OPEN DRIVE

OPEN DRIVE

Sensorless Manual

revision 3.0

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GENERAL INDEX

OPEN DRIVE

OPEN DRIVE

Standard sensor-less application

Standard sensor-less application

(references generation)

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The OPEN DRIVE standard application makes it possible to control the motor in frequency or in current by inputting the references analogically and digitally. Management of digital input/output and Field-Bus references can also be carried out.

1. Application configuration

1.1. Application parameters

PAR	DESCRIPTION	Variation FIELD	Default VALUE	Normalisation UNIT	internal Repr.
P01	14 bit analog ref. correction factor 1 (AN_INP_1)	±400.0	100.0	%	10
P02	14 bit analog corrective offset ref. 1 (AN_INP_1)	±16383	0	16383=100%	1
P03	14 bit analog ref. correction factor 2 (AN_INP_2)	±400.0	100.0	%	10
P04	14 bit analog corrective offset ref. 2 (AN_INP_2)	±16383	0	16383=100%	1
P05	14 bit analog ref. correction factor 3 (AN_INP_3)	±400.0	100.0	%	10
P06	14 bit analog corrective offset ref. 3 (AN_INP_3)	±16383	0	16383=100%	1
P07	Digital frequency reference (JOG1)	±100.00	0.00	% n_{MAX}	16383
P08	Digital motor potentiometer starting frequency	±100.0	2.0	% n_{MAX}	16383
P09	Analog torque reference time filter constant	0.0÷20.0	0.0	ms	10
P10	Offset on high precision analog reference	±19999	0	/100 mV	1
P11	NUM – Frequency input slip ratio	±16383	100		1
P12	DEN – Frequency input slip ratio	0÷16383	100		1
P16	Maximum motor potentiometer frequency reference	±105.0	105.0	% n_{MAX}	16383
P17	Minimum motor potentiometer frequency reference	±105.0	-105.0	% n_{MAX}	16383
P20	Digital potentiometer acceleration time	0.3÷1999.9	50.0	s	10

1.2. Application connections

CON	DESCRIPTION	Variation FIELD	Default value	Meaning of default	Type
C01	Logic input 1 meaning	0÷63	8	RESET ALL	r
C02	Logic input 2 meaning	0÷63	2	CONSENT	r
C03	Logic input 3 meaning	0÷63	3	ENABLE REF AI1	r
C04	Logic input 4 meaning	0÷63	0	RUN	r
C05	Logic input 5 meaning	0÷63	4	ENABLE REF AI2	r
C06	Logic input 6 meaning	0÷63	12	CW/CCW	r
C07	Logic input 7 meaning	0÷63	5	ENABLE JOG	r
C08	Logic input 8 meaning	0÷63	22	ENABLE RAMPS	r
C09	Frequency input determination : 1=digital encoder; 2=digital frequency/sign	1÷2	1	DIGITAL ENCODER	r
C10	Logic output 1 meaning	-32÷31	3	RUN	r
C11	Logic output 2 meaning	-32÷31	0	RESET READY	r
C12	Logic output 3 meaning	-32÷31	6	END OF RAMP	r
C13	Logic output 4 meaning	-32÷31	10	SWITCH ON POWER INPUT	r
C15	Meaning of programmable analog output 1	-63÷63	11	CURRENT	
C16	Meaning of programmable analog output 2	-63÷63	4	FREQUENCY	
C17	Meaning of 14 bit analog input A .I.1	0÷2	0	FREQUENCY REF	r
C18	Meaning of 14 bit analog input A .I.2	0÷2	1	TORQUE REF	r
C19	Meaning of 14 bit analog input A .I.3	0÷2	2	LIMIT REF	r

C20	Load last digital potentiometer frequency	0.1	0		
C22	Enable 14 bit analog reference A.I.1	0,1	0		
C23	Enable 14 bit analog reference A.I.2	0,1	0		
C24	Parallel bit at REF3 (jog)	0,1	0		
C25	Parallel bit at REF4 (digital motor potentiometer)	0,1	0		
C26	Ramp inclusion	0,1	x		
C31	Enable 14 bit analog reference A.I.3	0,1	0		
C36	Reference signal software reversal	0,1	0		
C39	Impulses/revolution selection FREQUENCY INPUT	0÷9	5	1024 impulses/revolution	
C43	Enables frequency reference in frequency	0,1	0		
C52	Enable FIELD-BUS references	0,1	0		r
C53	Enable locked RUN	0,1	0		r

1.3. Input logic functions

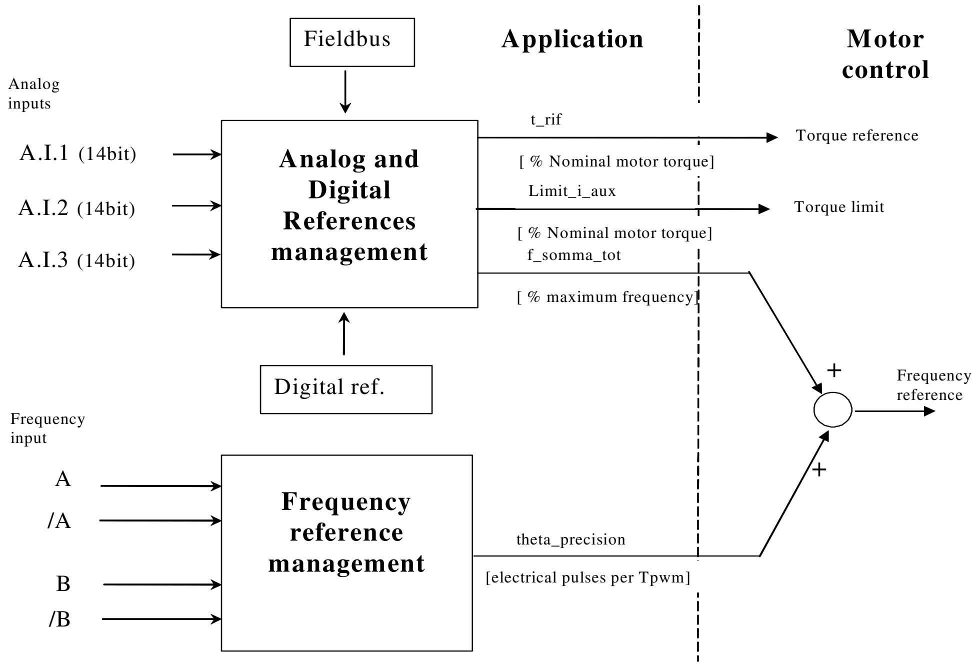
INP	LOGIC FUNCTION ASSIGNED
I00	Run
I01	Torque control
I03	Enable 14 bit analog reference A.I.1.
I04	Enable 14 bit analog reference A.I.2.
I05	Enable frequency jog
I06	Enable digital potentiometer frequency reference
I07	Enable 14 bit analog reference A.I.3.
I09	DP UP digital potentiometer up
I10	DP DOWN digital potentiometer down
I11	Load last digital potentiometer value
I12	Reference reversal
I14	Enable FIELD-BUS references
I18	Enable frequency reference in frequency decoded in time
I19	Enable frequency reference in frequency
I20	
I21	STOP command (locked run)
I22	Enable line ramps
I23	Motor thermo-switch

1.4. Application internal quantities

INT	INTERNAL ASSIGNED VARIABLE	Normalisation unit	Internal repr.
d10	Reference for torque generated by the application	% $C_{NOM\ MOT}$	4095
d12	14 bit analog frequency reference	% n_{MAX}	16383
d14	Reference in frequency generated by the application	% n_{MAX}	16383
d32	Reference for torque limit generated by the application	% $C_{NOM\ MOT}$	4095
d33	Reference for frequency percentage generated by the application	% n_{MAX}	16383

2. References management

The standard application regards the configuration and management of various digital inputs for the generation of frequency, torque and torque limit references for the actual control of the motor.

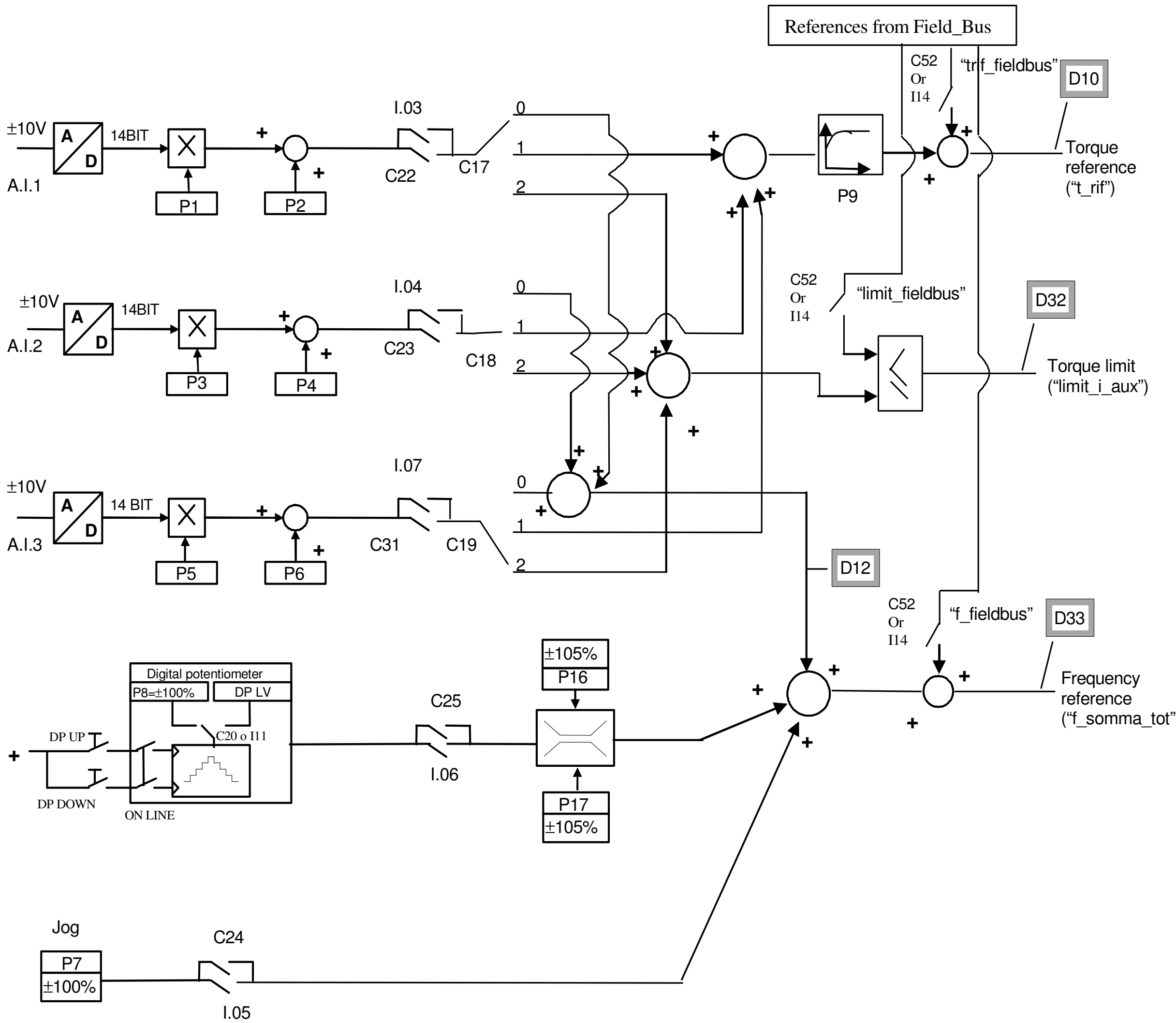


4 references for the motor control are generated by this block:

1. a torque reference (“t_rif”) as percentage of the motor's nominal torque
2. a torque limit reference (“limit_i_aux”) as percentage of the motor's nominal torque.
3. a frequency reference (“f_somma_tot”) as percentage of the maximum frequency
4. another frequency reference (“theta_precision”) in electrical pulses for the period of PWM. This particular reference is to ensure no pulse is lost if frequency input is used. Internal normalisation requires there to be 65536 pulses per electrical revolution.

Inside the motor control, the two frequency references are added up after they have been suitably adapted.

2.1. Digital and analog references management



It's possible to enable separately all references using connections or logic input functions.
For frequency and torque references the active reference is the sum of all enabled references, for torque limit prevails the more constrain active reference, between the sum of analog and the Fieldbus references.

2.1.1. 14 bit analog references

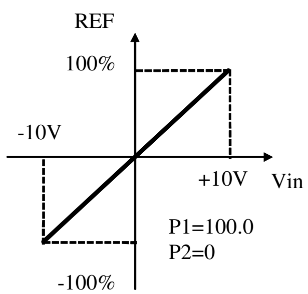
There can be up to 3 differential analog inputs (A.I.1 ÷ A.I.3) ± 10V which, after being digitally converted with a resolution of 14 bits, can be:

- conditioned by digital offset and a multiplicative coefficient
- enabled independently through configurable logic inputs or connections
- configured as meaning through the corresponding connection (**C17 ÷ C19**)
- added together for the references with the same configuration

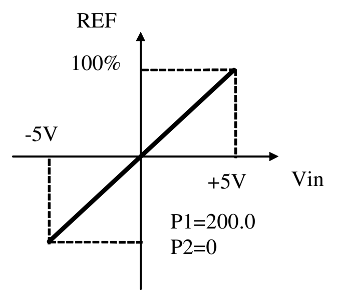
For example in the case of A.I.1, the result of the conditioning is given by the following equation:

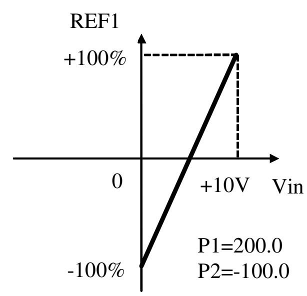
REF1= ((A.I.1/10)*P1) + P2

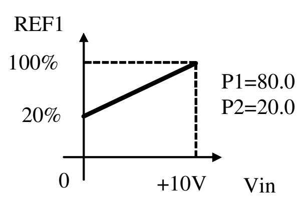
By selecting a suitable correction factor and offset the most varied linear relationships can be obtained between the input signal and the reference generated, as exemplified below.

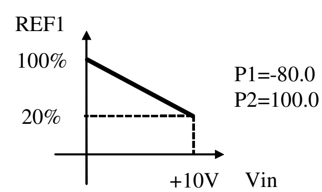


Default setting









Note: for the offset parameters (P02, P04 and P06) an integer representation has been used on the basis of 16383, in order to obtain maximum possible resolution for their settings.
For example if P02=100 ⟹ offset = 100/16383 = 0.61%

As said above, the enabling of each analog input is independent and can be set permanently by using the corresponding connection or can be controlled by a logic input after it has been suitably configured.
For example to enable input **A.I.1** the connection **C22** or the input logic function **I03** can be used, with the default allocated to logic input 3.

The connections C17 ÷and C19 are used to separately configure the three analog inputs available:

C17 – C19	Meaning
0	Frequency reference
1	Torque reference
2	Torque limit reference

Several inputs can be configured to the same meaning so that the corresponding references, if enabled, will be added together.

Note: using the appropriate multiplicative coefficient for each reference it is therefore possible to execute the subtraction of two signals.

In the case of the torque limit, if there is no analog input configured to the given meaning and enabled, the reference is automatically put at the maximum that can be represented, i.e. 400%. In internal quantities **d32** it is possible to view the torque limit imposed by the application.

In the case of the torque reference there is a first order filter with time constant that can be set in milliseconds in parameter **P9**. In the internal quantity **d10** the torque reference can be viewed as set by the application

2.1.2. Digital frequency reference (Jog)

The value programmed in parameter **P7** can be used as digital frequency reference either by activating the logic function "Enable Jog" I.05 assigned to an input (default input L.I.5) or with the connection **C24**=1. The resolution is 1/10000 of the maximum working frequency.

2.1.3. Digital Potentiometer frequency reference

A function that makes it possible to obtain a terminal board adjustable frequency reference through the use of two logic inputs to which are assigned the input functions digital potentiometer up **I09**" (DP.UP) and "Digital potentiometer down **I10**" (DP.DOWN) .
The reference is obtained by increasing or decreasing an internal counter with the DP.UP and DP.DOWN functions respectively.
The frequency of increase or decrease set by parameter **P20** (acceleration time of the digital potentiometer) which sets how many seconds the reference takes to go from 0 to 100%, keeping the DP.UP active (this times is the same as to go from 100.0% to 0.0% by holding DP.DN active). If DU.UP are DP.DOWN are activated at the same time the reference remains still.
The movement of the reference is only enabled when the converter is in RUN.
The initial reference value at the time of start up of the converter, is set by the value programmed by the parameter **P8** (P8=2.0% default) if neither the function "last digital potentiometer value I20" (DP.LV not active by default), nor connection **C20** (C20=0 default) is active, while the initial reference value remains the same as that when the converter was stopped, even if power has been removed in the meantime, when the DP.LV function is active or connection C20 is active. Thanks to this permanent memory, even if the power supply is lost, the digital potentiometer can be used as if it were a physical potentiometer.

The functioning is summarised in the following table :

Converter running on-line	DP.UP	DP.DOWN	DP.LV	C20	REF
H	H	L	x	x	increases
H	L	H	x	x	decreases
H	L	L	x	x	stopped
H	H	H	x	x	stopped
L	x	x	x	x	stopped
L -> H	x	x	L	L	P8
L -> H	x	x	H	L	REF4 L.v.
L -> H	x	x	L	H	REF4 L.v.
L -> H	x	x	H	H	REF4 L.v.

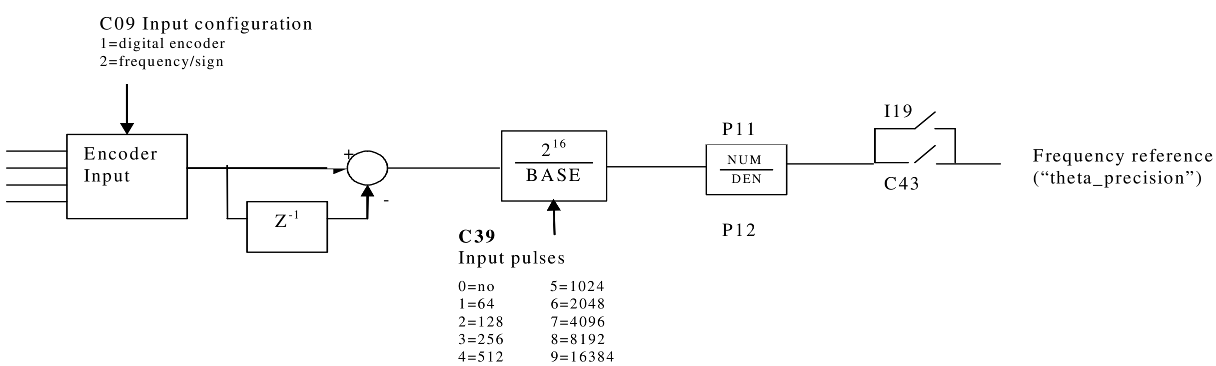
H = active x = does not matter L = not active L -> H = From Off-line to On-line

The digital potentiometer reference requires, to be enabled, activation of function **I06** after allocating an input or activating connection **C25** (C25=1) .
In the parameters **P16** and **P17** the maximum and the minimum admitted reference values can be marked for the digital potentiometer reference.

2.2. Frequency reference in frequency management

This frequency reference in pulses ("theta_precision") can be provided in 2 different ways (alternatives to each other), that can be selected by means of connection C09.

C 09	Mode of working
1	4 track frequency reference (default)
2	Frequency reference (freq. and up/down) counting all edges



To be used Frequency reference in pulses must be enabled either by activating the function " Enable reference in frequency **I19** "assigned an input or by means of connection **C43**=1 .

2.2.1. Frequency reference

Two working modes can be selected with C09 :

- Setting **C09 = 1** a reference can be provided with an encoder signal with 4 tracks of a maximum range varying between 5V and 24V and a maximum frequency of 300KHz.
- Setting **C09 = 2** a frequency reference can be provided with an frequency signal with a maximum range varying between 5V and 24V and a maximum frequency of 300KHz.

The number N of impulses/revolution for the reference is set by connection **C39**:

	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
N° of impulses/revolution	disable	64	128	256	512	1024	2048	4096	8192	16384

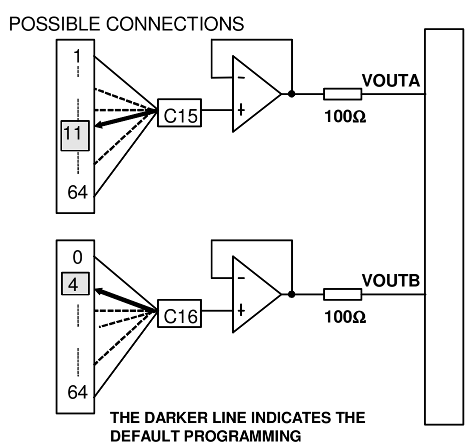
There are the parameters **P11** and **P12** that permit specification of the ratio between the reference frequency and input frequency as a Numerator/Denominator ratio.

In general terms, therefore, if you want the frequency of rotation of the rotor to be **x** Hz, the relationship to use to determine the input frequency is the following:

$$f = \frac{x \times N_{pulses/revolution} \times P12}{P11} \qquad \text{and vice versa} \qquad x = \frac{f \times P11}{N_{pulses/revolution} \times P12}$$

3. *Analog outputs management*

There can be a maximum of two analog outputs, VOUTA and VOUTB ± 10 V, 2mA.
To each of the two outputs can be associated an internally variables selected from the list here below; 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 variable selected). The default for VOUTA is a signal proportional to the current supplied by converter (C15=11), in VOUTB the signal is proportional to the working frequency (C16=4).
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: for example taking C15=-4 there will be an analog output signal proportional to the absolute value of the working frequency.
It is also possible to have a analog output fixed to +10V: to do this it is simply necessary to program the connection corresponding to 64.



NORMALISED BASE INTERNAL VARIABLES FOR ANALOG OUTPUTS			
O 00	Actual electrical rotor flux position (alfa_fi)	100%=180°	32767
O 01	Reference frequency in input to V/f characteristic	% f_{MAX}	4095
O 02	Reference frequency before the ramp	% f_{MAX}	4095
O 03	Reference frequency after the ramp	% f_{MAX}	4095
O 04	Frequency of rotation filtered	% f_{MAX}	4095
O 05	Torque requirement	% $C_{NOM\ MOT}$	4095
O 09	Voltage requirement in output from V/f characteristic	% V_{MAX}	4095
O 11	Current module	% $I_{NOM\ AZ}$	4095
O 13	U phase current measured	% $I_{MAX\ AZ}$	4095
O 15	Torque component of measured current	% $I_{NOM\ AZ}$	4095
O 16	Magnetising component of current measured	% $I_{NOM\ AZ}$	4095
O 17	Duty-cycle U phase voltage		32767
O18	Reference stator ground voltage module	% $V_{NOM\ MOT}$	4095
O19	Modulation index	$0 \Leftrightarrow 1$	4095

O20	Q axis voltage requirement (Vq_rif)	% V_{MAX}	4095
O21	Power supplied	% P_{NOM}	4095
O22	D axis voltage requirement (Vd_rif)	% V_{MAX}	4095
O23	Current limitation loop output	% V_{MAX}	4095
O24	Bus voltage	100%=900V	4095
O25	Measured radiator temperature	% 37.6°	4095
O26	Measure motor temperature	% 80°	4095
O27	Active current limit	% $C_{NOM\ MOT}$	4095
O28	Motor thermal current	% A6 action threshold	4095
O29	Current limit	% $I_{MAX\ AZ}$	4095
O30	CW maximum torque	% $C_{NOM\ MOT}$	4095
O31	CCW maximum torque	% $C_{NOM\ MOT}$	4095
O34	Measured phase V current	% $I_{MAX\ AZ}$	4095
O35	Measured phase W current	% $I_{MAX\ AZ}$	4095
O36	Torque limit imposed by current limit	% $C_{NOM\ MOT}$	4095
O37	Analog input A.I.1	100%=16383	16383
O38	Analog input A.I.2	100%=16383	16383
O39	Analog input A.I.3	100%=16383	16383
O41	Total frequency reference (f_somma_tot)	% n_{MAX}	16383
O42	Total torque reference (t_rif) for the application	% $C_{NOM\ MOT}$	4095
O43	Total torque limit reference (limit_i_aux)	% $C_{NOM\ MOT}$	4095
O49	Unfiltered frequency of rotation	% n_{MAX}	16383
o53 ÷ o63	----- Reserved for special applications ----- see special application file		
o64	Output fixed to +10V		

4. Input logic management

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

		INPUT LOGIC FUNCTIONS	DEFAULT INPUT	DEFAULT STATUS
I	00	Run command	L.I.4	L
I	01	Torque control		L
I	02	External enable	L.I.2	H
I	03	Enable 14 bit analog reference A.I.1.	L.I.3	L
I	04	Enable 14 bit analog reference A.I.2.	L.I.5	L
I	05	Enable frequency jog	L.I.7	L
I	06	Enable digital potentiometer frequency reference		L
I	07	Enable 14 bit analog reference A.I.3.		L
I	08	Alarms reset	L.I.1	L
I	09	UP digital potentiometer		L
I	10	DOWN digital potentiometer		L
I	11	Load last digital potentiometer value		L
I	12	Reversal reference	L.I.6	L
I	13	Enable power soft-start		H
I	14	Enable FIELD-BUS references		L
I	15			L
I	16	Activation second rank of parameters		L
I	17			L
I	18			
I	19	Enable frequency references in frequency		L
I	20			L
I	21	STOP command (locked run)		L
I	22	Enable line ramps	L.I.8	L
I	23	Motor thermo-switch		L
I	29	--- Reserved for special applications ----		
I	63	see special application enclosure		

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.

For example, to assign a specific logic function to logic input 1 you must first write the desired logic number for connection C01 :

C01 = 14 → logic input 1 can be used to enable Fieldbus references

The logic functions that have been configured become active (H) when the input level is at high status (20V < V < 28V), and there is a 2.2ms hardware filter.
The functions that have not been assigned assume default value ; for example, if the function "external enable" is not assigned it becomes, as default, "active (H)" so the converter is as if there were no assent from the field.

4.1.1. 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:

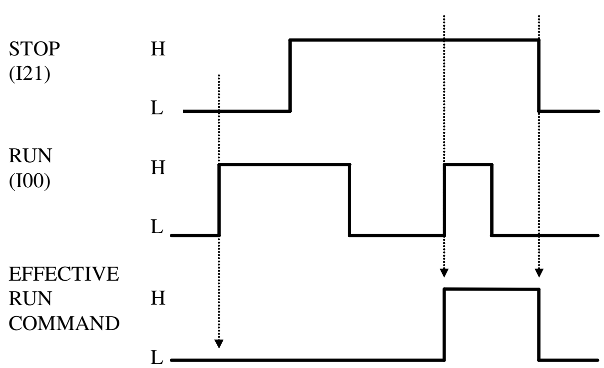
- I00 Run = stands alone, it has to be confirmed by terminal board inputs, by the serial and by the fieldbus, though in the case of the latter the default is active and so, if unaltered, controls only the terminal board input.
- I01÷ I28 = is the parallel of the corresponding functions that can be set at the terminal board, the serial or the fieldbus.
- I29 ÷ I63 = only the functions reserved for special applications, they can certainly be changed by suitably configuring the terminal board inputs, and other possibilities can be attributed by the application itself.

4.1.2. Locked Run from terminal board

It may be a matter of interest that the RUN command can be given by the commutation edge from a low to high signal: to enable this function set **C53=1**.
In this operational mode the STOP command is also used (I21, after having configured one of the logic inputs) which is level sensitive:

- low level: converter in STOP, power disabled
- high level: the converter can be at RUN

The diagram below shows the working logic:



- The RUN command is only given if there is a risign edge L->H on I00 with I21 high.
- Once RUN has been give to logic input I00 can return to low level
- As soon as the STOP signal (I21) goes to low the RUN command is switched off
- If the converter goes into an alarm state the run command will be switched off and so it will be necessary to repeat the start up procedure as soon as the converter is ready again.

5. Logic outputs management

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:

		OUTPUT LOGIC FUNCTIONS	DEFAULT OUTPUT
O	00	Drive ready	L.O.2
O	01	Thermal motor alarm	
O	02	Frequency above minimum	L.O.4
O	03	Run drive	L.O.1
O	04	CW / CCW	
O	05	Current/torque relay	
O	06	End of ramp	L.O.3
O	07	Current limit drive	
O	08	Torque limit drive	
O	09	Motor in stall	
O	10	Switch on power soft-start	
O	11	Braking active	
O	12	No supply mains	
O	13	Bus regeneration activated (Support 1)	
O	14	Motor thermal current above threshold (P96)	
O	15	Radiator temperature too high (above threshold P120)	
O	16	Frequency reached (above absolute value at P47)	
O	17	No supply main to Power electronic card	
O o	21 31	----- Reserved for special application ----- see special application enclosure	

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 " end of ramp " to logic output 1 active low, you have to program connection 10 with the number -6 (C10=-6).

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

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Common functions

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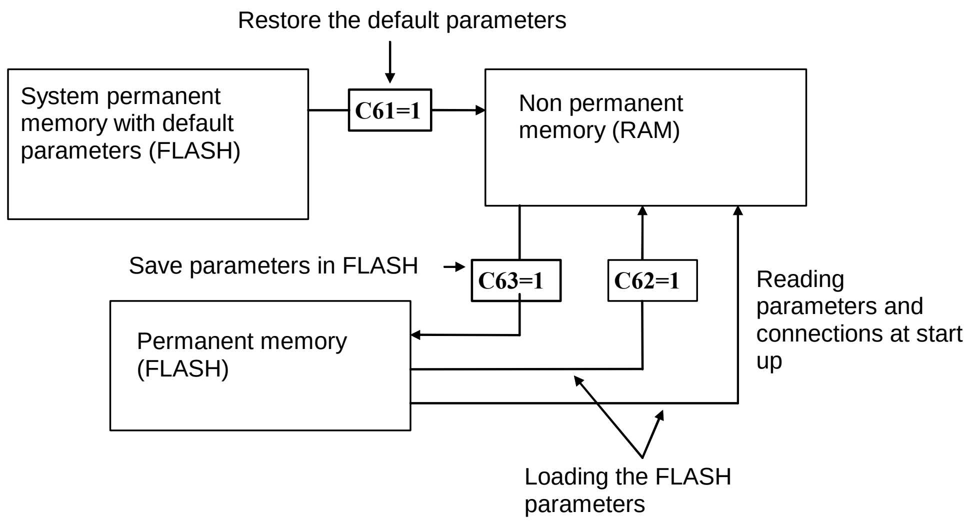
The standard functions of the OPEN DRIVE are common to all versions of the product.

1 Storage and recall of the working parameters

The drive has three types of memory:

1. 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.
2. The permanent work memory (FLASH), where the actual working parameters become stored to be used in sequence (C63=1, Save Parameters on FLASH).
3. The permanent system memory where the default parameters are contained.

When switched on, the 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 FLASH Parameter C62=1).
If for some reason the parameters in FLASH change, it is necessary to resume the default parameters (C61=1 Load Default Parameters), to make the appropriate corrections and then save them in the permanent working parameter (C63=1).
It is possible to save the data in the permanent memory also at 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.



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.

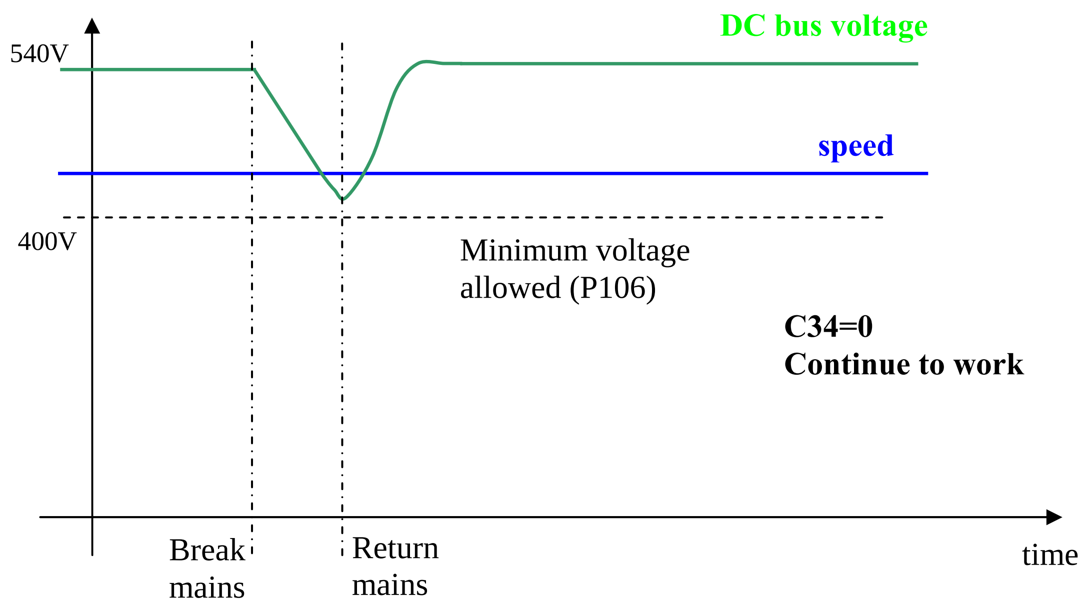
2 Voltage break control for mains feeding

The mains break control is configurable through the following connections:

Connection	Significance
C34	Mains break out control 0= continuing to work; 1= recovery of Kinetic Energy; 2= free; 3= emergency brake
C35	Alarms automatically reset when the mains return

2.1 *Continuing to work (C34=0; default)*

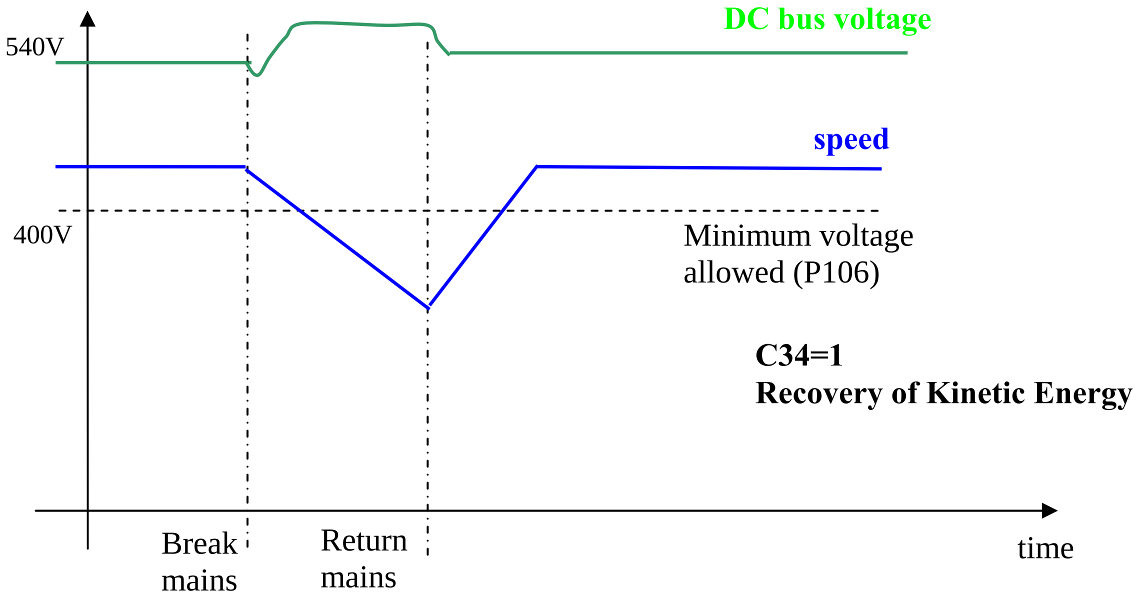
This operating procedure is adapted to those applications in which it is fundamental to have unchanged working conditions in each situation. Setting C34=0 the drive, even if the mains supply voltage is no longer available, continues to work as though nothing has been modified over the control, pulling the energy from the present capacitor to the inner drive. This way making the intermediate voltage of the DC Bus will begin to go down depending on the applied load; when it reaches the minimum tolerated value (in parameter P106) the drive goes into alarm A10 of minimum voltage and leaves to go to the motor in free evolution.
Therefore, this function will allow exceeding short-term mains break out (tenths/hundredths of milliseconds on the basis of the applied load) without changing the motor operation in any way.



If the alarm condition starts, there is the possibility to enable, setting C35=1 the alarms to an automatic reset at the mains restore.

2.2 *Recovery of Kinetic Energy (C34=1)*

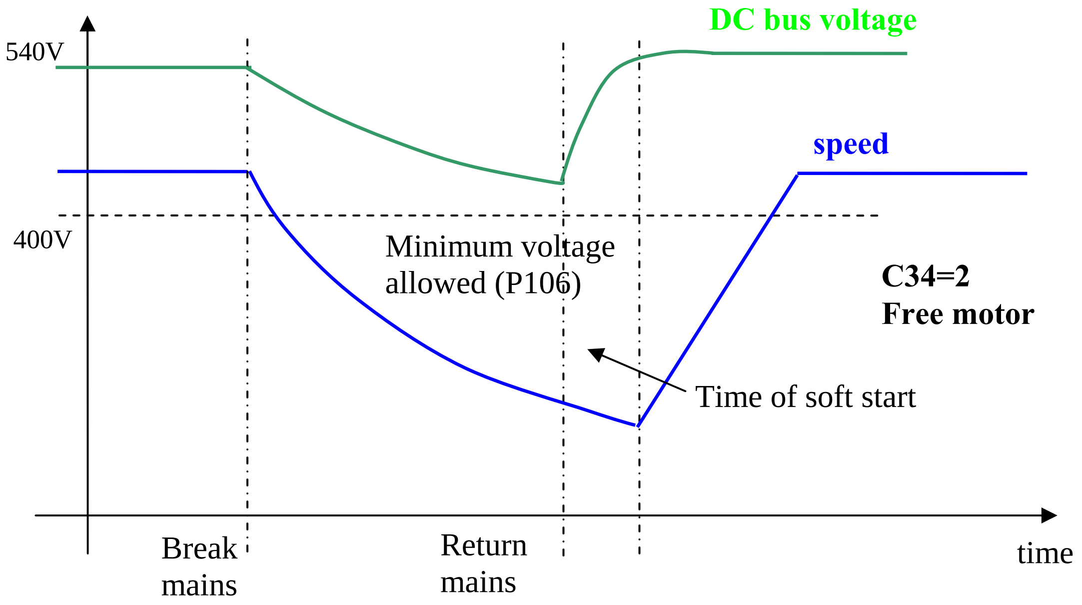
This operating procedure is adapted to those applications in which it is temporarily possible to reduce the speed of rotation to confront the mains break. This function particularly adapts in the case of fewer applied motors and with high energy.
The qualification of such a function is obtained setting C34=1.
During the mains break out, the voltage control of the DC Bus is achieved using a proportional regulator, with fixed proportional gain set in P86 (default=3.5), that controls the DC Bus voltage d24, compare it with the threshold in P98 (default=600V) and functions on the torque limits d30 of the motor that, in time, will slow down to work in recovery. Such regulation, when qualified (C34=1), at mains break out (o.L.12=H) or if the DC Bus voltage goes below the threshold set in P97 (425V), replaces the normal regulation (o.L.13=H) and is excluded when mains supply is on.



If the alarm condition starts, there is the possibility to enable, setting C35=1 the alarms to an automatic reset at the mains restore.

2.3 *Overcoming mains breaks of a few seconds with flying restart (C34=2)*

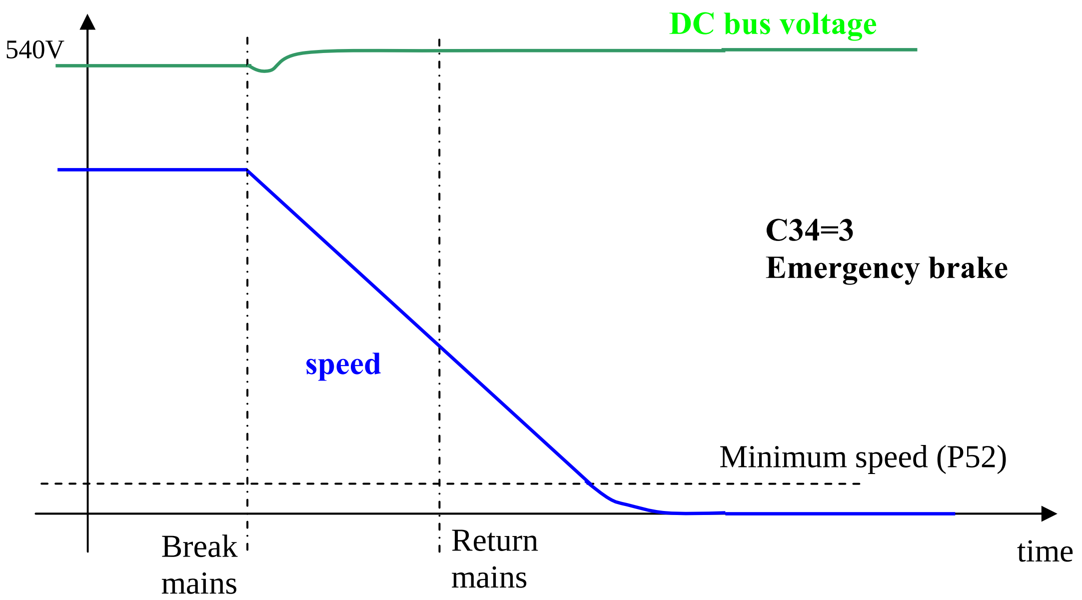
This operating procedure is adapted to those applications in which it is fundamental to not go into alarm in the case of mains break out and is temporarily prepared to disable the power in order for the motor to resume when the mains returns.
The qualification of such a function is obtained setting C34=2.
When there is a mains break or if the voltage of the Bus goes below the threshold set in P97r (425 V), the drive is immediately switched off, the motor rotates in free evolution and the Bus capacitors slowly discharges. If the mains returns in a few seconds, a fast recovery of the motor is carried out in a way in which the working regulation of the machine is resumed.



At the return of the mains, it will need to wait for the time of soft start for the gradual recharging of capacitors for the motor to be able to resume.

2.4 *Emergency brake (C34=3)*

This particular control is adapted to those applications in which the machine may be stopped with an emergency brake in case of mains breaks.
Under this circumstance, the linear ramps becomes qualified and the ramp time is imposed with the parameter P30. When the minimum speed is reached, alarm A10 of minimum voltage starts and the motor is left rotating in free evolution. If in the meantime the mains returns, the emergency brake will be not interrupted.

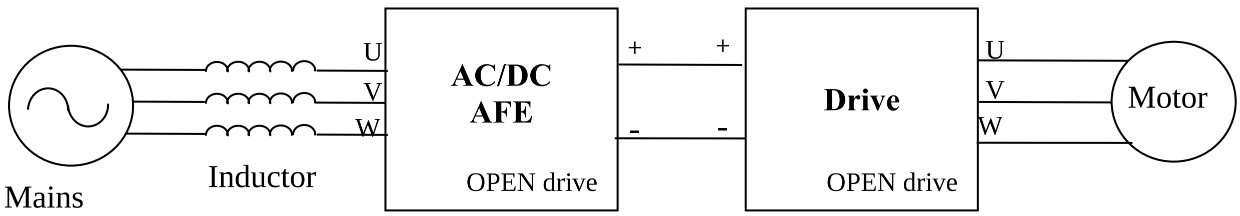


3 Braking management

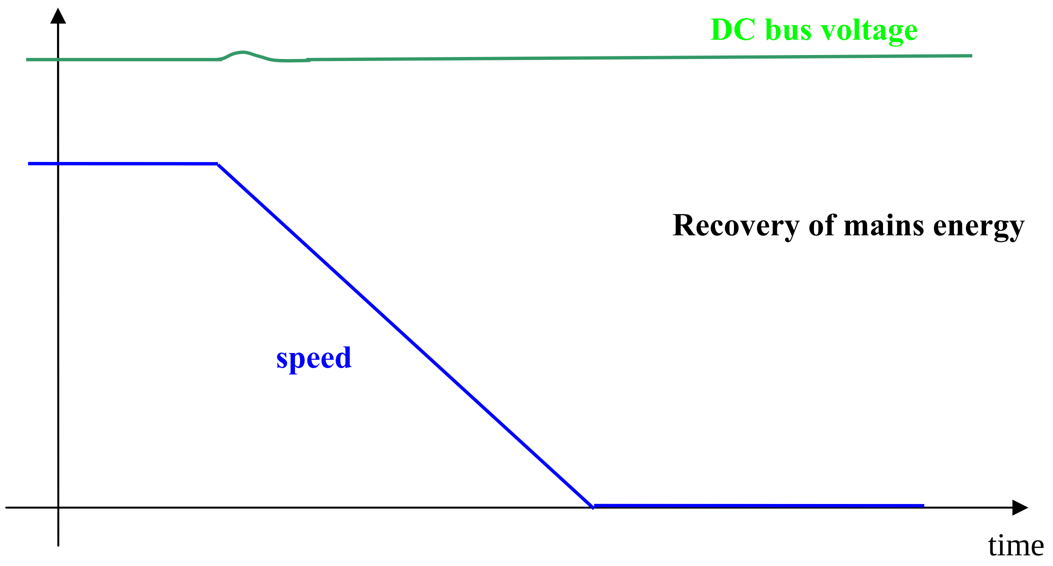
The drive is in a position to work on four quadrants, therefore is also in a position to manage the motor recovery Energy. There are three different, possible controls:

3.1 *Recovery mains energy*

To be able to restore the kinetic Energy into the mains, it is necessary to use another OPEN drive , specifically the **AC/DC Active Front End (AFE).** A Power Factor Controller deals with the position to have a power factor close to unity. Specific documentation is sent back from specific details. This solution is adapted to those applications in which the additional cost justifies another drive with a lot of energy that is recovered in the mains or for particular thermal dissipation problems in the use of a braking resistor.

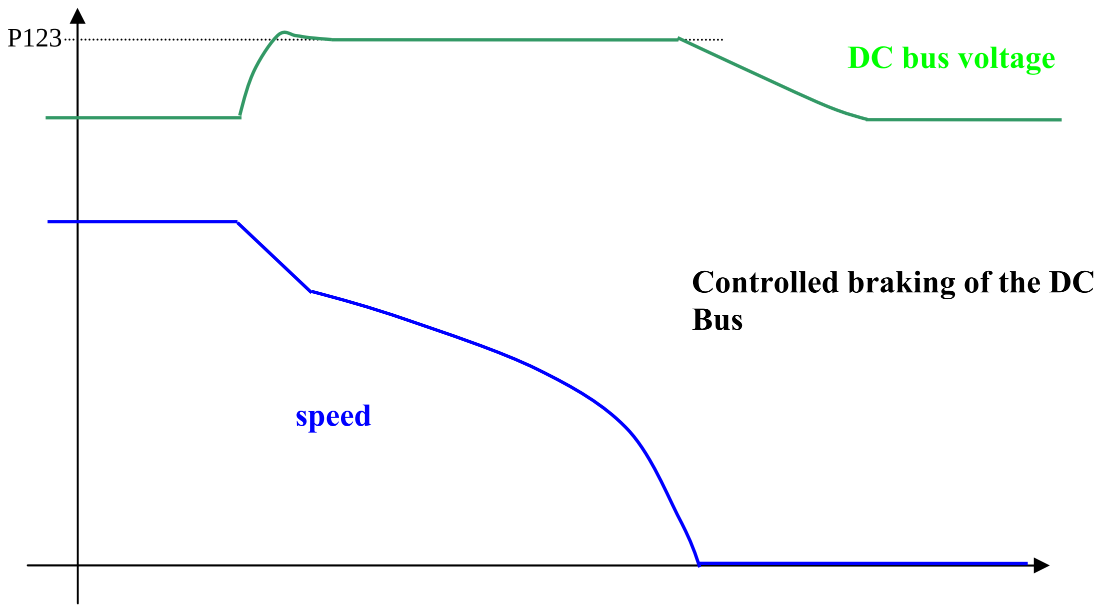


The use of an AC/DC AFE permits a controlled voltage level of the intermediate power (DC Bus) and raises to best control the motors winded to a voltage close to the line voltage. The drive's dynamic behavior results in a way that optimizes the work as motor or generator.
There is a possibility to connect more than one drive to the DC Bus, with the advantage of energy exchange between drives in case of contemporary movements and only one energy exchange with the mains.



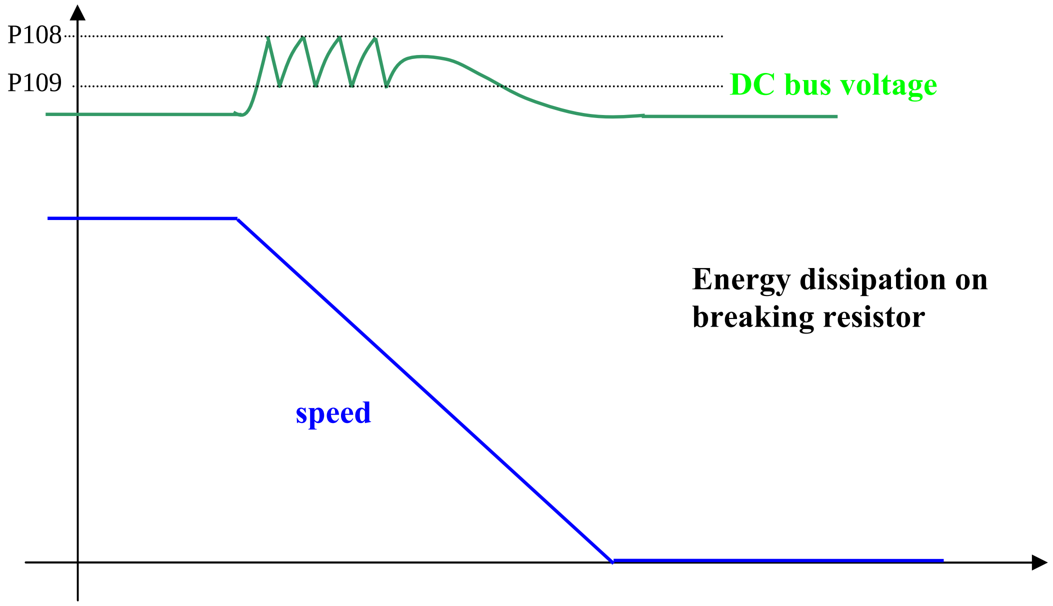
3.2 *Braking with DC Bus control (C47=1)*

A further possibility of recovery control of kinetic energy exists: if the outer braking resistance is not present (or is not working properly), it is possible to enable (setting **C47=1**) the braking with DC Bus control. This function, when the Bus voltage reaches the threshold set in **P123**, limits the maximum admitted regenerated torque, slowing down the motor. In practice, the motor will slow down in minimum time thus the over voltage alarm does not start.
This function is not active by default (C47=0) in a way to leave the intervention of the braking circuit.



3.3 *Kinetic energy dissipation on breaking resistance*

The standard solution for the OPEN drive is the dissipation of kinetic Energy on braking resistor. All the OPEN drives are equipped with an eternal braking circuit, while the braking resistor must be connected externally, with the appropriate precautions.
With this solution, the Bus' maximum level of voltage becomes limited through a power device that connects in parallel the resistor with the DC Bus capacitors, if the voltage exceeds the threshold value in **P108**, the drive keeps it inserted until the voltage goes below the value of **P109**; in such a way, the energy that the motor transfers onto the DC Bus during the braking, is dissipated from the resistor.
This solution guarantees good dynamic behavior also in braking mode.
In the follow figure it's shown the Bus voltage and the speed during a dissipation on breaking resistance.



A maximum voltage limit allowed exists for the DC Bus voltage. This is checked by the software (threshold **P107**), and by the hardware circuitry: in case the voltage exceeds this level, the drive will immediately go into an over voltage alarm **A11** to protect the internal capacitors.
In case of A11 alarm condition starts, verify the correct dimensioning of the braking resistor power.

Refer to the installation manual for the correct dimensioning of the outer braking resistor.

The braking resistor may reach high temperatures, therefore appropriately place the machine to favor the heat dissipation and prevent accidental contact from the operators.

3.3.1 Braking Resistance Thermal protection

The Braking Resistance Thermal protection protects the resistance both from Energy peaks and from average Power that have to be dissipated.
It's possible to enable this protection setting **C72=1**, by default this function is disabled.

Instantaneous Power: the quickly Energy exchange is an adiabatic process since heat diffusion on case resistance is very slow, in the meantime the resistance is dimensioning for a maximum energy overload. This protection is based on the follow parameters:

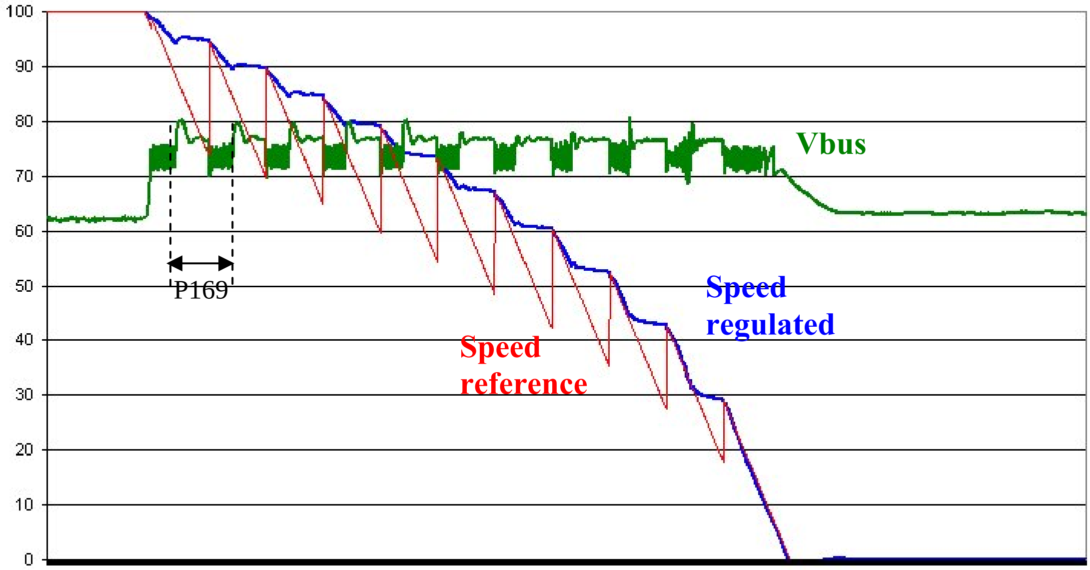
PAR	DESCRIPTION	RANGE	DEFAULT	UNIT	Internal rappr.
P167	Braking resistance value	1 ÷ 1000	82	Ohm	1
P168	Braking resistance Maximum Adiabatic Energy	0.0 ÷ 500.0	4.5	KJoule	10
P169	Time to test the Maximum Adiabatic Energy	1 ÷ 30000	2000	ms	1

After the first Braking resistance activation, the dissipated Energy is accumulated, knowing the DC bus voltage, the Braking resistance value and the activation time.
This accumulation is done for a time set in milliseconds in **P169** parameter: if in this period the Energy becomes greater than maximum threshold (set in KJoule into **P168** parameter) the control disables the Braking resistance. At that point, if it is enables the braking with DC Bus control (C47=1, see par.3.2) it starts to work, otherwise the alarm **A4** code **d49=1** (Instantaneous Power Braking Resistance) becomes active.

At the end of every accumulation period it is possible to show the total dissipated Energy on the period in KJoule in the internal value **d39**, than can start a new period, the Braking resistance is enabled again and the speed reference is aligned with the real speed.

NB: this function has two possible uses:

- It takes the converter in alarm if the Instantaneous Power is too high (C47=0)
- It is possible to choose how many Energy could be dissipated on Braking resistance and in the remaining time braking with the DC Bus control (C47=1). With P169=1000ms it is possible to set in P168 the Power in KWatt that could be dissipated on the resistance. In the follow figure is shown an experimental measurement of this function:



Average Power: the Energy dissipated every PWM period is used to estimate the average Power dissipated on Braking Resistance. The parameters used are:

PAR	DESCRIPTION	RANGE	DEFAULT	UNIT	Internal rappr.
P167	Braking resistance value	1 ÷ 1000	82	Ohm	1
P170	Braking Resistance Maximum Average Power	1 ÷ 30000	150	Watt	1
P171	Average Power Filter time constant	1 ÷ 2000	720	s	1

Every second the total dissipated Energy is equal to the Average dissipated Power.
This value is filtered with a first order filter with a time constant set in seconds in **P171** (the time constant depends on Braking Resistance thermal characteristics). In **P170** parameter is possible to set the maximum average power. In the internal value **d38** it's possible to see the Average Dissipated Power in Watt, if this value becomes greater than the threshold P170 the alarm **A4** code **d49=2** (Average Power Braking Resistance) becomes active.

4 Power soft start

The bridge rectifier build in the drive may be uncontrolled (diode) or semi-controlled (up to OPEN 40 it is uncontrolled). If the diode bridge is implemented, the power soft start function acts bypassing a soft start resistor (in series with the output of the power bridge), after the DC Bus Voltage has charged; otherwise the same function unblocks the semi-controlled input power bridge permitting the gradual charge of the DC Bus voltage and supplying the drive feeding for the following work.

N.B: It is fundamental to correctly set up the connection C45 build in Power Bridge : 0= uncontrolled (diode) ; 1 = semi-controlled

The function becomes active if the entry functions are active **"Enable soft start" I.13**, and the connection C37 (C37=1) and the presence of mains supply voltage becomes noticed, with the following logic:

Mains supply presence: in case the presence of alternated mains supply voltage becomes noticed once (at soft start) with the logic power input **MAINS_OFF=H,** from that moment the control refers only to the **MAINS_OFF** to check the mains presence. Otherwise, in the case of drive feeding with a continuous direct voltage on the DC Bus, it is possible to begin the soft start, even if the measured voltage on the DC Bus exceeds the indicated value in P97.
Mains break out: the mains break becomes noticed either when the MAINS_OFF signal is monitored (if this went to the high logic level at least one time during the soft start) either monitoring directly the DC Bus voltage with minimum threshold setup in P97.

The function of "Soft start enable" may be assigned to one of the logic input thus to enable or disable the soft start through an external contact.
The power fault alarm (power fault A03), that checks drive over current, insert the soft start limiting current.
The soft start follows the following criteria:

I13	**C37**	**A03**	**Mains Presence**	**Soft start enable**	**oL10**
X	X	H	X	OFF	L
0	X	L	X	OFF	L
X	0	L	X	OFF	L
1	1	L	L	OFF	L
1	1	L	H	ON	H

From default PR.ON=1 and C37=1 thus connecting the drive to the mains supply, the power is enable immediately with the soft charging of the capacitors.
The soft start charge of the intermediate circuit capacitors lasts a preset time set in P154, after this time the voltage level is checked to verify the voltage level reached: if this is below the minimum (P97), the soft start alarm starts.

The drive is not enabled to switch on if soft start function has not ended successfully.

4.1 *Safety Stop*

The OPEN drive converters have the possibility to give the separated IGBT supply, see Installation manual. This supply voltage can be see like safety STOP input and there are two different managements for this input, selectable with **C73** connection:

For OPEN DRIVE versions with Safe Torque Off safety function (STO) according to EN 61800-5-2 and EN 13849-1 see STO installation manual.

4.1.1 Machine safety (C73=0)

Setting **C73=0** (default) the Safety STOP is compatible with EN945-1 specification against accidental starts. When this input is at low logical level the IGBT power bridge isn't supplied and the motor couldn't run more than 180°/motor poles couple for brushless motor (for asynchronous motors the movement is zero), also if there is a brake in the power bridge.
The converter signals this state with the alarm **A13 d49=1**, the output **o17 "Power electronic not supplied"** goes at high level, the output o0 "Drive ready" goes at low level and the Power Soft start command is taken off.
To recover the normal converter state, follow this steps:

- Give +24V to the IGBT driver supply input (Safety STOP). At this point the converter goes at low level the output o17 "Power electronic not supplied".
- After 500ms the converter is able to start the Soft start sequence, like to see in par.4
- Reset the converter alarms for eliminate the alarm A13.The normal converter state is recovered.

4.1.2 Power part enable input (C73=1)

Setting **C73=1** the Safety STOP is like a Power part enable input. Like in the preceding case, when this input is at low logical level the IGBT power bridge isn't supplied and the motor couldn't run more than 180°/motor poles couple for brushless motor (for asynchronous motors the movement is zero), also if there is a brake in the power bridge.
The converter signals this state with the output **o17 "Power electronic not supplied"** that goes at high level, the Power Soft start command is taken off, but unlike before no alarms goes at active state. To recover the normal converter state, follow this steps:

- Give +24V to the IGBT driver supply input (Safety STOP). At this point the converter goes at low level the output o17 "Power electronic not supplied".
- After 500ms the converter is able to start the Soft start sequence, like to see in par.4, there is an automatic alarm reset and the normal converter state is recovered.

In this case it isn't necessary to reset the alarms after take back at high level the Safety STOP input, it will be sufficient to wait 500ms + soft start time, after that the converter could be goes on run.

5 Sequences of drive switch on and switch off

5.1 *Drive ready*

The Drive 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>

5.2 *Drive switch on / RUN*

When the drive is "Ready to switch on / RUN" o.L.0=H, motor may start running "Drive 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:

Drive 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 given also via serial line or field-bus. See for details the Standard Application Manual.

5.3 *Drive switch off / STOP*

By default, the drive switch off instantaneously as soon as one of the switch on functions is disabled (immediate shutdown); that may also cause an almost immediate rotation shutdown, if the motor is loaded and the inertia is low, while coasting if the motor is without load and mechanical inertia is high.
Using the connection C28, it is possible to choose to switch off the drive only with motor at minimum speed. With C28=1, 0=immediate switch off by default, when SWITCH ON/RUN function is disable, the speed reference is brought to zero, thus the motor starts to slowdown following the ramp (the drive is still switched on). The system is switched off /STOP (offline) only once the motor absolute speed goes below the threshold set in P50 (2.0% default), that is when the motor is almost motionless (shutdown for minimum speed).

Calibrating P50 may coincide the drive block with the motionless motor. The state of speed above the minimum is signaled from the logical output function **o.L.2,** moreover the output function **o.L.16** is available, that signals the drive speed (absolute value) is above the threshold speed level P47. In every way, whichever is the chosen type of shutdown, there is an immediate drive block in presence of any alarm condition, oL.0 = L.

6 Thermal protections hardware

Thermal probes are managed by the drive with the intent of protecting the drive itself and the motor from damage.

6.1 *Thermal protection drive*

The drive is equipped with thermal probe in the heatsink that may be a PTC or a NTC depending on the size of the drive. Setting the connection **C57≠0** the thermal probe control is enabled. In this case, it is possible to visualize the heatsink temperature in internal value **d25**, in degrees Celsius.
The following thresholds are foreseen:

- With the parameter **P120** it is possible to set a temperature level above which the function o15 “excessive radiator temperature” goes to a logic level high.
- If the temperature exceeds the maximum value setup in the parameter **P118**, the drive goes into **A4 d49=0** alarm “Thermal heatsink”
- If the measured temperature is above the threshold level set in parameter **P119** and the RUN command is switched on , the drive goes into **A12 d49=2** alarm.

6.2 *Motor thermal protection*

The drive can manage the motor thermal probe. For the correct wiring of the probe, make reference to the installation manual.
The connection C46 selects the type of probe used:

C46	Description	Visualization in d26
0	No motor thermal protection enabled	
1	**PT100 management** : The motor’s temperature is measured and compared to the maximum setup in parameter **P91**, If the temperature exceeds the threshold, the **A5** alarm starts.	Motor temperature in °C
2	**PTC management**: The thermal resistance is measured and compared to the maximum setup in the parameter **P95**, If the temperature exceeds the threshold, the **A5** alarm starts.	Thermal probe resistance in Ω
3	**NTC management**: The thermal resistance is measured and compared to the minimum setup in the parameter **P95**, If the value is below, the **A5** alarm starts.	Thermal probe resistance in Ω
4	**Termo-switch management:** it’s possible to configure a logic input to **I23** function, in this case if this input goes to a low level the **A5** alarm starts.	------

7 Current/power relay

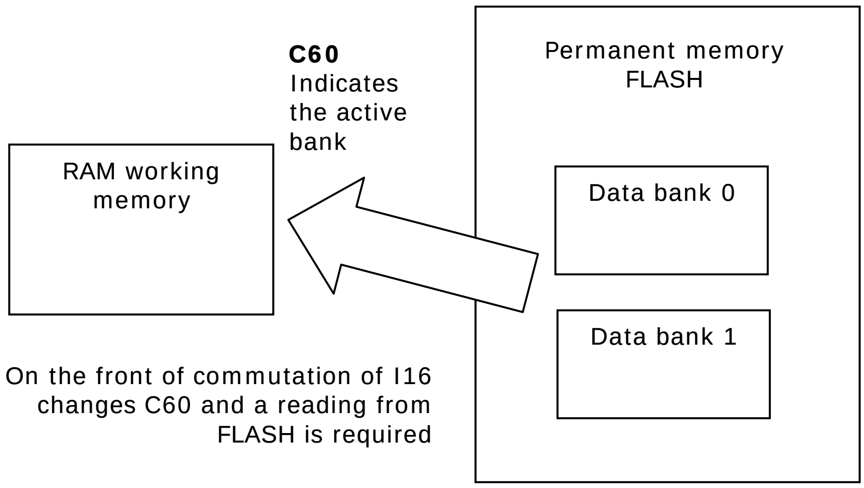
The drive is in the position to control a logic output of current/power relay.
The connection C55 serves to select the type of monitored values:

C55	**Description**
1	**Current** : Current model referred to the motor's nominal current
2	**Torque of currents**: refers to the torque of the motor nominal current
3	**Power**. Refers to the motors nominal power

The selected value is filtered with a first order filter with constant time setup in seconds in P27, and then compared with threshold setup in the parameter P26; if it is greater, the high logic level brings the logic function **o.L.5** to the logic level high.

8 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

OPEN DRIVE

OPEN DRIVE

Sensorless core

"SLES" Sensorless Core

INDEX

The “Sensorless core” controls the frequency of a vector induction motor without feedback.
This type of control has a good dynamic performance also in flux weakening area (4-5 times base frequency) and it’s able to start the motor also with high load (2 times the nominal motor torque), but it’s no useful in that application where it’s necessary to produce torque in steady state at frequency below 1Hz (in this case we recommend to use a motor with feedback and a Vector control).
The frequency and current reference values are generated by the application. See specific documentation for further information.
The “Sensorless core” also manages the auto-tuning test, which is crucial if the control is to adapt perfectly to the motor and to ensure excellent dynamic performance all-round.

1. Complete list of control values

1.1. Parameters

The parameters are drive configuration values that are displayed as a number within a set range. The parameters are mostly displayed as percentages, which is especially useful if the motor or drive size have to be changed in that only the reference values (**P61÷P65**) have to be modified and the rest changes automatically. The parameters are split up into free, reserved and TDE MACNO reserved parameters.
The following rules apply:

- **Free parameters**: may be changed without having to open any key, even when running;
- **Reserved parameters (r)**: 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 (t)**: 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.

Hereunder is a complete list of vector control parameters.
Take careful note of the reference values for each parameter so that they are set correctly. The penultimate column shows the internal representation base of the parameters. This value is important if the parameters have to be read or written with a serial line or fieldbus.

Example1: P7 = Frequency jog

Normalization unit = % f_{MAX}
Int. rep. base = 16383
Internal value = 4000 → real value = 4000/16383 = 24.4% of the maximum frequency

Example1: P62 = Rated motor voltage

Normalization unit = Volt
Int. rep. base = 10
Internal value = 3800 → real value = 3800/10 = 380.0 Volt

The last column explains the parameter: a number refers to a paragraph in this file; letters refer to an abbreviated name for the document to be consulted.

1.1.1. List of free parameters

PAR	DESCRIPTION	Range	Default value	Normalization unit	Int. rep. base	See
P01	Corrective factor for 14 bit analog reference 1 (AN_INP_1)	±400.0	100.0	%	10	APPL
P02	Corrective offset for 14 bit analog reference 1 (AN_INP_1)	±16383	0	16383=100%	1	APPL
P03	Corrective factor for 14 bit analog reference 2 (AN_INP_2)	±400.0	100.0	%	10	APPL
P04	Corrective offset for 14 bit analog reference 2 (AN_INP_2)	±16383	0	16383=100%	1	APPL
P05	Corrective factor for 14 bit analog reference 3 (AN_INP_3)	±400.0	100.0	%	10	APPL
P06	Corrective offset for 14 bit analog reference 3 (AN_INP_3)	±16383	0	16383=100%	1	APPL
P07	Digital frequency reference value (JOG1)	±100.00	0.00	% f_{MAX}	16383	APPL
P08	Motor potentiometer starting speed	±100.0	2.0	% f_{MAX}	16383	APPL
P09	Filter time constant for analog torque reference value	0.0÷20.0	0.0	ms	10	APPL
P11	NUM – Frequency input slip ratio	±16383	100		1	APPL
P12	DEN – Frequency input slip ratio	0÷16383	100		1	APPL
P15	Logic input I08 digital filter	0.0÷20.0	2.2	ms	10	
P16	Max. motor potentiometer frequency reference value	±105.0	105.0	% f_{MAX}	16383	APPL
P17	Min. motor potentiometer frequency reference value	±105.0	-105.0	% f_{MAX}	16383	APPL
P18	Max. CW frequency reference value limit	±105.0	105.0	% f_{MAX}	4095	4.2.1
P19	Max. CCW frequency reference value limit	±105.0	105.0	% f_{MAX}	4095	4.2.1
P20	Digital potentiometer acceleration time	0.3÷1999.9	50.0	s	10	APPL
P21	CW acceleration time	0.01÷199.99	10.00	s	100	4.2.2
P22	CW deceleration time	0.01÷199.99	10.00	s	100	4.2.2
P23	CCW acceleration time	0.01÷199.99	10.00	s	100	4.2.2
P24	CCW deceleration time	0.01÷199.99	10.00	s	100	4.2.2
P25	Rounded filter time constant	0.1÷20.0	5.0	s	10	4.2.2
P26	Current/power relay cut-in threshold	0.2 ÷ 150.0	100.0	%	4095	COMM
P27	Filter time constant for current/power relay	0.1 ÷ 10.0	1.0	s	10	COMM
P28	Motor demagnetizing time	0 ÷ 3000	10000	0.1 ms	1	4.8.1
P29	Motor magnetizing time	50 ÷ 3000	300	ms	1	4.7.1
P30	Emergency brake deceleration time	0.01÷199.99	10.00	s	100	COMM
P31	KpV frequency regulator proportional gain	0.5÷100.0	15.0		10	4.3
P32	TiV frequency regulator lead time constant	4.0÷1000	100.0	ms	10	4.3
P33	TfV frequency regulator (filter) time constant	0÷25	0.0	ms	10	4.3
P34	Multiplying factor motor voltage	90 ÷ 110	100.0	% $V_{MAX\ MOT}$	10	2.1
P35	Motor slip compensation	0÷20.0	0.0	% f_{MAX}	4095	4.7.2
P36	Stator voltage drop motor compensation (% ΔVRS)	0.0÷400.0	70.0	% P66	4095	4.7.1
P40	Current limit	0 ÷ P103	P103	% $I_{NOM\ AZ}$	4095	4.6.2
P41	Maximum motor torque with full magnetic field	0 ÷ 800.0	400.0	% τ_{NOM}	4095	4.6.1
P42	Maximum torque in the positive direction of rotation	0 ÷ 400.0	400.0	% τ_{NOM}	4095	4.6
P43	Maximum torque in the negative direction of rotation	- 400.0 ÷ 0	- 400.0	% τ_{NOM}	4095	4.6
P44	End speed for frequency PI gain change	0.0÷100.0	0.0	% n_{MAX}	4095	4.3.1
P45	KpV initial frequency PI proportional gain	0.5÷100.0	15.0		10	4.3.1
P46	TiV initial frequency PI lead time constant	4.0÷1000	100.0	ms	10	4.3.1
P47	Frequency threshold for logic output o.16	0÷100.0	2.0		4095	COMM
P48	DC Injection current limit	0÷100.0	100.0	% $I_{NOM\ AZ}$	4095	4.8.4
P49	DC Injection frequency threshold	0÷100.0	0.0	% f_{MAX}	4095	4.8.4
P50	Minimum frequency for relay	0÷100.0	2.0	% f_{MAX}	4095	COMM
P51	Maximum frequency for alarm	0÷125.0	120.0	% f_{MAX}	4095	5.2
P53	**Rated drive current ($I_{NOM\ AZ}$)**	0.0÷400.0		Ampere	10	4.6.1
P54	MONITOR sampling period	1÷19999	1	T_{PWM}	1	SUP
P55	Points memorized after MONITOR trigger	1÷2000	1		1	SUP
P56	MONITOR trigger level	-200.0÷200.0	0.0	%	4095	SUP
P57	% value of 10V for analog output A	100.0÷400.0	200.0	%	10	APPL

P58	% value of 10V for analog output B	100.0÷400.0	200.0	%	10	APPL
P59	Minimum frequency and frequency reached Hysteresis	0.0÷100.0	1.0	% f_{MAX}	4095	
P60	Access key to reserved parameters	0÷19999	P100		1	1.1

1.1.2. List of reserved parameters

PAR	DESCRIPTION	Range	Default value	Normalization unit	Int. rep. base	See
P61	**Rated motor current ($I_{NOM\ MOT}$)**	10.0÷100.0	100.0	% $I_{NOM\ AZ}$	32767	2
P62	**Rated motor voltage ($V_{NOM\ MOT}$)**	100.0÷1000.0	380.0	Volt.	10	2
P63	**Rated motor frequency**	20.0-1000.0	50.0	Hz	10	2
P64	**Rated motor power factor**	0.500÷0.999	0.850		1000	2
P66	Stator resistance voltage drop (ΔVRS)	0.0 ÷ 20.0	4.0	% $V_{NOM\ MOT}$	32767	3.1.1
P68	Maximum motor working frequency (f_{MAX})	20.0÷400.0	100.0	% $f_{NOM\ MOT}$	10	2.1
P69	Maximum motor working voltage ($V_{MAX\ MOT}$)	50.0÷200.0	100.0	% $V_{NOM\ MOT}$	10	2.1
P70	Motor thermal current	10÷110.0	100.0	% $I_{NOM\ MOT}$	10	4.6.2.2
P71	Motor thermal time constant	30÷2400	180	s	1	4.6.2.2
P72	Point 1 voltage of V/f characteristic	0.0 ÷ 100.0	0.0	% $V_{MAX\ MOT}$	4095	2.2
P73	Point 1 frequency of V/f characteristic	0.0 ÷ 94.8	0.0	% $f_{MAX\ MOT}$	4095	2.2
P74	Point 2 voltage of V/f characteristic	0.0 ÷ 100.0	0.0	% $V_{MAX\ MOT}$	4095	2.2
P75	Point 2 frequency of V/f characteristic	0.0 ÷ 94.8	0.0	% $f_{MAX\ MOT}$	4095	2.2
P76	Initial frequency of dead zone 1	0.0 ÷ 100.0	0.0	% $f_{MAX\ MOT}$	4095	4.7.3
P77	Final frequency of dead zone 1	0.0 ÷ 100.0	0.0	% $f_{MAX\ MOT}$	4095	4.7.3
P78	Initial frequency of dead zone 2	0.0 ÷ 100.0	0.0	% $f_{MAX\ MOT}$	4095	4.7.3
P79	Final frequency of dead zone 2	0.0 ÷ 100.0	0.0	% $f_{MAX\ MOT}$	4095	4.7.3
P80	Kpi current limit regulator proportional gain	0.5÷100.0	0.6		10	4.5
P81	Tii current limit regulator lead time constant	0.0÷1000	30.0	ms	10	4.5
P82	Tfi current limit regulator (filter) time constant	0÷25	0.0	ms	10	4.5
P83	Kpc active current regulator proportional gain	0.5÷100.0	0.3		10	4.4
P84	Tic active current regulator lead time constant	0.0÷1000.0	4.0	ms	10	4.4
P85	Tfc active current regulator (filter) time constant	0÷25	0.0	ms	10	4.4
P86	Kp3 Bus control proportional gain	0.05÷10.00	3.50		100	COMM
P87	Main Supply voltage	180.0÷690.0	400	Volt rms	10	
P88	Multiplying factor derivative term active current regulator	0.0÷100.0	100.0	%	32767	4.4
P89	Start frequency motor flying restart	0.0÷100.0	100.0	% f_{MAX}	4095	4.8.2
P90	Minimum target frequency motor flying restart	0.0÷100.0	2.9	% f_{MAX}	4095	4.8.2
P91	Maximum motor temperature (if read with PT100)	0.0÷150.0	130.0	°C	10	COMM
P92	Serial identification number	0÷255	1		1	SERIAL
P93	Serial baud rate	19.2, 38.4, 57.6	19.2	Kbit/s	10	SERIAL
P94	Maximum limit working time	1÷100	30	seconds	1	4.8.3
P95	Motor NTC or PTC resistance value for alarm	0-19999	1500	Ω	1	COMM
P96	Motor thermal logic output 14 cut-in threshold	0.0÷200.0	100.0	%P70	4095	4.6.2.2
P97	Minimum voltage level for forced mains off	0÷800	425	Volt	10	COMM
P98	Voltage reference value in Support 1	220÷850	600	Volt	10	COMM
P99	Access key to TDE parameters	0÷19999	-------		1	1.1
P101	PWM frequency	2500÷16000	5000	Hz	1	
P114	Current in connection tests for reading ΔVRs	0.0÷100.0	50.0	% $I_{NOM\ MOT}$	32767	3.1.1
P128	Flying restart torque limit	0.0÷100.0	5.0	% τ_{NOM}	4095	4.8.2
P151	Xb = cubic radius zone amplitude	0÷50.0	5.0	% $I_{NOM\ AZ}$	16383	3.1.1
P152	Yc = compensation at rated drive current	0÷100.0	100.0	% P102	32767	3.1.1

P153	Xoo = dead zone amplitude	0÷50.0	0.0	% $I_{NOM\ AZ}$	16383	3.1.1
P162	CAN BUS node ID	1÷127	1		1	FIELD
P163	Enable alarms	-100.0÷100.0			16383	
P167	Braking resistance value	1 ÷ 1000	82	Ohm		COMM
P168	Braking resistance Maximum Adiabatic Energy	0.0 ÷ 500.0	4.5	KJoule		COMM
P169	Time to test the Maximum Adiabatic Energy	1 ÷ 30000	2000	ms		COMM
P170	Braking Resistance Maximum Average Power	1 ÷ 30000	150	Watt		COMM
P171	Average Power Filter time constant	1 ÷ 2000	720	s		COMM
P172	Vbus measure filter	0 ÷ 1000	5	R=Tf/Tc		
P173	Maximum delay admitted between 2 byte of the same frame	0 ÷ 19000	32	1/10 ms	1	
P177	DC Bus logic output function o20 threshold	220.0÷1200.0	400.0	Volt	10	

1.1.3. List of TDE MACNO reserved parameters

PAR	DESCRIPTION	Range	Default value	Normalization unit	Int. rep. base	See
P100	Value of access key to reserved parameters	0÷9999			1	1.1
P102	Dead time compensation	0÷100.0	22.0	‰ V max	3276	3.1.1
P103	I drive limit current	0÷800.0	200.0	% $I_{NOM\ AZ}$	4095	4.6.1
P104	Radiator time constant	10.0÷360.0	80.0	Seconds	10	4.6.1
P105	Corrective factor for Bus voltage	80.0÷120.0	100.0	%	10	
P106	Minimum voltage of DC Bus	220.0÷1200.0	400.0	Volt	10	COMM
P107	Maximum voltage of DC Bus	300.0÷1200.0	760.0	Volt	10	COMM
P108	Bus voltage threshold for brake ON	300.0÷1200.0	730.0	Volt	10	COMM
P109	Bus voltage threshold for brake OFF	300.0÷1200.0	710.0	Volt	10	COMM
P110	Offset A/D 1	-100.0÷100.0	0.0	% Vmax	32767	
P111	Offset A/D 2	-100.0÷100.0	0.0	% Vmax	32767	
P112	Display screensaver cut-in time	3÷20	10	Seconds	1	TAST
P113	Maximum drive current	0÷900.0	0	Ampere	10	4.6.1
P115	Multiplying factor for motor PTC/NTC/PT100 analog reference value	0.0÷200.0	100.0		16383	COMM
P116	Junction time constant	0.1÷10.0	3.5	Seconds	10	4.6.1
P117	Multiplying factor for radiator PTC/NTC analog reference value	0.0÷200.0	100.0		16383	COMM
P118	Max. temperature permitted by radiator PTC/NTC	0.0÷150.0	100.0	°C	10	COMM
P119	Max. temperature permitted by radiator PTC/NTC for start-up	0.0÷150.0	75.0	°C	10	COMM
P120	Radiator temperature threshold for logic output o.15	0.0÷150.0	90.0	°C	10	COMM
P121	Maximum static voltage module Vs	0.0÷100.0	97.5	% P122	32767	
P122	Maximum modulation index	0.500÷0.995	0.98		1000	
P123	Smart brake voltage cut-in level	300.0÷850.0	750.0	Volt	10	COMM
P124	Slip compensation filter time constant	0.0÷150.0	35.0	ms	10	4.7.2
P125	Ta Energy saving lead time constant	100÷2000	400	ms	1	4.8.5
P126	Energy saving minimum flux admitted	0.0÷100.0	20.0	%		4.8.5
P127	Over-current A2 alarm filter time constant	2.0÷150.0	10.0	ms		5.2
P154	Soft start enabling time	150÷19999	250	ms	1	COMM
P155	Ambient temperature reference value during overload	0.0÷150.0	40.0	°C	10	4.6.2.1
P156	PWM frequency for drive definition	2500÷16000	5000	Hz	1	
P157	Dead time amplitude	3.0÷10.0	4.0	usec	10	
P174	Main Supply voltage for drive definition	180.0÷690.0	400	Volt rms	10	

P175	Hardware dead time	0.0÷10.0	0.0	usec	10	
P176	IGBT command minimum pulse	0.0÷10.0	0.0	usec	10	

1.1.4. Reserved parameters for specific applications

The parameters ranging from **P180** to **P199** are available for specific applications and other 100 parameters. See the specific applications file for their meaning.

1.2. Connections

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

1.2.1. Free connections

CON	DESCRIPTION	Range	Default value	Default meaning	See
C00	Automatic display of internal values	0÷63	21	Speed	TAST
C14	Choose TRIGGER type 0 ≤ inputs 1 = 1st alarm 2...63= analog value	-31÷63	0	Trigger on Run	SUP
C15	Meaning of programmable analog output 1	-63÷64	11	Current module	APPL
C16	Meaning of programmable analog output 2	-63÷64	4	Rotation frequency	APPL
C20	Load final digital potentiometer reference value	0.1	0		APPL
C21	Run software	0.1	1	Run sw enabled	COMM
C22	Enable 14 bit analog reference value A.I.1	0.1	0		APPL
C23	Enable 14 bit analog reference value A.I.2	0.1	0		APPL
C24	Enable JOG digital frequency reference value (P7)	0.1	0		APPL
C25	Enable digital potentiometer frequency reference value	0.1	0		APPL
C26	Enable linear ramp	0.1	1	Ramps enabled	4.2.2
C27	Rounded ramp	0.1	0		4.2.2
C28	Stop with minimum speed	0.1	0		COMM
C29	Drive software enable	0.1	1	sw enabled	COMM
C30	Reset alarms	0.1	0		COMM
C31	Enable 14 bit analog reference value A.I.3	0.1	0		APPL
C32	Motor thermal switch → Block drive ?	0.1	1	Alarm A5 on ther. swtch	4.6.2.2
C33	Choose thermal curve	0÷3	0	Assisted ventilation	4.6.2.2
C34	Managing mains failure 0 = trying to work; 1 = recovery; 2= free; 3= emergency brake	0÷3	0	Trying to work on mains failure	COMM
C35	Automatic alarm reset when mains back on	0.1	0		COMM
C36	Invert reference signal software	0.1	0		4.2.1
C37	Enable power soft start	0.1	1	Enabled	COMM
C38	Enable frequency dead-zones 0 = disable; 1 = zone 1 ; 2= zone 1 and 2	0÷2	0		4.7.3
C39	Choose pulses\rev. FREQUENCY INPUT	0÷9	5	1024 impulses/rev.	APPL
C40	Enable that drive in current or torque limit for a long time causes stall alarm A7	0.1	1		4.8.3
C43	Enable frequency reference in frequency	0.1	0		APPL
C47	Enable smart brake	0.1	0		COMM
C53	Enable locked RUN	0.1	0		APPL

C55	Choose value for current relay 0 = $\lvert I \rvert / I_{NOM\ MOT}$ 1 = $I\tau / I\tau_{NOM}$ 2 = P / P_{NOM}	0÷2	0	Current module	COMM
C58	Reset CAPTURE monitor	0.1	0		SUP
C61	Read default parameters	0.1	0		COMM
C63	Save parameters in permanent memory (FLASH)	0.1	0		COMM
C66	Intervention edge monitor TRIGGER 0 = up ; 1 = down	0.1	0	Raising edge	SUP

1.2.2. Reserved connections

CON	DESCRIPTION	Range	Default value	Default meaning	See
C01	Meaning of logic input 1	-1÷63	8	Reset alarms	APPL
C02	Meaning of logic input 2	-1÷63	2	External enable	APPL
C03	Meaning of logic input 3	-1÷63	3	Enable ref. A.I.1	APPL
C04	Meaning of logic input 4	-1÷63	0	Run	APPL
C05	Meaning of logic input 5	-1÷63	4	Enable ref. A.I.2	APPL
C06	Meaning of logic input 6	-1÷63	12	Towards CW/CCW	APPL
C07	Meaning of logic input 7	-1÷63	5	Enable JOG	APPL
C08	Meaning of logic input 8	-1÷63	22	Enable ramps	APPL
C09	Frequency input setting: 1 = digital encoder; 2=digital f/s	1÷2	1	2-channel Encoder	APPL
C10	Meaning of logic output 1	-32÷31	3	Run	APPL
C11	Meaning of logic output 2	-32÷31	0	Drive ready	APPL
C12	Meaning of logic output 3	-32÷31	6	End of ramp	APPL
C13	Meaning of logic output 4	-32÷31	2	Frequency above minimum	APPL
C17	Meaning of 14 bit analog input A.I.1 0 = frequency ref. 1 = torque ref. 2 = torque limit ref.	0÷2	0	Frequency reference value	APPL
C18	Meaning of analog input A.I.2 14 bit 0 = frequency ref. 1 = torque ref. 2 = torque limit ref.	0÷2	1	Torque reference value	APPL
C19	Meaning of analog input A.I.3 14 bit 0 = frequency ref. 1 = torque ref. 2 = torque limit ref.	0÷2	2	Torque limit ref. value	APPL
C42	Enable auto-tuning	0÷1	0		
C46	Enable motor thermal probe management 0=no 1=PT100 2=PTC 3=NTC 4=I23	0÷4	2	Motor PTC enabled	COMM
C48	Configuration CAN Bus BAUD RATE 0=1M 1=800K 2=500K 3 =250K 4=125K 5=50K 6=20K 7=10K	0÷7	0	1 Mbit/s	FIELD
C49	Enable DC Injection	0,1	0		4.8.4
C50	Enable motor flying restart	0÷4	0		4.8.2
C51	Enable open loop control	0,1	0		
C52	Enable FIELD-BUS reference values	0.1	0		APPL
C54	Enable Energy Saving	0,1	0		4.8.5
C56	Type of overload 0=120%×30″; 1=150%× 30”; 2=200%× 30″; 3=200%× 3″+155%×30″	0÷3	3	200%× 3″+155%×30″	4.6.1
C57	Enable radiator heat probe management 0=no 1=PTC modulo 2=NTC new 3=NTC inverter 4=Tyco	0÷4	1	Radiator probe enabled	COMM
C60	Parameter bank active	0.1	0		COMM
C62	Read parameters from permanent memory	0.1	0		COMM
C64	Enable current control	0.1	0		4.1
C71	Enable bypass flux angle – frequency input	0,1	0		
C72	Enable Braking Resistance Thermal Protection	0,1	0		COMM

C73	Enable Safety STOP only like signaling	0,1	0		COMM
C76	Invert positive speed rotation	0,1	0		4.2.1

1.2.3. Reserved connections TDE MACNO

CON	DESCRIPTION	Range	Default value	Default meaning	See
C44	Reset alarm counters and save serial number	0.1	0		
C45	Rectification bridge 0 = diodes 1 = semicontrolled	0.1	0	Diode bridge	COMM
C80	Enable PWM frequency divided by 2	0,1	0		

1.2.4. Reserved connections for specific applications

The connections ranging from **C90** to **C99** are available for specific applications. See the specific application file for their meaning.

1.3. Input logic functions

The input logic functions are commands that come from configured terminal board logic inputs, from the serial line, and from the fieldbus.

INPUT LOGIC FUNCTIONS		DEFAULT INPUT	DEFAULT STATUS	See
I00	Run Command	4	L	COMM
I01	Torque control		L	4.1
I02	External enable	2	H	COMM
I03	Enable 14 bit analog reference value A.I.1.	3	L	APPL
I04	Enable 14 bit analog reference value A.I.2.	5	L	APPL
I05	Enable frequency jog	7	L	APPL
I06	Enable digital potentiometer frequency reference value		L	APPL
I07	Enable 14 bit analog reference value A.I.3.		L	APPL
I08	Reset alarms	1	L	COMM
I09	Digital potentiometer UP		L	APPL
I10	Digital potentiometer DOWN		L	APPL
I11	Load final digital potentiometer value		L	APPL
I12	Invert frequency reference value	6	L	4.2.1
I13	Enable power soft start		H	COMM
I14	Enable FIELD-BUS reference values		L	APPL
I15				
I16	Enable second parameter bank		L	COMM
I17				
I18				
I19	Enable frequency reference in frequency		L	APPL
I20				
I21	STOP command (locked run)		L	APPL
I22	Enable linear ramps	8	L	4.2.2
I23	Motor thermo-switch		L	COMM
I29	--- Reserved for specific applications ----			
I63	See specific application file			

1.4. Internal values

Internal values are variables within the drive that can be shown on the display or via serial on the supervisor. They are also available from the fieldbus.
Pay close attention to the internal representation base of these values as it is important if readings are made via serial line or fieldbus.

INT	DESCRIPTION	UNIT	Int. rep. base
d00	Software version		256
d01	Active power delivered	KWatt	16
d02	Frequency reference value before ramp	% f_{MAX}	4095
d03	Frequency reference value after ramp	% f_{MAX}	4095
d04	Frequency controlled	% f_{MAX}	4095
d05	Torque produced	% $C_{NOM\ MOT}$	4095
d07	Request torque current Iq rif	% $C_{NOM\ MOT}$	4095
d10	Torque reference value (application generated)	% $C_{NOM\ MOT}$	4095
d11	Current module	A rms	16
d12	14 bit analog frequency reference value	% f_{MAX}	4095
d14	Frequency reference in frequency (application generated)	% f_{MAX}	4095
d15	Active current component ($I \cdot \cos\varphi$)	% $I_{NOM\ AZ}$	4095
d16	Reactive current component ($I \cdot \text{sen}\varphi$)	% $I_{NOM\ AZ}$	4095
d17	Stator voltage reference value module	Volt rms	16
d18	Stator voltage reference value module	% $V_{NOM\ MOT}$	4095
d19	Modulation index	assoluto	4095
d21	Working motor frequency	Hz	1
d22	Maximum drive current	% $I_{NOM\ AZ}$	4095
d23	Current limitation loop output	% $V_{MAX\ MOT}$	4095
d24	Bus voltage	Volt	16
d25	Radiator temperature reading	°C	16
d26	Motor temperature reading (if C46=1, PT100 present) NTC/PTC resistor (if C46=2 or 3, PTC/NTC present)	°C Ω	16
d27	Rotor flux	% ϕ_{NOM}	4095
d28	Motor thermal current	% alarm threshold A6	4095
d29	Maximum active current admitted	% $I_{NOM\ AZ}$	4095
d30	Maximum torque CW	% $C_{NOM\ MOT}$	4095
d31	Maximum torque CCW	% $C_{NOM\ MOT}$	4095
d32	Maximum torque limit (application generated)	% $C_{NOM\ MOT}$	4095
d33	Frequency reference value as a percentage (application generated)	% f_{MAX}	4095
d38	Braking Resistance Average Power Dissipated	Watt	1
d39	Adiabatic Energy Dissipated in the measure period	KJoule	32
d47	OD firmware version		1
d48	OPEN DRIVE serial number		1
d49	Alarm code		1
d50 ÷ d60	----- Reserved for application ----- See application file		
d61	Application code		4095
d62	Code of firmware-managed sensor		1
d63	Code of hardware-managed sensor		1

1.5. Output logic functions

The logic functions display drive status and can be assigned to one of the 4 logic outputs. See the chapter in the applications file for an explanation of their configuration.

		OUTPUT LOGIC FUNCTIONS	DEFAULT OUTPUT	See
o	00	Drive ready	2	COMM
o	01	Motor thermal alarm		4.6.2.2
o	02	Frequency exceeds minimum	4	
o	03	Drive running	1	COMM
o	04	CW / CCW		4.2.1
o	05	Current/torque relay		COMM
o	06	End of ramp	3	4.2.2
o	07	Drive at current limit		
o	08	Drive at torque limit		
o	09	Motor in stall		4.8.3
o	10	Power Soft start active		COMM
o	11	Braking active		COMM
o	12	No mains power		COMM
o	13	Bus regeneration enabled (Support 1)		COMM
o	14	Motor thermal current exceeds threshold (P96)		4.6.2.2
o	15	Radiator overheating (higher than P120 threshold)		COMM
o	16	Frequency reached (absolute value higher than P47)		
o	17	Power electronic card not supplied		COMM
o	19	Regulation card supplied and DSP not in reset state		
o	20	DC Bus exceeds threshold (P177)		
o o	21 31	----- Reserved for specific applications ----- See specific application file		

1.6. List of alarms

Hereunder is a list of all the alarms managed. Some alarms have more than one meaning; if these are triggered check internal value d49 to establish the cause.

ALARMS		Code d49
A0	Failed attempt to save data in EEPROM	
A1	EEPROM contains altered data	
A2	Over-current software alarm	
A3	Power fault	
A4	Radiator thermal alarm	0 = radiator temperature too high 1 = Braking Resistance Instantaneous Power 2 = Braking Resistance Average Power
A5	Motor thermal alarm	
A6	Motor thermal switch	
A7	Motor in stall	
A8	External alarm	
A9	Over- frequency	
A10	Minimum power circuit voltage	
A11	Power circuit over-voltage	
A12	Internal alarm	0 = C29 ≠ 1 1 = Run command without power soft start 2 = Run command with trad > P119

A13	Soft start not enabled	0 = power soft start problems 1 = Safe Torque Off
A14	Auto-tuning test unfinished	
A15	Auto-tuning failed	1 = Current too low (is the motor connected?) 2 = Dead time compensation term too high 3 = Voltage resistance drop too high

1.7. List of internal values for monitors and analog outputs

Hereunder is a list of the internal values that can be monitored via the analog outputs or via the Supervisor's monitor.

INTERNAL VALUES		NORMALIZ.	BASE
o00	Rotoric flux angular position (alfa_fi)	100%=180°	32767
o01	Frequency reference in input to V/f characteristic	% f_{MAX}	4095
o02	Frequency reference value before ramp	% f_{MAX}	4095
o03	Frequency reference value after ramp	% f_{MAX}	4095
o04	Working frequency filtered	% f_{MAX}	4095
o05	Torque request	% $C_{NOM\ MOT}$	4095
o06	Internal value: ***status*** (MONITOR only)		
o07	Torque produced	% $C_{NOM\ MOT}$	4095
o09	Request voltage in output from V/f characteristic	% $V_{MAX\ MOT}$	4095
o10	Internal value: ***alarms*** (MONITOR only)		
o11	Current module	% $I_{NOM\ AZ}$	4095
o13	U phase current reading	% $I_{MAX\ AZ}$	4095
o14	Internal value: ***inputs*** (MONITOR only)		
o15	Active current component ($I \cdot \cos\varphi$)	% $I_{NOM\ AZ}$	4095
o16	Reactive current component ($I \cdot \text{sen}\varphi$)	% $I_{NOM\ AZ}$	4095
o17	U phase voltage duty-cycle		32767
o18	Stator voltage reference value module	% $V_{MAX\ MOT}$	4095
o19	Modulation index	0 ⇔ 1	4095
o20	Request Q axis voltage (Vq_rif)	% V_{NOM}	4095
o21	Delivered power	% P_{NOM}	4095
o22	Request D axis voltage (Vd_rif)	% $V_{MAX\ MOT}$	4095
o23	Current limitation loop output	% $V_{MAX\ MOT}$	4095
o24	Bus voltage	100%=900V	4095
o25	Radiator temperature reading	% 37,6°	4095
o26	Motor temperature reading	% 80°	4095
o27	Active current limit	% $I_{NOM\ AZ}$	4095
o28	Motor thermal current	% alarm threshold A6	4095
o29	Current limit	% $I_{MAX\ AZ}$	4095
o30	CW maximum torque	% $C_{NOM\ MOT}$	4095
o31	CCW maximum torque	% $C_{NOM\ MOT}$	4095
o32	Internal value: ***outputs*** (MONITOR only)		
o33	Internal value: **inputs_*hw*** (MONITOR only)		
o34	V phase current reading	% $I_{MAX\ AZ}$	4095
o35	W phase current reading	% $I_{MAX\ AZ}$	4095
o36	Torque limit imposed by current limit	% $C_{NOM\ MOT}$	4095
o37	Analog input A.I.1	100%=16383	16383
o38	Analog input A.I.2	100%=16383	16383
o39	Analog input A.I.3	100%=16383	16383
o41	Overall frequency reference value (f_somma_tot)	% f_{MAX}	4095
o42	Overall torque reference value (t_rif) from application	% $C_{NOM\ MOT}$	4095
o43	Overall torque limit reference value (limit_i_aux)	% $C_{NOM\ MOT}$	4095
o44	Frequency reference in frequency from application (theta_prec)	Electrical pulses per T_{PWM}	

o45	Rotor flux	% ϕ_{NOM}	4095
o46	Maximum torque imposed by Maximum motor torque (P41)	% $C_{NOM\ MOT}$	4095
o49	Working frequency not filtered	% f_{MAX}	4095
o50	Delta pulses read in PWM period in frequency input	Pulses per PWM	
o53 ÷ o63	----- Reserved for specific applications ----- See specific application file		

2. Setting basic parameters

Setting the parameters that establish the exact type of motor used is important if the drive is to run correctly. These parameters are:

P61	Rated motor current as a % of the rated drive current
P62	Rated motor voltage in Volt
P63	Rated motor frequency in Hertz
P67	Rated motor power factor

These parameters are fundamental in that they are the basis of all the motor operating characteristics: frequency, speed, voltage, current, torque and thermal protection.
P62 and P63 can be read directly on the motor rating plate and P61 can be calculated with the following formula:

P61 = (Inom_motor *100.0))/(Inom_drive)

Example: Drive: OPEN 22 Inom_drive = 22A overload 200%
Motor: MEC series, P = 10.2 KW, Vn = 380V, f = 50Hz, Inom_motore = 20A, cosφ = 0.85

P61 = (20*100)/22 = 90.9%
P62 = 380.0
P63 = 50.0
P64 = 0.85

If the motor power factor is unknown but in the motor plate are written the rated power and the efficiency (usually 0.85 – 0.93 for motors from 7.5 to 55Kw, for example η = 0.92), it is possible to calculate P64 with the following equation:

P64 = cosφ = (P*1000)/(η*√3*Vn*In) = (10.2*1000)/(0.914*√3*380*20) = 0.85

Default parameters correspond to a motor with rated voltage 380V, rated current equal to rated drive current (22A for OPEN 22), rated frequency 50Hz and power factor 0.85.

2.1. Setting of maximum working frequency and voltage

The maximum working frequency (correspond to 100% of frequency reference) is set, referred to rated motor frequency (P63), with the following formula:

P68 = (fmax_work *100.0) / P63

Example. P63 = 50 Hz, f max_work = 60Hz P68 = 60*100.0/50 = 120.0%

Default value is P68 = 100.0% so f max_work = P63

The maximum working voltage is set with reference to the rated motor voltage (P62) using the following formula:

P69 = (Vmax_work *100.0) / P62

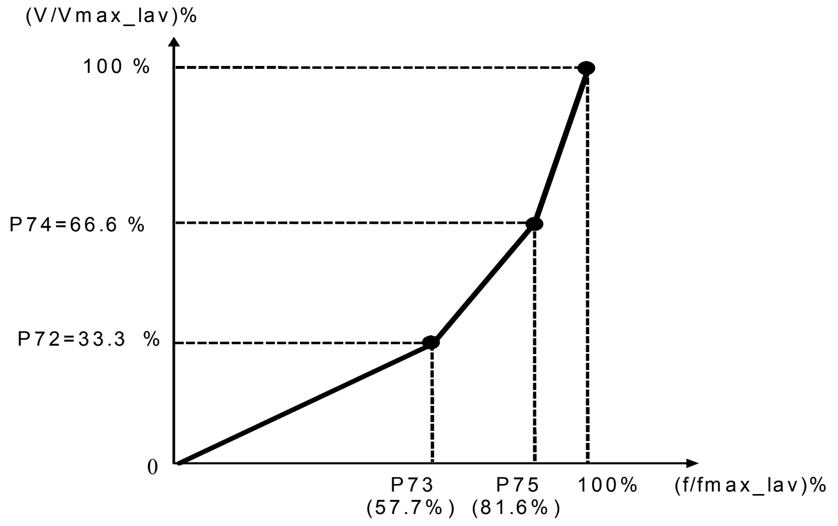
Example. P62 = 380 V Vmax_work = 440V P69 = 440*100.0/380 = 115.7%

When the drive is running (on-line), by using **P34** it is possible to correct the working voltage according to the ratio P34/100.

With the default values P68 , P69 and P34 , the maximum working values correspond to the motor's rated frequency and voltage set in P63 and P62.

2.2. Setting of working Voltage/frequency characteristic

Using the parameters **P72** , **P73** , **P74** and **P75** it is possible to define a three-section working curve by points (so as to be better able to adjust to the desired characteristics).
Points P73 and P75 define the frequency percentage with reference to the maximum working frequency (P68) while points P72 and P74 define the percentage voltage with reference to the maximum working voltage (P69).
The following curve should clarify the explanation.



"TYPICAL CURVE WITH QUADRATIC TORQUE LOAD"

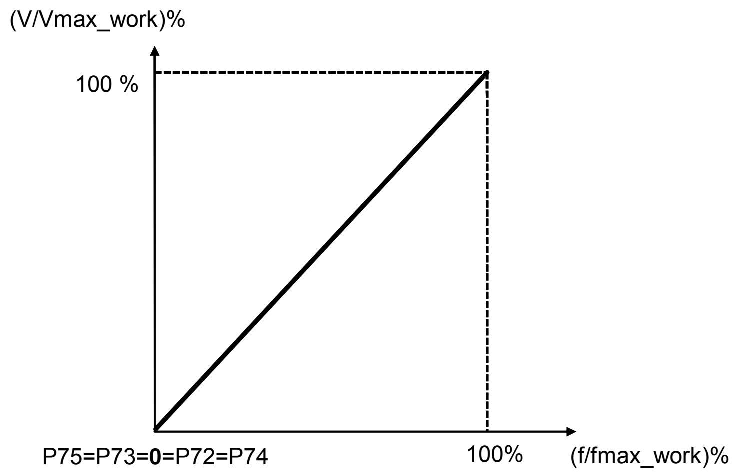
If a number of points which is less than two is sufficient to define the curve just program at 0 the frequencies of the points which are not used (P73 and/or P75), so that they will not be considered in the interpolation.

There are some limitations on setting the characteristic:

- Frequencies (P73 and P75) must be in rising order and the distance between two adjacent points must be grater than 5%
- Corresponding voltages (P72 and P74) must be in rising order

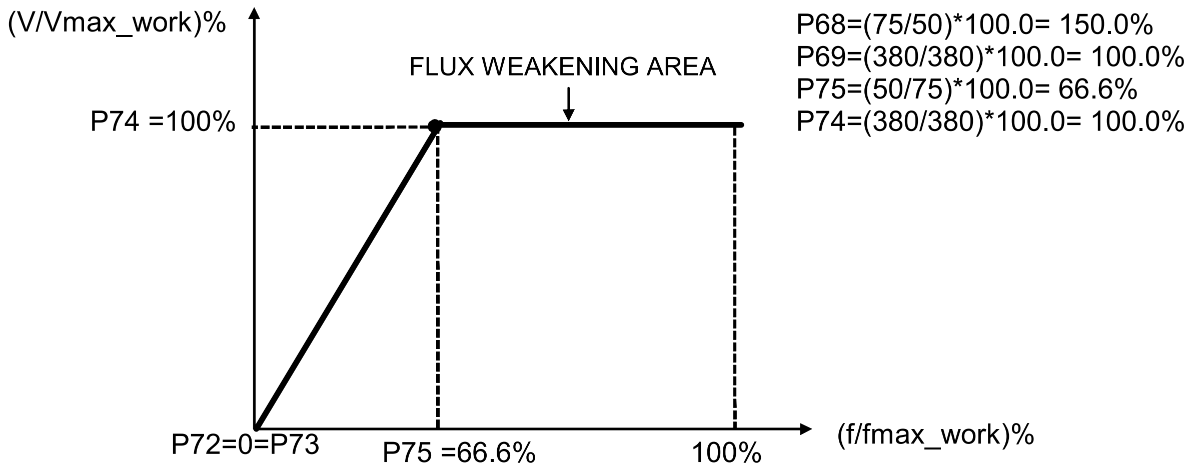
If this limitations are not respected the system doesn't take in account the point whose component was set wrongly and it is cleared to 0. Every time one of this parameters (from P72 to P75) is changed, it is better to verify if the system has accepted the new value.

A linear type Voltage-Frequency characteristic is provided for the default for which P72=P73=P74=P75=0.



"STANDARD CURVE FOR A MOTOR WORKING IN CONSTANT TORQUE IN ALL ITS CHARACTERISTICS

As an example we calculate the settings of the parameters in the case of a motor with a rated voltage of 380 Volts and a frequency of 50 Hz, which we want to work at full flux up to 50 Hz and a constant voltage from 50 Hz to 75 Hz.
Having traced the desired voltage-frequency we see that to program it is sufficient to use only one section point (see diagram).
From the maximum working frequency desired (75Hz) and from the maximum working voltage (380V) we calculate P68 and P69 in relation to the rated frequency and voltage and then we can calculate the P74 and P75 values with reference to the maximum values, while P72 and P73 will remain at 0.

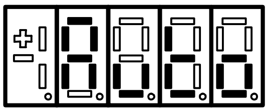


"CURVE FOR MOTOR WORKING ALSO IN FLUX WEAKENING AREA"

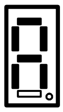
3. Auto-tuning procedures

3.1.1. Reading stator drop and dead time compensation

This test establishes the voltage drop caused by the stator resistor and the IGBT. It also estimates the signal amplitude required to compensate the effects of the dead times so that the internal representation base of the stator voltage and the one actually generated match.
Connection **C42** is used to enable this test, if it is set to 1 (after that reserved parameter key is open with P60=95), the display shows:



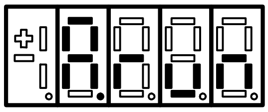
display



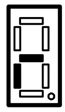
7 segments

The drive is ready to start the test, to begin the measures gives the RUN command using the corresponding digital input or with connection C21 (commands in series)

Once the test has started this setting will appear:

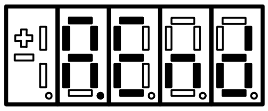


display

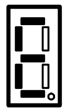


7 segments

The test is successful if this setting appears alongside and the drive does not trigger an alarm.



display



7 segments

Now disable RUN command by clearing the corresponding digital input to 0 or C21,

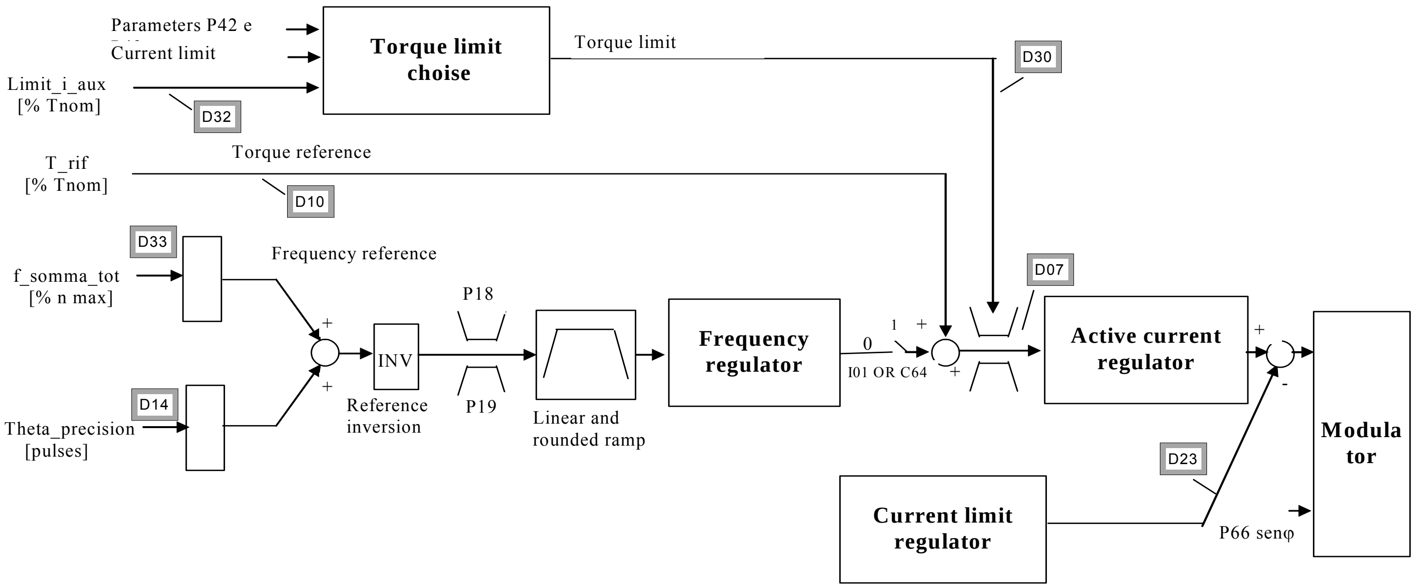
<u>The tests may be halted at any moment by disabling RUN</u>; the drive will trigger an alarm (A7) but any results will be saved.
Once C42≠0 has been set again, the default values of the parameters being tested will be automatically reloaded.

This test modifies the following parameters:

P76	ΔV_{RS} Voltage drop due to stator resistor and IGBT at the rated motor current as a % of the rated motor voltage
1P02	Dead-time compensation

4. Regulation

The regulation system consists of a frequency regulation loop and a current limit control.
All the loops are controlled by integral proportional regulators with an error signal filter and work with normalized signals so that the regulation constants are as independent as possible from the size of the motor in relation to the drive and from the system mechanics.



The following paragraphs analyse each regulation block in detail.

4.1. Choosing control type: frequency or torque

Regulation controls frequency by default; here the application manages the frequency reference values, and the torque request is used as a reference value added to the frequency regulator output (feed-forward).

Torque control can be enabled on its own by setting function **I01** "**Torque control**" to high logic level or by setting **C64=1**. In this case, only the torque request generated by the application will be considered as long as it is within the admitted torque limits.

NB: Keep attention that torque control is very critical if the steady state working frequency is lower than 1 Hz: in that case it's recommended do not use it.

4.2. Managing frequency reference values

The application generates two frequency reference values:

- One ("f_somma_tot") is a percentage of the maximum frequency (set in parameter P68) displayed in internal value d33 and on monitor o41.
- The other ("theta_precision") is pulses for a period of PWM. Internal normalization is done with 65536 pulses per electrical revolution.

After these two reference values have been processed they are added together in order to obtain the total frequency reference value.

4.2.1. Inverting and limiting frequency reference values

Logic function **I12** "**Frequency reference value inversion**", which is assigned to an input (the default is input 6), or connection **C36** are used to invert the reference value according to the following logic (OR-exclusive):

I12 = 0	C36 = 0	Reference value not inverted (default values)
I12 = 1	C36 = 0	Reference value inverted
I12 = 0	C36 = 1	Reference value inverted
I12 = 1	C36 = 1	Reference value not inverted

The reference value is inverted before the ramp thus, if the ramp is not disabled, the direction of rotation changes gradually (default C36=0 and I12=0).

There is another chance, to invert positive speed rotation setting **C76=1**.
Enabling this function, with the same frequency reference the motor rotates in reverse direction.

Parameters P18 and P19 are used to limit the total reference value within a range set between these two values; P18 is the maximum limit (positive frequency) and P19 is the minimum limit (negative frequency). These two parameters may be set at a range from ±105%, thus special settings may be used to limit operation within the 2 quadrants or within just one quadrant.
The following settings are provided by way of example:

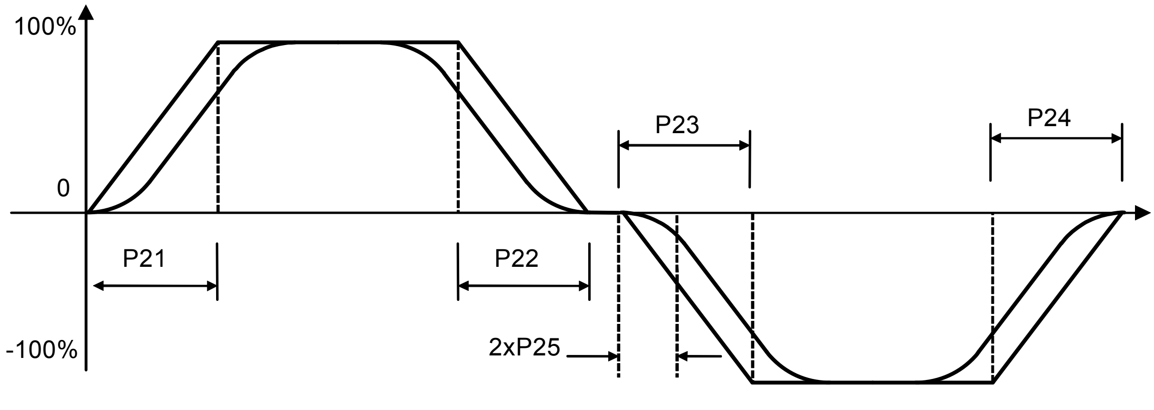
P18 = 100.0%	P19 = 100.0%	-100.0% < frequency reference value < 100%
P18 = 30.0%	P19 = 20.0%	-20.0% < frequency reference value < 30%
P18 = 80.0%	P19 = -20.0%	20.0% < frequency reference value < 80.0%
P18 = -30.0%	P19 = 60.0%	-60.0% < frequency reference value < -30.0%

4.2.2. Linear and rounded ramps

By default (**C26=1**) the frequency reference value passes across a ramp circuit that graduates its variations before it is used. Parameters **P21, P22, P23** and **P24** can be used to establish independent acceleration and deceleration slopes in both directions of movement, establishing the time required to pass from 0 to 100% in seconds. In particular (see diagram):

P21 sets the time the reference value requires to accelerate from 0 to +100%
P22 sets the time the reference value requires to decelerate from 100% to 0%
P23 sets the time the reference value requires to accelerate from 0% to -100%
P24 sets the time the reference value requires to decelerate from -100% to 0%

Setting sensitivity is 10 msec and the time must be between 0.01 and 199.99 seconds.
The default values are the same for all the parameters and are equal to 10 sec.
Ramps can be enabled via a configurable logic input (**I22**) which works parallel to connection C26: I22=H is the same as setting C26=1. This input ensures maximum flexibility in ramp use in that the ramps are enabled only when required.
The ramp may also be rounded in the starting and finishing phases by setting **C27=1** via the rounding time set in seconds in **P25** with resolution 0.1 sec and a range from 1 to 199.9 sec. (default 10 sec).



Rounding can be enabled on its own with C27=1, which will filter the overall frequency reference value only.

Some special applications may enable the linear ramps differently. See the respective instruction file for further information.

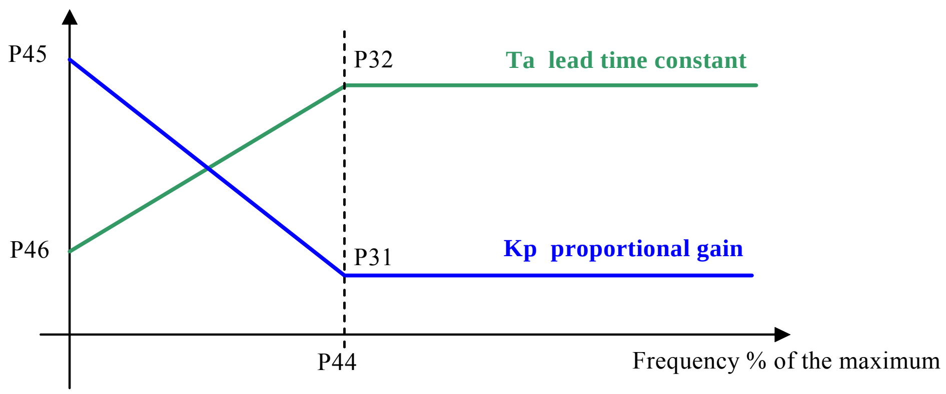
4.3. Frequency regulator

The frequency regulator generates the request for active current needed to maintain the rotation frequency the same as the reference frequency value.
The frequency is normalized in relation to the maximum operating frequency and is displayed as a percentage: D3 is the frequency percentage reference value, D4 is the measured frequency percentage while the operating frequency value is displayed in Hz in D13.
The frequency regulator constants are set in engineering units by parameters **P31**, proportional gain Kp; **P32**, time in ms of the lead time constant Ta equal to the time constant of the integral regulator multiplied by the gain (Ta = Ti*Kp); **P33**, 1st order filter constant Tf in ms.

The default values of such constants are calculated to ensure stability under almost all conditions, however if the machine were to be rather too jumpy it is sufficient just to act on P31 to reduce the gain until stable, or alternatively to increase the gain if the regulator were to be too slow.

4.3.1. Variable frequency regulator gains

Frequency regulator gains can be varied according to actual frequency: **P45** is the proportional gain at zero frequency and **P46** is the initial lead time constant. Setting **P44** (a percentage of the maximum frequency) with the end variation gain frequency establishes a linear gain variation that ranges from the initial values (P45 and P46) to the final values in P31and P32. Setting P44=0.0 disables this function so that the gains set in P31 and P32 are used.



4.4. Active current regulation

Active current regulator protects the mechanical system limiting the maximum torque gives to the motor within maximum limits arranged.
The torque signal is get from measured active motor current normalized to the product In * cos φ (**P61*P64**) so there is 100% of torque when the active current measured is equal to its rated value multiply to the rated power factor (cos φ).
Due to stator voltage drop that alters the active current measured, also if there is a compensation of this drop with **P36**, the torque signal can be correctly estimated only with working frequency greater than 1 Hz.
The current signals processed by these regulators are expressed according to the maximum drive current, which means that they are affected by the ratio between the rated motor current and the rated drive current (P61). To ensure good control, this ratio should not drop below 35 - 40% i.e. <u>Do not use a drive that is more than two and a half times larger than the motor, nor a motor that is more than one and a half times larger than the drive.</u>
With this limitation and with standard motors, the active current regulator default parameters **P83**, (proportional gain) **P84**, (time in ms of the lead time constant) and **P88** (derivative term) ensure stability; however if there are high frequency vibrations it is sufficient to reduce **P83** from 0.3 (default value) to 0.1.

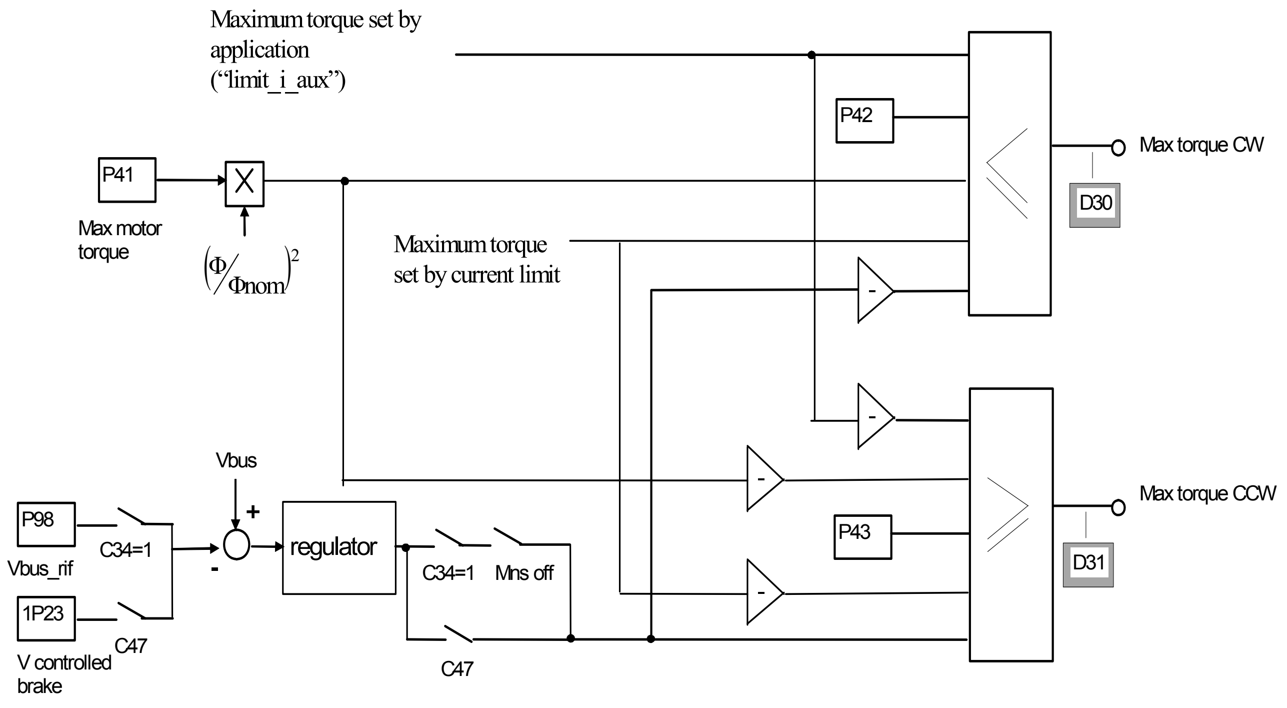
4.5. Current limit regulation

There is another regulation loop that limits the reactive current if it exceeds the admitted limit (shown in **d22**) reducing the stator voltage.
The current limit regulator constants are set in engineering units by parameters **P80**, proportional gain Kp; **P81**, time in ms of the lead time constant Ta equal to the time constant of the integral regulator multiplied by the gain (Ta = Ti*Kp); **P82**, 1st order filter constant Tf in ms. It's possible to see the regulator output in the internal value **d23** and monitor **23**.

4.6. Choosing the active torque limit

The positive and negative torque limits are chosen to restrict the following values:

- P42 / P43 = maximum torque, in both directions according to rated torque;
- Maximum torque linked to maximum motor torque according to the rated torque (parameter **P41**);
- Maximum torque set by the current limit;
- Maximum torque limit reference value generated by the application ("limit_i_aux");
- Maximum torque limited by the regulator output in order to back up the bus voltage should the mains fail (as long as this function is enabled by setting **C34=1**);
- Maximum torque controlled in the startup phase with the motor magnetized;
- Maximum torque limited in the controlled brake phase (as long as this function is enabled by setting **C47=1**).



The following paragraphs analyse the existing torque limits in detail.

4.6.1. Maximum motor torque limit

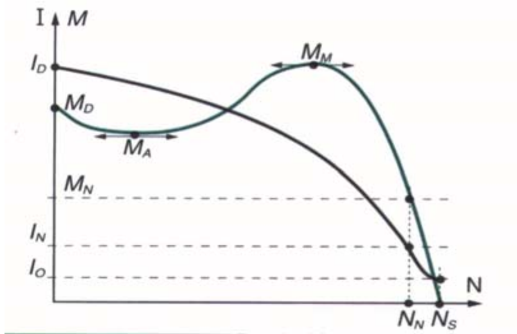
The induction motor has a maximum torque that depends on its construction characteristics.
The graph below illustrates the progress of a torque curve according to speed with the motor powered by a constant frequency (Ns). The same graph can also be referred to when an inverter is used, reading it as torque delivered according to slip, i.e. the difference between the rotation speed of the electrical values and the rotor (Ns – N in the graph).

3-phase induction motor torque (M) and current (I) curve according to number of revolutions (N).

Id = starting current
In = rated current
Io = no-load current

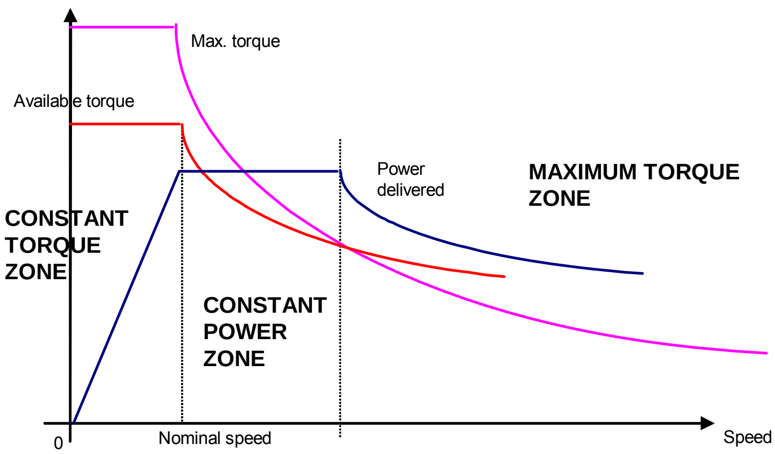
Md = starting torque
Ma = acceleration torque
Mm = max. torque
Mn = rated torque

Nn = rated speed
Ns = synchronism speed



The graph illustrates how the delivered torque increases according to slip up to a certain point represented by the maximum motor torque. If the maximum torque is exceeded, control is lost in that the torque decreases even when the current is increased.
<u>It is proved that the maximum motor torque decreases during flux weakening in proportion to the square of the ϕ/ϕnom ratio</u>. Thus the motor has three working areas:

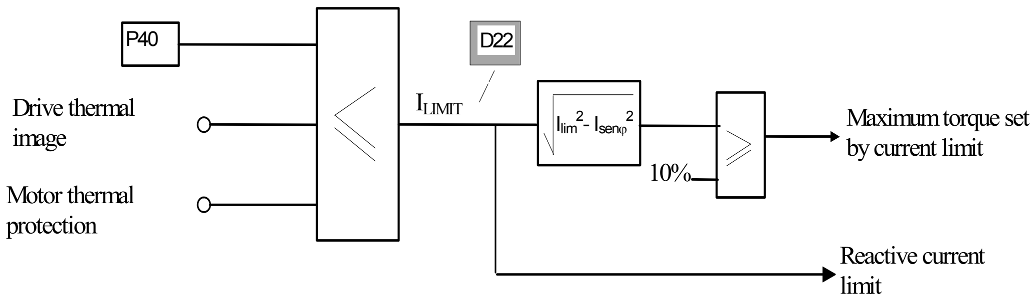
- **Constant torque**: the maximum torque is available up to the rated speed (as long as the current to deliver it is available);
- **Constant power**: over the rated speed, flux is reduced proportionally to speed, the available torque also drops in proportion to speed, the power delivered is constant;
- **Maximum torque**: after reaching the maximum torque, which decreases with the square of the speed, the available torque will start to drop with the square of the speed and the power delivered will decrease in proportion to the speed.



To ensure regulation stability, P41 must be set with the Maximum torque divided by Rated motor torque. This limit will decrease during flux weakening with the square of the speed

4.6.2. Maximum current limit

The drive is fitted with a maximum current limiting circuit that cuts in if exceeded, restricting the maximum current delivered to the lowest value from among parameter **P40,** the value calculated by the drive thermal image circuit, and the motor thermal protection circuit.
P40 is used to programme the maximum current limit delivered by the drive from 0% to the maximum authorised value, which depends on the type of overload chosen with connection **C56**.



4.6.2.1. Drive thermal image

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

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

The delivered current is also used to calculate the operating temperature reached by the power component junctions with the drive presumed to be working with standard ventilation at the maximum ambient temperature permitted.
If this temperature reaches the maximum value permitted for the junctions, 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 (see following table).

Now the drive 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 junction temperature calculation also considers the temperature increase that occurs while operating at low frequencies (below 2.5 Hz) due to the fact that the current is sinusoidal and thus has peak values that are higher than the average value. With electrical operating frequencies lower than 2.5Hz, the drive goes into maximum overload for 20-30ms after which the maximum current limit is reduced by $\sqrt{2}$ as shown by the following table:

C56	Max. drive current	Drive thermal current	Limit below 2.5 Hz
0	120% $I_{NOM\ AZ}$ for 30 seconds	103% $I_{NOM\ AZ}$	84% $I_{NOM\ AZ}$
1	150% $I_{NOM\ AZ}$ for 30 seconds	108% $I_{NOM\ AZ}$	105% $I_{NOM\ AZ}$
2	200% $I_{NOM\ AZ}$ for 30 seconds	120% $I_{NOM\ AZ}$	140% $I_{NOM\ AZ}$
3*	200% $I_{NOM\ AZ}$ for 3 seconds 155% $I_{NOM\ AZ}$ for 30 seconds	110% $I_{NOM\ AZ}$	140% $I_{NOM\ AZ}$

N.B. = the overload time illustrated is calculated with the drive running steady at the rated motor current. If the average delivered current is lower than the rated motor current, then the overload time will increase. Thus the overload will be available for a longer or identical time to the ones shown.

N.B. 3* = the 200% overload is available until junction temperatures are estimated to be 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 drive's actual overload capacity.

4.6.2.2. Motor thermal protection

Parameters **P70** (thermal current as a % of the rated motor current), **P71** (motor thermal constant in seconds) and the current delivered by the drive are used to calculate the presumed operating temperature of the motor considering an ambient temperature equal to the permitted maximum; the losses are evaluated with the square of the absorbed current and filtered with the motor thermal constant. When this value exceeds the maximum thermal current set in P70 (value proportional to the square of this current) the thermal protection cuts in, enabling logic output **o.L.1** and alarm A06. The action taken may be programmed via connection **C32** and by enabling alarm **A06**:

If A06 is disabled, no action will be taken.

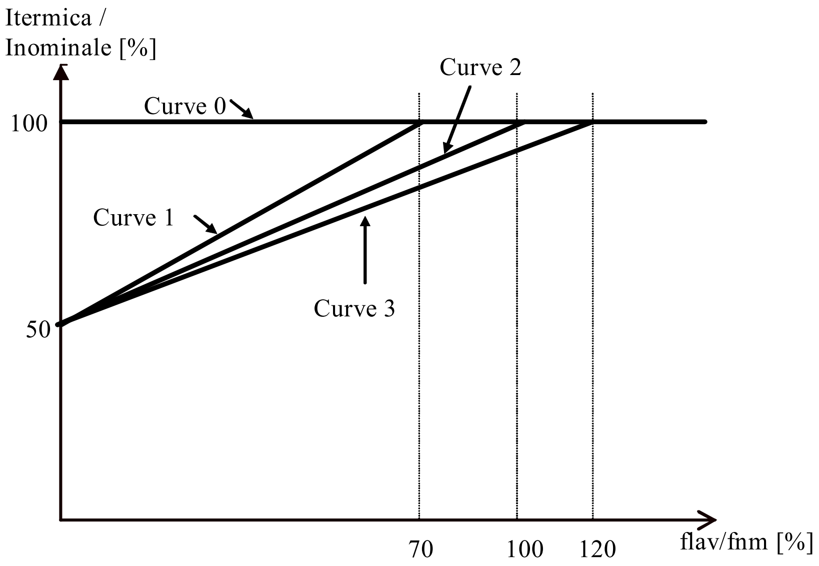
If A06 is enabled, action will depend on C32:

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

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

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

The maximum motor thermal current depends on the operating frequency, provided that the motor does not have assisted ventilation regardless of its revolutions.
Four permitted thermal current curves are used to reduce the current in accordance with motor operating frequency (see diagram); the required curve is chosen with Connection C33 as per the table.



C33	Characteristics
0	No reduction according to frequency; to be chosen for assisted ventilation motors
1	Choose for self-ventilated high speed motors (2 poles) where ventilation is more efficient. There is no current reduction for frequencies over 70% of the rated frequency
2 default	Typical curve for self-ventilated motors
3	Curve for motors that heat up excessively with curve 2

4.7. Load effect compensation

4.7.1. Voltage stator drop compensation (start up under load)

Using **P36** parameter it is possible to increase the voltage value at low frequencies so as to compensate for the drop due to the stator resistance and so as to be able to have current and therefore torque even in the start up phase; this is necessary if the motors starts up under load.
The value which can be set refers to the drop voltage on the Stator Resistor (P66) and can be adjusted from 0 up to a maximum of 400.0%. Particular care must be taken in setting the P36 value as it determines the current values fed at low speed: a value too low for P30 results in limiting the torque of the motor, while a value too high results in feeding high currents at low speed, whatever the load condition is.

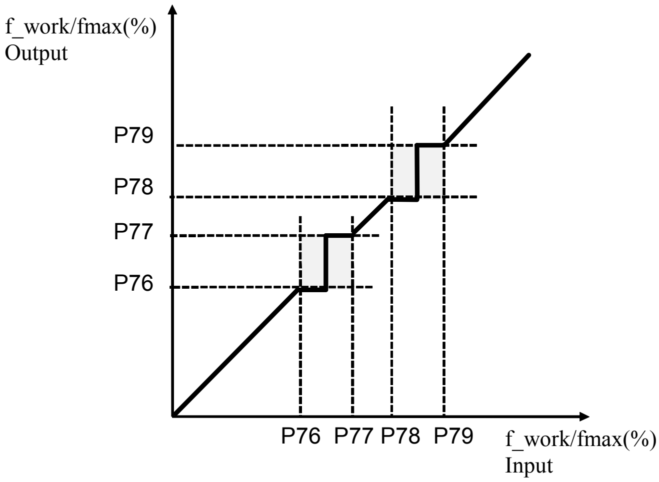
In the start up under load it is useful to introduce a waiting time on the common 'converter running' so that the motor can magnetize itself, so that it has from the outset the torque expected available.
The **P29** parameter makes it possible to quantify this wait time in milliseconds, in which the system is in an on-line state, but the frequency reference is forcibly held at 0.
The most suitable value for P29 should be chosen according to the rating of the motor and the load conditions, but in any case should be from a minimum of 400ms for motors of 7.5 KW up to 1s for motors of 55KW.

4.7.2. Slip compensation

By using parameter **P35** it is possible to partly compensate for the motor's fall in speed when it takes up the load; the adjustment is in fact that regulation of motor controls stator frequency and does not control the real speed.
This compensation is obtained by increasing the motor's working frequency by a quantity which is proportional to the percentage working torque multiplied by the percentage value set in P35 , in relation to the motor's rated frequency.
The value to be set depends both on the motor's rating and poles, in any case it can in general terms vary from 4% for a 7.5 KW motor to 1,8 - 2.0% for 45 KW motors. In default the compensation is excluded P35 = 0.

4.7.3. Frequency jumps to avoid resonances

Using the parameters **P76**, **P77**, **P78** and **P79** it is possible to exclude, as working frequencies, all those frequencies falling within the two bands defined between P76 - P77 and P78 - P79, where P76, P77, P78 and P79 are expressed as % of the maximum working frequency (see diagram)



Wherever exclusion bands are pre-set the drive behaves in the following way:
If the set frequency reference falls within the exclusion band it is maintained at the lower value of the band, if the set value is less than the mid band value, while if the value is greater than the mid band value it assumes the upper value.
In a transitional phase however the system passes through all of the band's frequencies (ramp).
The use or otherwise of the exclusion bands requires the setting of the corresponding connection **C38**:

Band 1 (P76-P77) **C38=0 (Default)** not excluded, **C38=1** excluded
Band 2 (P78-P79) **C38<2** not excluded, **C38=2** excluded

For example if the working fmax = 50Hz and the plant presents two resonance frequencies which are quite clear at 45Hz and 35Hz the frequencies between 43 - 47 Hz and 33 - 37 Hz could be excluded setting

P76 = (33/50)* 100.0 = 66.0% ----------- First band
P77 = (37/50)* 100.0 = 74.0% -----------

P78 = (43/50)* 100.0 = 86.0% ----------- Second band
P79 = (47/50)* 100.0 = 94.0% -----------

C38=2 Enables both exclusion bands

4.8. Particular control functions

4.8.1. Wait for motor demagnetizing

When the drive is switched off it is dangerous to switch on immediately, due to the unknown magnetic flux position that could produce a motor over–current. The only chance it’s to wait the time needed for the magnetic flux to reduce itself with its time constant that depend on the motor type and can vary from few milliseconds to hundreds of milliseconds.
For this reason has been introduced the parameter **P28** that set the wait time after power switch off after that, it’s possible to switch on the power another time: also if the user gives the RUN command during this wait time, the drive waits to complete it before enabling another time the power. Parameter P28 is defined in time units of 100us so the default value 10000 correspond to 1 second.

4.8.2. Motor flying restart

Since the driver has a maximum current limit it can always be started running with no problems even if the motor is already moving, for example, by inertia or dragged by part of the load.
In that event, on starting up, given that normally the frequency reference starts from values close to zero to gradually rise with the ramp times to the working value, the motor is first subjected to a sudden deceleration, within the limit, to then hook onto the reference and follow it with the ramp; this may be undesirable from a mechanical standpoint, and the process could also trigger the over-voltage alarm for converters which do not have a braking device.
To avoid this it is possible to suitably program connection **C50** , “Enable motor flying restart“, which makes it possible to identify the speed of rotation of the motor, stressing it as little as possible, and to position the output reference from the ramp at a value corresponding to that rotation so as to start from that reference to then go on to working values.
This motor search function is primarily in one direction and thus needs to know in advance the direction of rotation of the motor, positive frequency or negative frequency, which must be programmed in C50 ; if the selection is wrong the motor is first braked to about zero speed to then follow the reference to go to working speed (as if the search function had not been used).
If there is a passive load and the inertia keeps the motor in rotation, it’s possible to select a search dependently upon the sign of enabled frequency reference (C50=3-4).

There are two different values for C50 to enable this kind of search, the only difference is for manage the case in which the frequency reference was zero: in this particular situation with C50=3 the system searches for positive frequency, while with C50=4 the search will be made for negative frequency.
The C50 connection has five programming values which are selected as indicated below :

- C50=0 flying restart doesn't enabled
- C50=1 flying restart managed with positive frequency quadrant search
- C50=2 flying restart managed with negative frequency quadrant search
- C50=3 flying restart managed dependently upon the sign of enabled frequency reference (like C50=1 for 0)
- C50=4 flying restart managed dependently upon the sign of enabled frequency reference (like C50=2 for 0)

The start frequency in motor flying restart can be set in parameter **P89** (default 100%) in percentage of maximum frequency. This parameter can help the search algorithm limiting the range of frequency. With parameter **P90** it's possible to set the minimum target frequency in order to inject an active current also if the motor is stopped.

If the maximum frequency is greater than 250% of nominal motor frequency could be some problems in the motor flying restart because it's difficult to inject the active current with a slip so high. In that case the only possibility is to reduce the start search frequency (with P89) on condition that really the motor cannot run more quickly.

If it's enabled the motor flying restart, the power is switch-on with the motor standstill and there is low load, it's possible to have a transient initial state in which the motor starts running in the searching sense.

If the flying restart doesn't work correctly it's possible to increase the reserved parameter **P128** (default value 5%) for increase the admitted search window .

In default the flying restart isn't managed (C50=0)

4.8.3. Motor in stall

During start with torque, if the load is too high, the motor could be in stall with consequently risk of over-temperature.
In order to prevent motor's damages it's advisable to use a protection function, setting **C40**=1: the driver will be enabled to work in current limit only for the time expressed in **P94** (default value is 30 seconds), after that the alarm **A7** will be active, with consequence power off.
This protection can be interesting if the load changes during the work, however preserves converter and motor from mechanical break down.

4.8.4. DC Injection

The DC Injection, if enabled with **C49=1**, keeps the motor “stopped in torque” by injecting a continuous current if the frequency reference is under the intervention threshold express in **P49**. With this function is possible to obtain only a low torque (< 10% of nominal value) at zero speed for the asynchronous motor characteristics, if the active load torque is greater than this value the motor runs at slip frequency correspondent to the load applied.

When the DC Injection is active the amplitude of the current depends on parameter **P48** which is the Current limit in this situation.

Remember that if is active the “Motor in stall protection” (C50=1) after the time express in P92, the converter will be in alarm (A7).

4.8.5. Energy saving

This function, if enabled with **C54=1**, allows an energy saving with an automatic current reduction matched to the load, reducing the conduction loss (proportional to the current square value).
The basic idea is to find the best subdivision between active and reactive current, because the first is proportional to the torque current, the second to the magnetic field produced.
With reduced working load it’s better to reduce the magnetic field under its nominal value and increase the torque current.
The energy saving is significant especially for motors with low cos φ and for load lower than 40-50% of nominal value, for load much great of this the saving is negligible.
When the Energy Saving is enabled the dynamic performances decreases also if it’s always guarantee a good stability in every working area.

5. Maintenance and controls

The drive has a range of functions that cut in if there is a fault in order to prevent damage to both the drive and the motor. If a protection switch cuts in, the drive output is blocked and the motor coasts.
If one or more of the protection switches (alarms) cut in, they are signalled on the displays, which start to flash and to show a cycle of all the alarms triggered (the 7-segment display shows the alarms that have been set off in hexadecimal).
Should the drive malfunction or an alarm be 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.

5.1. Malfunctions without an alarm: troubleshooting

MALFUNCTION	POSSIBLE CAUSES	CORRECTIVE ACTION
Motor does not run	RUN command not given	Check operating status of input I00
Motor does not turn	Terminals L1, L21 and L3 are not wired properly or the power voltage is disabled	Ensure wiring is correct and check mains and motor connection Check any contactors upstream and downstream of drive are closed
	Terminals U,V and W are not wired properly	
	An alarm has been triggered	See following paragraph
	Parameters programmed incorrectly	Check parameter values via the programming unit and correct any errors
Motor direction inverted	Motor connection phase sequence incorrect.	Set C76=1
	Speed reference value inverted	Invert reference value
Motor revolutions cannot be regulated	No reference signal	Check wiring and apply reference signal if not present
	Excessive load	Reduce motor load
Irregular motor acceleration and braking	Acceleration – deceleration time/times is/are too low	Check parameters and change if necessary
	Load too high	Reduce load
Number of motor revolutions too high or too low	Rated motor speed, minimum or maximum speed, offset, or reference gain value are set incorrectly	Check parameters and compare setting with motor rating plate
Motor does not turn smoothly	Excessive load	Reduce load
	Motor load changes a lot or displays excessive load points	Reduce load points. Increase motor size or use a larger frequency drive

5.2. Malfunctions with an alarm: troubleshooting

ALARM		DESCRIPTION		CORRECTIVE ACTION
A0	FLASH writing	When data is being written in the FLASH the required values are always shown afterwards: an alarm triggers if differences are detected.		Try rewriting the values in the FLASH. The information may have been disturbed in some way. If the problem continues contact TDE as there must be a memory malfunction.
A1	FLASH reading	A Check Sum error occurred while the FLASH was reading the values. Default values loaded automatically.		Try rereading the values with the FLASH. The reading may have been disturbed in some way. If the problem continues contact TDE as there must a memory malfunction.
A2	Over – current alarm	It has been measured a current greater than its limit		Check if in a transient state the active current reference is increased to high values in a short time. Eventually increase the current limit regulator gain.
A3	Power circuit	The drive output current has reached a level that has set off an alarm; this may be caused by an overcurrent due to leakage in the wires or the motor or to a short circuit in the phases at the drive output. There may also be a regulation fault.		Check the connection wires on the motor side, in particular on the terminals, in order to prevent leakages or short circuits. Check the motor insulation by testing the dielectric strength, and replace if necessary. Check the drive power circuit is intact by opening the connections and enabling RUN; if the safety switch cuts in, replace the power. If the safety switch cuts in only during operation, there may be a regulation problem (replace along with current transducers) or vibrations causing transient D.C.
A4	Radiator thermal switch	**d49=0**	The radiator temperature (**d25**) is higher than the maximum (**P118**).	Check the temperature reading on d25 and then check the radiator. If -273.15 is displayed, the electrical connection towards the radiator heat probe has been interrupted. If the reading is correct and the motor is overheating, check that the drive 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 drive is within the limits permitted by its technical characteristics. Check parameter P118 is set correctly.
		d49=1	The Adiabatic Energy dissipated on Braking resistance during the time selected in **P169** has overcame the threshold set in KJoule in **P168**	Check the correct setting of parameters P167, P168 and P169 compared to the Resistance plate. Check the correct dimensioning of Braking Resistance Maximum Power related to maximum speed, load inertia and braking time.
		d49=2	The Average Power dissipated on Braking has overcome the threshold set in Watt in **P170**	Check the correct setting of parameters P167, P170 and P171 compared to the Resistance plate. Check the correct dimensioning of Braking Resistance Average Power related to maximum speed, load inertia and braking time

ALARM		DESCRIPTION	CORRECTIVE ACTION
A5	Motor thermal switch	Connection C46 runs a range of motor heat probes. If C46=1, a PT100 is being used: the temperature reading (**d26**) must be higher than the maximum temperature (**P91**). If C46=2 or 3, a PTC/NTC is being used and its Ohm value (**d26**) has breached the safety threshold (**P95**).	Check the temperature reading in d26 and then check the motor. With a PT100, if -273.15 appears the electrical connection towards the motor heat probe has been interrupted. If the reading is correct and the motor is overheating, check that the motor 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 motor is within the limits permitted by its technical characteristics.
A6	Motor heat overload	The motor electronic overload safety switch has cut in due to excessive current absorption for an extensive period.	Check the motor load. Reducing it may prevent the safety switch cutting in. Check the thermal current setting, and correct if necessary (P70). Check that the heat constant value is long enough (P71). Check that the safety heat curve suits the motor type and change the curve if necessary (C33).
A7	Motor in stall	Drive worked in torque or current limit for a time equal to P94 seconds	If the motor has to work in limit for a long time, disable this alarm set C40=0 or lengthen the limit time admitted increasing P94. The motor is in stall because it has not been given sufficient voltage boost at low frequencies: increase the parameter P36. The start-up load is too high: reduce it or increase the rating of motor and drive.
A8	External alarm triggered	The control input can no longer detect the high level of the signal from the field that authorises drive operation.	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. Authorise or do not assign the function.
A9	Excessive working frequency	The working frequency is greater than its limit threshold (P52)	If the intervention takes place in a transient phase, increase frequency regulator gain or increase the maximum frequency admitted P52.
A10	DC power circuit voltage at minimum	Intermediate drive circuit voltage (DC Bus see **d24**) has dropped below the minimum value (**P106**).	Undervoltage may occur when the mains transformer is not powerful enough to sustain the loads or when powerful motors are started up on the same line. Try to stabilise the line by taking appropriate measures. If necessary, enable the BUS support function for mains failure (C34=1). This however can only help motors with light loads.
A11	Overvoltage on DC power circuit	Intermediate drive circuit voltage (DC Bus see **d24**) has exceeded the maximum value (**P107**).	The safety switch cuts in mainly due to excessively short braking times. The best solution is to lengthen the braking times. An overvoltage in the mains may also trigger the safety switch. If the drive is fitted with a braking circuit, check that the resistance value is not too high to absorb the peak power. If the resistor is not too hot, check the resistor and connection continuity and ensure that the circuit functions correctly.
A12	Internal alarm	**d49=0** Software Enable C29	Check and enable connection **C29** "Drive software enable"
		d49=1 RUN without Power Soft start	Check why the Power Soft start isn't enabled
		d49=2 RUN with Trad>P119	Check the radiator temperature (d25)

ALARM		DESCRIPTION		CORRECTIVE ACTION
A13	Power not delivered	**d49=0**	The bridge that enables the line by gradually loading the DC bus condensers 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.
		d49=1	Safe Torque Off: +24Vare missing in connectors S1 and S3. For this reason it's enabled certified STOP function	Bring +24V to connectors S1 and S3. If the user want to use the Safe Torque Off function without alarms, it's necessary to set C73=1.
A14	Auto-tuning test unfinished	The RUN command was disabled during auto-tuning test.		Reset the alarms and repeat the test by re-enabling with C42.
A15	Auto-tuning failed	**d49=1**	Current too low	Check if the motor is correctly connected to the drive via power phases.
		d49=2	Dead time compensation term too high	Check if are correct the motor parameters P61-P65 and in the motor is too small in power compared with the drive
		d49=3	Voltage resistance drop too high	Check if are correct the motor parameters P61-P65

Manual information

The contents of this manual are based on software version **1.0**

If you have any queries regarding the installation or operation of the equipment illustrated within this manual, please contact the following address:

TDE MACNO
s.p.a. tecnologie digitali elettroniche

via dell'oreficeria, 41 36100 Vicenza tel.0444/343555
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Internet E-Mail: info @ tdemacno.it
Tax payer's code – VAT no. 00516300241 telefax 0444/343509

OPEN DRIVE

OPEN DRIVE

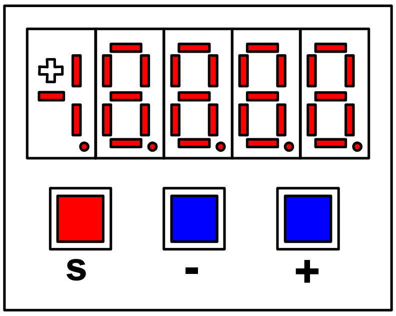
Remote Keypad

OPERATIONS OF THE REMOTE KEYPAD

INDEX

1. Physical disposition

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



2. Layout of the internal dimensions

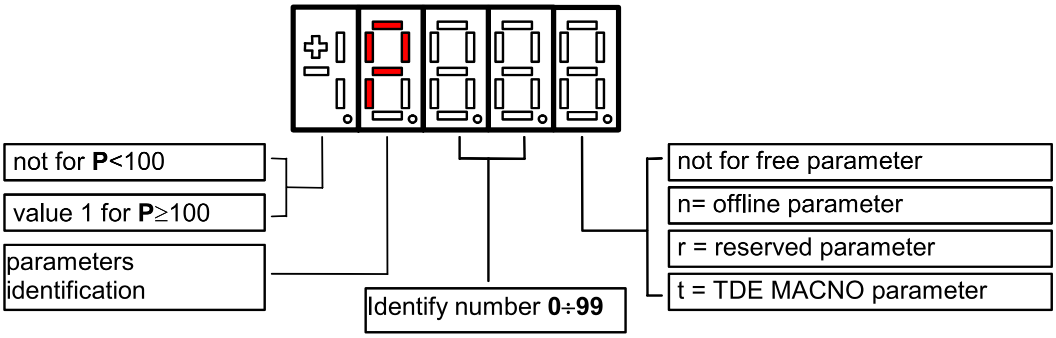
The converter is a full digital, then other hardware settings are not necessary, if not made in factory, and the setups, settings and visualizations, all digital, they go effect through the keypad and the display, or by serial line or by fieldbus.
For easy access of formulations and mnemonics all the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

- Parameters (PAR),
- Connections (CON),
- Internal dimensions (INT),
- Alarms (ALL) ,
- Digital input (INP),
- Digital output (OUT).

in each group the dimensions are orderly in progressive order and they are visualized only that indeed use.

2.1. Parameters (PAR)

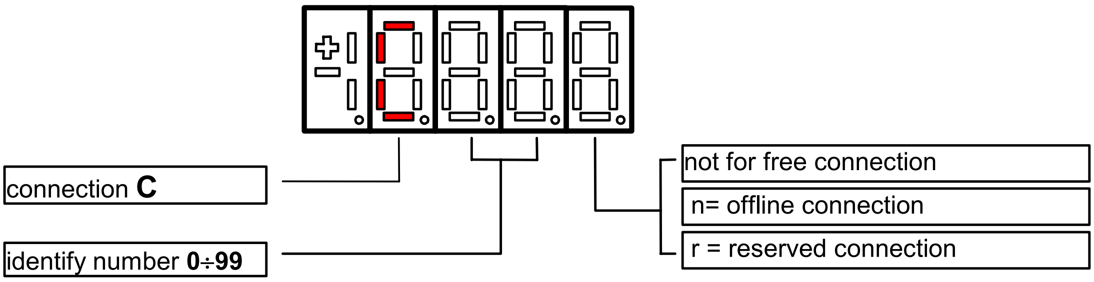
They are definite parameters of dimension of setting whose numerical value has an absolute meaning (for example: P63 = nominal frequency motor = 50 Hz) or they are of proportional value to the limit range (for example: P61 = motor nominal current = 100 % of the drive nominal current). They are distinguished in **free** parameters, some modifiable always (On-line), other only to converter not in run (off-line), **reserved**, modifiable only off-line 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 off-line.
The characteristics of each parameter are recognizable from the code of identification as under:



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

2.2. Connections (CON)

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

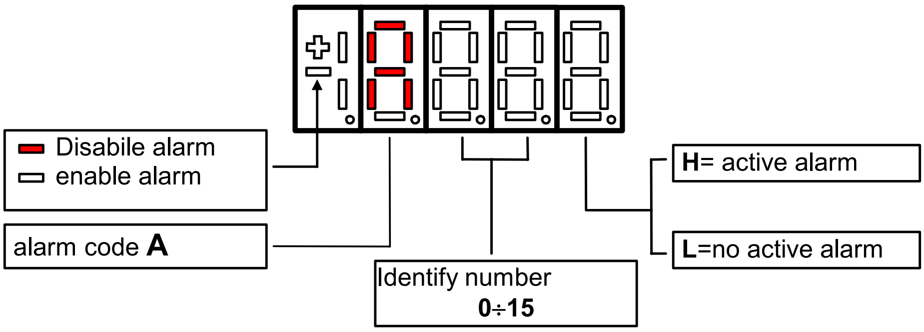


2.3. Alarms (ALL)

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 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:

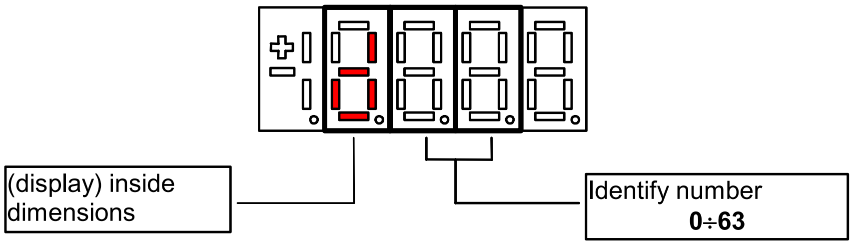
For example A03.l = power fault doesn't activate

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).



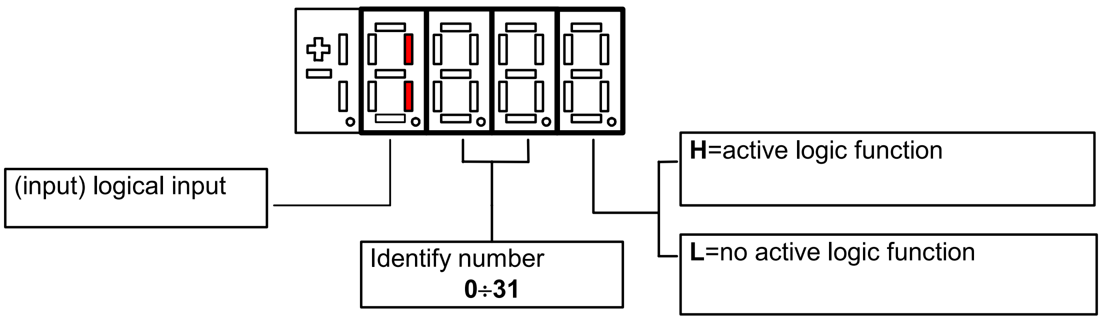
2.4. Internal values (INT)

Overall of working values of regulation (for example: voltage, speed, torque, ect…) showed in absolute unit or percent (for example: motor tension in volt or current in percent of the maximum value).
Code of identification:



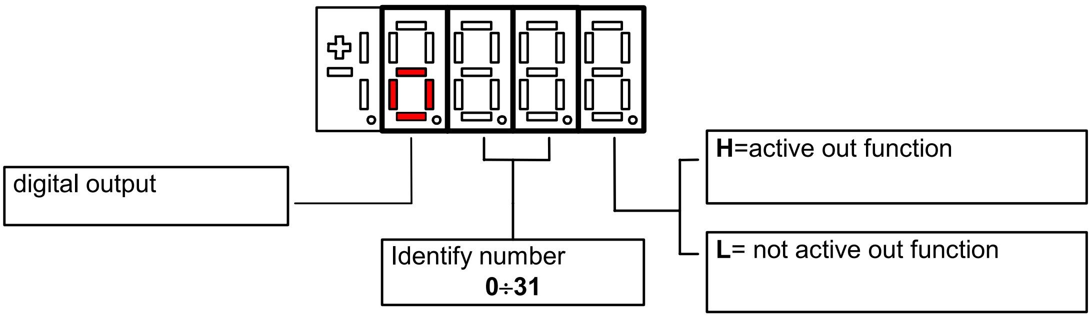
2.5. Logics functions of input (INP)

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



2.6. Logics functions of output (OUT)

Visualization of the status, of the logical functions, of protection or sequence (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:



3. Status of rest

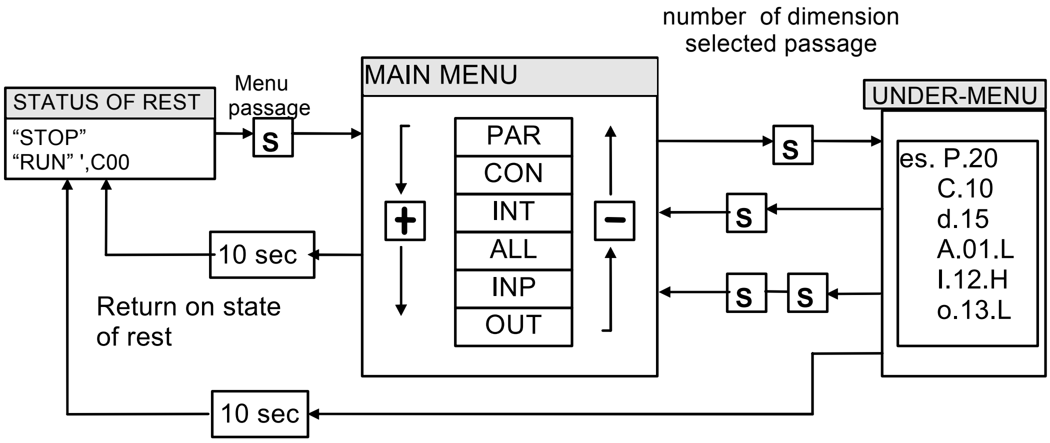
It is the status that the display assumes right after the lighting or when none is programming (P112 seconds, 10 of default, after the last movement, except that is not is visualizing an internal dimensions, or an input, or a digital output).
When the keypad is on tat the status rest, if the converter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

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 dimensions:

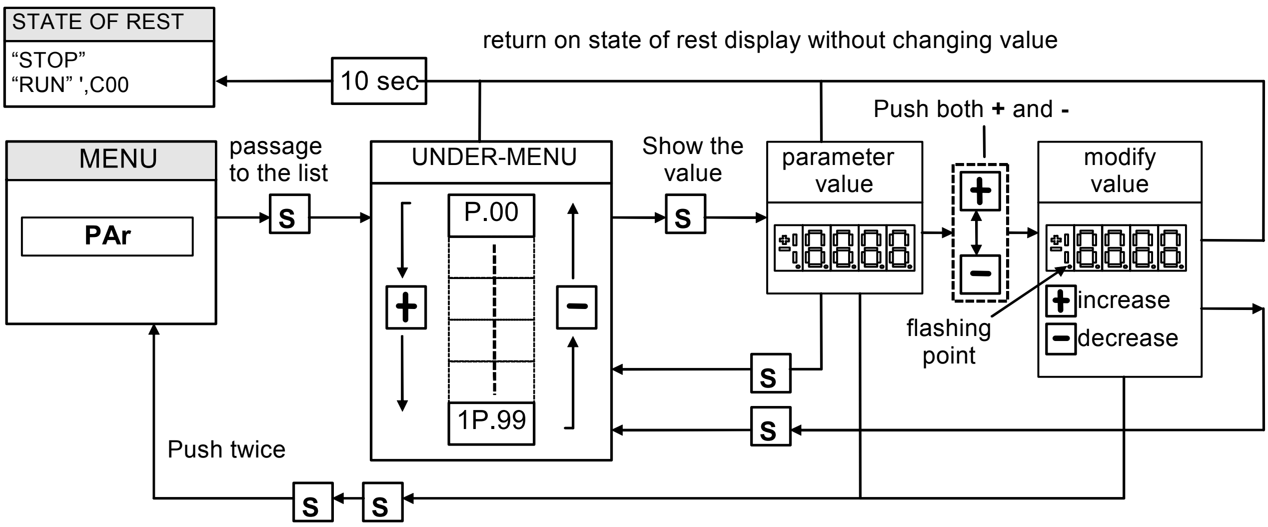
PAR = parameters	CON = internal connections	INT = internal dimensions
ALL = alarm	INP = digital input	OUT= digital output

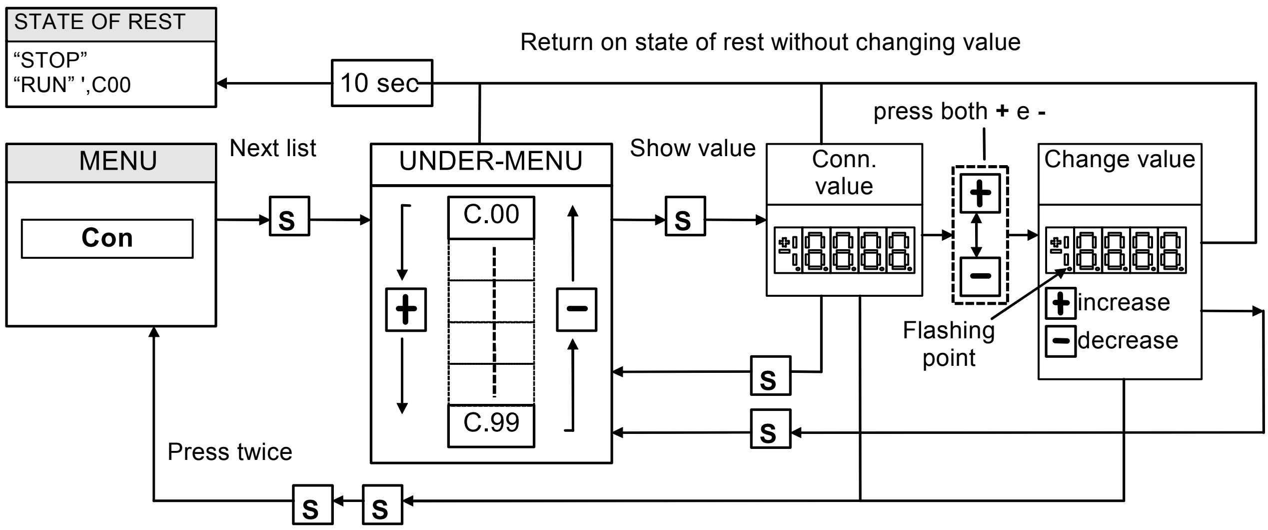
To change from a list to another enough is necessary to use the ' + ' or ' - ' keys and the passage will happen in the order of figure.
Once select the list you pass on the relative under-menu pressing ' s ' ; the re-entry to the main menu from the following visualizations will be able future through 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 under-menu that goes by the main menu.



4.1. Under-menu of parameters and connections management (PAR and CON)

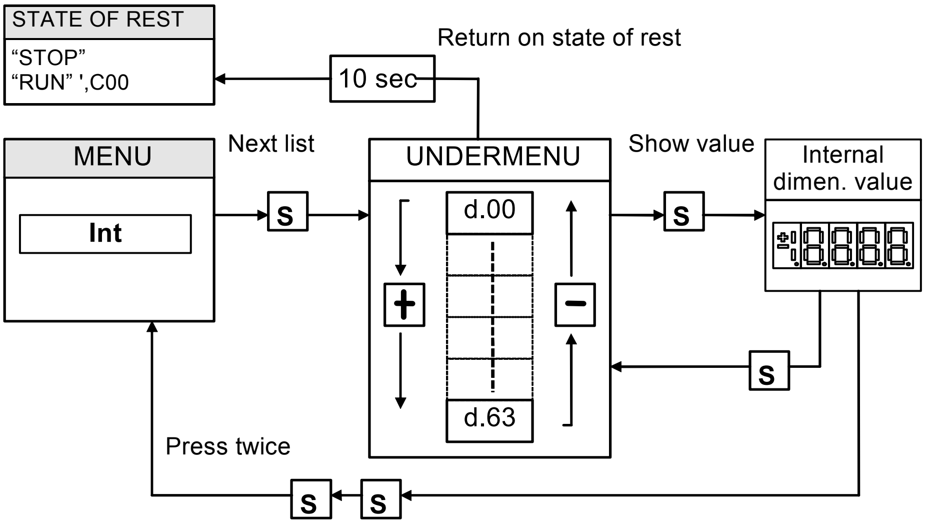
From ' PAR ' or ' CON ' You enter into the under-menu list pressing ' S ' ; once entered into the list is able look through the parameters or the existing connections by pressing the keys ' + ' or ' - ' to move in increase or in decrement; even in this case the list is circular.
At the number corresponding 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 (off-line); all the reserved parameters are of type ' n ' modifiable only by stop (off-line).
If You pressed the key ' S ' comes visualized the value of the parameter or of the connection that may be read; at this point re- press ' S ' once You return to the under-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 under 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.





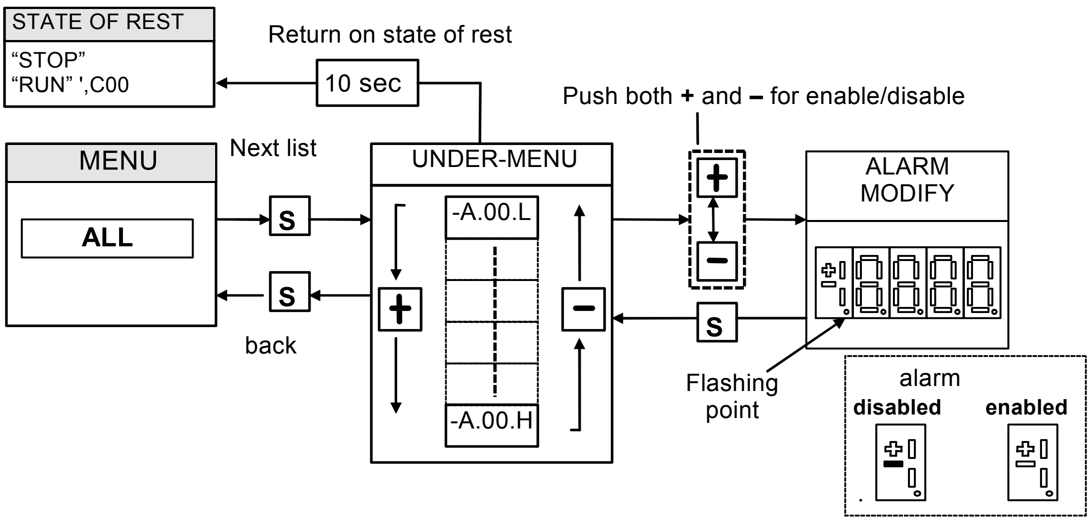
4.2. *Visualization of the internal dimensions (INT)*

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



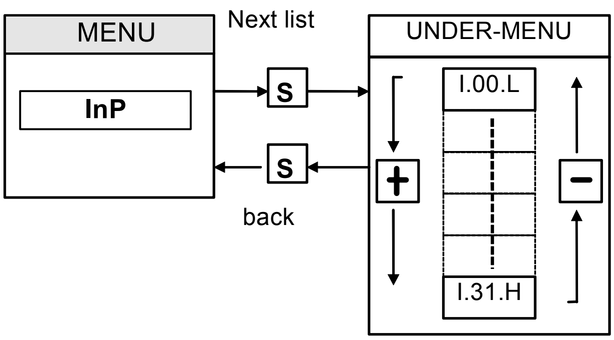
4.3. Alarms (ALL)

From ALL You enter into of under-menu list of the alarms pressing ' S '.
From the corresponding under-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 under-menu and You return operative the select made pressing ' S ' , from the menu and from the under-menu You turn automatically to the status of rest after a time closed to 10 seconds.



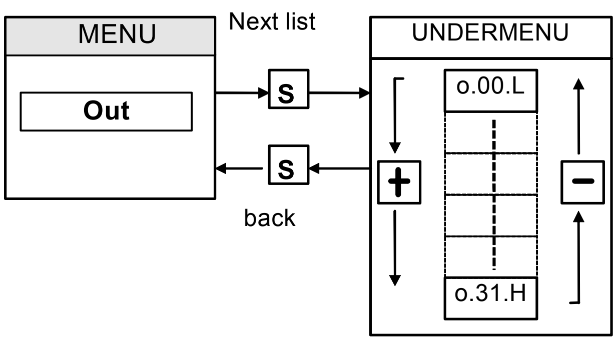
4.4. *Visualization of the input and output (INP and OUT)*

From the INP or from the OUT You enter into corresponding list of under-menu pressing ' S '.
From the corresponding list of under-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 '.



To note the last three digital input are about the power logical input:

		POWER LOGICAL INPUT	STATUS(H=ON L=OFF)
I	29	/ PTM	H = OK; I = active alarm
I	30	/ MAXV	H = OK; I = active alarm
I	31	/ MAINS SUPPLY OFF	H = OK; I = active alarm



OPEN DRIVE

OPEN DRIVE

Modbus protocoll

Modbus Protocol

INDEX

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

www.modicon.com/TECHPUBS/intr7.html

1. Application Configuration

1.1. *Node Configuration*

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

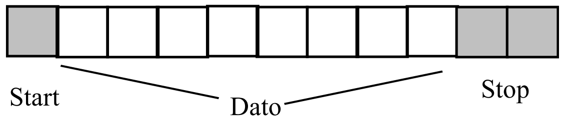
Name	Description	Range	Default
P92	Serial identification number	0÷255	1
P93	Serial baud rate	19,2 ; 38,4 ; 57,6	19,2 Kbit/s

By setting these parameters in real time, they will become instantly active :

Note: the communication mode in broadcast with address = 0 is not managed

2. Managed services

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



The Modbus protocol requires a long functions series; our application requires less than these : in the following table you can find the implemented functions and their codification :

Code	Function	Description
01	Read Coil Status	Reading of digital input/output
03	Read Holding Registers	Reading of memorised data
15	Force Multiple Coils	Writing of digital inputs
16	Preset Multiple Registers	Writing of memorised data

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

2.1. 01 Read Coil Status

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

starting address(hex)	Max number of data	Description
0300	32	Digital inputs
0320	32	Digital outputs

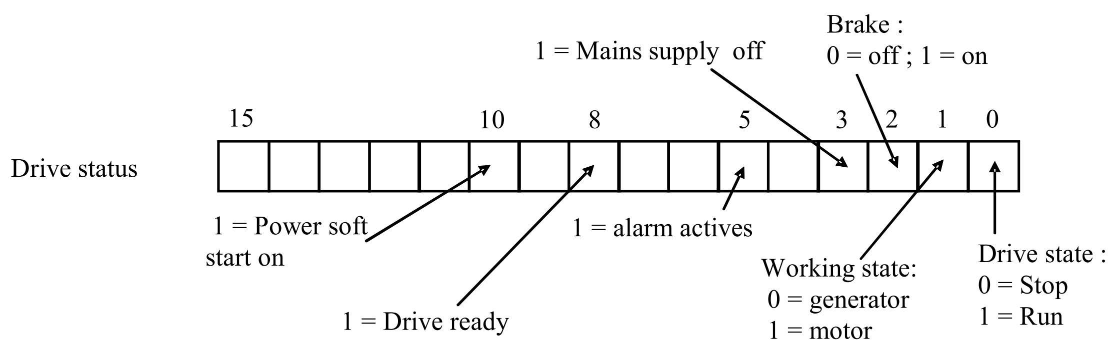
The order number of the inputs and the outputs is the one specified in the related tables (see specific description of the control's core)

2.2. 03 Read Holding Register

This function allows the user to read the values of all the Parameters, Connections, Internal Sizes and some status variables. Writing the correct address you can access these data (see the table under for the address) ; considering the internal representation you can rightly interpret the read data : as usual it is necessary to see the related tables in the specific description of the core :

starting address (hex)	Max number of data	Description
0000	200	Parameters table
00C8	100	Connections table
012C	100	Application Data table
0380	64	Internal sizes
0200	1	Drive status
0202	1	Drive alarms
0203	1	Alarm enabling

It is not possible to read more than 127 registers at a time due to the memory limits of the buffer.
The order number of the parameters, of the connections and of the internal sizes is the one related to the lists contained in the description of the control's core.
See the specific documentation for data area application.
The status variable is the same for all the implementations; hereinafter you can find the meaning of the most important bit :



referring to alarms and their enabling, the order number for the bit of the word corresponds to the number of the alarm itself. (e.g. A2= external enable corresponding to the bit 2 of drive alarms)

2.3. 15 (OF hex) Force Multiple Coils

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

Starting address	Max data number	Digital inputs
Starting address(hex)	Max data number	Description
0340	32	Digital inputs

2.4. 16 (10 hex) Preset Multiple Registers

This function allows to set the value of the parameters, connections and to enable the alarms even if the corresponding keys are opened.
To correctly set these data it is required the right address (that you can find in the following table) and it is necessary to consider the internal data representation, referring to the specific descriptions of the core. The application area's meaning depends on the present application (see specific documentation):

starting address	Max data number	Description
0000	200	Parameters table
00C8	100	Connections table
012C	100	Applications data table
0203	1	Alarms enabling

If it is written a value not included in the range, the value will be ignored and the previous one will remain valid.

2.5. Exception Responses

The following exception codes in the answer are managed:

Code	Name	Description
01	Not managed function	The drive doesn't manage this Modbus function
02	Wrong data address	The address is not valid
03	Wrong data value	The data number required is too big

OPEN DRIVE

OPEN DRIVE

Canbus

INDEX

OPEN DRIVE line products are compatible with CAN open Communication Profile DS301 of CiA rev 4.02. This document describes the mandatory and the optional functions that complete the implementation.

1 Configuration of the application

1.1 *Configuration of the node*

The drive configuration as CAN node includes the use of the following customer parameters (of conventional use):

Name	Description	Range	Default
P162	ID CAN BUS node	1÷127	1
C48	Configuration CAN BUS baud rate	0 ÷ 7 0 = 1 Mbit/s 1 = 800 Kbit/s 2 = 500 Kbit/s 3 = 250 Kbit/s 4 = 125 Kbit/s 5 = 50 Kbit/s 6 = 20 Kbit/s 7 = 10 Kbit/s	0 = 1 Mbit/s

These parameters must be rightly configured and saved in the permanent memory of the drive (C63=1). At start up these data are considered and become operating.

1.2 Configuration of the communication objects

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

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

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

2 Managed services

2.1 Service data object (SDO)

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

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

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

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

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

2.2 Process Data Object (PDO)

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

2.2.1 Transmit PDO

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

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

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

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

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

The TPDO mapping can be dynamically effectuated by rightly configuring the following communication objects:

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

the PDO mapping must be done by following these instructions:

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

2.2.2 Received PDO

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

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

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

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

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

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

RPDO mapping must be executed by following the next directives as well:

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

2.3 Emergency Object (EMCY)

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

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

In our implementation only two codes of the error code are implemented :

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

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

Bit	Meaning	Corresponding alarms
0	General error	all
1	Current	A3
2	Voltage	A10 - A11 -A13
3	temperature	A4 - A5 - A6

In Manufacturer specific only the bytes 3 and 4 are assigned which contain the state of the various alarms of the drive. Further 3 bytes for the transmission of possible other user's data are available.

The management of 1003h "pre-defined error field " object memorises the chronology of the alarm events (from start up of the drive) up to a maximum of 32 elements.
At every new alarm event 4 bytes are memorised, 2 are mandatory and correspond to the Error Code; the other 2 are Manufacturer specific and in our specific case correspond to the state of all the drive alarms.

MSB LSB

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

2.4 Network Management Objects (NMT)

This function allows the NMT master to check and set the state to every NMT slave.
All the services of Module Control and also the Node Guarding Protocol which uses the COB-ID = 700h + ID CAN node are implemented: this allows the slave to communicate that the bootup ended and the pre-operational modality is active, thus the master can interrogate the different slaves with an RTR.

The Life guarding function is implemented as well: the drive (NMT slave) can be set up by the objects:

100Ch **Guard time** in ms

100Dh **Life time factor** (multiplier factor)

} their product yields the **Node life time**

note: node life time is internally saturated in the period time of 32767/fpwm sec.

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

2.5 Objects dictionary : communication profile area

The following objects of the communication profile are supported:

Index (hex)	Object	Name	Type	Access	Par.
1000	VAR	Device type	UNSIGNED32	Reading	
1001	VAR	Error register	UNSIGNED8	Reading	2.3
1002	VAR	Manufacturer status register	UNSIGNED32	Reading	
1003	ARRAY	Pre-defined error field	UNSIGNED32	Reading	2.3
1005	VAR	COB-ID SYNC	UNSIGNED32	Reading/writing	2.2
1006	VAR	Communication cycle period	UNSIGNED32	Reading/writing	2.2
1008	VAR	Manufacturer device name	Vis-String	constant	
1009	VAR	Manufacturer hardware version	Vis-String	constant	
100A	VAR	Manufacturer software version	Vis-String	constant	
100C	VAR	Guard time	UNSIGNED16	Reading/writing	2.4
100D	VAR	Life time factor	UNSIGNED8	Reading/writing	2.4
1010	ARRAY	Store parameters	UNSIGNED32	Reading/writing	1.2
1011	ARRAY	Restore dafault parameters	UNSIGNED32	Reading/writing	1.2
1014	VAR	COB-ID EMCY	UNSIGNED32	Reading/writing	2.3
1015	VAR	Inhibit Time EMCY	UNSIGNED16	Reading/writing	2.3
1018	RECORD	Identity Object	Identity (23h)	Reading	
Server SDO Parameter					
1200	RECORD	1st Server SDO parameter	SDO parameter	Reading/writing	2.1
1201	RECORD	2nd Server SDO parameter	SDO parameter	Reading/writing	2.1
1202	RECORD	3rd Server SDO parameter	SDO parameter	Reading/writing	2.1
1203	RECORD	4th Server SDO parameter	SDO parameter	Reading/writing	2.1
Receive PDO Communication Parameter					
1400	RECORD	1st receive PDO parameter	PDO CommPar	Reading/writing	2.2.2
1401	RECORD	2nd receive PDO parameter	PDO CommPar	Reading/writing	2.2.2
1402	RECORD	3rd receive PDO parameter	PDO CommPar	Reading/writing	2.2.2
1403	RECORD	4th receive PDO parameter	PDO CommPar	Reading/writing	2.2.2
Receive PDO Mapping Parameter					
1600	RECORD	1st receive PDO mapping	PDO Mapping	Reading/writing	2.2.2
1601	RECORD	2nd receive PDO mapping	PDO Mapping	Reading/writing	2.2.2
1602	RECORD	3rd receive PDO mapping	PDO Mapping	Reading/writing	2.2.2
1603	RECORD	4th receive PDO mapping	PDO Mapping	Reading/writing	2.2.2
Transmit PDO Mapping Parameter					
1800	RECORD	1st transmit PDO parameter	PDO CommPar	Reading/writing	2.2.1
1801	RECORD	2nd receive PDO parameter	PDO CommPar	Reading/writing	2.2.1
1802	RECORD	3rd receive PDO parameter	PDO CommPar	Reading/writing	2.2.1
1803	RECORD	4th receive PDO parameter	PDO CommPar	Reading/writing	2.2.1
Transmit PDO Mapping Parameter					
1A00	RECORD	1st transmit PDO mapping	PDO Mapping	Reading/writing	2.2.1
1A01	RECORD	2nd transmit PDO mapping	PDO Mapping	Reading/writing	2.2.1
1A02	RECORD	3rd transmit PDO mapping	PDO Mapping	Reading/writing	2.2.1
1A03	RECORD	4th transmit PDO mapping	PDO Mapping	Reading/writing	2.2.1

2.6 Objects' dictionary : manufacturer specific profile area

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

Index (hex)	Object	Type	Name	Description	Access
2000	VAR	INTEGER16	Block size	SDO Block size Block Download	Reading/writing
2001	VAR	DOMAIN	Tab_formati	Formats of the 200 parameters	reading
2002	VAR	DOMAIN	Tab_con_formati	Formats of the 100 connections	Reading
2003	VAR	DOMAIN	Tab_exp_int	Formats of the 64 internal values	reading
2004	VAR	DOMAIN	Tab_exp_osc	Formats of the 64 monitor's sizes	Reading
2005	VAR	DOMAIN	Tab_par_def	Values of the default parameters	Reading
2006	VAR	DOMAIN	Tab_con_def	Values of the default connections	Reading
2007	**VAR**	**INTEGER16**	**hw_software**	Sensor managed by the firmware	Reading
2008	**VAR**	**INTEGER16**	**hw_sensore**	Sensor managed by electronic card	Reading
2009	VAR	INTEGER16	K_zz	Monitor counter	Reading
200A	VAR	INTEGER16	Via_alla_conta	Monitor trigger	Reading
200B	VAR	DOMAIN	Tab_monitor_A	Data saved in the channel A of the monitor	Reading
200C	VAR	DOMAIN	Tab_monitor_B	Data saved in the channel B of the monitor	Reading
200D	ARRAY	INTEGER16	Tab_par [200]	Actual values of the parameters	Reading/writing
200E	ARRAY	INTEGER16	Tab_con [100]	Actual values of the connection	Reading/writing
200F	**ARRAY**	**INTEGER16**	**Tab_int [64]**	Actual values of the internal words	Reading
2010	**ARRAY**	**INTEGER16**	**Tab_inp_dig [32]**	Actual values of the logical input's functions	Reading
2011	**ARRAY**	**INTEGER16**	**Tab_out_dig [32]**	Actual values of the logical output's functions	Reading
2012	**ARRAY**	**INTEGER16**	**Tab_osc [64]**	Actual values of the checked words	Reading
2013	**VAR**	**UNSIGNED16**	**ingressi**	Logical status of the 8 inputs of the terminal board	Reading
2014	**VAR**	**UNSIGNED16**	**ingressi_hw**	Logical status of the 3 inputs from the power	Reading
2015	**VAR**	**UNSIGNED16**	**uscite_hw**	Logical status of the 4 digit outputs	Reading
2016	**ARRAY**	**INTEGER16**	**Tab_inp_dig_field [32]**	Values set by CAN of the output logical function	Reading/writing
2017	**VAR**	**UNSIGNED16**	**stato**	Variable of the drive's status	Reading
2018	**VAR**	**UNSIGNED16**	**allarmi**	Drive alarms' status	Reading
2019	**VAR**	**UNSIGNED16**	**abilitazione_allarmi**	Word for enabling drive's alarms	Reading
201A	**VAR**	**INTEGER16**	**f_fieldbus**	Speed reference in % of n_{MAX} in 16384	Reading/writing
201B	**VAR**	**INTEGER16**	**limit_fieldbus**	torque limit in % di Tnom in 4095	Reading/writing
201C	**VAR**	**INTEGER16**	**trif_fieldbus**	torque reference in % di Tnom in 4095	Reading/writing
201D	**VAR**	**INTEGER16**	**theta_fieldbus**	Speed reference in electr. pulses x Tpwm	Reading/writing
201E	**ARRAY**	**INTEGER16**	**Tab_dati_applicazione [100]**	Data Area available for the application	Reading/writing
201F	**VAR**	**UNSIGNED32**	**Ingressi_standard_wr**	Writing standard logical inputs	Reading/writing
2020	**VAR**	**UNSIGNED32**	**Ingressi_appl_wr**	Writing application logical inputs	Reading/writing
2021	**VAR**	**UNSIGNED32**	**Ingressi_standard_rd**	Reading standard inputs	Reading
2022	**VAR**	**UNSIGNED32**	**Ingressi_appl_rd**	Reading application inputs	Reading
2023	**VAR**	**UNSIGNED32**	**Uscite logiche_rd**	Reading logical outputs	Reading
2024	**VAR**	**UNSIGNED16**	**word_vuota**	Unused Word	Reading/writing
2025	**VAR**	**UNSIGNED32**	**double_vuota**	Unused Double word	Reading/writing
2026	VAR	DOMAIN	Tab_formati_extra	Formats of extra parameters	Reading

2.6.1 Format parameters table (Tab_format 2001h)

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

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

0x 0 0 0 0 (in hexadecimal)

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

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

- Type of parameter:

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

For example:

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

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

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

1st word = 0x1131
2nd word = 0000 free parameter in percent of the base: the real value is = (internal
3rd word = 8190 representation divided by the base)*100
4th word = 4095

if the current value is 1000→ (1000/4095)*100 = 24,4%
the variation range is included between 0 and 200%

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

1st word = 0x2231
2nd word = 5 reserved parameter proportional to the base : the real value is
3rd word = 1000 internal representation divided by the base
4th word = 10

if the current value is 400→ (400/10) = 40,0%
the variation range is included between 0,5 and 100%

2.6.2 Format connections table (tab_with_formats 2002h)

This table is composed by 400 words (100x4), 4words for each connection:

1st word : it defines the type of connection ,its internal representation and the number of integer and decimal digits that will show up on the display. Each nibble has the following meaning:

0x 0 0 0 0 (hexadecimal)

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

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

- Parameter type:

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

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

the internal representation is always the direct value.

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

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

2.6.3 Format Extra parameters table (Tab_format 2026h)

This table is made by 1000word (200*5) 5 words for each parameter :

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

0x 0 0 0 0 (in hexadecimal)

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

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

Type of parameter:

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

For example:

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

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

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

1st word = 0x1131
2nd word = 0000 free parameter in percent of the base: the real value is = (internal
3rd word = 8190 representation divided by the base)*100
4th word = 4095
5th word = 4095

if the current value is 1000→ (1000/4095)*100 = 24,4%
the variation range is included between 0 and 200%
the default value is 100%

2.6.4 Format of internal values table (tab_exp_int 2003h)

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

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

0x 0 0 0 0 (hexadecimal)

internal representation :

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

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

0x0002 internal representation of the value : percent of 4095.
For example if its value is 2040 → (2040/4095)*100 = 49,8%

Example 2 (hexadecimal if leaded by '0x…')

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

2.6.5 Format of monitor values table (tab_exp_osc 2004h)

This table is composed by 64 words, one word for each monitor value.

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

0x 0 0 0 0 (hexadecimal)

internal representation :

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

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

0x0003 internal representation of the internal value: percent of 32767.
For example if its value is 5000 → (5000/32767)*100 = 15,2%

2.6.6 Management of the speed sensor (hw_software 2007h and hw_sensor 2008h)

The two variables hw_software and hw_sensor can assume the following values :

value	Corresponding sensor
0	--- none ---
1	Incremental encoder
2	Incremental encoder + Hall probes
4	Resolver
8	Sinuisoidal encoder Sin/Cos analog
9	Sinuisoidal encoder Sin/Cos absolute analog
10	Endat

hw_software represents the managed sensor of the version of the drive firmware.
hw_sensor represents the sensor managed by the feedback board mounted in the drive.

2.6.7 Management of the monitor (objects from 2009h to 200Ch +2012h)

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

2.6.8 Input logic functions (objects 2010h, 2013h, 2014h, 2016h, 201Fh, 2020h, 2021h, 2022h)

The management of the input logic functions is totally controlled via CAN.
In the variable **inputs (2013h)** it is possible to read the status of the 8 input available in the terminal-box in the less significant bit. The 8 logic input are configured by the C1-C8 connections, each one checking a particular input logic function.

Standard input logic functions (I00 ÷ I28)

The status of the 32 input logic functions is available in two different dictionary objects:
the array **Tab_inp_dig (2010h)** in which it's possible to read function by function using sub-index (logic state 0 = low ; 32767 = high) and the 32 bit variable **Ingressi_standard_rd (2021h)** in which every bit is related to the state of corresponding function.
Via CAN it's possible to set the status of the input logic functions: writing function by function with the array **Tab_inp_dig_field (2016h)** (0=low, 32767=high) or setting the state of all 32 logic functions writing the 32bit variable **Ingressi_standard_wr (201Fh)**.

The implemented logic provides that:

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

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

Application input logic functions (I29 ÷ I63)

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

The implemented logic provides that:

- The 32 application input logic functions can be set via CAN
- If one application input logic function is configured to a connector logic input, the physical state imposes the state of corresponding logic function.

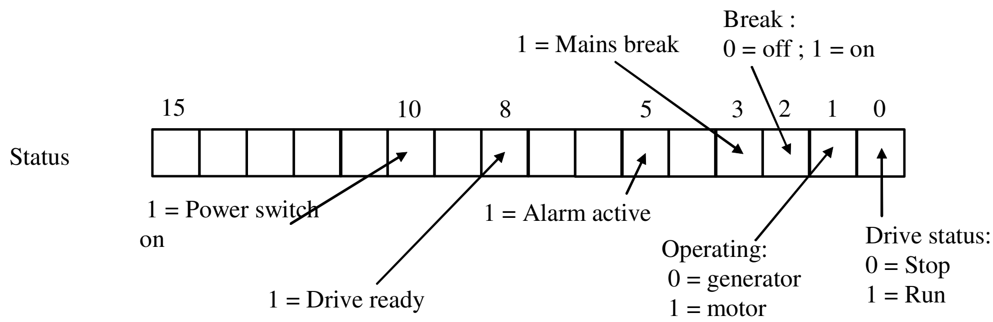
2.6.9 Output logic functions (objects 2011h, 2015h, 2023h)

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

- the status of the 4 logic outputs in the 4 less significant bits of the variable **output (2015h)**
- the status of the 32 logic output functions in the array **Tab_out_dig (2011h)** using the sub-index. Like the inputs logic levels are: 0=low and 32767=high
- the status of all 32 output logic functions in the 32 bit variable **Uscite_logiche_rd (2023h)** in which every bit is related to the corresponding function

2.6.10 Status words (objects 2017h, 2018 and 2019h)

the object **2017h** is available as **status word** of the drive with the following meaning:



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

2.6.11 Control reference via CAN BUS (objects 201Ah,201Bh,201Ch and 201Dh)

These objects can be used to give: speed-reference, torque-reference, torque-limit to the drive. For doing this it is necessary to enable their management, setting **C52=1**.

f_fieldbus (201A) = speed reference in percent of the max speed set. Base representation is equal to16384; thus 16384 is equal to 100%.

Theta_fieldbus (201D) = speed reference in electric pulses per period of PWM, considering that there are 65536 pulses per revolution and that the term ‘electric’ means they must be multiplied by the number of polar pairs of the motor.

Trif_fieldbus (201C) = couple reference in percent of the nominal torque of the motor. Base of Representation = 4095 : thus 4095 is = 100%

Limit_fieldbus (201A) = torque limit in percent of the nominal torque of the motor (it is in alternative to the other existing limits, the most restricted is the one that values). Representation base is 4095 : thus 4095 = 100%

OPEN DRIVE

OPEN DRIVE

Super Visor

INDEX

1. INTRODUCTION

This supervision software is a program designed to easy configure and control the OPEN DRIVE drives.
The program uses the PC RS485 serial line to communicate with the drive.

2. MINIMUM SYSTEM REQUIREMENTS

- Developed for Windows 2000, NT, XP, ME, 9X.
- Minimum video resolution: 800x600 (optimal)
- 32 Mbyte RAM

3. SOFTWARE INSTALLATION

- Launch the file “setup.exe” from the CD or from the folder in wich the files have been copied.
- Follow the instructions of the setup program. It will install the supervisor software and the Runtime Engine (Labview 6.1)

During the setup procedure the program will ask you to specify the folder where you desire to install the supervisor. The default floder is:

C:\Supervisori azionamenti\Open v xx

In this folder are created the support files for the supervisor, and the supervisor itself: “Open v xx.exe”

If the files are compressed, before to launch the setup procedure decompress them using the program pkunzip.

To uninstall the supervisor program double click on the same file “setup.exe” used to install it and follow the instructions.

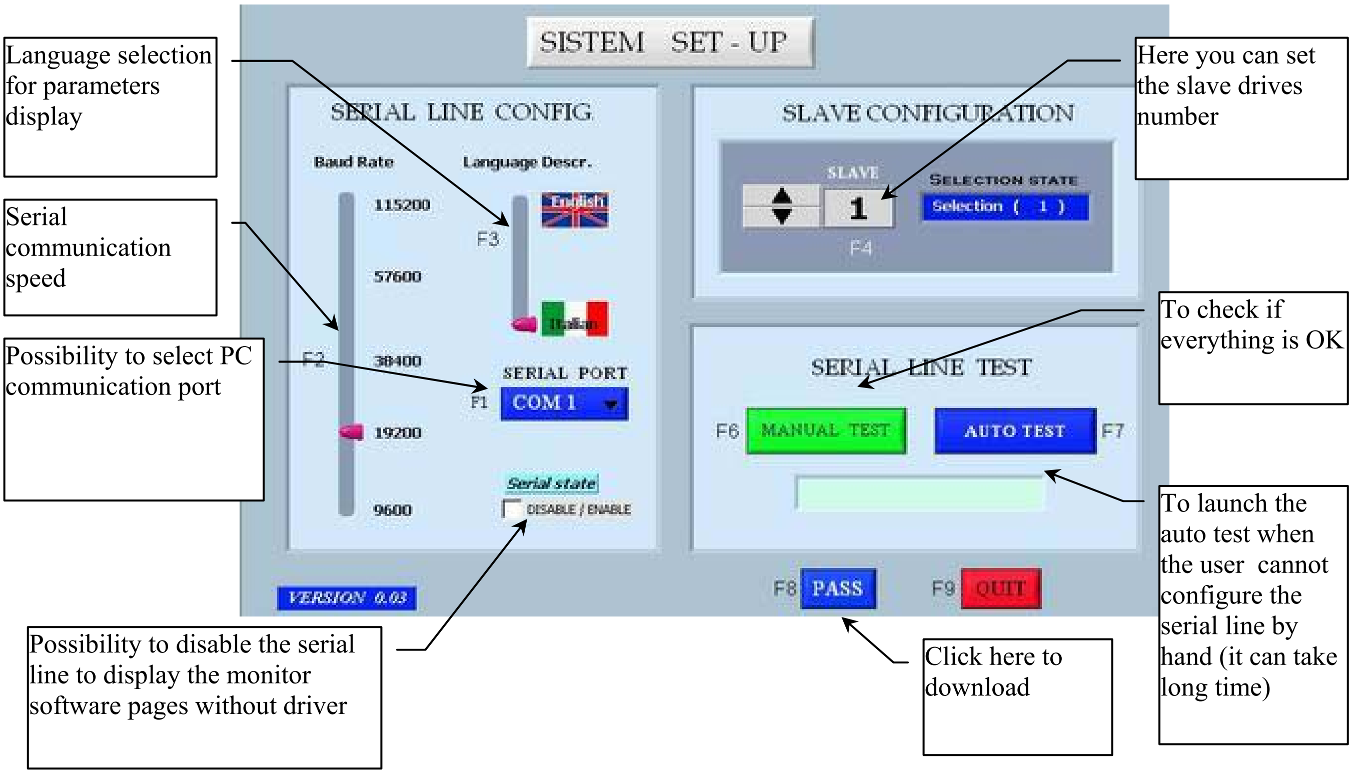
4. CONNECTION WITH THE DRIVE

Two different modes are available to connect the PC to the drive:

- Connect to the RS485 port in the drive. In this case it is needed a RS485/RS232 adapter. the cable type and the pinout depend on the adapter used.

TDEMACNO can provide the RS232/485 adapter with relative cable.

5. GETTING STARTED



The first step to access the program is the setting of the correct communication parameters:

- the slave number set in the supervisor must correspond to the slave number set in the drive (see parameter P92)
- the baudrate set in the supervisor must correspond to the baudrate set in the drive (see P93)
- select the COM port where the communication cable is connected

In the drive the default values are:
- Baudrate: 19200 baud (P93 =19.2)
- N. slave: 1 (P 92 = 1).

The user can select the language that will used in the program.

The second step is to check if the communication is correct:

- manual test: the communication between the PC and the drive is checked with the data set in the screen.
- automatic test: the first 20 slave number, the COM ports and the baudrates are scanned until the correct combination is found. (to abort the test disable the button)

When the communication is correct the message “Communication OK” is displayed, and the user can access the program pressing the “PASS” button.
The download screen is displayed to indicate that data are being downloaded from the drive:

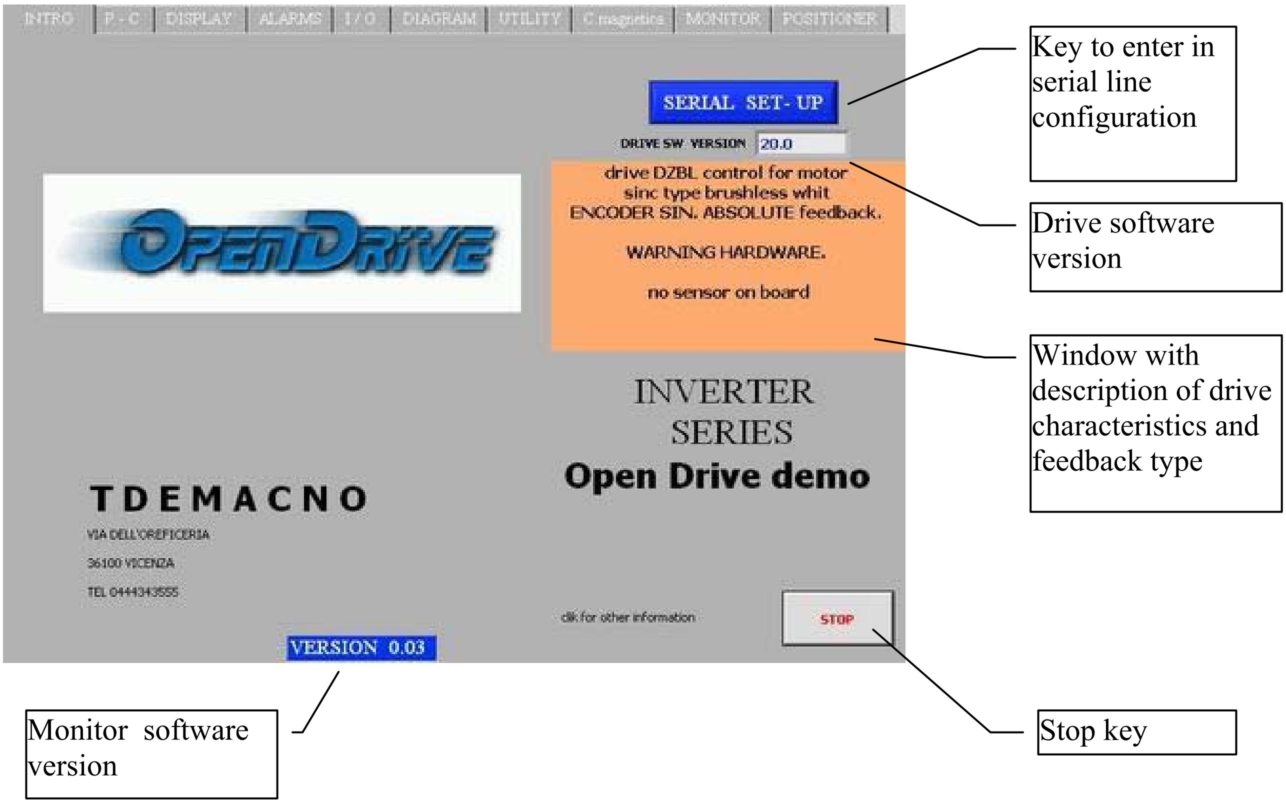
Note: the supervisor program uses the Modbus RTU communication protocol.

The supervisor program can work in "**OFFLINE**" mode, to allow the setting and saving of parameters configurations in the hard disk without having a drive connected to the serial line. To work in "OFFLINE" mode check the "Serial state" checkbox, and then press the "PASS" button.

6. PAGES DESCRIPTION

6.1. INTRODUCTION

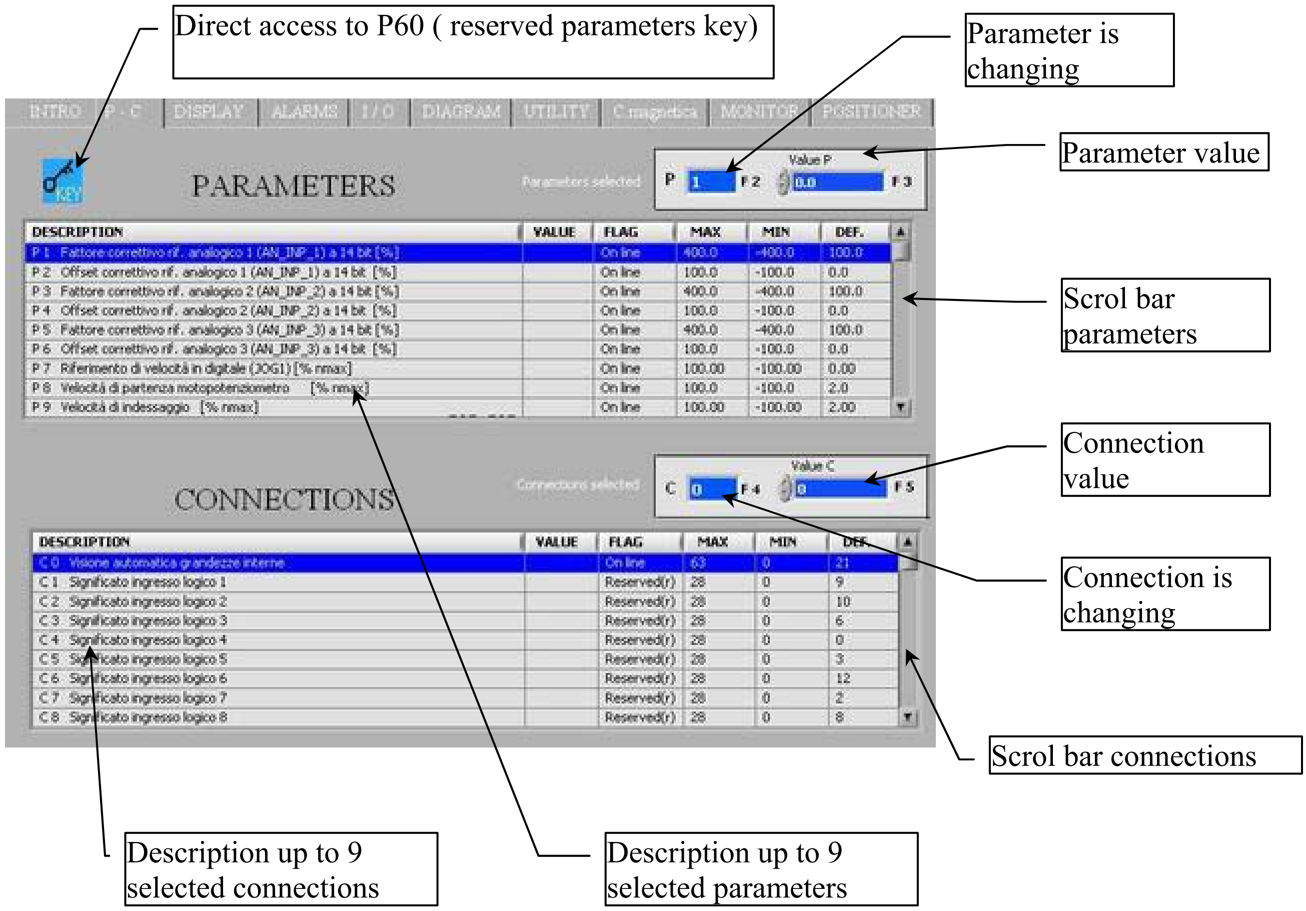
In the first page you can go back to the serial configuration page or terminate the program pressing "ESC".



6.2. P,C

In this page the user can access all the parameters "P" of the drive : the table contains the actual value of the parameter in the RAM of the drive, and then the default value and the limits.
To change the value of one parameter, select it in the table and write the new value in the field above the table, then press enter to confirm.

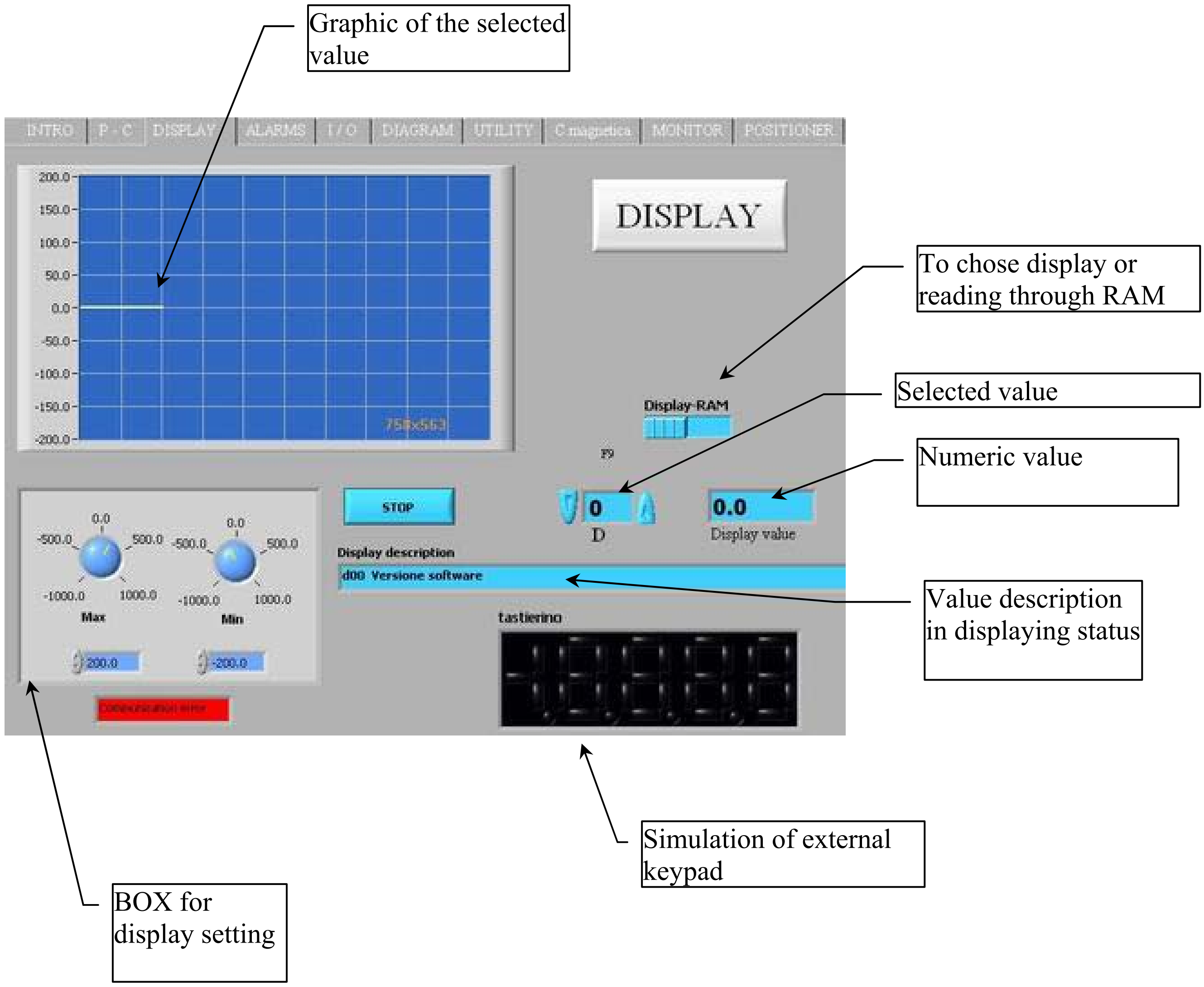
To enable the access to the protected parameters "r", select the "key" button and set the value equal to 95. The same is to read and set the connections "c".
To access the direct commands "dcd" press the button below the table, and then select the desired command.



6.3. DISPLAY

There are displayed some of the internal variables of the drive. The graph shows the value of the variable versus the time.
The max and min displayable value can be selected with the two controls below the graph. The limits can be increased beyond ±200 overwriting the value of the controls.

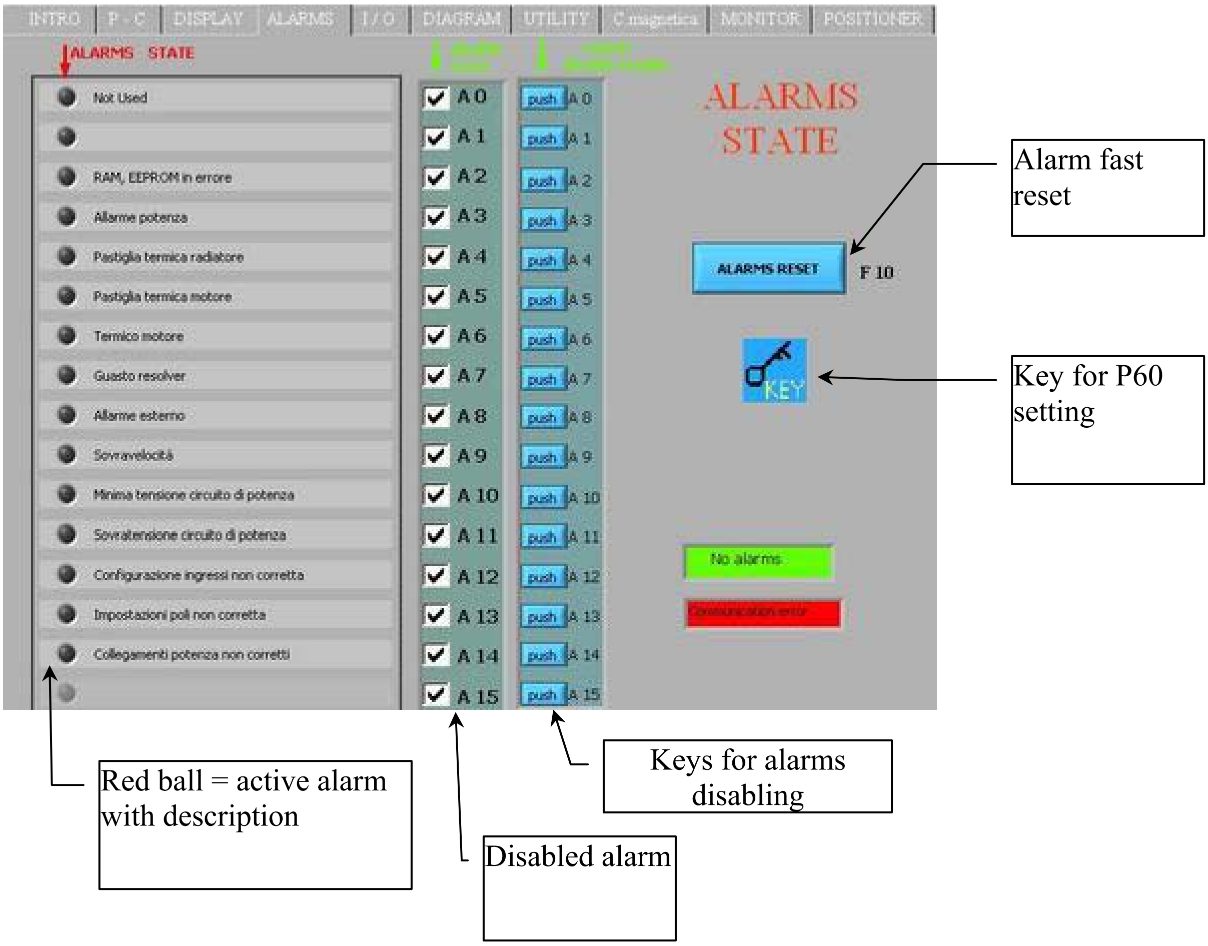
Note: the values are updated very slowly, because of the serial communication time. Thus these values can monitor smooth variations but not fast dynamic changes.



6.4. ALARMS

In this page is displayed the state of the alarms of the drive "Axx".
The alarms can be reset pressing the "Alarms reset" button (command C30=1 in the drive keypad).
Some alarms can be disabled; to do this set the key P60=95 and select the undesired alarms, then press "Send".

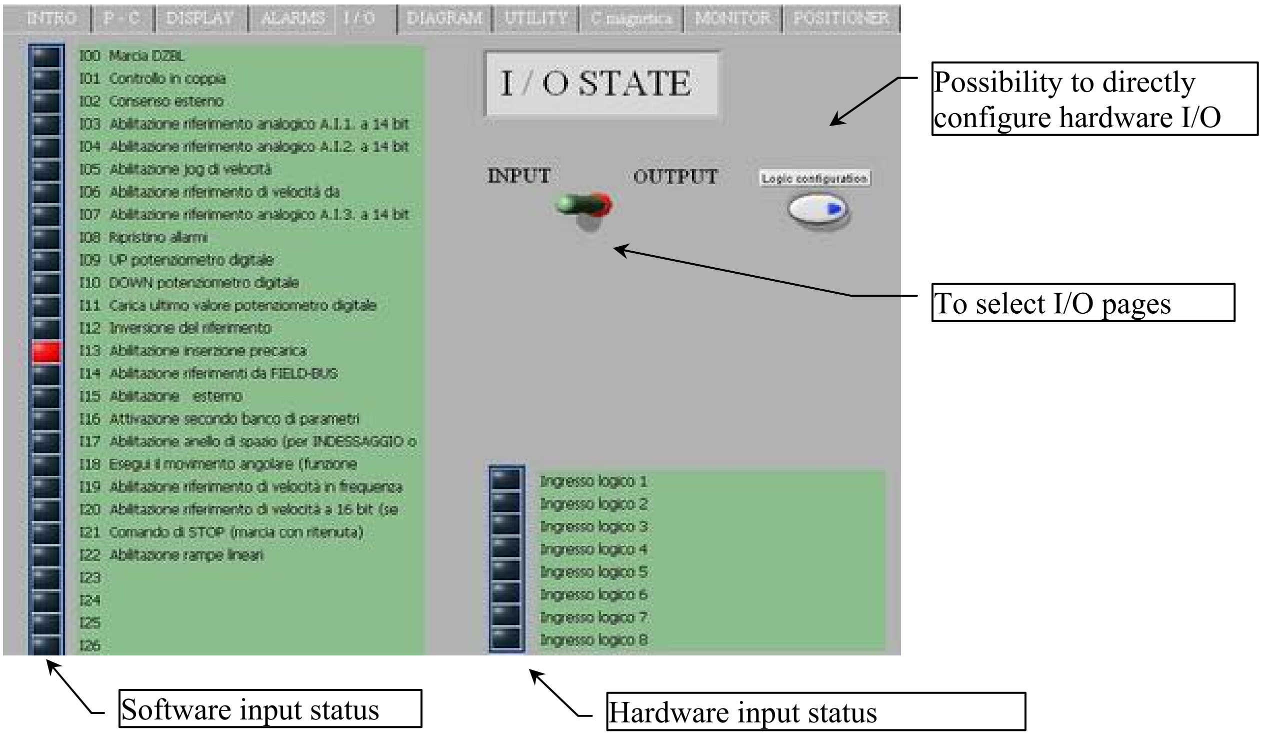
See the user manual to read more informations about the alarms and the disabilitations.



6.5. I / O STATE

This page shows the state of the inputs and the outputs of the drive. Some input and outputs are not used (N.U.).

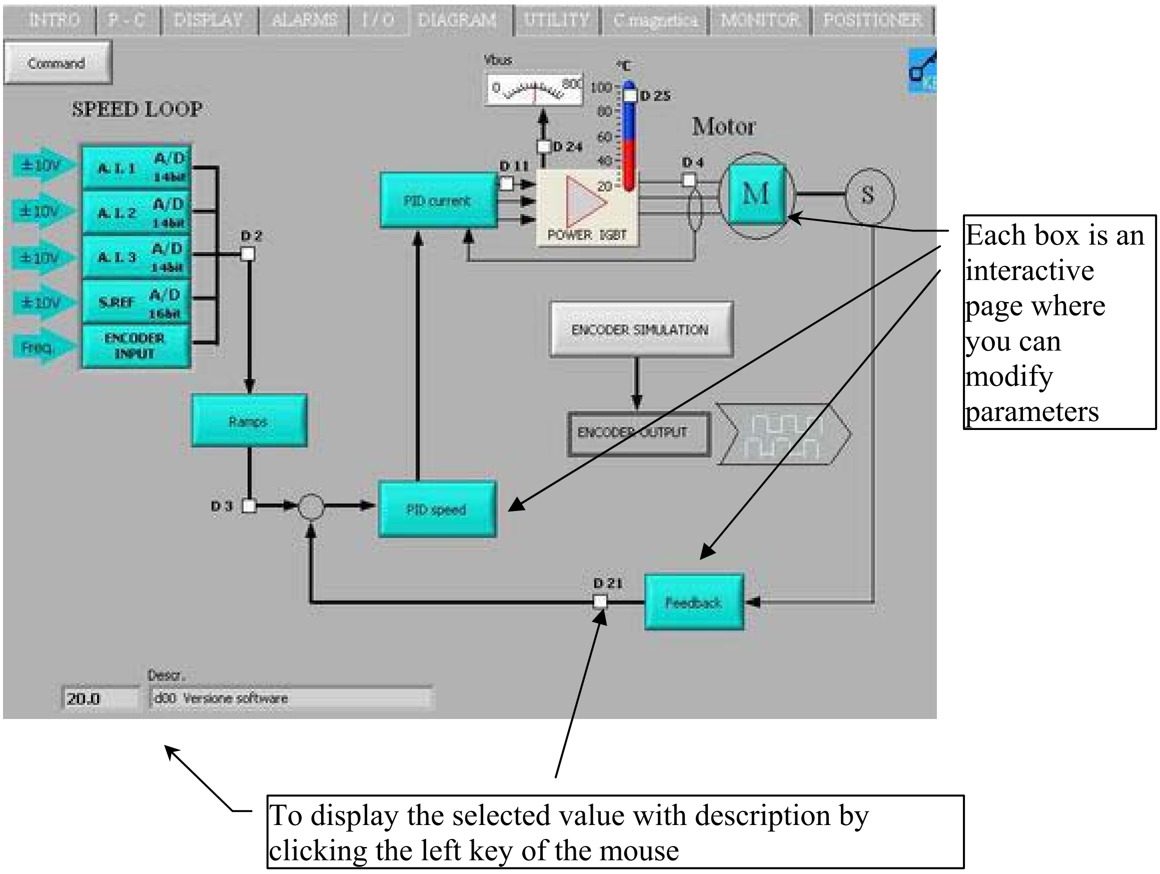
The function “logic configuration” allows the quick configuration of the logic inputs and outputs (note: the change of the configuration is allowed if P50=95 and the drive is in “stop”). In the popup menu are displayed the available functions.



TDE MACNO

6.6. DIAGRAM

This page shows a diagram of the drive-motor system: the user can set quickly the main parameters (press the light buttons?????).
If the mouse arrow stops over one of the parameters, a small windows pops up showing its limits and its default value.
To change the value of the parameters, just write the new value and press “enter



TDE MACNO

6.7. UTILITY

Default data report: creates a report of the default values (parameters P1÷P130 and connections C1÷C80); the format of this file is "html".

RAM data report: creates a report of the RAM values (parameters P1÷P130 and connections C1÷C80); the format of this file is "html".

Alarms report: creates a report of alarms A1÷A15; the format of this file is "html".

Data saving: creates a binary file in which the RAM values (P1÷P130 e C1÷C80) are saved.

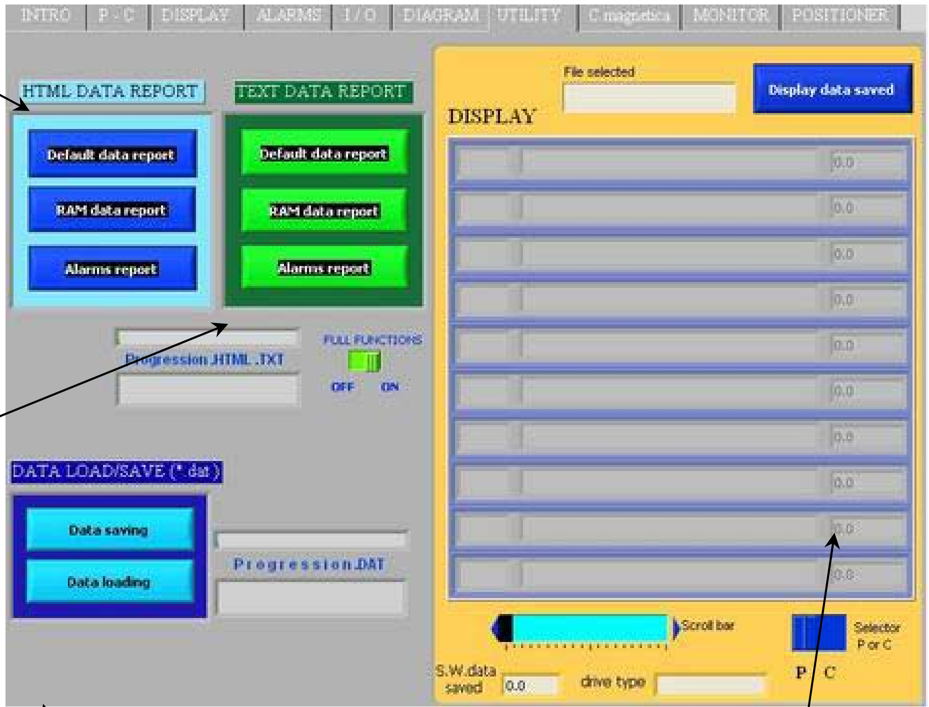
Data loading: uploads to the drive the data previously saved in a binary file using the "Data saving" (P1÷P130 e C1÷C80).

Protected parameters and connections are modified on the drive only if P50=95.
If some error occurs, a warning message is displayed to avoid incorrect settings in the drive.

Display data saved: this function displays the contentes of a binary file previously saved using the "Data saving" function. The first 140 parameters and 80 connections are displayed (description and value).
The switch selector and the scroll bar can be used to select "parameter-connection" and to quickly access the desired data.

Possibility to generate .html files and to save DEFAULT data, data in RAM and ALLARM status

Possibility to generate .txt files and to save DEFAULT data, data in RAM and ALLARM



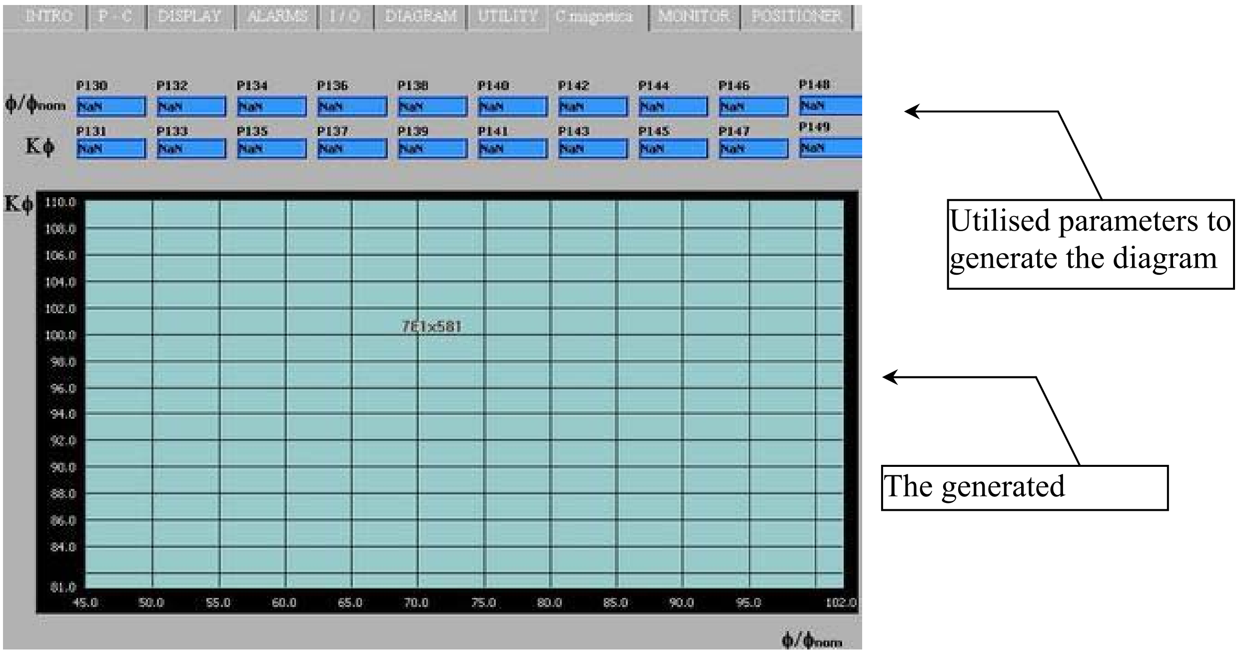
Receipts in dat format are not readable by standard editor progr. To check the data use this tool

First function allows to generate .dat data to customised receipts. The second one download an existing receipt in the drive and check the compatibility with the drive type

6.8. CHARACTERISTIC

This test has the dual purpose of determine the magnetizing current of the motor and his magnetic characteristic (for version DVET)

Using the parameters P71 , P72 , P73 and P74 it is possible to define a three-section working curve by points (so as to be better able to adjust to the desired characteristics).
Points P72 and P74 define the frequency percentage with reference to the maximum working frequency (P68) while points P71 and P73 define the percentage voltage with reference to the maximum working voltage (P69). (for version DFNT)



6.9. MONITOR

With the "MONITOR" function the user can manage the real-time acquisition of the drive internal variables.
THe page is divided into three subpages:

- settings
- acqiosition
- analisys and data processing

In the setup subpage can be set the acuisition parameters: the trigger level, the trigger type, the sample time.

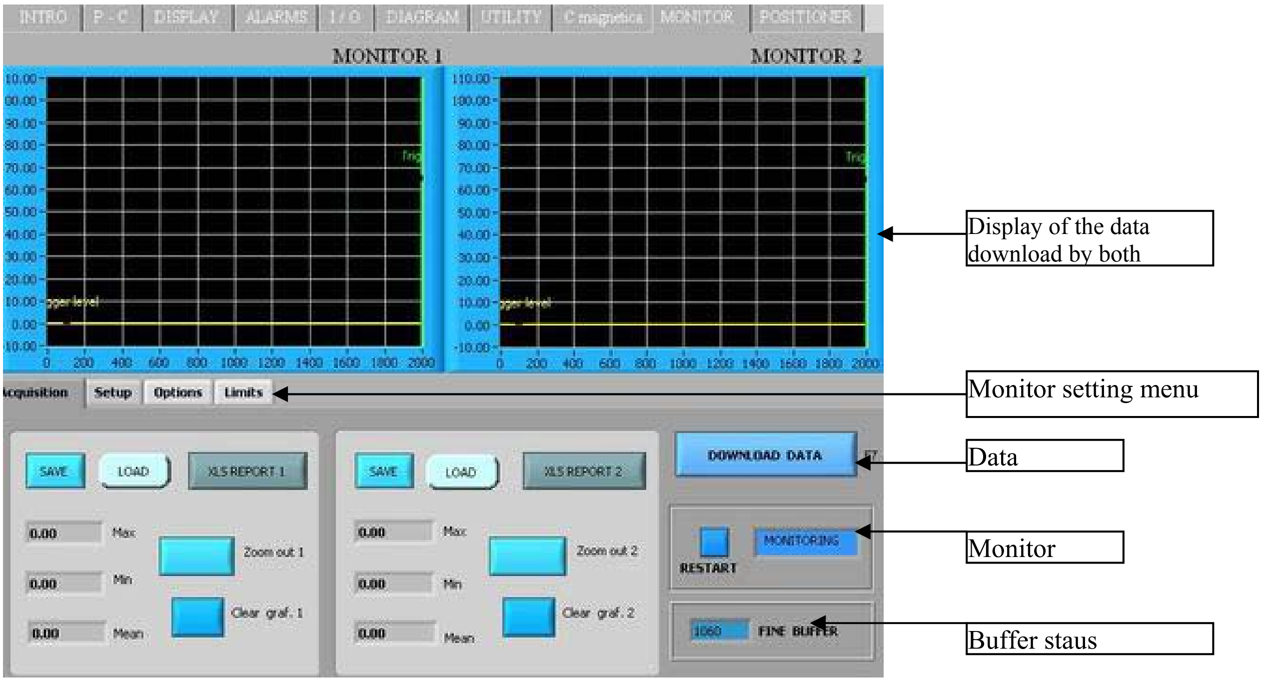
Then open the "acquisition" subpage: press the "restart" button and the acquisition begins in the drive, following the settings.
The box near the "restart" button tells the user if the acquisition has already been triggered.
Once triggered, the acquisition keep on until the number of points after trigger is reached (post trigger points). When the value in the box "fine buffer" stops, press te button "Download data".
Now the data are being downloaded from the drive to the PC (2000 samples per channel).

The user can save the obtained waveshape (SAVE) or can load a previously saved waveshape (LOAD), or can even create a report in "xls" format.

Selectiong the function "Options" the user can hide or unhide the trigger line and the trigger level in the graph. Two vertical and horizontal markers can be enabled to measure the time delta and the amplitude delta of the acquired signals.

There are two different possibilities for the zooming of the graph: window zoom and digital zoom.
In the first case select the desired graph area dragging the mouse arrow.
In the second case write in the fields the desired limit values and the graph will change accordingly.
Acquisition example: we suppose to acquire the waveshape of the current in the U and V phases.

First step, set these two variables on the channel one and two (c15, c16).
Then select the trigger type "level of channel 1", set the desired level (P56, "trigger level") to 50%.
Set the "sample time" (P54); remember to multiply this number by 200µsec to obtain the correct time.
Finally set the number of samples to acquire after the trigger (P55).


INTRO
P - C
DISPLAY
ALARMS
I / O
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MONITOR
POSITIONER
MONITOR 1
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Zoom out 2
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Clear graf. 2
DOWNLOAD DATA
RESTART
MONITORING
FINE BUFFER
Display of the data download by both
Monitor setting menu
Data
Monitor
Buffer staus