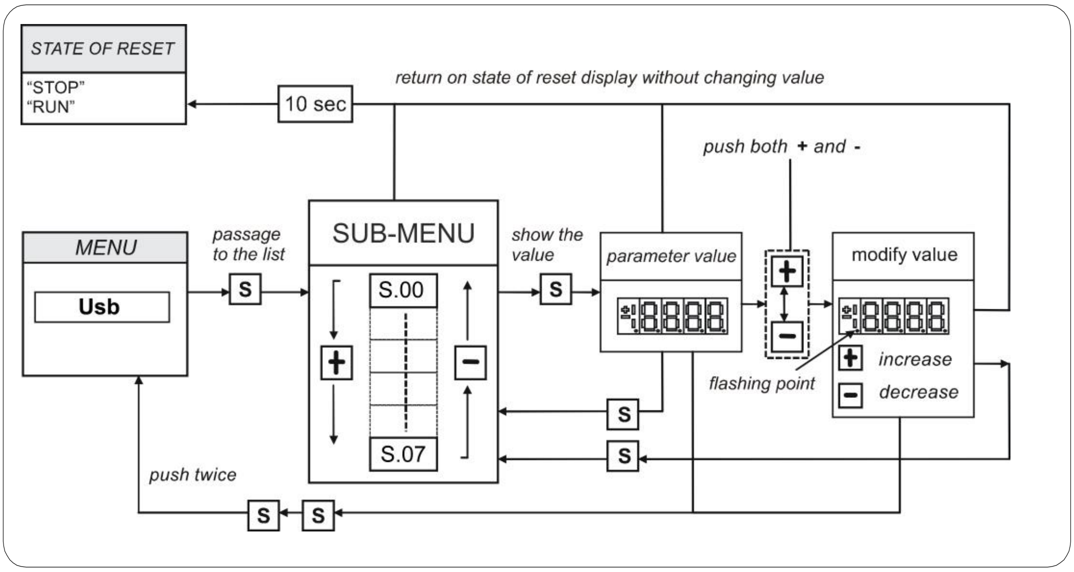


FIG. 20 (USB commands)

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:

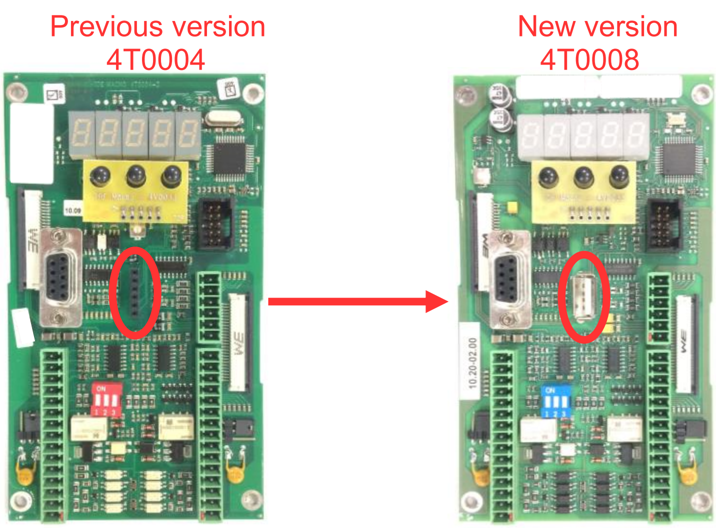
- Insert the key into the suitable slot with the correct way (otherwise it's not read);
- Open the reserved parameter key with **P60=95**;
- Select the "**LoAd**" function with the buttons ▼ and ▲ located on the keyboard of the drive and push "●" as confirm;
- Set **C63=1** to save the new parametrization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

- <u>it's a **Host** when connected to a USB flash drive</u>: 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.
  <u>Connection of USB Hosts or Devices other than MSD class was not fully tested and then can lead to unexpected results: please avoid them.</u>

- <u>it's a **Device** when connected to a PC</u>: 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) command 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 <u>during the upload/download of the core/application firmware started from another source</u> (like OPDExplorer and RS485 serial interface).

7.5.2.3.1 Enabling USB Host interface – connection of a pen-drive

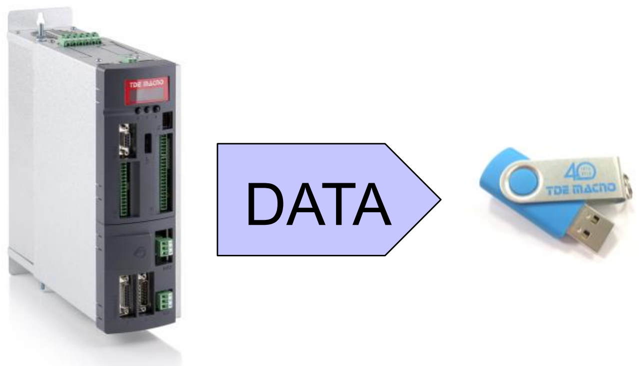
Before connecting a pen-drive in the menù is available only the command **S.00=0** (default).
Set **S.00=1** to enable the USB Host interface: the power supply is applied to the USB connector and then a pen-drive can be connected and recognized by the OPDE; if a MSD Device is not recognized within 30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

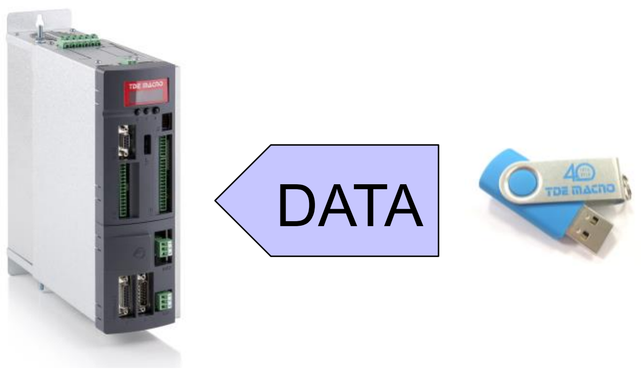
Command **S.01** stores **all the OPDE parameters** to the flash drive; the data are stored into the flash drive working directory in a file named **RCPxx_cc.cc_aa.aa_.MRA** where **xx** is the slot # number choosed by parameter S.01, **cc.cc** is the firmware "core" version and **aa.aa** is the firmware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

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: <u>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.</u>

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).

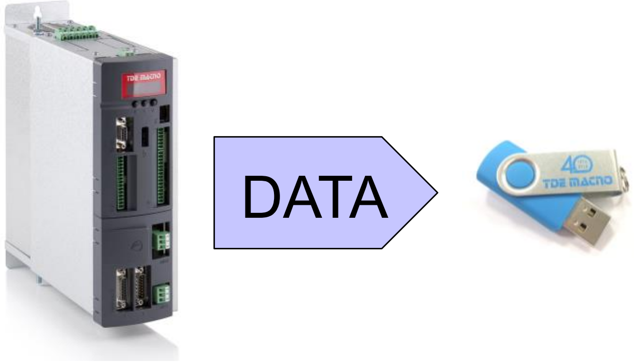
There are a variety of situations and problems that can happen and that prevent a correct execution of the command: in these cases the display will show a message (for 10s) that indicates the cause of failure:

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.

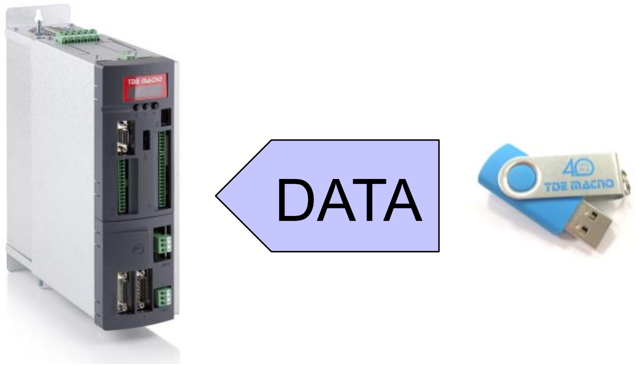
Firmwares (“core” and “app” together) are stored into the flash drive working directory in 2 separated files named **CORExx_cc.cc_.LDR** and **APPxx_aa.aa_.LDR** where **xx** is the slot # number choosed by parameter **S.05**, **cc.cc** is the firmware “core” version and **aa.aa** is the firmware “app”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

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: <u>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.</u>

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

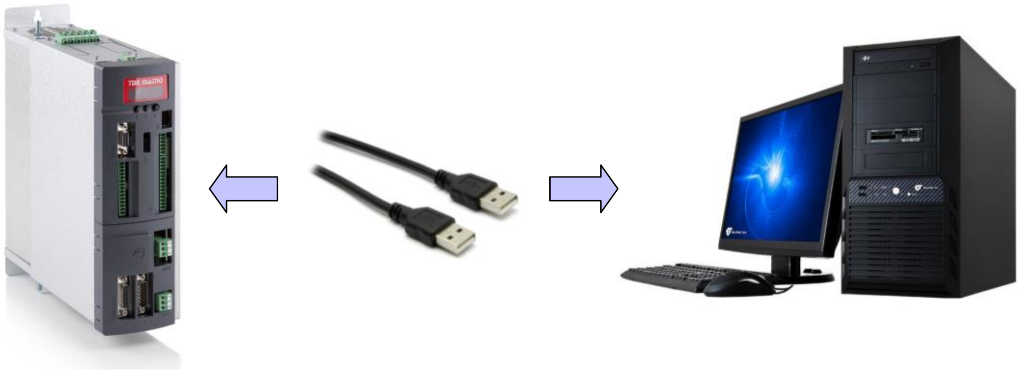
Warning:
<u>Loading the firmware the control board of the OPDE is fully busy, so we suggest to power off the main voltage of the drive before these operations.</u>

Warning: <u>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**.</u>

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: <u>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.</u>

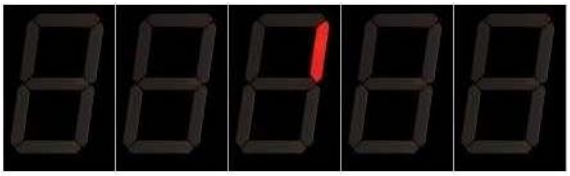


At the first connection the Operative System of the PC will ask for a driver that are powerd by TDE Macno with the .inf file (that's good for both 32 and 64bit Windows OSes) and that can be downloaded by the website www.bdfdigital.it a the voice **PRODUCTS/DOWNLOAD/UTILITY SW**, folder **DRIVER_USB_4T0008.zip**.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

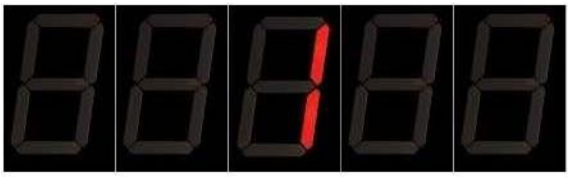
When a PC is directly connected to the OPDE, the Operator Interface is not working as the internal serial link is used exclusively for data communication with the PC.
For the same reason **speed is 38400 bps and Modbus address is 1** (regardless to settings in parameters P92 and P93) and can't be changed.

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 OF CORE

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 Nominal Voltage / Reference	30.0	1200.0	650.0	V	10
Vo_READ	P09 - Vo READING fs	30.0	1200.0	550.0	V	10
Vo_REF	P10 - DC Output Voltage Reference	10.0	1200.0	30.0	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
VOLT_REF_RAMP	P16 - Voltage reference ramp time	0.0	10000	0	ms	1
INDUC_CURR_RIPPLE	P22 - Current ripple on leg-inductance (Vbus = V_GRID_NOM)	1.0	100.0	10.0	% CONV_I_PEAK	10
CAP_CHARGE_TIME	P23 - Capacitor charging time at CONV_I_PEAK at V_GRID_NOM	0.1	250.0	10.00	ms	100
CURR_PM	P24 - Current loop phase margin	30	80	60	deg	10
CURR_BANDWIDTH_RATIO	P25 - Bandwidth over maximum bandwidth ratio for current loop	10.0	100.0	85.0	%	10
VOLT_PM	P27 - Voltage loop phase margin	30	85	70	deg	10
VOLT_BANDWIDTH_RATIO	P28 - Bandwidth over maximum bandwidth ratio for voltage loop	10.0	100.0	80.0	%	10
V_REG_TF	P33 - TfV voltage regulator filter time constant	0.0	25.0	0.4	ms	10
DC_DC_I_TF	P37 - TfV DcDc Curr Control Tf	0.0	25.0	0.0	ms	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
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
LEM_CURRENT_OFFSET_U	P46 - LEM current sensor offset U	-100.0	100.0	0	%	327.67
LEM_CURRENT_OFFSET_W	P47 - LEM current sensor offset W	-100.0	100.0	0	%	327.67
LEM_CURRENT_OFFSET_V	P48 - LEM current sensor offset V	-100.0	100.0	0	%	327.67
K_V_VO	P52 - Corrective Factor for Vo Voltage	5.0	2000.0	100.0	%	10
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
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	15.0	780.0	400	V	10
LimitDuty	P64 - Limit Duty Cycle (upper limit in step-down mode, lower limit in step-up mode)	10.0	100.0	100.0	%	163.84
WaitDcDcReady	P65 - Wait after Converter Ready	20	2000	1000	ms	1
REACT_TF_THERM	P71 - Main reactor thermal time constant	30	2400	600	s	1
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	20.0	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	10000	Hz	1
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	20.0	1200.0	400	V	10
DCBUS_MAX	P107 - Maximum DC Bus voltage	350.0	1200.0	760	V	10
OUTVOLT_MAX	P109 - Maximum output voltage on external feedback	0.0	1200.0	760	V	10

Name	Description	Min	Max	Default	UM	Scale
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	Â°C	10
CONV_START_TEMP_MAX	P119 - Max. temperature permitted by heat sink PTC/NTC for start-up	0.0	150.0	75	Â°C	10
RAD_DO_TEMP_THR	P120 - Heat sink temperature threshold for logic output o.15	0.0	150.0	80	Â°C	10
FAN_CTRL	P121 - FAN ctrl	0	3	1		1
KP_BOARD_THERM_PRB	P138 - Corrective factor for card thermal sensor	0.00	200.00	100	%	163.84
PW_SOFT_START_TIME	P154 - Soft start enabling time	150	19999	500	ms	1
OVR_LOAD_T_ENV	P155 - Ambient temperature reference value during overload	0.0	150.0	40	Â°C	10
CHR_F_PWM	P156 - PWM frequency for converter definition	1000	16000	10000	Hz	1
DEAD_TIME	P157 - Dead time duration	0.0	20.0	4	Âµs	10
ID_CANOPEN	P162 - CAN BUS node ID	1	127	1		1
ALL_ENAB	P163 - Alarm enable	-32768	32767	-1	Hex	1
CHR_V	P167 - Characterization voltage	200.0	690.0	460	V rms	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	Âµs	10
MIN_PULSE	P199 - Minimum command pulse duration	0.0	20.0	1.0	Âµs	10
AI_VOLT_READ	C18 - Analog input for external voltage reading board	0	3	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
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
RECT_BRIDGE_SEL	C45 - Rectification bridge	0	1	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	0		1
THERM_PRB_SEL	C57 - Enable heat sink heat probe management (PTC/NTC)	0	4	1		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_NOT_LI	C79 - Enable negative logic for digital inputs	0	255	0		1
DC_DC Control	C81 - DcDc Control Mode	0	3	0		1
EN_VCTRL_EXT_IQ_REF	C82 - Enable external Iq reference during voltage control	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
LEM_OFF_COMP_EN	U01 - Enable AT offset compensation for LEM (step-up mode)	0	1	0		1
MAPPING_CONFIG	U03 - Select the mapping configuration	0	32767	0	Hex	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

Name	Description	Min	Max	Default	UM	Scale
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
CURR_BANDWIDTH	P26 - Current loop cross-over frequency	0	16000	0	Hz	1
VOLT_BANDWIDTH	P29 - Voltage loop cross-over frequency	0	16000	0	Hz	1
V_REG_KP	P31 - KpV voltage regulator proportional gain	0.1	400.0	2.0		10
V_REG_TI	P32 - TiV voltage regulator lead time constant	0.1	3000.0	30.0	ms	10
DC_DC_I_KP	P35 - KpV DcDc Curr Control Kp	0.1	400.0	2.0		10
DC_DC_I_TI	P36 - TiV DcDc Curr Control Ti	0.1	3000.0	30.0	ms	10
I_NOM	P53 - Rated Converter current	0.0	400	0	A	10
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

Name	Description	Min	Max	Default	UM	Scale
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 - Delivered output power (Vo)			0	kW	16
DRV_I_CONN_TH_MODEL	D06 - Drive inner connection limit			0	% DRV_I_CONN_MAX	163.84
DCDC_STATUS	D09 - DcDc_status			0		1
REACT_I	D11 - Current module			0	A rms	16
CURR_U	D13 - U current			0	A rms	16
P_CONV_NOM	D14 - Nominal power			0	kW	16
VOUT_REF_NORM	D22 - DC Output voltage Reference (Norm)				% DC_BUS_REF	40,96
Vo	D23 - Output DC Voltage Vo			0	V	16
DC_BUS	D24 - Bus voltage Vb			0	V	16
RAD_TEMP	D25 - Heat sink temperature reading			0	Â°C	16
LOAD_TEMP	D26 - Reactor temperature			0	Â°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
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	% V_GRID_NOM	163.84
CURR_V	D34 - V current			0	A rms	16
CURR_W	D35 - W current			0	A rms	16
REG_CARD_TEMP	D40 - Regulation card temperature			0	Â°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	Â°C	16
IGBT_J_TEMP_MARGIN	D46 - IGBT junction temperature margin with its limit			0	Â°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
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

Name	Description	Min	Max	Default	UM	Scale
BOOTLOADER_REV	Bootloader revision					1
PN_LED_STATUS	Profinet Led Status					1

Via dell’Oreficeria, 41
36100 Vicenza - Italy
Tel +39 0444 343555
Fax +39 0444 343509
www.bdfdigital.com