HSD

DPL series

3 ÷ 18,5 kW

200 - 400V three phase

User Manual

Thank you for having chosen this HSD product.

Please e-mail us any comments or corrections that might help improve this manual to HSD@HSD.it.
Read this manual thoroughly, especially the Safety Precautions before using the drive.
Throughout the drive's working life, keep this manual safe and at the disposal of all technical personnel associated with the drive.
HSD S.P.A. reserves the right to modify products, data, and dimensions, at any time and without prior notice.
The technical specifications in this manual are provided only for the purpose of describing the drive, and are not legally binding in any way.

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1. Safety Precautions

KEY TO SAFETY SYMBOLS

This symbol identifies procedures or operating conditions that may lead to injury or even death if the specified precautions are not followed.

This symbol identifies procedures or operating conditions that may lead to damage to or destruction of the equipment if the specified precautions are not followed.

This symbol identifies procedures or operating conditions that are essential to the correct functioning of the equipment.

NOTE! This symbol identifies information, procedures or operating conditions of particular relevance.

This section lists the safety precautions that must be followed when using this equipment.
Failure to observe these precautions can lead to serious injury and even death as well as to damage to the drive itself and other equipment connected to it.

Grounding (earthing)

Drives and the motors they control must be electrically grounded in accordance with applicable electrical standards.
It is strictly forbidden to operate the drive without an adequate earth connection.
To avoid electromagnetic interference, the body of the motor must be grounded by a separate cable, independent of the ground cables of other items of equipment.
Drives and input filters generate earth leakage currents in excess of 3.5 mA. Standard EN 50178 specifies that in the presence of earth leakage currents greater than 3.5 mA, the ground cable must be fixed and doubled for redundancy.

Electrical risks

Internal parts of the drive are live during normal functioning.

Make sure that all covers are in place before switching the drive on. Failure to observe this precaution can lead to serious injury or even death.
Never open the drive or remove its covers while it is powered on. Respect the minimum safety delay defined in 'Safety delay before working on the drive' later in this manual before attempting to work on the terminals or inside the drive.
Never work on the motor connections if the drive is powered on.

Mechanical risks

Drives are installed in systems that generate mechanical movement. It is the responsibility of the person in charge of the entire system to ensure that these mechanical movements do not cause danger. Never bypass or tamper with the equipment's safety interlocks or operating limitations.
In the event of a fault, even if the drive has been disabled it may still cause sudden movements if it has not been disconnected from the mains power.
The drive provides no protection against overspeed apart from its software-controlled protection logic.
Always respect the maximum speed declared by the motor manufacturer, irrespective of the maximum frequency the drive can deliver.

Fire and explosion risks

Installation of the drive in hazardous areas and in the presence of flammable substances or combustible vapours or powders can lead to fire or explosion. Install the drive well away from hazardous areas. Whenever any residual risk remains, controlled motors must be explosion-proof.
Never use water-based fire extinguishers to combat fires near the equipment.
Take great care to prevent water or any other fluids from penetrating inside the equipment.

Conformity to CEE directives

Always make sure that systems destined for use in Europe have been designed and built with the safety devices required by European industrial automation directive 89/392/CEE in place and operative before powering on and using the drive or the motor it controls.

Measuring instruments

When using test apparatus like oscilloscopes to take measurements from electrically live equipment, always connect the body of the oscilloscope to ground and always use differential probes. To ensure accurate readings, choose probes and terminals with care, and make sure that the oscilloscope is correctly set up. Refer to the manual provided by the oscilloscope manufacturer for details of how to operate and adjust the oscilloscope correctly .
Never perform dielectric rigidity testing on any parts of the drive. Only use appropriate test instruments (with a minimum internal resistance of 10 kΩ/V) to measure signal voltage.

Other precautions

Make sure that ventilation is always adequate to dissipate heat from the drive.

Never connect up power supplies that operate at voltages outside the drive's permitted voltage range. Excess voltage can damage the internal parts of the drive.

The drive must be installed on a partition made from heat-resistant materials. The drive's cooling fins can reach 90°C during normal operation.

Do not connect capacitive loads like power factor correction capacitors to the drive's output terminals (U2, V2, W2).

Make sure that the motor controlled by the drive is protected against overload.

If the drive is not equipped with suitable filters, and is connected to low voltage public power networks, it may generate radio frequency interference.

Proper use and installation

Modifications or operations not specified in this manual must never be performed without the explicit authorisation of the manufacturer, and even then must only be carried out by qualified personnel. The manufacturer declines all responsibility for the consequences of failure to observe these precautions, which also invalidates the warranty.

Variable frequency inverter drives are electrical devices designed for industrial use.
The manufacturer declines all responsibility for uses of the drive other than those described in this manual.

Only qualified electricians should install and start up the drive. The electrician so doing is directly responsible for ensuring that all applicable safety standards and legislation is complied with.

NOTE!

Storage of the drive for periods longer than two years could lead to malfunctioning of the DC link capacitors. These must be regenerated before the drive can be used. Before starting up the drive, power it on for at least two hours with no load and without enabling output.

NOTE!

The terms 'inverter', 'controller' and 'drive' are interchangeable in industrial automation contexts. This manual may use the terms 'drive' and 'inverter' interchangeably.

1.1. Power and ground connections

TN and TT mains power supplies

HSD drives are designed for use with standard three phase mains power supplies, symmetrical with respect to ground.

Single phase drives must be connected to one phase, neutral and ground. Three phase drives must be connected to all three phases plus ground.

IT mains power supplies

In the case of an IT mains supply, always use a star/delta transformer with secondary wiring referenced to ground.

Attenzione!

If IT mains power is used, loss of insulation in one of the other devices connected to the same circuit can cause the drive to malfunction if no star/delta transformer is provided.

2. General Description

DPL drives offer a perfect combination of performance, functional simplicity and compact dimensions.
They are specifically designed for use in applications that demand high levels of performance and reliability, dynamic response and ease of operation.
DPL drives are designed for use with three phase power supplies from 230 to 460 V, and to control motor between 3 and 18.5 kW (400 V) and from 4 to 25 HP (400 V).
The drive rectifies the voltage of the mains power supply to obtain an intermediate circuit voltage, then uses an inverter bridge applying sinusoidal PWM modulation to generate a three phase power supply with variable voltage and frequency permitting regular, smooth motor control even at very low speeds.

Feed voltages to the various control cards are obtained from a switching power supply that also draws its power from the intermediate circuit.
The inverter bridge is based on IGBT (Insulated Gate Bipolar Transistor) devices. Output is protected against short circuits between the phases and to ground. If more than one motor is driven in parallel by a single drive (obviously of adequate power) motors can be switched in and out independently even during normal drive functioning (see 'The inverter bridge' in the 'Electrical Connections' section).
If the motors used are not specifically designed for inverter control, a drop in output current of around 5 - 10% must be allowed for. If nominal torque is demanded from such a motor at low speeds, an auxiliary motor cooling fan will be necessary to dissipate the heat generated. If the necessary cooling assistance cannot be provided, then the motor will have to be over-sized. In either case the user should contact the technical service of the motor manufacturer for further information.
If a motor has to function at a frequency greater than its nominal frequency, the user should again contact the manufacturer's technical service to ascertain what mechanical problems (bearing wear, balancing problems, etc.) could be incurred.

DPL drives can be controlled in a number of ways

- via their control terminals
- using the control keys and display
- over an RS 485 serial line
- using a standard PC control program

NOTE!

The electronic control circuit terminals are electrically separate from the power circuit terminals.

2.1. Standard functions

- Reduced motor noise thanks to special PWM control technology.
- Output protected against short circuits between phases and to ground.
- Protection against over-current, over-voltage and under-voltage.
- Ability to withstand mains power outages of up to 15 ms.
- Sinusoidal output current from sinusoidal PWM.
- Smooth, controlled motor rotation even at very low speeds.
- Programmable slip compensation to minimise load-related speed variation.
- Manual or automatic low speed voltage boost.
- Automatic voltage and frequency control in case of overload to avoid motor stalling.
- Keypad or RS 485 serial line parameter control.
- Referencing with 0...10 V, -10...10 V, 0...20 mA, 4...20 mA analog signal, or via serial line.
- Programmable DC braking.
- Wide selection of V/f ratios.
- Overload level control.
- Non-volatile memory for the last 4 alarm event messages; messages not lost even if power is switched off.
- Choice of open loop or closed loop functioning.
- RS 485 serial line control.
- IP 23 or IP 40 protection rating with special covers (supplied) fitted.

- 4 sets of linear or ‘S’ acceleration/deceleration ramps.
- 8 multi-speeds.
- Drive potentiometer with or without memory.
- Independent PID function.
- Critical frequency skipping.
- DCBUS control overvoltage prevention.
- Maximum output frequency 500Hz.
- PWM regulation up to 18 kHz.
- 150% overload for 60 secs. every 10 minutes.
- Integrated EMI filter (class A or B).
- 6 programmable digital inputs.
- 1 TTL/HTL encoder input that becomes +2 digital inputs.
- 2 NO/NC programmable relay outputs.
- 1 analog input for 0...10 V, 0...20 mA, 4...20 mA signals.
- 1 differential analog input for 0...10 V, 0...20 mA, 4...20 mA signals.
- 1 +/- 10V dc analog output.
- 2 programmable digital outputs.
- Integrated braking unit.

Options

- → Field Bus options.
- → E^2PROM key for saving custom settings for specific applications.
- → Remote keyboard kit.
- → Serial keyboard.
- → Class A or class B EMC filter
- → External braking resistance.

3. Description, Components and Specifications

3.1. Storage and transport

3.1.1 General

DPL drives are carefully packed for shipment. Transport must be undertaken using adequate means for the weights involved. Respect all instructions and symbols printed on the packaging. The same applies to drives removed from their transport packaging for installation in control cabinets.

Perform the following checks as soon as you receive your drive.
Check that the packaging has not been visibly damaged.
Check that the details on the delivery bill correspond to those of the original order.

Unpack the drive carefully and perform the following checks.
Check that no part of the drive has been damaged during transport.
Check that the drive delivered corresponds to that ordered.

If any damage is found, or if the drive is either incomplete or incorrect, notify the supplier's sales department immediately.
The drive must only be stored in dry places and within the specified storage temperature range.

NOTE!

Excessive temperature variations can cause condensation to form inside the drive. While this may be acceptable under certain storage conditions (see 'Ambient conditions and standards'), the presence of condensation is absolutely unacceptable under normal drive operating conditions. Before powering your drive on for the first time, always make sure that there is no condensation inside it!

3.1.2 Drive identification

The drive's basic technical details are shown in its model identification and on its data plate.

Example:

	Power*	Option	Filter
DPL	**055**		**A**
Series with 3 x 230...460 Vac -15% +10% 50/60Hz +/-5% power supply	**030** = 3 kW **040** = 4 kW **055** = 5.5 kW **075** = 7.5 kW **110** = 11 kW **150** = 15 kW **185** = 18.5 kW	with RS485 with opto-isolated RS485 with provision for Field Bus options	**X =** no filter **A =** integrated class A[1] filter Power / Size 1 / Size 2 3 kW / X 4 kW / X 5.5 kW / X[2] 7.5 kW / - / X 11 kW / X 15 kW / X[2] 18.5 kW / - **B =** external class B filter

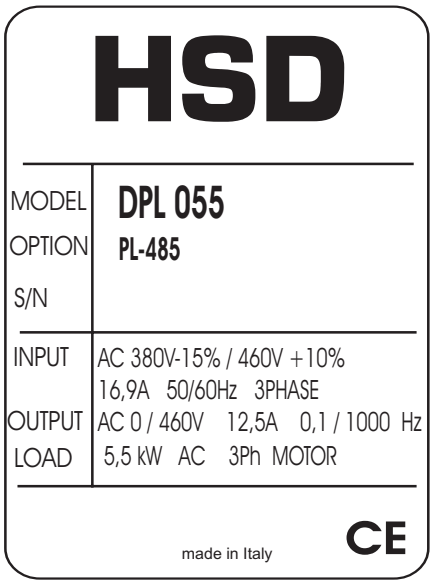
*Power values refer to a voltage of 400V; [1] EMC filter to EN55011 Class A standards; [2] Under development.

Choose a drive to suit the nominal current of the controlled motor. The drive's nominal output current must be equal to or greater than that required by the controlled motor.

The speed of an asynchronous motor depends on the number or terminal pairs it has and on its operating frequency (as specified on the data plate and in the catalogue). If a motor has to be run above its nominal speed, consult the manufacturer's technical service to ascertain what mechanical problems may be incurred (bearing wear, balancing problems, etc.). Also contact the manufacturer's technical service to ascertain what thermal problems may be incurred if the motor has to be run at a frequency below approximately 20 Hz (e.g. insufficient cooling if no auxiliary ventilation is provided).

3.1.3 Data plate

Check that the specifications on the drive's data plate correspond to the original order.



3.2. Component identification

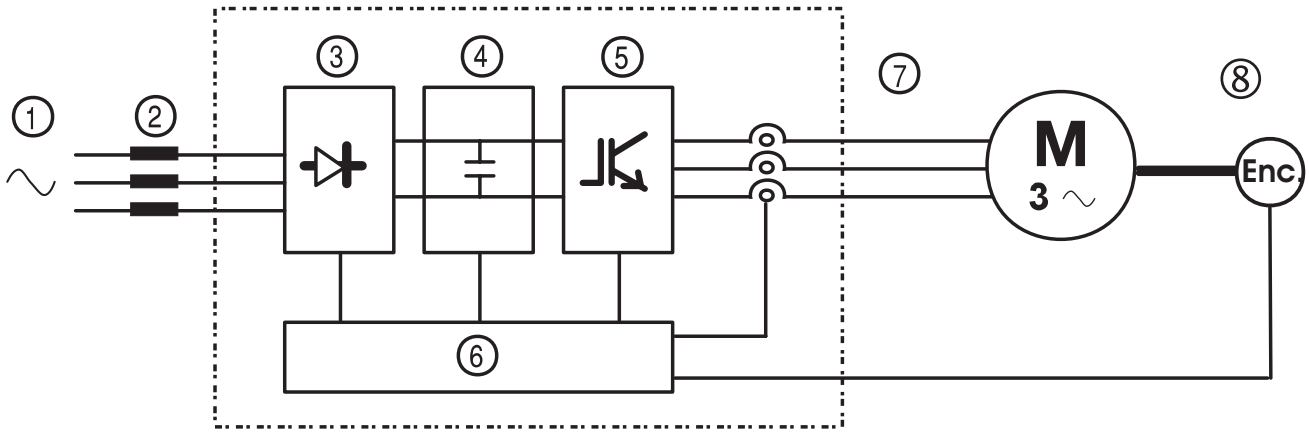


Figure 3.2.1: Basic schematic of a frequency inverter

Inverters convert a constant frequency, constant voltage mains supply into DC voltage. From this DC voltage, they then generate a three phase AC supply with variable voltage and frequency. This variable three phase power enables smooth speed control of three phase asynchronous motors.

1 Mains supply: 230 V – 460 V three phase.

2 Mains choke (see 'Chokes and filters')

3 Rectifier bridge.
Uses full wave technology to convert AC into DC voltage.

4 Intermediate circuit.
- Comprises precharge resistors and smoothing capacitors.
- DC voltage (U_{DC}) = 1.41 x mains line voltage (U_{LN}).
- Braking unit also integrated in this stage to control external braking resistance.

5 IGBT inverter bridge.
Converts DC voltage into three phase AC voltage with variable amplitude and frequency.

6 Configurable control section.
Comprises all the necessary cards for the control and regulation of the closed or open loop power section. Commands, references and feedbacks are all connected to these cards.

7 Output.
AC voltage variable between 0 and 94% of mains power (U_{LN}).

8 Speed feedback (e.g. encoder, tachometer, serial line etc.).

3.3. General specifications

3.3.1 Ambient conditions and standards

Table 3.3.1.1: Ambient conditions and standards

AMBIENT CONDITIONS		
Ambient temperature TA	[°C]	0…+40; +40…+50 declassed
	[°F]	32…+104; +104…+122 declassed
Installation environment		Pollution level 2 or better (out of direct sunlight, free from vibration, dust, corrosive or inflammable gases, mist, oil vapour and water droplets; salt mist to be avoided).
Installation altitude		Up to 1000 m (3281 feet) above sea level. For installations at greater altitudes, declass current by 1.2% for every additional 100 m (328 feet) of altitude.
Temperature:		
Functioning [1]		0…40°C (32°…104°F)
Functioning [2]		0…50°C (32°…122°F)
Storage		-25…+55°C (-13…+131°F), EN 50178 class 1K4
		-20…+55°C (-4…+131°F), for drives with keypads
Transport		-25…+70°C (-13…+158°F), EN 50178 class 2K3
		-20…+60°C (-4…+140°F), for drives with keypads
Airborne humidity:		
Functioning		From 5% to 85%, from 1 g/m^3 to 25 g/m^3 non-condensing, non-freezing (EN 50178 class 3K3)
Storage		From 5% to 95%, from 1 g/m^3 to 29 g/m^3 (EN 50178 class 1K3)
Transport		95 % [3] 60 g/m [4]
		Slight condensation may form occasionally and for short periods only while the drive is not in use (EN 50178 class 2K3).
Air pressure:		
Functioning	[kPa]	From 86 to 106 (EN 50178 class 3K3)
Storage	[kPa]	From 86 to 106 (EN 50178 classe 1K4)
Transport	[kPa]	From 70 to 106 (EN 50178 class 2K3)
STANDARDS		
General conditions		EN 61800-1, IEC 143-1-1.
Safety		EN 50178, UL 508C
Climatic conditions		EN 60721-3-3, class 3K3. EN 60068-2-2, test Bd.
Distances and leakage levels		EN 50178, UL508C, UL840. Input circuit overvoltage class III; pollution rating 2
Vibrations		EN 60068-2-6, test Fc.
EMC		EN 61800-3 (see the "EMC Guide")
Input voltage		IEC 60038
Protection rating		IP20 conforming to EN 60529
		IP40 for cabinets with external heat sink
Certification		CE

1) Ambient temperature = 0 ... 40°C (32°...104°F)
Over 40°C (104°F) and up to 50°C: 2% reduction in output current per K.

2) Ambient temperature = 0 ... 50°C (32°...122°F):
20% reduction in output current.

3) Higher airborne humidity values with temperature at 40°C (104°F) or if drive temperature suddenly rises between -25 ...+30°C (-13°...+86°F).

4) Higher airborne humidity values if drive temperature suddenly drops between 70...15°C (158°...59°F).

Disposing of the drive

DPL drives must be disposed of as electronic waste in compliance with national legislation.

The front covers are made from recyclable ABS.

3.3.2 Mains input and drive output connections

DPL drives must be connected to a mains supply capable of providing symmetrical short circuit power better than or equal to the values given in table 3.3.2.1. See 'Chokes and filters' for information on the addition of mains chokes.
See table 3.3.2.1 for the permitted mains voltages. Cyclical phase direction is irrelevant. Voltages below the minimum tolerance threshold cause the drive to lock.
The drive can be restarted automatically after an alarm condition occurs.

NOTE!

Under certain circumstances it may be essential to add mains chokes and EMI filters to the drive input. Refer to the 'Chokes and filters' section.

DPL drives and mains input filters have earth leakage currents greater than 3.5 mA. Standard EN 50178 requires that in the presence of earth leakage currents greater than 3.5 mA, the ground connection (to the PE terminal) must be fixed and double for redundancy.

Table 3.3.2.1: I/O specifications for drive models in Kw/Hp at 400 V

DPL drive model		030	040	055	075	110	150	185
O U T P U T								
Drive output (IEC 146 class 1) Continuous duty (@ 400 Vac)	[kVA]	5,00	6,50	8,50	12,00	18,00	24,00	28,00
Drive output (IEC 146 class 2) 180% overload for 40 s every 10 mins (@ 400Vac) [for 18.5 kW, 150% for 40 s every 10 mins (@ 400Vac)]	[kVA]	4,50	5,90	7,70	10,90	15,70	21,00	24,40
P_N mot (recommended motor power):								
@ U_{LN} = 230 Vac; f_{SW} = default; IEC 146 class 1	[kW]	1.5	2.2	3	4	6.6	7.5	11
@ U_{LN} = 230 Vac; f_{SW} = default; IEC 146 class 2	[kW]	1.5	2.2	3	4	6.6	7.5	11
@ U_{LN} = 230 Vac; f_{SW} = default; IEC 146 class 1	[Hp]	2	3	4	5	8.8	10	14.7
@ U_{LN} = 230 Vac; f_{SW} = default; IEC 146 class 2	[Hp]	2	3	4	5	8.8	10	14.7
@ U_{LN} = 400 Vac; f_{SW} = default; IEC 146 class 1	[kW]	3	4	5.5	7.5	11	15	18.5
@ U_{LN} = 400 Vac; f_{SW} = default; IEC 146 class 2	**[kW]**	**3**	**4**	**5.5**	**7.5**	**11**	**15**	**18.5**
@ U_{LN} = 460 Vac; f_{SW} = default; IEC 146 class 1	[Hp]	3	5	7.5	10	15	20	25
@ U_{LN} = 460 Vac; f_{SW} = default; IEC 146 class 2	[Hp]	3	5	7.5	10	15	20	25
Maximum output voltage U_2	[V]	0.94 x U_{LN} (AC input voltage)						
Maximum output frequency f_2	[Hz]	500						
Nominal output current I_{2N}:								
@ U_{LN} = 230..400 Vac; f_{SW} = default; IEC 146 class 1	[A]	0,3	0,4	0,6	0,8	1,1	1,5	1,8
@ U_{LN} = 230..400 Vac; f_{SW} = default; IEC 146 class 2	**[A]**	**7.0**	**9.0**	**12.5**	**17.0**	**25.0**	**32.0**	**40.0**
@ U_{LN} = 460 Vac; f_{SW} = default; IEC 146 class 1	[A]	0,3	0,3	0,5	0,6	23,9	1,2	1,6
@ U_{LN} = 460 Vac; f_{SW} = default; IEC 146 class 2	[A]	6.1	7.9	10.9	14.8	21.7	27.8	34.8
Switching frequency f_{SW} (default)	[kHz]	12						
Switching frequency f_{SW} (higher)	[kHz]	18						
Reduction factor:								
Voltage factor K_Va 460 Vac		0.87	0.87	0.87	0.87	0.87	0.87	0.87
Ambient temperature factor K_T		0.8 @ 50°C (122°F)						
Switching frequency factor K_F		0.82 for f_{sw} values above 12 kHz						
I N P U T								
AC input voltage U_{LN}	[V]	230 V -15% … 460 V +10%, Trifase						
AC input frequency	[Hz]	50/60 Hz ±5%						
AC input current for continuous duty I_N :								
- Connections with input choke								
@ 230 Vac; IEC 146 class 1	[A]	5.5	7	9.5	14	25.4	32.6	40.7
@ 400 Vac; IEC 146 class 1	[A]	6.2	7.9	10.7	15.8	28.8	36.8	46
@ 460 Vac; IEC 146 class 1	[A]	5.4	7	9.3	13.8	25	32	40
- Connections without input choke								
@ 230 Vac; IEC 146 class 1	[A]	7.9	11	15.5	21.5	28.8	36.8	46
@ 400 Vac; IEC 146 class 1	[A]	9	12	16.9	24.2	32.5	41.6	52
@ 460 Vac; IEC 146 class 1	[A]	7.8	10.4	14.7	21	28.3	36.2	45.2
Overvoltage threshold	[V]	400 VDC (for a 230 VAC mains) 800 VDC (for a 400 VAC mains) 800 VDC (for a 460 VAC mains)						
Undervoltage threshold	[V]	230 VDC (for a 230 VAC mains) 250 VDC (for a 400 VAC mains)						

3.3.3 Mains input current

The mains input current to the drive depends on the duty status of the controlled motor.

NOTE!

Table 3.3.2.1 shows nominal continuous duty values (IEC 146 class 1) with typical output power factors for each model of drive.

3.3.4 Output and connections

The output from DPL drives is protected against short circuits between phases and to ground.
It is forbidden to connect any external voltage to the drive's output terminals! Nevertheless, once a motor has been disabled, it can be disconnected from the drive output while the drive is still functioning.

The nominal continuous output current value (I_{CONT}) depends on mains voltage (K_V), ambient temperature (K_T) and switching frequency (K_F) if higher than the default frequency:

$I_{CONT} = I_{2N} \times K_V \times K_T \times K_F$ (see table 3.3.2.1 for reduction factors), with a maximum overload capacity of

$I_{MAX} = 1.8 \times I_{CONT}$ for 40 seconds every 10 minutes or

$I_{MAX} = 1.5 \times I_{CONT}$ for 60 seconds every 10 minutes.

NOTE!

I_{CONT}, which is derived from I_{2N} according to the settings made on the drive and the formula given above, can be read from parameter **d.950_**.

Recommended motor power

The combinations of nominal motor power and drive model specified in table 3.3.2.1 is based on the use of motors whose nominal voltages correspond to that of the mains power supply.
If the motors involved have other voltages, select the drive model on the basis of nominal motor current.

3.3.5 The regulation and control section

2 analog inputs

1 programmable analog input:
- in voltage -10/+10 V, 0.5 mA max, 10 bit (+ sign)
- in voltage 0-10 V, 0.5 mA max, 10 bit (default)
- in current 0...20 mA, 10 V max, 10 bit
- in current 4...20 mA, 10 V max, 10 bit

1 programmable differential analog input:
- in voltage -10/+10 V, 0.5 mA max, 10 bit (+ sign)
- in voltage 0-10 V, 0.5 mA max, 10 bit (default)
- in current 0...20 mA, 10 V max, 10 bit

in current 4...20 mA, 10 V max, 10 bit

6 digital inputs 6 programmable digital inputs: 24V / 6 mA

Digital input 1 = Run (default)

Digital input 2 = Reverse (default)

Digital input 3 = Frequency select 1 (default)

Digital input 4 = Frequency select 2 (default)

Digital input 5 / Input B+ Encoder (J5 for B-)

Digital input 6 / Input A+ Encoder (J4 for A-)

4 digital outputs 3 programmable digital outputs:

Open collector output 1 = Drive ready (default)

Open collector output 2 = Steady State (default)

Relay type output (A) = Motor running (230 Vac - 0.2 A / 30 Vdc – 1A)

1 digital alarm output:

Relay type output (B) = Alarm state (230 Vac - 0.2A / 30 Vdc - 1A)

Auxiliary voltages from drive terminals

Capacity: + 24 Vdc, 300 mA

+ 10 Vdc, 50 mA

- 10 Vdc, 50 mA

Tolerance: + 24 Vdc ±5 %

+/- 10Vdc ±3 %

3.3.6 Precision

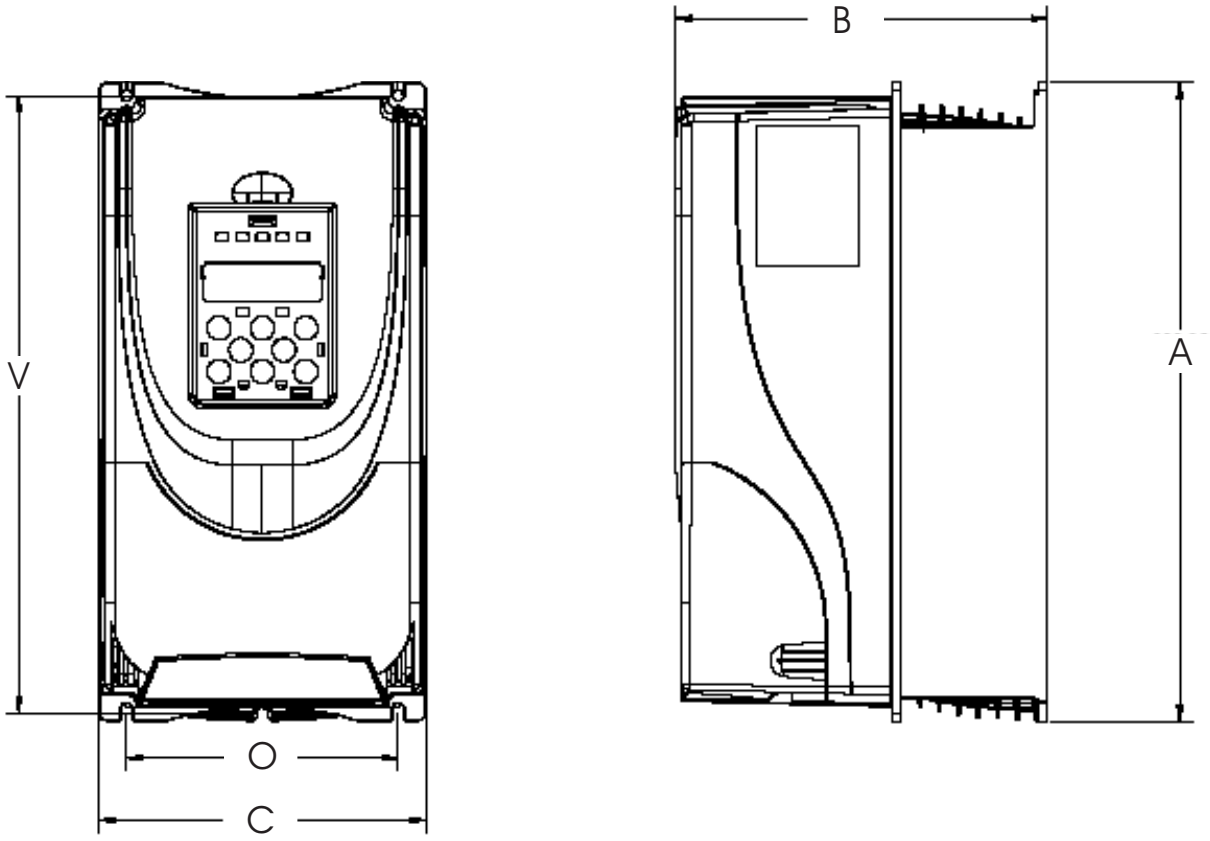
Reference:	Resolution of reference from analog inputs to terminals (full scale function and 1 bit for sign)	0.1 Hz
	Resolution of reference from serial line	0.01 Hz

Open loop speed: Load related speed loss can be partly compensated for using slip compensation.

Precision nevertheless also depends on the characteristics of the controlled motor (number of poles and torque/speed characteristics).

4. Installation

4.1. Mechanical and installation specifications



DPL	Dimensions			Fixing holes		Minimum ventilation gaps		
MEASUREMENTS in mm	A	B	C	O	V	Above and below	Sides	Front
Size 1	260.0	165.0	145.0	120.0	251.0	150	25	50
Size 2	323.0	188.2	165.5	137.6	315.5	150	25	50

Maximum permitted angle to the vertical is 30°.

Respect the distances given in this manual when installing the drive. Use only appropriate tools and equipment. Incorrect handling and the use of improper tools can damage the drive.

Do not install other items of equipment that generate heat near the drive.

Check the terminal connections for tightness after a few days of operation.

Internal ventilation is provided by a fan with a micro-controller. The fan functions for one minute

intervals when the drive is switched on, and for one minute after the stop command is given. During normal functioning, the micro-controller starts the fan whenever the temperature inside the drive so requires.

4.2. Motors

DPL drives are designed for the open or closed loop control of standard asynchronous motors.

4.2.1 Asynchronous AC motors

Choose an asynchronous motor with a minimum slip of 3-5 %, with a single cage rotor, designed for use with an inverter.
a) Minimum motor size. Nominal motor current must not be less than 30% of nominal drive current @ 400 V.
b) General purpose motors (i.e. motors not specifically designed for inverter control) must only be used if an additional output choke is fitted.
c) We recommend that you use special motors with reinforced insulation designed for inverter control. Motors of this type do not require the drive to be fitted with an output choke.

The electrical and mechanical specifications of standard asynchronous motors refer to a specific functioning range. When controlling motors of this type with an inverter, always bear the following points in mind.

Can standard asynchronous motors be used?

DPL series drives can be used with standard asynchronous motors. Certain characteristics of these motors, however, have a major influence on performance. The motor's torque/speed specifications, available from the motor manufacturer, must be used to qualify the complete system comprising drive and motor.
Motor manufacturers also take greater care over the insulation of motors designed specifically for use with inverter drives.

Star or delta connection?

Motors can be wired up either in a star or a delta configuration. Star wired motors are generally easier to control and star wiring is therefore to be preferred under most circumstances.

Cooling

Asynchronous motors are normally cooled by a fan keyed directly on to the motor shaft. Care must be taken, however, because fan efficiency drops at low motor speeds and the motor may receive insufficient cooling. Discuss motor operating conditions with the motor manufacturer's technical service to ascertain whether it is necessary to provide additional ventilation (forced cooling).

Functioning at speeds above nominal speed

If a motor has to operate above its nominal speed, contact the manufacturer's technical service to ascertain what mechanical problems (bearing wear, balancing problems etc.) and what electrical losses may occur as a result.

Motor specifications you must know for inverter control

Motor data plate specifications:

- Nominal motor voltage
- Nominal motor current
- Nominal motor frequency
- Nominal motor speed
- Power factor (Cos φ)
- Number of terminal pairs
- Connection type (star/delta)

Motor protection

Use of Klixon protectors in motor windings

The contacts of the Klixon overheating protectors can be used to disable the motor either via auxiliary control circuits or using the input to signal an alarm condition.

NOTE!

The motor's Klixon interface circuit can be considered and managed to all intents and purposes like a signalling circuit. Connections to the motor's Klixon protectors must therefore use a shielded twisted pair cable laid if possible not parallel with other motor cables or at a distance of at least 20 cm (8 inches) from them.

Drive current limitation

Current limitation can be used to protect the motor against damaging overloads. To do so, the current limit and overload control parameters must be set so that current to the motor always remains within the motor's acceptable limits.

NOTE!

Bear in mind that current limitation can only protect the motor against overheating caused by overload, and not against overheating caused by inadequate cooling.

Always fit the windings of motors destined for use at low speeds with the necessary over-heating protectors!

Output chokes

In certain cases output chokes may be needed to protect the winding insulation of standard motors. See 'Output chokes'.

5. Electrical Connections

5.1. Accessing the electrical terminals

NOTE!

Observe the safety precautions given elsewhere in this manual. The terminal covers can be removed without the use of force.

Disconnect the drive from the mains and wait for the capacitors to discharge before you start work on the power or control terminals.
The red LED to the left of the terminals B1, B2 and B3 signals that the capacitors still hold charge.

Figure 5.1.1: Accessing the power and control terminals

Remove the terminal cover to access the control card terminals.

5.2. The power section

Table 5.2.1.1: Power terminal identification and functions

NAME	FUNCTION	MAX
L1 L2 L3	Three phase power	Table 3.3.2.1.
-	DC stage negative	
R	Connections for braking resistance	
+	DC stage positive	
U V W	Motor connection	
PE	**Make ground connection to copper plate.**	

See figure 5.1.1: Accessing the power and control terminals

5.2.1 Power terminal wire cross sections

DPL		030	040	055	075	110	150	185
L1,L2,L3,U,V,W	mm^2	2	4	4	4	8	10	10
+,R,-	mm^2	2	4	4	4	8	10	10
PE	mm^2	2	4	4	4	8	10	10

NOTE! Use only copper wire rated for 75°C.

If the output of a DPL drive short circuits to ground, current in the motor's ground wire may reach up to twice nominal current I_{2N}.

5.2.2 The rectifier bridge and intermediate circuit

Mains power is rectified and filtered by capacitors. All DPL drive models incorporate a precharge resistance diode bridge.

If over-voltage ('OV' signal) or under-voltage ('UV' signal) occurs in the intermediate circuit, no power can be drawn from it because the inverter bridge locks.

During normal functioning, the DC voltage of the intermediate circuit U_{DC} has a value equal to U_{LN} *√2. If the motor is turned by its load (as occurs during deceleration or braking), power flows into the intermediate circuit through the inverter bridge. Voltage in the intermediate circuit therefore increases. The inverter bridge locks at a predetermined voltage, and the contacts of the relay programmed to signal an alarm state open.

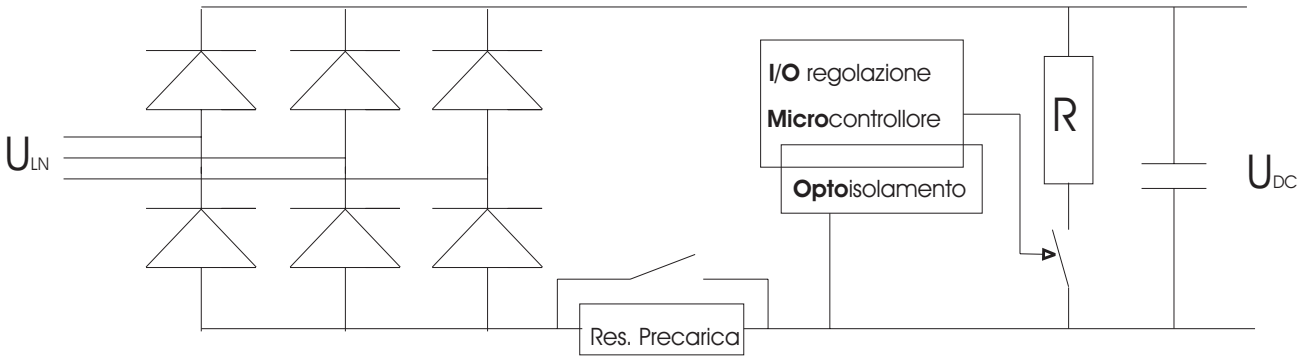


Figure 5.2.3.1 The rectifier bridge and intermediate circuit

The drive can be restarted automatically after an alarm condition.

In certain cases, locking can be prevented by extending the deceleration ramp.

5.2.3 The inverter bridge

The inverter bridge features IGBT (Insulated Gate Bipolar Transistor) technology in all models of DPL drive. The inverter bridge is protected by internal circuitry against over-voltage, over-current, short circuit between phases and short circuit to ground. In the event a fault, the inverter bridge locks and trips the contacts of the relay programmed to signal an alarm state.
The drive can be restarted automatically after an alarm condition.

Inverter bridge protection alarm signalling

Signal	Lock caused by
OV	Overvoltage
OC	Overcurrent, short circuit between phases
OC	Short circuit to ground

Variable voltage output is derived from the intermediate circuit voltage using PWM technology. Special sinusoidal modulation in conjunction with the motor's own inductance produces an extremely good sinusoidal curve for the output current I_2. The voltage/frequency ratio is programmable and can be adapted to suit the motor being controlled.
More than one motor can be connected in parallel to the drive output. Motors may run at different speeds even though they have the same number of terminal pairs, because motor slip can vary with the load applied and motor characteristics may vary too. Motors can also be switched in and out individually, though great care must be taken when doing so.
Switching a motor in or out causes voltage peaks by interrupting an inductive current flow. These voltage peaks do not normally disturb the drive output provided the motor is a low power model and other motors remain connected to the inverter after it is switched out.


Attenzione!

If the motor being switched out is the last motor connected to the drive, make sure that the motor's magnetising current has dropped to zero before switching it out. The best way of doing this is to lock the inverter bridge and disconnect the motor only after a fixed delay calculated to suit the characteristics of the motor, in practice from about 0.5 seconds up to a number of seconds.

Motors can likewise be switched in to an already functioning drive one at a time. If you wish to do so, bear in mind that the instant the motor is connected its inrush current far higher than its nominal current. The drive must therefore be carefully selected so that inrush currents do not exceed the drive's nominal current. You must also consider the overload that the drive is able to cope with if the duty cycle during which the new motor is connected coincides with the limited period for which overload is permitted.

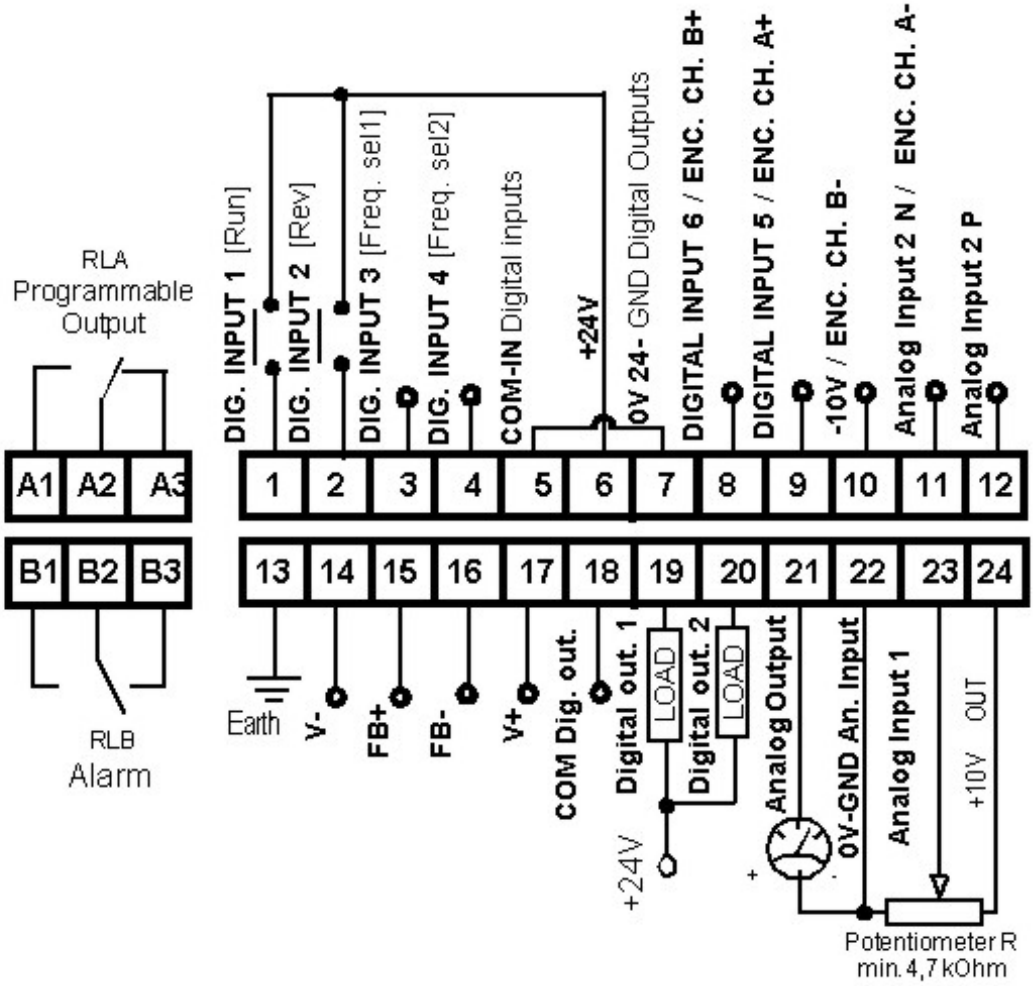

Attenzione!

Outputs from more than one inverter cannot work directly in parallel.

5.3. The control section

5.3.1 The control card

Figure 5.3.1.1: The A404 control card terminals



Connection for PNP command enabling

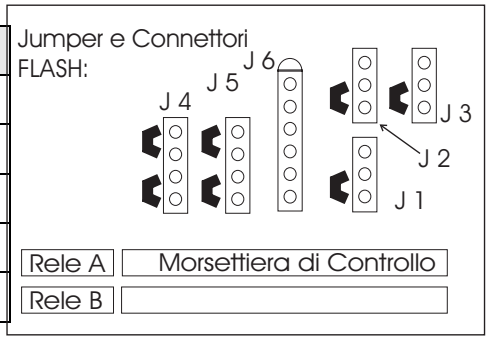
(For NPN commands, connect COM-IN to +24V and use individual commands to switch the inputs to GND.)

Table 5.3.1.1: Connectors and jumpers

Name	Terminal	Function
J1	23	Analog input 1: default voltage (or current) input
J2	12	Analog input 2P : default voltage (or current) input
J3	21	Analog output : default 0-10 V (or +/- 10 V)
J4	11	Selects function of terminal 11: default Analog input 2N (or Enc.A-)
J5	10	Selects function of terminal 10: default -10 V (or Enc.B-)
J6		Programming key connector

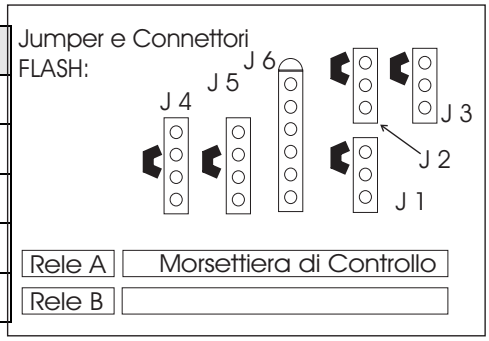
FACTORY CONFIGURATION

Jumper	Terminal	Function	Configuration
J1	23	Analog Input 1	VOLTAGE
J2	12	Analog Input 2P	VOLTAGE
J3	21	Analog Output	0-10V
J4	11	Multifunction input	Analog input 2N
J5	10	Multifunction input	-10V



ALTERNATIVE CONFIGURATION (ALL JUMPERS ARE INDEPENDENT)

Jumper	Terminal	Function	Configuration
J1	23	Analog Input 1	CURRENT
J2	12	Analog Input 2P	CURRENT
J3	21	Analog Output	-10V / +10 V
J4	11	Multifunction input	Encoder Ch.A-
J5	10	Multifunction input	Encoder Ch.B-



5.3.2 Control card terminal identification

Figure 5.3.2.1: Control card terminal identification

Strip 1	*Designazione*	*Funzione* *[Default]*	*Max*
A1	**Digital Output RLA - NO**	Uscita digitale a relè programmabile - [I 102=3**]** Motor running	230V AC 0,2A 125V AC 0,3A (UL rating) 110V DC 0,3A (UL rating) 30V DC 1A (UL rating)
A2	**Digital Output RLA-COM**		
A3	**Digital Output RLA - NC**		
1	**Digital Input 1**	Ingresso digitale programmabile - **[**I 000=1**] R**un	6mA @ +24V
2	**Digital Input 2**	Ingresso digitale programmabile - **[**I 001=3**] Ext Fault**	
3	**Digital Input 3**	Ingresso digitale programmabile - **[**I 002=2**] Reverse**	
4	**Digital Input 4**	Ingresso digitale programmabile - **[**I 003=7**]Freq sel 1**	
5	**COM-IN Digital Inputs**	Alimentazione ingressi digitali	-
6	**+ 24V OUT**	Potenziale + 24 V	+24V / 300mA
7	**0 V 24 - GND Dig. Inputs**	Riferimento 0 V 24 per ingressi digitali	-
8	**Digital Input 6 / B+ Enc.**	Ingresso digitale programmabile - **[**I 005**] /** Canale encoder B+	6mA @ +24V / HTL 24V /17mA -TTL 5V/9mA
9	**Digital Input 5 / A+ Enc.**	Ingresso digitale programmabile - **[**I 004**] /** Canale encoder A+	
10	**+ 10V OUT**	Potenziale + 10 V	+10V / 50mA
11	**Analog Input 2N/A- Enc.**	Ingresso analogico differenziale **[I 210=0] +/-10V/Ch. encoder A-**	+/-10V / 5mA
12	**Analog Input 2P**	Ingresso analogico differenziale (positivo)	

Strip 2	*Designazione*	*Funzione* *[Default]*	*Max*
B1	**Digital Output 3 - NO**	Uscita digitale a relè :ALLARME - [I 103=1**] Alarm State**	230V AC 0,2A 125V AC 0,3A (UL rating) 110V DC 0,3A (UL rating) 30V DC 1A (UL rating)
B2	**Digital Output 3 - COM**		
B3	**Digital Output 3 - NC**		
13	**GROUND REF**	Riferimento di terra per lo schermo dei cavi	-
14	**V-**	Riferimento 0V alimentazione esterna	0V
15	**FB+**	Bus di comunicazione (seriale / CAN) (high)	-
16	**FB-**	Bus di comunicazione (seriale / CAN) (low)	-
17	**V+**	Alimentazione esterna positiva	+11 ..... 30V
18	**COM Digital outputs**	Potenziale comune per uscite digitali (open-collector)	-
19	**Digital Output 1**	Uscita digitale open-collector program. - **[I 100=0] Drive ready**	+50V / 50mA
20	**Digital Output 2**	Uscita digitale open-collector program. - [I 101=**6] Steady state**	
21	**Analog Output 1**	Uscita analogica programmabile - **[I 300=0] Freq out abs**	+/-10V / 5mA
22	**0V - GND Analog input**	Potenziale 0 V 10 per ingressi / uscite analogiche	
23	**Analog Input 1**	Potenziale + 10 V	+/-10V / 0.5mA
24	**+ 10V OUT**	Ingresso analogico in TENSIONE program. - Default: **[0] 0-10V**	+10V / 50mA

Table 5.3.2.1: Maximum wire sections for control card terminals

Rigido / Flessibile / Dim. Conduttori	[mm²] / [mm²] / AWG	0,22-1 / 0,22-1 / 26-18
Flessibile con capocorda a puntale senza / con collare isolante	[mm²]	0,25 - 0,34 / 0,25 - 0,34
Lunghezza dispelatura	[mm]	10

Maximum wire length

Table 5.3.2.2: Maximum wire length

Sezione cavo [mm²]	0.22	0.5	0.75	1
Lunghezza max. m [feet]	27 [88]	62 [203]	93 [305]	125 [410]

5.4. The RS 485 serial interface

5.4.1 General

With DPL drives, an RS 485 serial line can be used to transmit data over a twisted pair cable made of two symmetrical twisted wires with a common shield. Maximum data transmission speed is 38.4 KBaud.

Transmission uses a standard differential RS 485 signal (half-duplex).

Up to a maximum of 32 DPL drives can be connected in Multidrop configurations.

The serial line is not opto-isolated.

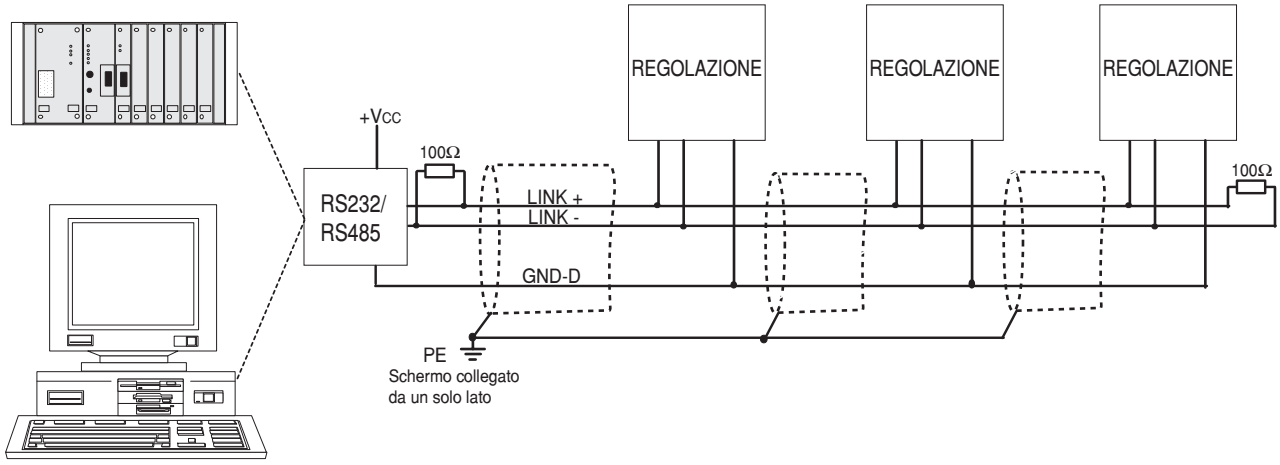
Plug-in cards are available for the following field bus types:

Field Bus plug-in cards				
Article	**Bus**	**Maximum number of nodes**	**Max. distance in metres**	**Baud Rate**
PL-485	RS485	32	1000	38.4kb/s
PL-ProfiBus	ProfibusDP ProfiDrive	32	1200	12Mb/s
PL-Can	CANopen	64	1000	1Mb/s
PL-485	MODBus	32	1000	38.4Kb/s
PL-Can	DeviceNet	64	500	500kb/s
PL-EnetX	Enet_X	32	100	3Mb/s

The serial connection

The RS485 serial line is supported by terminals V-, FB+, FB-, V+ on the DPL drive's control card.

To prevent interference, termination resistors (100 Ohm) must be fitted at the beginning and end of the RS 485 serial line's physical connection cables.



NOTE!

When connecting and laying serial lines, make sure that the power cables are laid in separate cable runways from the switchgear and relay cables.

Serial protocol

Serial protocol is set using the I.600 (Serial link cfg) parameter, which provides a choice of the following protocols: FoxLink proprietary protocol, Modbus RTU (default) and Jbus protocols.

The device address on the serial line is set using the I.602 (Device address) parameter.

See 'INTERFACE /Serial Configuration' later in this manual for further details about data transmission parameters, protocols, ranges and values. See chapter 8 later in this manual for instructions on the use of Modbus RTU communication protocol with DPL drives.

5.5. Typical Connection Schematics

5.5.1 DPL drive connections

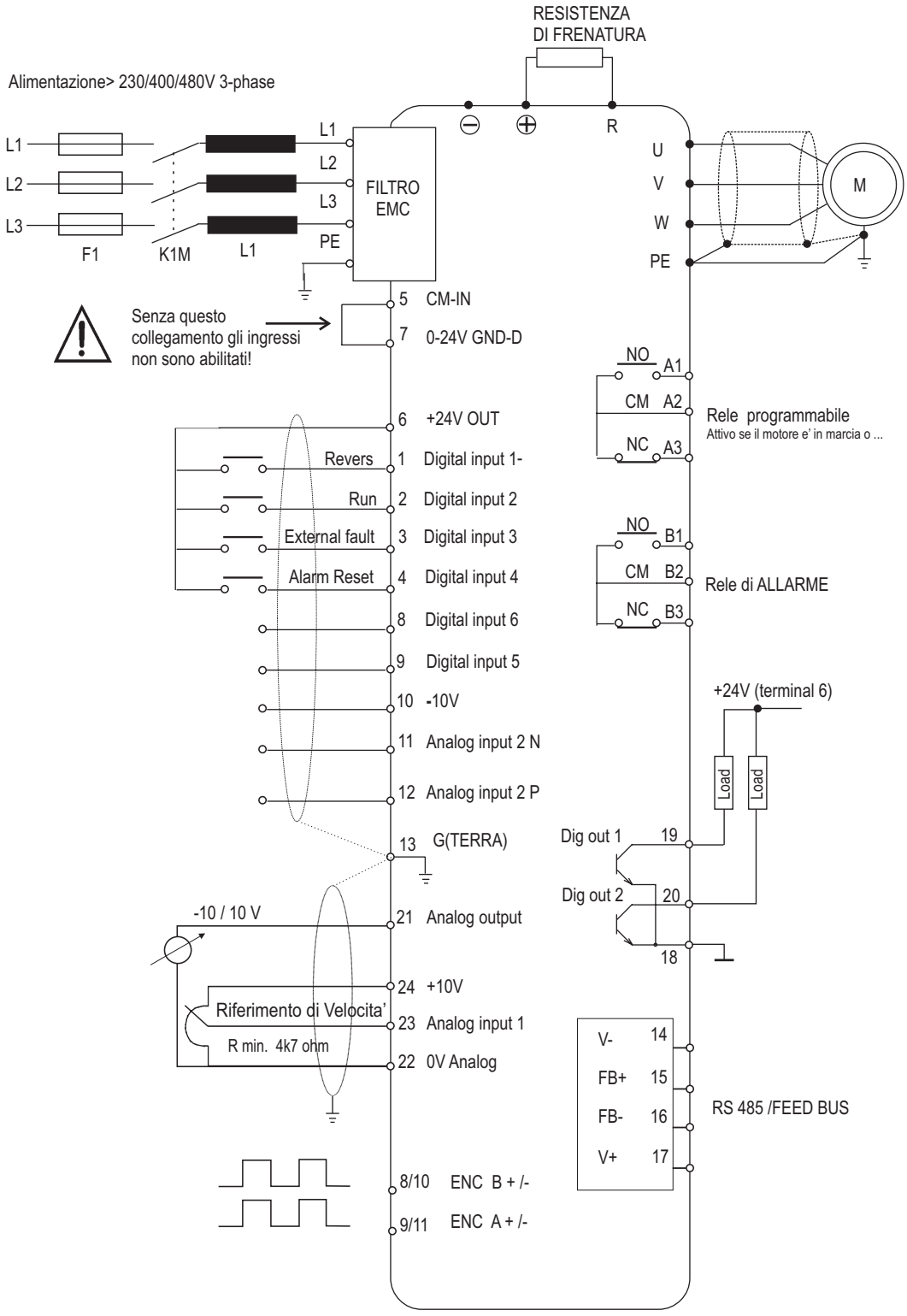


Figure 5.5.1.1: Control via terminals, typical connection schematic

Connection for PNP command enabling

(For NPN commands, connect COM-IN to +24V and use individual commands to switch the inputs to GND.)

NOTE!

The control input connections shown above represent the most common connection solution for NPN control.

5.5.2 Design constraints

The wires for the analog signals must be shielded (connection to terminals 22, 23, 24).

The shielding must be connected to the PE terminal at only one side.

Grounding of the reference potential

The terminal wire shielding potential must normally be grounded.
Terminal 13 provides the control signals ground connection to link the potential of the shielding or the control itself (terminal 7 to 13)
If a single installation comprises more than one drive, the different potentials of their terminal wire shields must be connected in common to the control panel's ground bus.

Direct connection to PLC inputs/outputs

Observe the following points if control commands or references are obtained directly from PLC inputs/outputs.
The PLC's 0V terminal must normally be grounded. if this is done, the drive control reference potential must not be grounded (i.e. terminal 13 must NOT be used).
To ensure good immunity to interference, connect a 0.1μF 250 V DC capacitor between terminal 22 and ground. If more than one drive is present in a single installation, this must be done for each individual drive.

Drive relays

To ensure good immunity to interference, install RC filters in parallel with the coils of contactors connected to the drive's potential-free contacts.

5.5.3 Parallel mains AC input connections to more than one drive

Characteristics and limitations

Drives installed in homogeneous groups must all be of the same model.
All input chokes must be identical (same specifications and same supplier).
All drives must receive power simultaneously. In other words they must all share the same switch/line contactor.
No more than 6 drives must be connected in parallel to the same mains supply.

5.6. Chokes and filters

NOTE!

A choke can be fitted to the mains input to DPL drives to limit RMS input current. Inductance can be provided either by a single phase choke or by a mains transformer.

NOTE!

Contact your nearest HSD office for information on the use of sinusoidal output filters.

5.6.1 Mains input chokes

Use of a mains choke is recommended for all drive models:

- to extend the life of the intermediate circuit capacitors and improve the reliability of the input diodes;
- to reduce harmonic distortion in the mains;
- to reduce the problems caused by power feed from a low impedance line.

NOTE!

Determine the nominal current of chokes on the basis of the nominal current of the standard motors whose power ratings are specified in table 3.3.2.1.

5.6.2 Output chokes

DPL drives can be used with general purpose motors as well as motors specifically designed for inverter control. Motors designed for inverter control normally have better insulation to withstand PWM voltages.

The following are generally applicable rules.

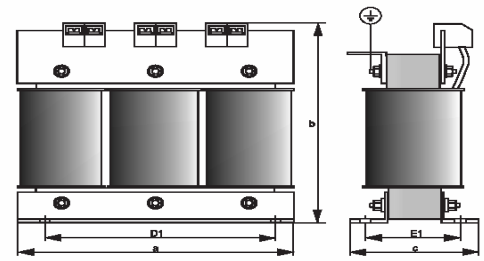
Motors designed for control by inverters do not require special inverter output filters. Standard motors on the other hand, especially those with long cables (typically longer than 30 metres) may need a choke on the inverter output to keep the voltage wave form within specified limits.

The nominal current of these chokes must be approximately 20% greater than that of the inverter itself to compensate for additional losses caused by modulation of the output wave form.

NOTE!

At the drive's nominal current and a frequency of 50 Hz, output chokes cause an output voltage drop of about 2%.

Mains input choke				Output choke			
Code	Dimensions in mm			Code	Dimensions in mm		
	A	B	C		A	B	C
IF3F-030	120	125	65	IU3-030	180	170	110
IR3F-040				IU3-055			
IR3F-055			75				
IR3F-075	150	155	79	IU3-110	180	180	130
IR3F-110							
IR3F-150		168	100	IU3-185	180	160	170
IR3F-185	180	180	130				



5.6.3 Noise filters

DPL drives are fitted with an EMI filter to limit radio frequency interference that could affect the mains.

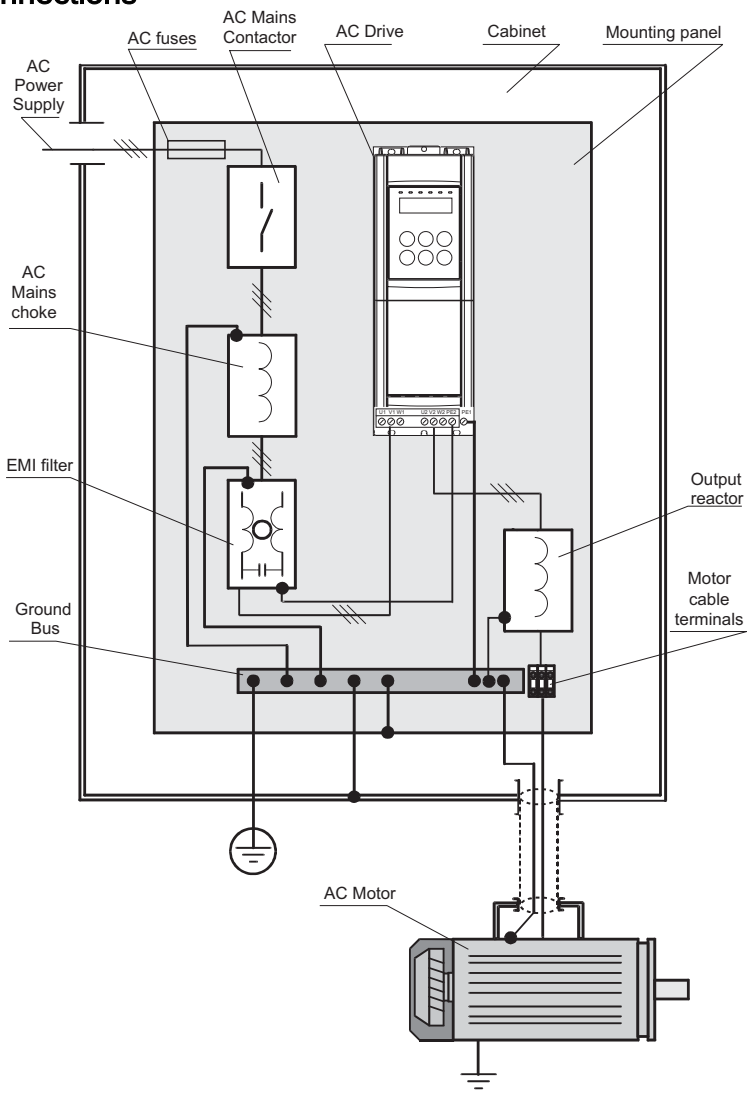
See 'Drive identification' to identify the type of filter fitted.

Consult the Electro-Magnetic Compatibility Guide for further information on the subject of noise filters. You can request a copy of the 'Electro-Magnetic Compatibility Guide' from your nearest HSD office.

The Guide lists the power and control panel installation standards that must be followed to ensure EMC conformity according to Directive 89/336/EEC. (These standards cover the installation, whenever necessary, of external filters and mains chokes, cable shielding, ground connections, etc..)

The Guide also explains the background to EMC standards and lists the various conformity tests performed on HSD equipment.

External EMI filter connections



5.7. DC braking

DPL drives provide DC braking as a standard function. The DC braking function applies a DC current to two of the motor phases to generate braking torque. The machine's kinetic energy is dissipated inside the motor in the form of heat.

The DC braking function cannot provide intermediate braking (e.g. rapid braking from 1400 to 1200 rpm), but only braking to zero speed from already low speeds. If required, braking current can be measured from phase 'U'.

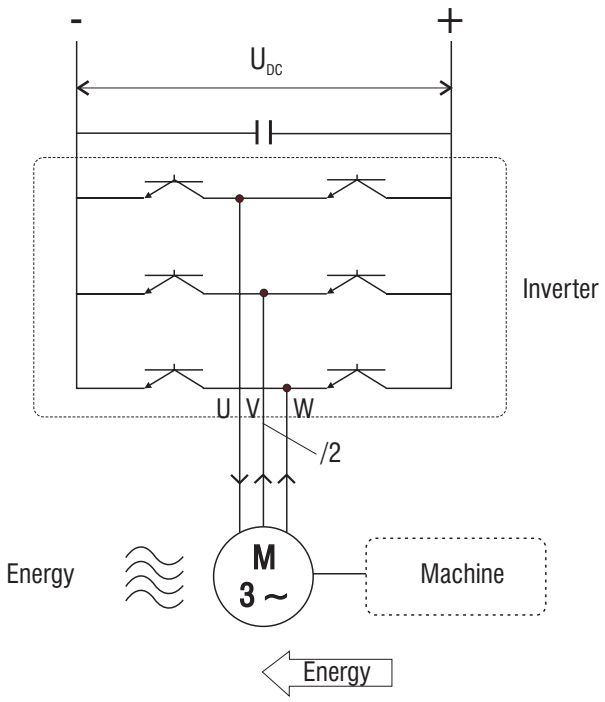


Figure 5.8.7: Principle of functioning of DC braking

5.8. Braking with an external resistance

During regenerative functioning, voltage in the intermediate stage can increase enough to trigger the overvoltage alarm. By connecting a resistance of suitable Ohms and Wattage to the 'R' and '+' terminals, you can dissipate the energy accumulated in the capacitors and reduce intermediate circuit voltage.

Extremely short braking times can be achieved in this way, even from high frequencies.

	Braking resistance					Dimensions in mm			IP	Fig.
DPL ..... (230V.....480V)	**Drive model**	**Rmin. (Ohms)**	**Value (Ohms)**	**Power (Watts)**	**Code**	**A**	**B**	**D**		
	030	75	100	240	**RRE-2,4-100R**	232	30	25	54	1
	040	75	100	350	**RRE-3,5-100R**	160	80	20	54	2
	055	40	70	550	**RRE-5-70R**	200	80	20	54	2
	075	25	50	550	**RRE-5-50R**	200	80	20	54	2
	110	25	50	650	**RRE-6,5-50R**	240	80	20	54	2
	150	20	30	1000*	**RRE-6,5-30R**	240	80	20	54	2
	185	15	20	2200	**RRE-22-20R**	506	107	300	23	3

(*) Mounting on heat sink

The rating of the braking resistance must be determined according to the duty cycle, especially for models marked with an asterisk.

($P_R=(V^2/R)*d$ where d = (Ton/T) with Ton = braking time and T = complete cycle time)

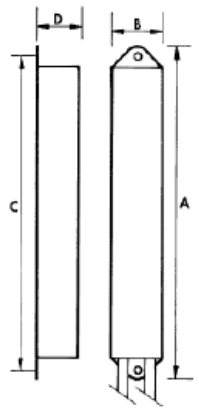


FIG.1

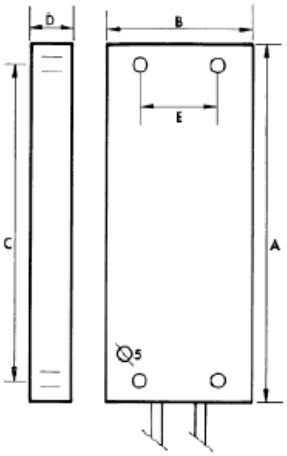


FIG.2

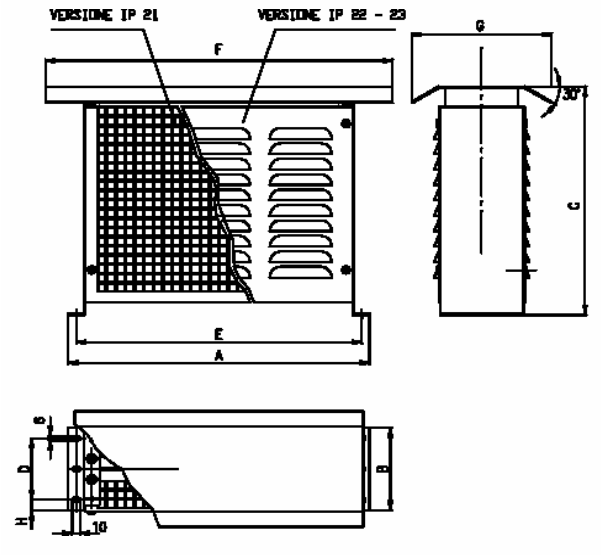


FIG.3

5.9. Safety delay before working on the drive

After disconnecting a DPL drive from the mains supply, always respect a minimum delay of 180 seconds before starting any work on its internal parts.

Chapter 6 - Drive Keypad Operation

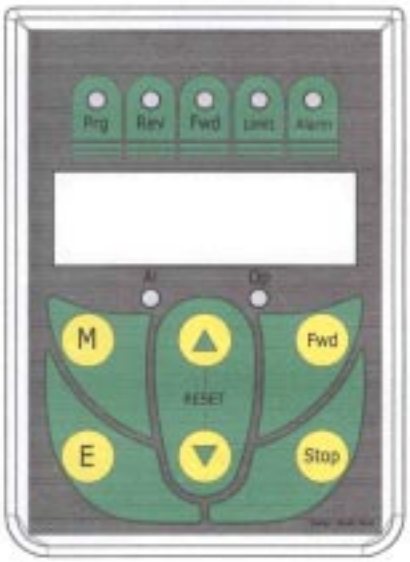
In this chapter are described the parameters management, by the using of the drive keypad.

6.1 Keypad

Caution

Changes made to parameter values which take effect immediately are not automatically stored in memory, but require a specific memory procedure which is obtained through command

"***C.000 - Save parameters = Yes"*** and confirming with Enter.



M	Scroll menu:	Allows movement within the parameters menu (**d.xxx**, **S.xxx**, **I.xxx**, **F.xxx**, **P.xxx**, **A.xxx** and **C.xxx**).
E	Enter buttom:	Used to enter the value of the selected parameter and/or confirm the value.
▲	UP buttom:	Used to **scroll up** through parameters and/or increase numeric values in the drive menus; it can also be used to increase motorpotentiometer reference value, when "F.000-Motorpot ref" parameter is displayed (F, FREQ RAMP menu).
▼	DOWN buttom:	Used to **scroll down** through parameters and/or decrease numeric values in the drive menus; it can also be used to decrease motorpotentiometer reference values, when "F.000-Motorpot ref" parameter is displayed (F, FREQ RAMP menu).

Keypad LED's meaning:

PRG (Yellow LED): flashes if the parameters have not been permanently saved to memory.

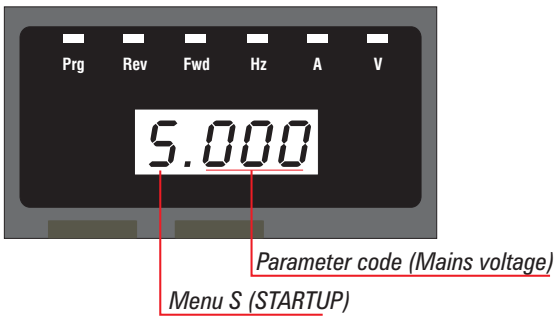
REV (Green LED): reverse running (*)

FWD (Green LED): forward running (*)

Hz,A,V Indicates the unit of measurement of magnitude displayed on the d-xx menu.

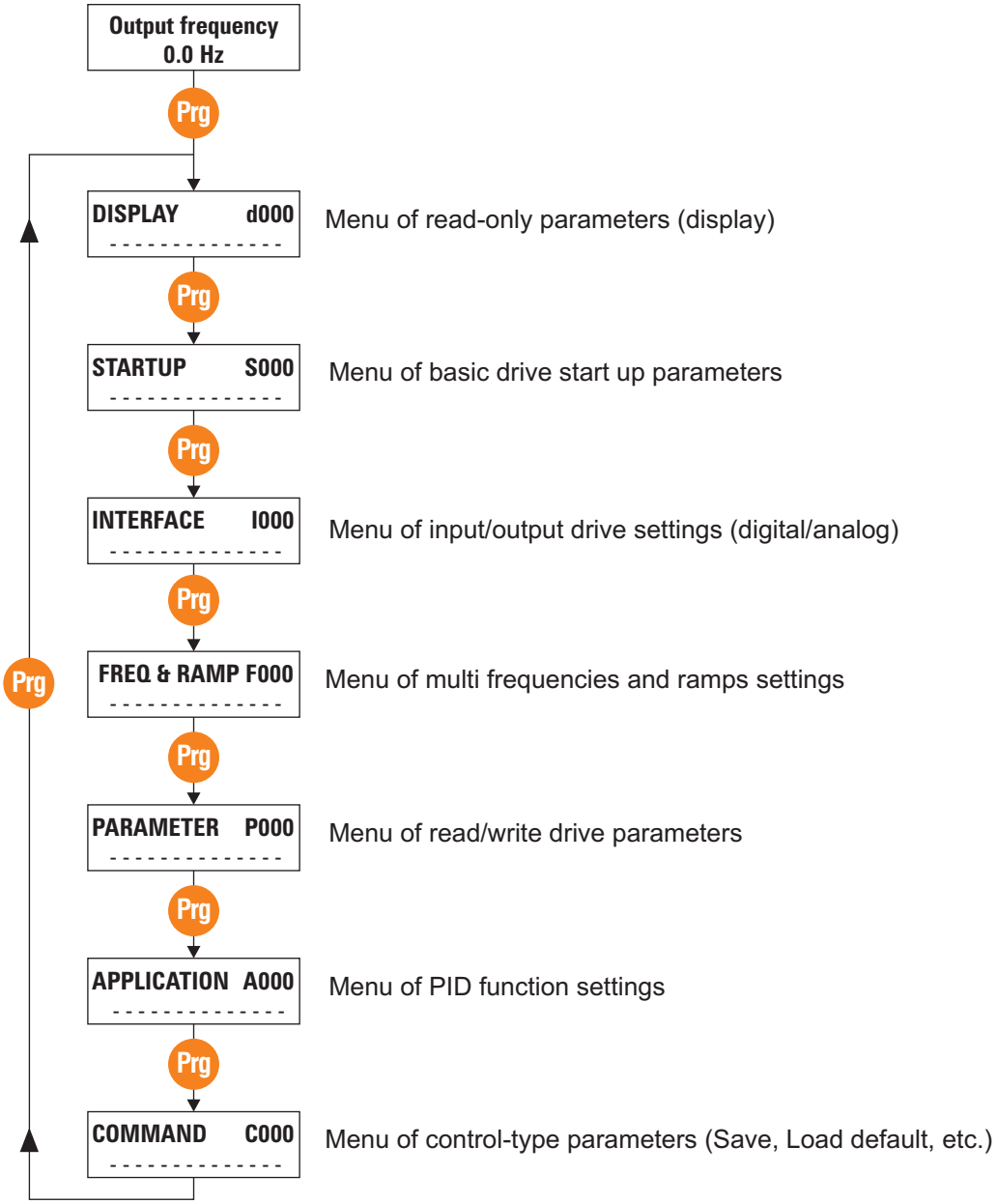
(*) NOTE: the flashing of Green LED's, indicates the action of the motor stall prevention.

The pictures below show the 7 segnents dispaly meaning (both available):



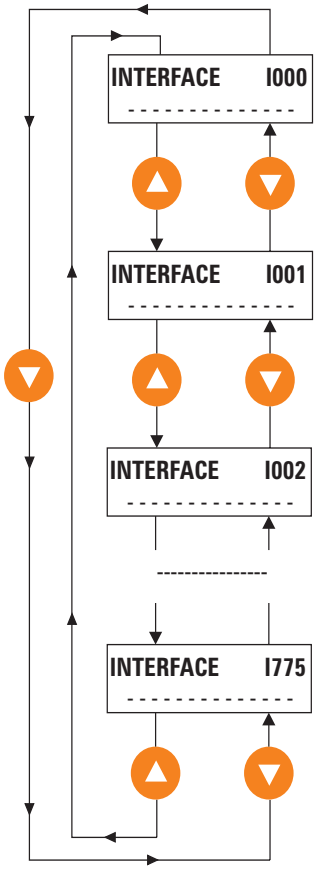
6.3 Moving Through the Drive Main Menu

At the drive power up the keypad display will show "Output frequency (d.000)" parameter of DISPLAY menu.



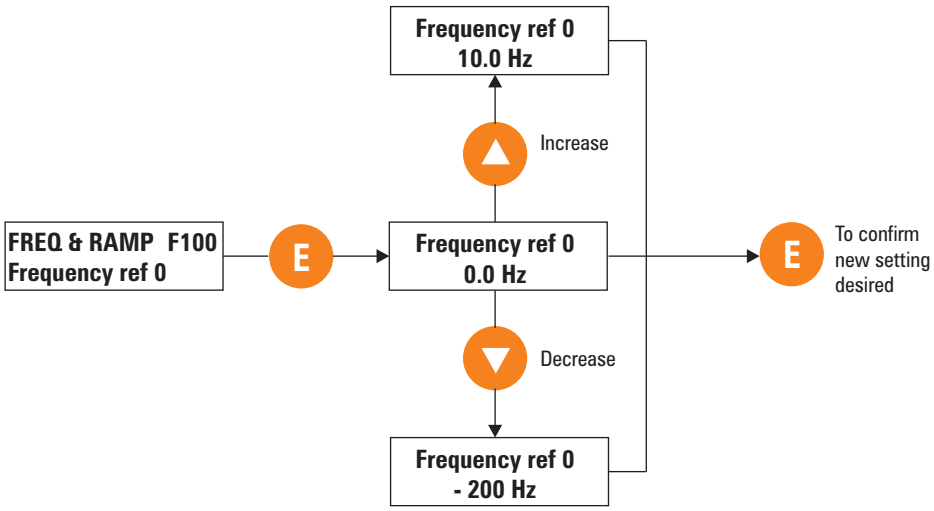
6.4 Scrolling Through the Drive Parameters

INTERFACE menu example:



6.5 Parameters Modification

Example: how to change a frequency reference (FREQ & RAMP menu).



NOTE! Same procedure is also valid to Enable/Disable a function (ex.: S.401 Automatic boost) or program the drive I/Os (ex.: I.000 Dig input 1 cfg, etc. …).

6.6 Quickstart Procedure

Step	Operation	Description
1	Go to the menu S - Startup	Scroll drive menus using "Prog" button, until Startup menu
2	Set the drive main voltage	Enter the parameter ***S.000*** to set the drive main voltage: 230V, 400V and 460V only for AGy..-4; 575V only for AGy..-5.
3	Set the drive main frequency	Enter the parameter ***S.001*** to set the drive main frequency: 50Hz or 60Hz.
4	Set the maximum drive output voltage applied to the motor.	Enter the parameter ***S.100*** to set the motor rated voltage (nameplate data).
5	Set the motor rated frequency	Enter the parameter ***S.150*** to set the motor rated frequency: (nameplate data).
6	Set the motor rated current	Enter the parameter ***S.150*** to set the motor rated current (nameplate data).
7	Set the motor pole pairs	Enter the parameter ***S.151*** to set the motor pole pairs (poles/2).
8	Set the motor power factor	Enter the parameter ***S.152*** to set the motor power factor (nameplate data).
9	Set the drive main command	Enter the parameter ***S.200*** to select the source of the drive command: [0] selection = START&STOP via keypad (+24V between terminal 5 and 8 is always required as interlock). [1] selection = START&STOP via terminal (default)
10	Set the drive maximum frequency reference	Enter the parameter ***S.201*** to set the maximum frequency
11	Set the drive main reference	Enter the parameter ***S.202*** to select the source of the drive frequency reference: [1] selection = Analog input 1 reference (default) [3] selection = Digital reference via ***S.203*** parameter ***NOTE!*** Enter the parameter ***S.203*** to set the digital reference value (if required).
12	Set the drive acceleration and deceleration ramp times	Enter the parameter ***S.300*** to set acceleration time (5sec=default) Enter the parameter ***S.301*** to set deceleration time (5sec=default)
13	Set the drive manual boost %	Enter the parameter ***S.400*** to set manual boost % at low speed
14	Enable the motor stator resistance autotune	Enter the parameter ***S.900*** to enable the motor stator resistance autotune: - enter the command with "YES" on the alphanumeric display - enter the command with "do" on the 7 segments drive display.
15	Save the drive parameters	Enter the parameter ***S.901*** to enable the procedure of save parameters in a permanent memory.

NOTE! Refer to the chapter 7.3 of this manual for the enabling of an automatic boost function (***S.400***) and the settings of the motor slip compensation (***S.450*** & ***S.451***).

Chapter 7 - Parameter Description

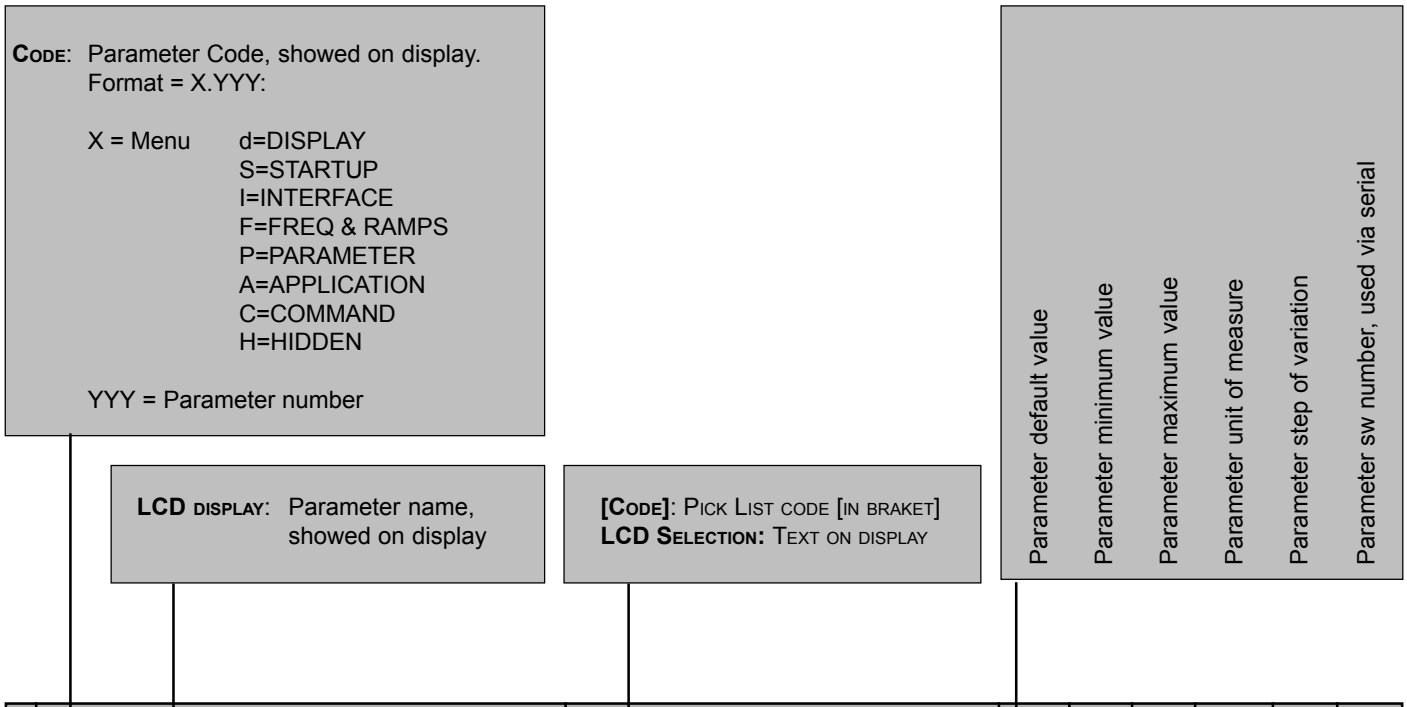
7.1 Parameters List

Legend of drive menu contents.

Menu d - DISPLAY	Menu of read-only parameters (display)
Menu S - STARTUP	Menu for basic drive start up
Menu I - INTERFACE	Menu of input/output settings (digital/analog)
Menu F - FREQ & RAMP	Menu of multi frequencies and ramps settings
Menu P - PARAMETER	Menu for drive regulation and optimization
Menu A - APPLICATION	Menu for PID function settings
Menu C - COMMAND	Menu of control-type parameters (Save, Load default, etc.)
Menu H - HIDDEN	Menu not available on the keypad. It is reserved to set the drive parameters through Serial line and/or through Field bus cards.

NOTE! In this chapter are described the functions of each drive parameter.
Anyway, the chapter 7 reports the description of the code and the name of each single parameter.

Figure 7.1: Parameters Description Legend



S.MENU	PARAMETER			PICK LIST		DEFAULT	MIN	MAX	UNIT	VARIATION	IPA (ALIAS)
	CODE	LCD DISPLAY	DESCRIPTION	[CODE] LCD SELECTION	DESCRIPTION						
START-UP											
POWER SUPPLY	**S.000**	**Mains voltage**	Rated value of the line voltage	**230** **400** **460**	230V 400V 460V	(****)	(****)	(****)	V		404 *(P.020)*
	S.001	**Mains frequency**	Rated value of the line frequency	**50** **60**	50Hz 60Hz	(****)	(****)	(****)	Hz		405 *(P.021)*

NOTE! *(ALIAS):* On STARTUP menu only. Parameter code of same parameter on other menu .

(*): Parameter value dependent of the drive size.

(**): Parameter value dependent of the drive nominal main voltage and main frequency.

(***): Value dependent of the setting of another parameter.

(****): Value dependent of the drive type: 230 ... 480V or 575V input.

	PARAMETER			PICK LIST		DE-FAULT	MIN	MAX	UNIT	VARIATION	IPA
	CODE	LCD DISPLAY	DESCRIPTION	[CODE] LCD SELECTION	DESCRIPTION						
DISPLAY											
Basic	**d.000**	**Output frequency**	Drive output frequency						Hz	0.01	001
	d.001	**Frequency ref**	Drive frequency reference						Hz	0.01	002
	d.002	**Output current**	Drive output current (rms)						A	0.1	003
	d.003	**Output voltage**	Drive output voltage (rms)						V	1	004
	d.004	**DC link voltage**	DC Bus drive voltage (DC)						V	1	005
	d.005	**Power factor**	Power factor							0.01	006
	d.006	**Power [kW]**	Power						kW	0.01	007
	d.007	**Output speed**	Drive output speed (d.000)*(P.600)							0.01/1	008
	d.008	**Speed ref**	Drive speed reference (d.001)*(P.600)							0.01/1	009
Overload	**d.050**	**Heatsink temp**	Drive heatsink temperature (linear sensor measured)						°C	1	010
	d.051	**Drive OL**	Drive overload (100% = alarm threshold)						%	0.1	011
	d.052	**Motor OL**	Motor overload (100% = alarm threshold)						%	0.1	012
	d.053	**Brake res OL**	Braking resistor overload (100%=alarm thr)						%	0.1	013
	d.054	**Reg board temp**	Regulation card temperature						°C	1	058
Input/Output	**d.100**	**Dig inp status**	Digital inputs acquired by the drive (terminal or virtual)								014
	d.101	**Term inp status**	Digital inputs terminal of the drive regulation board								015
	d.102	**Vir dig inp stat**	Virtual digital inputs received by drive serial link or field bus card								016
	d.120	**Exp dig inp stat**	Expansion digital inputs acquired by the drive (terminal or virtual)								017
	d.121	**Exp term inp**	Expansion digital inputs terminal of the drive expansion board								018
	d.122	**Vir exp dig inp**	Expansion virtual digital inputs received by drive serial link or field bus card								019
	d.150	**Dig out status**	Digital outputs executed by the drive (terminal or virtual)								020
	d.151	**Term dig out sta**	Digital outputs terminal of the drive regulation board								021
	d.152	**Vir dig out stat**	Virtual digital outputs executed by drive serial link or field bus card								022
	d.170	**Exp dig out stat**	Expansion digital outputs executed by the drive (terminal or virtual)								023

	PARAMETER			PICK LIST		DE-FAULT	MIN	MAX	UNIT	VARIATION	IPA
	CODE	LCD DISPLAY	DESCRIPTION	[CODE] LCD SELECTION	DESCRIPTION						
Input/Output	**d.171**	**Exp term out sta**	Expansion digital outputs terminal of the drive expansion board								024
	d.172	**Exp vir dig out**	Expansion virtual digital outputs executed by drive serial link or field bus card								025
	d.200	**An in 1 cnf mon**	Analog input 1 destination; it shows where the signal is programmed	**[0] Null funct** **[1] Freq ref 1** **[2] Freq ref 2** **[3] Bst lev fact** **[4] OT lev fact** **[5] Vred lev fac** **[6] DCB lev fact** **[7] RampExt fact**						026
	d.201	**An in 1 monitor**	Analog input 1 output block % value								027
	d.202	**An in 1 term mon**	Analog input 1 input block % value								028
	d.210	**An in 2 cnf mon**	Analog input 2 destination; it shows where the signal is programmed	**As for d.200**							029
	d.211	**An in 2 monitor**	Analog input 2 output block % value								030
	d.212	**An in 2 term mon**	Analog input 2 input block % value								031
	d.220	**An in 3 cnf mon**	Analog input 3 destination; it shows where the signal is programmed	**As for d.200**							032
	d.221	**An in 3 monitor**	Analog input 3 output block % value								033
	d.222	**An in 3 term mon**	Analog input 3 input block % value								034
Encoder	**d.300**	**EncPulses/Sample**	Reading of pulses sampling of encoder pulses (I.504)							1/100	035
	d.301	**Encoder freq**	Encoder frequency (Motor frequency)						Hz	0.01	036
	d.302	**Encoder speed**	Encoder speed (d.000)*(P.600)							0.01/1	037
OPTION	**d.350**	**Option 1 state**	Drive option 1 state (expansion board type programmed)								038
	d.351	**Option 2 state**	Drive option 2 state (expansion board type programmed)								039
	d.352	**Par port state**	It monitors the 16-bit parallel port state (option)								040
	d.353	**SBI State**	Communication state between SBI and Master	**0** **1** **2** **3**	Wait parametrizzation Wait configuration Data exchange Error						059

	PARAMETER			PICK LIST		DE-FAULT	MIN	MAX	UNIT	VARIATION	IPA
	CODE	LCD DISPLAY	DESCRIPTION	[CODE] LCD SELECTION	DESCRIPTION						
OPTION	d.354	SBI Baude rate	Communication speed between SBI and Master	**0** **1** **2** **3** **4** **5** **6** **7** **8** **15**	12 Mbit / s 6 Mbit / s 3 Mbit / s 1.5 Mbit / s 500 Kbit / s 187.5 Kbit / s 93.75 Kbit / s 45.45 Kbit / s 19.2 Kbit / s unknow						060
PID	d.400	PID reference	PID reference signal						%	0.1	041
	d.401	PID feedback	PID feedback signal						%	0.1	042
	d.402	PID error	PID error signal						%	0.1	043
	d.403	PID integr comp	PID integral component						%	0.1	044
Alarm List	d.404	PID output	PID output signal						%	0.1	045
	d.800	1st alarm-latest	Last alarm stored by the drive alarm list								046
	d.801	2nd alarm	Second to last alarm								047
	d.802	3rd alarm	Third to last alarm								048
Drive Identification	d.803	4th alarm	Fourth to last alarm								049
	d.950	Drive rated curr	Drive rated current (it depends on the drive size)							0.1	050
	d.951	SW version (1/2)	Software version - part 1	**03.00**						0.01	051
	d.952	SW version (2/2)	Software version - part 2	**00.00**						0.01	052
	d.953	Power ident code	Reseved								053
	d.954	Param ident code	Reseved								054
	d.955	Regul ident code	Reseved								055
	d.956	Startup id code	Reseved								056
	d.957	Drive size	Drive size code	**130** 2.0Hp - 575V **131** 3.0Hp - 575V **132** 5.0Hp - 575V **133** 7.5Hp - 575V **134** 10Hp - 575V **135** 15Hp - 575V **136** 20Hp - 575V **167** 25Hp - 575V **168** 30Hp - 575V **169** 40Hp - 575V **170** 50 Hp - 575V **171** 40Hp - 575V **172** 75Hp - 575V	**32** 0.75kW - 230/400/480V **33** 1.5kW - 230/400/480V **34** 2.2kW - 230/400/480V **35** 3kW - 230/400/480V **36** 4kW - 230/400/480V **37** 5.5kW - 230/400/480V **38** 7.5kW - 230/400/480V **39** 11kW - 230/400/480V **40** 15kW - 230/400/480V **41** 22kW - 230/400/480V **42** 30kW - 230/400/480V **43** 37kW - 230/400/480V **44** 45kW - 230/400/480V **45** 55kW - 230/400/480V **46** 75kW - 230/400/480V **47** 90kW - 230/400/480V **48** 110kW - 230/400/480V **49** 132kW- 230/400/480V						057
	d.958	Drive cfg type	Drive cofiguration type	**0** **1**	Standard : 400Vac American : 460/575Vac						061

	PARAMETER			PICK LIST		DE-FAULT	MIN	MAX	UNIT	VARIATION	IPA
	CODE	LCD DISPLAY	DESCRIPTION	[CODE] LCD SELECTION	DESCRIPTION						
Utility	**d.999**	**Display Test**	Drive display test								099

	PARAMETER			PICK LIST		DE-FAULT	MIN	MAX	UNIT	VARIATION	IPA (ALIAS)
	CODE	LCD DISPLAY	DESCRIPTION	[CODE] LCD SELECTION	DESCRIPTION						
START-UP											
Power Supply	**S.000**	**Mains voltage**	Rated value of the line voltage	**230** **400** **460** **575**	230V Only for "DS...-4" type 400V Only for "DS...-4" type 460V Only for "DS...-4" type 575V Only for "DS...-5" type	(****)	(****)	(****)	V		404 *(P.020)*
	S.001	**Mains frequency**	Rated value of the line frequency	**50** **60**	50Hz 60Hz	(****)	(****)	(****)	Hz		405 *(P.021)*
V/f	**S.100**	**Max out voltage**	Maximum value of the voltage applied to the motor			(**)	50	(**)	V	1	413 *(P.061)*
	S.101	**Base frequency**	Rated frequency of the motor			(**)	25	500	Hz	0.1	414 *(P.062)*
Motor Data	**S.150**	**Motor rated curr**	Rated current of the motor			(*)	(*)	(*)	A	0.1	406 *(P.040)*
	S.151	**Motor pole pairs**	Pole Pairs of the motor			(*)	1	60		0.01	407 *(P.041)*
	S.152	**Motor power fact**	Motor power factor			(*)	0.01	1		0.01	408 *(P.042)*
	S.153	**Motor stator R**	Measurement of the stator resistance of the motor			(*)	0	99.99	ohm		409 *(P.043)*
Commands & Referencies	**S.200**	**Cmd source sel**	Source of the START and STOP commands	**[0] Keypad** **[1] Terminals** **[2] Virtual** **[3] FoxLink** **[4] Control word**	START & STOP via keypad (+24V between 5 & 8 terminals required). START & STOP via terminal Main command via Virtual & Terminal setting Main command via serial line Reserved	1	0	4			400 *(P.000)*
	S.201	**Max ref freq**	Maximum frequency reference threshold and / or digital reference (both directions)			(****)	25	500	Hz	0.1	305 *(F.020)*
	S.202	**Ref 1 channel**	Source of the Reference 1	**[0] Null** **[1] Analog inp 1** **[2] Analog inp 2** **[3] Freq ref x** **[4] Multispeed** **[5] Motorpotent** **[6] Analog inp 3** **[7] Encoder** **[8] Profidrive**	Null Analog input 1 Analog input 2 Frequency reference S.203 (F.100) Multi frequencies Motorpotientometer reference Analog input 3 Encoder signal Reference by Profibus	3	0	7			307 *(F.050)*
	S.203	**Frequency ref 0**	Digital speed reference (F.100)			0	-S.201	S.201			311 *(F.100)*
	S.300	**Acc time 1**	Acceleration ramp delay time 1			5	1 (***)	999.9 (***)	sec	0.1 (***)	329 *(F.201)*
	S.301	**Dec time 1**	Deceleration ramp delay time 1			5	1 (***)	999.9 (***)	sec	0.1 (***)	330 *(F.202)*

	PARAMETER			PICK LIST		DE-FAULT	MIN	MAX	UNIT	VARIATION	IPA (ALIAS)
	CODE	LCD DISPLAY	DESCRIPTION	[CODE] LCD SELECTION	DESCRIPTION						
Functions	**S.400**	**Manual boost [%]**	Manual boost at low revolutions			1	0	25	% of S.100		421 *(P.120)*
	S.401	**Auto boost en**	Automatic boost function enabling	**[0] Disable** **[1] Enable**	Automatic boost function disabled Automatic boost function enabled	0	0	1			423 *(P.122)*
	S.450	**Slip compensat**	Slip compensation			0.1	0	10	%		419 *(P.100)*
	S.451	**Slip comp filter**	It is the response time for the reaction of the function			0.1	0	10	sec	0.1	420 *(P.101)*
Utility	**S.900**	**Measure stator R**	Motor tuning command	**Confirm? NO** **Confirm? YES**	No action Autotune command execution	NO	NO	YES			806 *(C.100)*
	S.901	**Save parameters**	Save parameters	**Confirm? NO** **Confirm? YES**	No action Save parameters command execution	NO	NO	YES			800 *(C.000)*

	PARAMETER			PICK LIST		De-fault	Min	Max	Unit	Variation	Ipa
	Code	LCD display	Description	[Code] LCD Selection	Description						
INTERFACE											
Digital Inputs Commands of the Regulation Board	**I.000**	**Dig input 1 cfg**	Digital Input 1 configuration	**[0] None** **[1] Run** **[2] Reverse** **[3] Ext Fault NO** **[4] Ext Fault NC** **[5] Alarm reset** **[6] Jog** **[7] Freq sel 1** **[8] Freq sel 2** **[9] Freq sel 3** **[10] Freq sel 4** **[11] Ramp sel 1** **[12] Ramp sel 2** **[13] Enable NO** **[14] Enable NC** **[15] DCBrake en** **[16] DCBrake** **[17] Autocapture** **[18] Ramp enable** **[19] Zero ref** **[20] PID enable** **[21] PID freeze** **[22] PID gain sel** **[23] Motorpot Up** **[24] Motorpot Dn** **[25] Reset Motorp** **[26] Fast stop** **[27] Zero freq**	Not active RUN command for the motor START Speed REVERSE command External fault with NO (Normal Open) contact External fault with NC (Norm. Closed) contact Alarm reset command JOG frequency reference enabling Binary selection for Multispeed Binary selection for Multispeed Binary selection for Multispeed Binary selection for Multispeed Binary selection for Multiramp Binary selection for Multiramp Drive Enable with NC (Norm. Closed) contact Drive Enable with NO (Normal Open) contact Enabling of the DC braking function Command for execution of DC braking Execution of the flying restart Enabling / Disabling of the Ramp block Ramp to 0Hz & main commands active Enabling of the PID regulation. Enabling PID freeze output signal. Selection of the PID regualtor gain. Motorpotentiometer reference increasing Motorpotentiometer reference decreasing Reset of Motorpotentiometer ref. Emergency stop Enabling output freq. to zero.	7	0	27			100
	I.001	**Dig input 2 cfg**	Digital Input 2 configuration	**As for I.000**		8	0	27			101
	I.002	**Dig input 3 cfg**	Digital Input 3 configuration	**As for I.000**		9	0	27			102
	I.003	**Dig input 4 cfg**	Digital Input 4 configuration	**As for I.000**		6	0	27			103
	I.004	**Dig input 5 cfg**	Digital Input 5 configuration	**As for I.000**		5	0	27			104
	I.005	**Dig input 6 cfg**	Digital Input 6 configuration	**As for I.000**		3	0	27			105
	I.006	**Dig input 7 cfg**	Digital Input 7 configuration	**As for I.000**		1	0	27			106
	I.007	**Dig input 8 cfg**	Digital Input 8 configuration	**As for I.000**		2	0	27			107

	PARAMETER			PICK LIST		DE-FAULT	MIN	MAX	UNIT	VARIATION	IPA
	CODE	LCD DISPLAY	DESCRIPTION	[CODE] LCD SELECTION	DESCRIPTION						
Digital Inputs Commands of the Expansion Board	**I.050**	**Exp dig in 1 cfg**	Expansion Digital Input 1 configuration (on Expansion board)	**As for I.000**	Not available	0	0	27			108
	I.051	**Exp dig in 2 cfg**	Expansion Digital Input 2 configuration (on Expansion board)	**As for I.000**	Not available	0	0	27			109
	I.052	**Exp dig in 3 cfg**	Expansion Digital Input 3 configuration (on Expansion board)	**As for I.000**	Not available	0	0	27			110
	I.053	**Exp dig in 4 cfg**	Expansion Digital Input 4 configuration (on Expansion board)	**As for I.000**	Not available	0	0	27			111
Digital Output State Regulation Board	**I.100**	**Dig output 1 cfg**	Digital Output 1 configuration	**[0] Drive Ready**	Drive ready to start	0	0	44			112
				[1] Alarm state	Positive logic for alarm signalling						
				[2] Not in alarm	Negative logic for alarm signalling						
				[3] Motor running	Run command active						
				[4] Motor stopped	Run command not active and frequency = 0Hz						
				[5] REV rotation	Anti-clockwise rotation of the motor.						
				[6] Steady state	Motor is running in steady state.						
				[7] Ramping	Acceleration or Deceleration Ramp on progress.						
				[8] UV running	Undervoltage detectetion during motor running.						
				[9] Out trq>thr	Output torque higher than the value of P.241.						
				[10] Current lim	Current limit (during ramp or at steady state).						
				[11] DC-link lim	DC Bus limit (during ramp or at steady state).						
				[12] Limit active	General signalling of drive limit condition.						
				[13] Autocapt run	Autocapture on progress.						
				[14] Reserved	Reserved.						
				[15] Neg pwrfact	Negative condition of the power factor .						
				**[16] PID err >< **	PID error is >A.058 & <=A.059.						
				[17] PID err>thr	PID error is >A.058.						
				[18] PID err<thr	PID error is <=A.059.						
				[19] PIDer><(inh)	PID error is >A.058 & <=A.059 (see chapter 7.7).						
				[20] PIDerr>(inh)	PID error is >A.058 (see chapter 7.7).						
				[21] PIDerr<(inh)	PID error is <=A.059 (see chapter 7.7).						
				[22] FWD enc rot	Clockwise rotation of the couter-encoder.						
				[23] REV enc rot	Anti-clockwise rotation of the encoder.						
				[24] Encoder stop	Encoder not rotating.						
				[25] Encoder run	Encoder rotation general signalling.						
				[26] Extern fault	Positive logic for Ext. fault alarm signalling. Negative logic for Extern.						

	PARAMETER			PICK LIST		De-fault	Min	Max	Unit	Variation	Ipa
	Code	LCD display	Description	[Code] LCD Selection	Description						
				[27] No ext fault	fault alarm signalling.						
				[28] Serial TO	Serial link communication time out.						
				[29] freq=thr1	Output frequency = to P.440 & P.441 values.						
				[30] freq!=thr1	Output frequency ? of P.440 & P.441 values.						
				[31] freq>thr1	Output frequency > than P.440 & P.441 values.						
				[32] freq<thr1	Output frequency < than P.440 & P.441 values.						
				[33] freq=thr2	Output frequency = to P.442 & P.443 values.						
				[34] freq!=thr2	Output frequency ? of P.442 & P.443 values.						
				[35] freq>thr2	Output frequency > than P.442 & P.443 values.						
				[36] freq<thr2	Output frequency < than P.442 & P.443 values.						
				[37] HS temp=thr	Heatsink temp = to P.480 & P.481 values.						
				[38] HS temp!=thr	Heatsink temp ? of P.480 & P.481 values.						
				[39] HS temp>thr	Heatsink temp > than P.480 & P.481 values.						
				[40] HS temp<thr	Heatsink temp < than P.480 & P.481 values.						
				[41] Output freq	Frequency in synchronism with output frequency.						
				[42] Out freq x 2	Frequency value x 2 in synchronism with output frequency.						
				[43]OutCoastThru	Coast thru stopping.						
				[44]OutEmgStop	Emergency stop.						
	I.101	**Dig output 2 cfg**	Digital Output 2 configuration	**As for I.100**		6	0	44			113
	I.102	**Dig output 3 cfg**	Digital Output 3 configuration	**As for I.100**		3	0	44			114
	I.103	**Dig output 4 cfg**	Digital Output 4 configuration	**As for I.100**		1	0	44			115
Dig. Output State Exp. Board	**I.150**	**Exp DigOut 1 cfg**	Expansion Digital Output 1 configuration (on Expansion board)	**As for I.100**		0	0	44			116
	I.151	**Exp DigOut 2 cfg**	Expansion Digital Output 2 configuration (on Expansion board)	**As for I.100**		0	0	44			117
	I.152	**Exp DigOut 3 cfg**	Expansion Digital Output 3 configuration (on Expansion board)	**As for I.100**	Bipolar -/+10V	0	0	44			180

	PARAMETER			PICK LIST		DE-FAULT	MIN	MAX	UNIT	VARIATION	IPA
	CODE	LCD DISPLAY	DESCRIPTION	[CODE] LCD SELECTION	DESCRIPTION						
Analog Input Regulation Board	**I.200**	**An in 1 Type**	Setting of the Analog Input 1 type reference	**[0] +/- 10V** **[1] 0-10V/0-20mA**	Unipolar +10V	1	0	1			118
	I.201	**An in 1 offset**	Analog Input 1 offset			0	-9.99	99.9	%	0.01	119
	I.202	**An in 1 gain**	Analog Input 1 gain			1	-9.99	9.99	%	0.01	120
	I.203	**An in 1 minimum**	An Input 1 minimun value			0	0	99.99	%	0.01	121
	I.204	**An in 1 filter**	Response time of the signal reaction			0.1	0.001	0.25	sec	0.001	122
	I.210	**An in 2 Type**	Setting of the Analog Input 2 type reference	**[0] +/- 10V** **[1] 0-10V/0-20mA**	~~Bipolar -/+10V~~ Unipolar +10V	0	0	1			123
	I.211	**An in 2 offset**	Analog Input 2 offset			0	-99.9	99.9	%	0.1	124
	I.212	**An in 2 gain**	Analog Input 2 gain			1	-9.99	9.99	%	0.01	125
	I.213	**An in 2 minimum**	An Input 2 minimun value			0	0	99.99	%	0.01	126
	I.214	**An in 2 filter**	Response time of the signal reaction			0.1	0.001	0.25	sec	0.001	127
	I.220	**An in 3 Type**	Setting of the Analog Input 3 type reference	**[1] 0-10V/0-20mA** **[2] 4-20mA**	~~0…20mA~~ 4…20mA	1	1	2			128
	I.221	**An in 3 offset**	Analog Input 3 offset			0	-99.9	99.9	%	0.1	129
	I.222	**An in 3 gain**	Analog Input 3 gain			1	-9.99	9.99	%	0.01	130
	I.223	**An in 3 minimum**	An Input 3 minimun value			0	0	99.99	%	0.01	131
	I.224	**An in 3 filter**	Response time of the signal reaction			0.1	0.001	0.25	sec	0.001	132
Analog Output Regulation Board	**I.300**	**Analog out 1 cfg**	Analog Output 1 configuration	**[0] Freq out abs** **[1] Freq out** **[2] Output curr** **[3] Out voltage** **[4] Out trq (pos)** **[5] Out trq (abs)** **[6] Out trq** **[7] Out pwr (pos)** **[8] Out pwr (abs)** **[9] Out pwr** **[10] Out PF** **[11] Enc freq abs** **[12] Encoder freq** **[13] Freq ref abs** **[14] Freq ref** **[15] Load current** **[16] Magn current** **[17] PID output** **[18] DClink volt** **[19] U current** **[20] V current** **[21] W current**	~~Output Frequency~~ absolute value. Output Frequency. Output Current. Output Voltage. Output Torque positive value. Output Torque absolute value. Output Torque. Output Power positive value. Output Power absolute value. Output Power. Output Power Factor. Encoder frequency absolute value. Encoder frequency. Frequency reference absolute value. Frequency reference Load Current. Motor Magnetizing Current. PID regulator output. DC bus capacitors level. Output phase U current signal. Output phase V current signal. Output phase W current signal.	0	0	21			133

	PARAMETER			PICK LIST		DE-FAULT	MIN	MAX	UNIT	VARIATION	IPA
	CODE	LCD DISPLAY	DESCRIPTION	[CODE] LCD SELECTION	DESCRIPTION						
	I.301	**An out 1 offset**	Analog output 1 offset			0	-9.99	9.99		0.01	134
	I.302	**An out 1 gain**	Analog output 1 gain			1	-9.99	9.99		0.01	135
	I.303	**An out 1 filter**	Time constant of output filter			0	0	2.5	sec	0.01	136
	I.310	**Analog out 2 cfg**	Analog Output 2 configuration	**As for I.300**		2	0	21			137
	I.311	**An out 2 offset**	Analog output 2 offset			0	-9.99	9.99		0.01	138
	I.312	**An out 2 gain**	Analog output 2 gain			1	-9.99	9.99		0.01	139
	I.313	**An out 2 filter**	Time constant of output filter			0	0	2.5	sec	0.01	140
Analog Output Exp Board	**I.350**	**Exp an out 1 cfg**	Expansion Analog Output 1 configuration (on Exp. board)	**As for I.300**		3	0	21			141
	I.351	**Exp AnOut 1 offs**	Expansion Analog Output 1 offset			0	-9.99	9.99		0.01	142
	I.352	**Exp AnOut 1 gain**	Expansion Analog Output 1 gain			1	-9.99	9.99		0.01	143
	I.353	**Exp AnOut 1 filt**	Time constant of output filter			0	0	2.5	sec	0.01	144
Enabling Virtual I/O	**I.400**	**Inp by serial en**	Virtual Digital enabling			0	0	255			145
	I.410	**Exp in by ser en**	Expansion Virtual Digital Inputs enabling			0	0	15			146
	I.420	**Out by serial en**	Virtual Digital Outputs setting enabling			0	0	15			147
	I.430	**Exp OutBySer en**	Expansion Virtual Digital Outputs enabling			0	0	3			148
	I.450	**An out by ser en**	Virtual Analog Outputs enabling			0	0	255			149
Encoder Config	**I.500**	**Encoder enable**	Enabling of the encoder feedback	**[0] Disable** **[1] Enable**	~~Encoder feeback disabled~~ Encoder feeback enabled	0	0	1			150
	I.501	**Encoder ppr**	Encoder nameplate pulses per revolution			100	1	9999			151
	I.502	**Enc channels cfg**	Encoder channels configuration	**[0] One Channel** **[1] Two Channels**	A (K1) encoder channel A and B (K1 and K2) encoder channels	0	0	1			152
	I.503	**Enc spd mul fact**	Multiplier factor of the encoder pulses, set in the I.501			1	0.01	99.99			153
	I.504	**Enc update time**	Encoder pulses sampling time			0.1	0	25	sec	0.01	154
	I.505		Reserved								

	PARAMETER			PICK LIST		DE-FAULT	MIN	MAX	UNIT	VARIATION	IPA
	CODE	LCD DISPLAY	DESCRIPTION	[CODE] LCD SELECTION	DESCRIPTION						
Serial Line Config	I.600	**Serial link cfg**	Serial line configuration protocol & mode	**[0] FoxLink 7E1** **[1] FoxLink 701** **[2] FoxLink 7N2** **[3] FoxLink 8N1** **[4] ModBus 8N1** **[5] JBus 8N1**	PROTOCOL TYPE / DATA BIT / PARITY / STOP BIT FoxLink 7E1 7 Even 1 FoxLink 7O1 7 Odd 1 FoxLink 7N2 7 None 2 FoxLink 7O1 8 None 1 Modbus 8N1 8 None 1 Jbus 8N1 8 None 1	4	0	5		0.1	155
	I.601	**Serial link bps**	Serial line baudrate	**[0] 600 baud** **[1] 1200 baud** **[2] 2400 baud** **[3] 4800 baud** **[4] 9600 baud** **[5] 19200 baud** **[6] 38400 baud** **[7] 57600 baud** **[8] 76800 baud** **[9] 115200 baud**	600 baud rate 1200 baud rate 2400 baud rate 4800 baud rate 9600 baud rate 19200 baud rate 38400 baud rate 57600 baud rate 76800 baud rate 115200 baud rate	4	0	9			156
	I.602	**Device address**	Serial line address of the drive			1	0	99		1	157
	I.603	**Ser answer delay**	Serial line answer delay time			1	0	250	msec	1	158
	I.604	**Serial timeout**	Serial line transmission timeout			0	0	25	sec	0.1	159
	I.605	**En timeout alm**	Setting time out alarm	**[0] Disable** **[1] Enable**	Drive NOT in alarm and signal on a digital output Drive IN alarm and signal on a digital output	0	0	1			160
Option Config Board	I.700	**Option 1 type**	Expansion optional 1 card type RESERVED	**[0] Board Off** **[1] Board master** **[2] IO Board** **[3] Board free** **[4] SBI Board**	Reserved Reseved Reserved Reseved Reserved	0	0	4			161
	I.701	**Option 2 type**	Expansion optional 2 card type RESERVED	**[0] Board Off** **[1] Board master** **[2] IO Board** **[3] Board free** **[4] SBI Board**	Reserved Reseved Reserved Reseved Reserved	0	0	4			162
Field Bus Config	I.750	**SBI address**	SBI Address			3	0	255			163
	I.751	**CAN baudraute**	CAN Open baudraute	**[0] 10 KHz** **[1] 20 KHz** **[2] 50 KHz** **[3] 125 KHz** **[4] 250 KHz** **[5] 500 KHz** **[6] 1000 KHz**		5	0	6			164
	I.752	**SBI Profibus mod**	SBI Profibus Mode	**[0] Custom** **[1] PPO1** **[2] PPO2** **[3] PPO3** **[4] PPO4**	Reserved Reserved Reserved Reserved Reserved	2	0	4	sec	0.1	165
	I.753	**SBI CAN mode**	Selection of the Bus protocol	**[0] OFF** **[1] CAN Open** **[2] DeviceNet**	Reserved Reserved	0	0	2			166
	I.754	**Bus Flt Holdoff**	Delay time for Bus Fault Alarm			0	0	60	sec		179
	I.760	**SBI to Drv W 0**	Word 0 from SBI to drive			0	0	1999			167
	I.761	**SBI to Drv W 1**	Word 1 from SBI to drive			0	0	1999			168

	PARAMETER			PICK LIST		DE-FAULT	MIN	MAX	UNIT	VARIATION	IPA
	CODE	LCD DISPLAY	DESCRIPTION	[CODE] LCD SELECTION	DESCRIPTION						
	I.762	**SBI to Drv W 2**	Word 2 from SBI to drive			0	0	1999			169
	I.763	**SBI to Drv W 3**	Word 3 from SBI to drive			0	0	1999			170
	I.764	**SBI to Drv W 4**	Word 4 from SBI to drive			0	0	1999			171
	I.765	**SBI to Drv W 5**	Word 5 from SBI to drive			0	0	1999			172
	I.770	**Drv to SBI W 0**	Word 0 from drive to SBI			1	0	1999			173
	I.771	**Drv to SBI W 1**	Word 1 from drive to SBI			2	0	1999			174
	I.772	**Drv to SBI W 2**	Word 2 from drive to SBI			3	0	1999			175
	I.773	**Drv to SBI W 3**	Word 3 from drive to SBI			4	0	1999			176
	I.774	**Drv to SBI W 4**	Word 4 from drive to SBI			5	0	1999			177
	I.775	**Drv to SBI W 5**	Word 5 from drive to SBI			6	0	1999			178

	PARAMETER			PICK LIST		DE-FAULT	MIN	MAX	UNIT	VARIATION	IPA
	CODE	LCD DISPLAY	DESCRIPTION	[CODE] LCD SELECTION	DESCRIPTION						
FREQ & RAMP											
Motorpotentiometer	**F.000**	**Motorpot ref**	Motopot reference (it can be set using up and down commands)			0	0	F.020	Hz	0.01	300
	F.010	**Acc/Dec time mp**	Motorpot Accel. and Decel. ramp time			10	0.1	999.9	sec	0.1	301
	F.011	**Motorpot offset**	Motopotentiometer minimum reference			0	0	F.020	Hz	0.1	302
	F.012	**Mp output mode**	Unipolar / bipolar Motorpotentiometer	**[0] Unipolar** **[1] Bipolar**	Motorpotentiometer unipolar Motorpotentiometer bipolar	0	0	1			303
	F.013	**Mp auto save**	Motopotenziometer auto save function	**[0] Disable** **[1] Enable**	Motorpot auto save function disabled Motorpot auto save function enabled	1	0	1			304
Reference Limit	**F.020**	**Max ref freq**	Motor maximum frequency value (for both the directions)			(****)	25	500	Hz	0.1	305
	F.021	**Min ref freq**	Minimum frequency value			0	0	F.020	Hz	0.1	306
Reference Sources	**F.050**	**Ref 1 channel**	Source of the Reference 1	**[0] Null** **[1] Analog inp 1** **[2] Analog inp 2** **[3] Freq ref x** **[4] Multispeed** **[5] Motorpotent** **[6] Analog inp 3** **[7] Encoder** **[8] Profidrive**	Null Analog input 1 Analog input 2 Frequency reference F.100 (S.203) Multi frequncies Motorpotientometer reference Analog input 3 Encoder signal Reference by Profibus	3	0	8			307
	F.051	**Ref 2 channel**	Source of the Reference 2	**[0] Null** **[1] Analog inp 1** **[2] Analog inp 2** **[3] Freq ref x** **[4] Multispeed** **[5] Motorpotent** **[6] Analog inp 3** **[7] Encoder** **[8] Profidrive**	Null Analog input 1 Analog input 2 Frequency reference F.101 Multispeed Motorpotientometer reference Analog input 3 Encoder signal Reference by Profibus	0	0	8			308
	F.060	**MltFrq channel 1**	Source of the Multispeed 1		As for F.050, Reference 1 source	3	0	8			309
	F.061	**MltFrq channel 2**	Source of the Multispeed 2		As for F.051, Reference 2 source	3	0	8			310
Multi Frequency Function	**F.100**	**Frequency ref 0**	Digital Reference frequency 0			0	-F.020	F.020	Hz	0.1	311
	F.101	**Frequency ref 1**	Digital Reference frequency 1			0	-F.020	F.020	Hz	0.1	312
	F.102	**Frequency ref 2**	Digital Reference frequency 2			0	-F.020	F.020	Hz	0.1	313
	F.103	**Frequency ref 3**	Digital Reference frequency 3			0	-F.020	F.020	Hz	0.1	314
	F.104	**Frequency ref 4**	Digital Reference frequency 4			0	-F.020	F.020	Hz	0.1	315
	F.105	**Frequency ref 5**	Digital Reference frequency 5			0	-F.020	F.020	Hz	0.1	316
	F.106	**Frequency ref 6**	Digital Reference frequency 6			0	-F.020	F.020	Hz	0.1	317
	F.107	**Frequency ref 7**	Digital Reference frequency 7			0	-F.020	F.020	Hz	0.1	318

	PARAMETER			PICK LIST		DE-FAULT	MIN	MAX	UNIT	VARIATION	IPA
	CODE	LCD DISPLAY	DESCRIPTION	[CODE] LCD SELECTION	DESCRIPTION						
	F.108	**Frequency ref 8**	Digital Reference frequency 8			0	-F.020	F.020	Hz	0.1	319
	F.109	**Frequency ref 9**	Digital Reference frequency 9			0	-F.020	F.020	Hz	0.1	320
	F.110	**Frequency ref 10**	Digital Refer. frequency 10			0	-F.020	F.020	Hz	0.1	321
	F.111	**Frequency ref 11**	Digital Refer. frequency 11			0	-F.020	F.020	Hz	0.1	322
	F.112	**Frequency ref 12**	Digital Refer. frequency 12			0	-F.020	F.020	Hz	0.1	323
	F.113	**Frequency ref 13**	Digital Refer. frequency 13			0	-F.020	F.020	Hz	0.1	324
	F.114	**Frequency ref 14**	Digital Refer. frequency 14			0	-F.020	F.020	Hz	0.1	325
	F.115	**Frequency ref 15**	Digital Refer. frequency 15			0	-F.020	F.020	Hz	0.1	326
	F.116	**Jog frequency**	Jogging frequency reference			1	-F.020	F.020	Hz	0.1	327
Ramp Config	**F.200**	**Ramp resolution**	Accuracy of the ramp setting	**[0] 0.01s** **[1] 0.1s** **[2] 1s**	From 0.01s to 99.99s From 0.1s to 999.99s From 1s to 9999s	1	0	2			328
	F.201	**Acc time 1**	Acceleration ramp time delay 1			5	0.1 (***)	999.9 (***)	sec	0.1 (***)	329
	F.202	**Dec time 1**	Deceleration ramp time delay 1			5	0.1 (***)	999.9 (***)	sec	0.1 (***)	330
	F.203	**Acc time 2**	Acceleration ramp time delay 2			5	0.1 (***)	999.9 (***)	sec	0.1 (***)	331
	F.204	**Dec time 2**	Deceleration ramp time delay 2			5	0.1 (***)	999.9 (***)	sec	0.1 (***)	332
	F.205	**Acc time 3**	Acceleration ramp time delay 3			5	0.1 (***)	999.9 (***)	sec	0.1 (***)	333
	F.206	**Dec time 3 / FS**	Deceleration ramp time delay 3 / Fast Stop decel.			5	0.1 (***)	999.9 (***)	sec	0.1 (***)	334
	F.207	**Acc time 4 / Jog**	Accel. ramp time delay 4 / Accel. time in jogging state			5	0.1 (***)	999.9 (***)	sec	0.1 (***)	335
	F.208	**Dec time 4 / Jog**	Decel. ramp time delay 4 / Decel. time in jogging state			5	0.1 (***)	999.9 (***)	sec	0.1 (***)	336
	F.250	**Ramp S-shape**	S Ramp shaping			0	0	10	sec	0.1	337
	F.260	**Ramp extens src**	Source for the Ramp time extension function	**[0] Null** **[1] Analog inp 1** **[2] Analog inp 2** **[3] Analog inp 3**	Null Analog input 1 Analog input 2 Analog input 3	0	0	3			338
Jump frequency	**F.270**	**Jump amplitude**	Jump frequencies hysteresys			0	0	100	Hz	0.1	339
	F.271	**Jump frequency 1**	Jump frequency 1			0	0	500	Hz	0.1	340
	F.272	**Jump frequency 2**	Jump frequency 2			0	0	500	Hz	0.1	341

	PARAMETER			PICK LIST		DE-FAULT	MIN	MAX	UNIT	VARIATION	IPA
	CODE	LCD DISPLAY	DESCRIPTION	[CODE] LCD SELECTION	DESCRIPTION						
PARAMETER											
Commands	**P.000**	**Cmd source sel**	It defines the use of START and STOP commands	**[0] Keypad** **[1] Terminals** **[2] Virtual** **[3] Serial** **[4] Control word**	START & STOP via keypad (+24V between 5 & 8 terminals required). START & STOP via terminal Main command via Virtual & Terminal setting Main command via serial line Reserved	1	0	4			400
	P.001	**RUN input config**	Command logic	**[0] Run / Rev** **[1] Fwd / Rev**	Disable negative rotation of the motor. Enable negative rotation of the motor.	0	0	1			401
	P.002	**Reversal enable**	Reversal enabling	**[0] Disable** **[1] Enable**	Disabling of the HW reverse command Enabling of the HW reverse command	1	0	1			402
	P.003	**Safety**	Safe start definition	**[0] OFF** **[1] ON**	START allowed with RUN temirnal connected at the power on START not allowed with RUN temirnal connected at the power on	1	0	1			403
	P.004	**Stop mode**	Motor stop control function	**[0] In ramp** **[1] Ramp to stop**	Decel. ramp up to 0Hz. Ramp to stop	0	0	1			493
Power Supply	**P.020**	**Mains voltage**	Rated value of the line voltage	**230** **400** **460** **575**	230V, only for DS-4 type 400V, only for DS-4 type 460V, only for DS-4 type 575V, only for DS-5 type	(****)	(****)	(****)	V		404
	P.021	**Mains frequency**	Rated value of the line voltage frequency	**50** **60**	50Hz 60Hz	(****)	(****)	(****)	Hz		405
Motor Data	**P.040**	**Motor rated curr**	Rated current of the motor			(*)	(*)	(*)	A	0.1	406
	P.041	**Motor pole pairs**	Pole Pairs of the motor			(*)	1	60			407
	P.042	**Motor power fact**	Motor power factor			(*)	0.01	1		0.01	408
	P.043	**Motor stator R**	Measurement of the stator resistance of the motor			(*)	0	99.99	ohm	0.01	409
	P.044	**Motor cooling**	Motor type cooling	**[0] Natural** **[1] Forced**	Self ventilated Assisted ventilation	0	0	1			410
	P.045	**Motor thermal K**	Motor thermal constant			30	1	120	min		411
V/F Curve	**P.060**	**V/f shape**	V/F Curve Type	**[0] Custom** **[1] Linear** **[2] Quadratic**	V/F curve defined by the user Linear characteristic Quadratic characteristic	1	0	2			412
	P.061	**Max out voltage**	Maximum output voltage			(**)	50	(**)	V	1	413
	P.062	**Base frequency**	Base frequency			(**)	25	500	Hz	0.1	414
	P.063	**V/f interm volt**	V/F intermediate voltage			(**)	0	P.061	V		415
	P.064	**V/f interm freq**	V/F intermediate frequency			(**)	1	P.062	Hz	0.1	416
Outp. Freq. Limit	**P.080**	**Max output freq**	Maximum output frequency			100	0	110	% of F.020	0.1	417
	P.081	**Min output freq**	Minimum output frequency			0.0	0.0	25.0	% of F.020	0.1	418

	PARAMETER			PICK LIST		DE-FAULT	MIN	MAX	UNIT	VARIATION	IPA
	CODE	LCD DISPLAY	DESCRIPTION	[CODE] LCD SELECTION	DESCRIPTION						
Slip Comp.	**P.100**	**Slip compensat**	Slip compensation			0	0	250	%		419
	P.101	**Slip comp filter**	Time constant of slip compensation			0.1	0	10	sec	0.1	420
Boost	**P.120**	**Manual boost [%]**	Torque boost level			1	0	25	% of P.061		421
	P.121	**Boost factor src**	Boost level source	**[0] Null** **[1] Analog inp 1** **[2] Analog inp 2** **[3] Analog inp 3**	Null Analog input 1 Analog input 2 Analog input 3	0	0	3			422
	P.122	**Auto boost en**	Automatic boost enabling	**[0] Disable** **[1] Enable**		1	0	1			423
Automatic Flux Regulation	**P.140**	**Magn curr gain**	Magnetizing current regulator gain			0	0	100	%	0.1	424
Anti Oscillation function	**P.160**	**Osc damping gain**	Damping gain			0	0	100			425
SW Curr. Clamp	**P.180**	**SW clamp enable**	Current clamp enable	**[0] Disable** **[1] Enable**		1	0	1			426
Current Limit	**P.200**	**En lim in ramp**	Enable current limitation during ramp	**[0] None** **[1] PI Limiter** **[2] Ramp freeze**		0	0	2			427
	P.201	**Curr lim in ramp**	Current limit in ramp			170	20	170	% I nom		428
	P.202	**En lim in steady**	Enable current limitation in steady state	**[0] Disable** **[1] Enable**		0	0	1			429
	P.203	**Curr lim steady**	Current limit at constant speed			170	20	170	% of I nom		430
	P.204	**Curr ctrl P-gain**	Current limiter proportional gain			30.0	0.1	100	%	0.1	431
	P.205	**Curr ctrl I-gain**	Current limiter integral gain			10.0	0.1	100	%	0.1	432
	P.206	**Curr ctr feedfwd**	Current limiter feed-forward			0	0	250	%		433

	PARAMETER			PICK LIST		DE-FAULT	MIN	MAX	UNIT	VARIATION	IPA
	CODE	LCD DISPLAY	DESCRIPTION	[CODE] LCD SELECTION	DESCRIPTION						
DC Link Limit	**P.220**	**En DC link ctrl**	Stall prevention during dec. for overvoltage	**[0] None** **[1] PI Limiter** **[2] Ramp freeze**		0	0	2			434
	P.221	**DC-lnk ctr Pgain**	DC link voltage limiter proportional gain			20.0	0.1	100	%	0.1	435
	P.222	**DC-lnk ctr Igain**	DC link voltage limiter integral gain			2.0	0.1	100	%	0.1	436
	P.223	**DC-link ctr FF**	DC link voltage limiter feed-forward			0	0	250	%		437
Over Torque Alarm Config	**P.240**	**OverTorque mode**	Overtorque mode	**[0] No Alm,Chk on** **[1] No Alm,Chk ss** **[2] Alm always** **[3] Alm steady st**	0: Overtorque detection always active and Over-torque alarm disabled. 1: Overtorque detection in steady state and Over-torque alarm disabled. 2: Overtorque detection always active and Over-torque alarm enabled. 3: Overtorque detection in steady state and Over-torque alarm enabled.	0	0	3			438
	P.241	**OT curr lim thr**	Current limit for overtorque			110	20	200	%		439
	P.242	**OT level fac src**	Overtorque level factor source	**[0] Null** **[1] Analog inp 1** **[2] Analog inp 2** **[3] Analog inp 3**	Null Analog input 1 Analog input 2 Analog input 3	0	0	3			440
	P.243	**OT signal delay**	Delay time for overtorque signaling			0.1	0.1	25	sec	0.1	441
Motor Overload Config	**P.260**	**Motor OL prot en**	Enabling of motor overload protection	**[0] Disable** **[1] Enable**		1	0	1			444
BU Config	**P.280**	**Brake res OL en**	Enabling of braking resistor overload protection	**[0] Disable** **[1] Enable**		0	0	1			445
	P.281	**Brake res value**	Ohmic value of braking resistor			(*)	1	250	ohm		446
	P.282	**Brake res power**	Braking resistor power			(*)	0.01	25	kW	0.01	447
	P.283	**Br res thermal K**	Braking resistor thermal constant			(*)	1	250	sec		448
DC Brake Config	**P.300**	**DC braking level**	DC braking level			0	0	100	% of I nom		449
	P.301	**DCB lev fac src**	DC braking level factor source	**[0] Null** **[1] Analog inp 1** **[2] Analog inp 2** **[3] Analog inp 3**	Null Analog input 1 Analog input 2 Analog input 3	0	0	3			450
	P.302	**DC braking freq**	Frequency for DC braking enabling			0	0	500	Hz	0.1	451
	P.303	**DC braking start**	DC braking time at start			0	0	60	sec	0.1	452
	P.304	**DC braking stop**	DC braking time at stop			0	0	60	sec	0.1	453

	PARAMETER			PICK LIST		DE-FAULT	MIN	MAX	UNIT	VARIATION	IPA
	CODE	LCD DISPLAY	DESCRIPTION	[CODE] LCD SELECTION	DESCRIPTION						
Autocapture function	**P.320**	**Autocapture mode**	Flying restart mode	**[0] Disable** **[1] 1st run only** **[2] Always**	Null Flying restar at power on Flying restart at run command	0	0	2			454
	P.321	**Autocapture Ilim**	Catch on flight current limit			120	20	170	% of I nom		456
	P.322	**Demagnetiz time**	Demagnetization minimun time			1	0.01	10	sec	0.01	457
	P.323	**Autocap f scan t**	Frequency scanning time during Pick Up			1	0.1	25	sec	0.1	458
	P.324	**Autocap V scan t**	Voltage scanning time during Pick Up			0.2	0.1	25	V	0.1	459
	P.325	**Autocap spd src**	Source of the reference for Pick Up function	**[0] Frequency ref** **[1] Max freq ref** **[2] Last freq ref** **[3] Encoder**	From active frequency reference From the Max fre ref parameter From freq. set desired From encoder	0	0	3			460
Undervoltage Config	**P.340**	**Undervoltage thr**	Undervoltage threshold			0	40	80	% of P.061		462
	P.341	**Max pwrloss time**	Restart time from undervoltage			0	0	25	sec	0.1	463
	P.342	**UV alarm storage**	Enabling of undervoltage alarm storage	**[0] Disable** **[1] Enable**		1	0	1			464
	P.343	**UV Trip mode**	Undervoltage tripping mode	**[0] Disabled** **[1] CoastThrough** **[2] Emg stop**	Function disabled Coast Through mode Emergency stop mode	0	0	2			491
Overvoltage Config	**P.360**	**OV prevention**	Automatic PickUp enabling after Overvoltage	**[0] Disable** **[1] Enable**		1	0	1			465
Autoreset Config	**P.380**	**Autoreset attmps**	Number of autoreset attempts			0	0	255			466
	P.381	**Autoreset clear**	En. automatic reset of autorestart attempts			10	0	250	min		467
	P.382	**Autoreset delay**	Autoreset time delay			5	0.1	50	sec	0.1	468
	P.383	**Autores flt rly**	Alarm relay contacts behaviour during autoreset	**[0] OFF** **[1] ON**		1	0	1			469
External Fault Config	**P.400**	**Ext fault mode**	External fault mode	**[0] Alm alw,No AR** **[1] Alm run,No AR** **[2] Alm alw, ARes** **[3] Alm run, ARes**	- Drive in alarm Alarm always active Alarm autoreset is not possible. - Drive in alarm Alarm active only with running motor. Alarm autoreset is not possible. - Drive in alarm Alarm always active Alarm autoreset is possible. - Drive in alarm Alarm active only with running motor Alarm autoreset is possible.	0	0	3			470

	PARAMETER			PICK LIST		DE-FAULT	MIN	MAX	UNIT	VARIATION	IPA
	CODE	LCD DISPLAY	DESCRIPTION	[CODE] LCD SELECTION	DESCRIPTION						
	P.410	**Ph Loss detec en**	Phase Loss detection enabling	**[0] Disable** **[1] Enable**		1	0	1			492
Voltage Reducuction Config	**P.420**	**Volt reduc mode**	Voltage reduction mode	**[0] Always** **[1] Steady state**	Always Costant speed only	0	0	1			471
	P.421	**V reduction fact**	Output voltage reduction factor			100	10	100	% of P.061		472
	P.422	**V fact mult src**	Source of voltage reduction factor multiplier	**[0] Null** **[1] Analog inp 1** **[2] Analog inp 2** **[3] Analog inp 3**	Null Analog input 1 Analog input 2 Analog input 3	0	0	3			473
Frequency Threshold	**P.440**	**Frequency prog 1**	Frequency 1 level detection			0	0	50	Hz	0.1	474
	P.441	**Freq prog 1 hyst**	Hysteresis amplitude related to P-420			0.5	0	50	Hz	0.1	475
	P.442	**Frequency prog 2**	Frequency 2 level detection			0	0	50	Hz	0.1	476
	P.443	**Freq prog 2 hyst**	Hysteresis amplitude related to P-422			0.5	0	50	Hz	0.1	477
Steady State Signalling	**P.460**	**Const speed tol**	Tolerance at constant speed			0	0	25	Hz	0.1	478
	P.461	**Const speed dly**	Ramp end signalling delay			0.1	0	25	sec	0.1	479
Heatsink Temp. Threshold	**P.480**	**Heatsnk temp lev**	Heatsink temperature signalling level			70	10	110	°C		480
	P.481	**Heatsnk temp hys**	Hysteresis band related to P.480			5	0	10	%#		481
PWM Settings	**P.500**	**Switching freq**	Modulation frequency	**[0] 1kHz** **[1] 2kHz** **[2] 3kHz** **[3] 4kHz** **[4] 6kHz** **[5] 8kHz** **[6] 10kHz** **[7] 12kHz** **[8] 14kHz** **[9] 16kHz** **[10] 18kHz**		(*)	0	10			482
	P.501	**Sw freq reduc en**	Enabling of switching frequency reduction under 5Hz	**[0] Disable** **[1] Enable**		0	0	1			483
	P.520	**Overmod max lev**	Overmodulation level			0	0	100	%		484
	P.540	**Out Vlt auto adj**	Automatic adjustment of output voltage	**[0] Disable** **[1] Enable**		1	0	1			485

	PARAMETER			PICK LIST		DE-FAULT	MIN	MAX	UNIT	VARIATION	IPA
	CODE	LCD DISPLAY	DESCRIPTION	[CODE] LCD SELECTION	DESCRIPTION						
Dead Time Compensation	**P.560**	**Deadtime cmp lev**	Dead times compensation limit			(*)	0	255			486
	P.561	**Deadtime cmp slp**	Dead times compensation slope			(*)	0	255			487
Display Settings	**P.580**	**Startup display**	Display IPA at start up			1	1	1999			488
	P.600	**Speed dsply fact**	Speed conversion constant for display			1	0.01	99.99		0.01	489
Protection	**P.999**	**Param prot code**	Parameters protection code		0 : All parameters are not protected 1 : Parameters F.100…F.116 are not protected; protected the others. 2 : All parameters are protected. 3 : All parameters are not protected; storage allowed while motor running. NOT RECOMMENDED.	0	0	3			490

	PARAMETER			PICK LIST		DE-FAULT	MIN	MAX	UNIT	VARIATION	IPA
	CODE	LCD DISPLAY	DESCRIPTION	[CODE] LCD SELECTION	DESCRIPTION						
APPLICATION											
PID Settings	**A.000**	**PID mode**	PID mode	**[0] Disable** **[1] Freq sum** **[2] Freq direct** **[3] Volt sum** **[4] Volt direct** **[5] Stand alone** **[6] St-Al always**	Null PID out in sum with ramp out ref (Feed forward) PID out not in sum with ramp out ref (no Feed forward) PID out not in sum with voltage ref (no Feed forward) PID out not in sum with voltage ref (no Feed forward) PID function as generic control (only with drive in RUN) PID function as generic control (any drive status)	0	0	6			1200
	A.001	**PID ref sel**	PID reference selector	**[0] Null** **[1] Analog inp 1** **[2] Analog inp 2** **[3] Analog inp 3** **[4] Frequency ref** **[5] Ramp output** **[6] Digital ref** **[7] Encoder freq**	Null Analog input 1 Analog input 2 Analog input 3 Frequency reference Ramp output Internal reference Encoder frequency	0	0	7			1201
	A.002	**PID fbk sel**	PID feedback selector	**[0] Null** **[1] Analog inp 1** **[2] Analog inp 2** **[3] Analog inp 3** **[4] Encoder freq** **[5] Output curr** **[6] Output torque** **[7] Output power**	Null Analog input 1 Analog input 2 Analog input 3 Encoder frequency Output peak current Output torque Output power	0	0	7			1202
	A.003	**PID digital ref**	PID digital reference			0	-100	100	%	0.1	1203
	A.004	**PID activat mode**	PID active in steady state only	**[0] Always** **[1] Steady state**		0	0	1			1204
	A.005	**PID-Encoder sync**	Enabling of encoder / PID synchronism	**[0] Disable** **[1] Enable**		0	0	1			1205
	A.006	**PID err sign rev**	Error sign reversal	**[0] Disable** **[1] Enable**		0	0	1			1206
	A.007	**PIDInteg init en**	Integral term initialization at start	**[0] Disable** **[1] Enable**		0	0	1			1207
	A.008	**PID update time**	PID updating time			0	0	2.5	sec	0.01	1208
PID Gains	**A.050**	**PID Prop gain 1**	Proportional term gain 1			0	0	99.99		0.01	1209
	A.051	**PID Int tconst 1**	Integral action time 1			99.99	0	99.99		0.01	1210
	A.052	**PID Deriv gain 1**	Derivative action time 1			0	0	99.99		0.01	1211
	A.053	**PID Prop gain 2**	Proportional term gain 2			0	0	99.99		0.01	1212
	A.054	**PID Int tconst 2**	Integral action time 2			99.99	0	99.99		0.01	1213
	A.055	**PID Deriv gain 2**	Derivative action time 2			0	0	99.99		0.01	1214
PID Limits	**A.056**	**PID high limit**	PID output upper limit			100	-100	100	%	0.1	1215
	A.057	**PID low limit**	PID output lower limit			-100	-100	100	%	0.1	1216
	A.058	**PID max pos err**	PID max. positive error			5	0.1	100	%	0.1	1217
	A.059	**PID min neg err**	PID max. negative error			5	0.1	100	%	0.1	1218

	PARAMETER			PICK LIST		DE-FAULT	MIN	MAX	UNIT	VARIATION	IPA
	CODE	LCD DISPLAY	DESCRIPTION	[CODE] LCD SELECTION	DESCRIPTION						
COMMAND											
Basic	**C.000**	**Save parameters**	Save parameters command	**Confirm? NO**	No action.	NO	NO	YES			800
				Confirm? YES	Save parameters command.						
	C.001	**Recall param**	Recall of the previous stored parameters	**Confirm? NO**	No action.	NO	NO	YES			801
				Confirm? YES	Recall previously parameters set.						
	C.002	**Load default**	Recall of the factory parameters.	**Confirm? NO**	No action.	NO	NO	YES			802
				Confirm? YES	Load default parameters.						
Alarm Reset	**C.020**	**Alarm clear**	Completer reset of the the Alarm List register	**Confirm? NO**	No action.	NO	NO	YES			803
				Confirm? YES	Clear alarm register command.						
External Key	**C.040**	**Recall key prog**	Recalling and storage of the parameters in the external key	**Confirm? NO**	No action.	NO	NO	YES			804
				Confirm? YES	Recall parameter from key.						
	C.041	**Save pars to key**	Storage of the inverter parameter on the external key	**Confirm? NO**	No action.	NO	NO	YES			805
				Confirm? YES	Storage parameters to key.						
Tuning	**C.100**	**Measure stator R**	Motor Autotune command	**Confirm? NO**	No action.	NO	NO	YES			806
				Confirm? YES	Autotune command.						

	PARAMETER		PICK LIST		DE-FAULT	MIN	MAX	IPA
	CODE	DESCRIPTION	[CODE] LCD SELECTION	DESCRIPTION				
HIDDEN								
		This menu is not available on the keypad. The setting and the reading of the parameters here contained, can be performed exclusively via serial line or through SBI card.						
Virtual I/Os Commands	**H.000**	**Virtual digital command**			0	0	255	1000
	H.001	**Exp virtual digital command**			0	0	255	1001
	H.010	**Virtual digital state**			0	0	255	1002
	H.011	**Exp Virtual digital state**			0	0	255	1003
	H.020	**Virtual An Output 1**			0	-32768	32767	1004
	H.021	**Virtual An Output 2**			0	-32768	32767	1005
	H.022	**Exp Virtual An Output 1**			0	-32768	32767	1006
Profidrive Profile	**H.030**	**Profidrive Control word (see Profibus instruction manual)**			0	0	65535	1007
	H.031	**Profidrive Status word (see Profibus instruction manual)**			0	0	65535	1008
	H.032	**Profidrive reference (see Profibus instruction manual)**			0	-16384	16383	1040
	H.033	**Profidrive actual reference (see Profibus instruction manual)**			1	-16384	16383	1041
Drive Status	**H.034**	**Drive status**			0	0	65535	1042
	H.040	**Progress**			0	0	100	1009
Parameters Reading Extension	**H.050**	**Drive output frequency 16 bit low (d.000)**			0	-2^{31}	$2^{31}-1$	1010
	H.051	**Drive output frequency 16 bit high (d.000)**			0	-2^{31}	$2^{31}-1$	1011
	H.052	**Drive reference frequency 16 low (d.001)**			0	-2^{31}	$2^{31}-1$	1012
	H.053	**Drive reference frequency 16 high (d.001)**			0	-2^{31}	$2^{31}-1$	1013
	H.054	**Output speed (d.000)*(P.600) 16 bit low (d.007)**			0	-2^{31}	$2^{31}-1$	1014
	H.055	**Output speed (d.000)*(P600) 16 bit high (d.007)**			0	-2^{31}	$2^{31}-1$	1015
	H.056	**Speed Ref (d.001)*(P.600) 16 bit low (d.008)**			0	-2^{31}	$2^{31}-1$	1016
	H.057	**Speed Ref (d.001)*(P.600) 16 bit high (d.008)**			0	-2^{31}	$2^{31}-1$	1017
	H.058	**Encoder freq 16 bit low (d.301)**			0	-2^{31}	$2^{31}-1$	1018
	H.059	**Encoder freq 16 bit high (d.301)**			0	-2^{31}	$2^{31}-1$	1019
	H.060	**Encoder speed (d.000)*(P.600) 16 bit low (d.302)**			0	-2^{31}	$2^{31}-1$	1044
	H.061	**Encoder speed (d.000)*(P.600) 16 bit high (d.302)**			0	-2^{31}	$2^{31}-1$	1045

	PARAMETER		PICK LIST		DE-FAULT	MIN	MAX	IPA
	CODE	DESCRIPTION	[CODE] LCD SELECTION	DESCRIPTION				
Remote I/Os Control	H.100	Remote Digital Inputs (0..15)			0	0	65535	1021
	H.101	Remote Digital Inputs (16..31)			0	0	65535	1022
	H.110	Remote Digital Outputs (0..15)			0	0	65535	1023
	H.111	Remote Digital Outputs (16..31)			0	0	65535	1024
	H.120	Remote Analog input 1			0	-32768	32767	1025
	H.121	Remote Analog input 2			0	-32768	32767	1026
	H.130	Remote Analog output 1			0	-32768	32767	1027
	H.131	Remote Analog output 2			0	-32768	32767	1028
Serial Link Commands	H.500	Harware reset			0	0	1	1029
	H.501	Alarm reset			0	0	1	1030
	H.502	Coast to stop			0	0	1	1031
	H.503	Stop with ramp			0	0	1	1032
	H.504	Clockwise Start			0	0	1	1033
	H.505	Anti-clockwise Start			0	0	1	1034
	H.506	Clockwise Jog			0	0	1	1035
	H.507	Anti-clockwise Jog			0	0	1	1036
	H.508	Clockwise Flying restart			0	0	1	1037
	H.509	Anti-clockwise Flying restart			0	0	1	1038
	H.510	DC Brake			0	0	1	1039

7.2 Menu d - DISPLAY

Basic

d.000 Output frequency

Drive output frequency [Hz].

d.001 Frequency ref (Frequency reference)

Drive frequency reference [Hz] .

d.002 Output current

Drive output current (rms) [A].

d.003 Output voltage

Drive output voltage (rms) [V].

d.004 DC link voltage

DC Bus drive voltage (DC) [V].

d.005 Power factor

Power factor.

d.006 Power [kW]

Active power.

d.007 Output speed

Drive output speed **(d.000)*(P.600).**

d.008 Speed ref (Speed reference)

Drive speed reference **(d.001)*(P.600).**

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
d.000	Output frequency					Hz	0,01	001
d.001	Frequency ref					Hz	0,01	002
d.002	Output current					A	0,1	003
d.003	Output voltage					V	1	004
d.004	DC link voltage					V	1	005
d.005	Power factor						0,01	006
d.006	Power [kW]					kW	0,01	007
d.007	Output speed						0.01 / 1	008
d.008	Speed ref						0.01 / 1	009

Overload

d.050 Heatsink temp (Heatsink temperature)

Drive heatsink temperature [°C] (linear sensor measured).

d.051 Drive OL (Drive overload)

Drive overload (100% = alarm threshold).

d.052 Motor OL (Motor overload)

Motor overload (100% = alarm threshold).

d.053 Brake res OL (Brake resistror overload)

Braking resistor overload (100%=alarm thr).

d.054 Reg board temp (Regulation temperature)

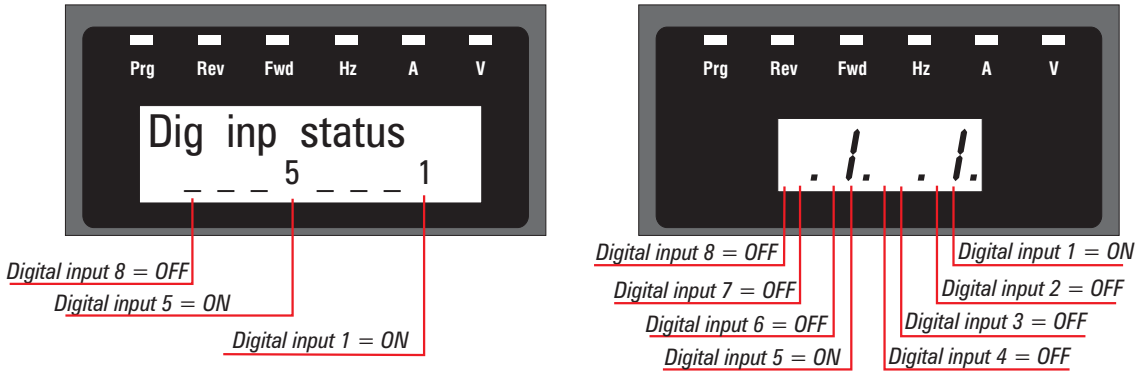
Temperature of regulation board (°C).

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
d.050	Heatsink temp					°C	1	010
d.051	Drive OL					%	0.1	011
d.052	Motor OL					%	0.1	012
d.053	Brake res OL					%	0.1	013
d.054	Regu board temp					°C	1	058

Inputs/Outputs

d.100 Dig inp status (Digital inputs status)

Status of the digital inputs acquired by the drive. They can come from drive regulation board terminal inputs or virtual inputs (ex.: by serial or field bus cards).
Example of displaying digital inputs with alphanumeric LDC display and 7 segments display:



NOTE! For LCD dispaly example all the other digital inputs are OFF.

d.101 Term inp status (Teminal inputs status)

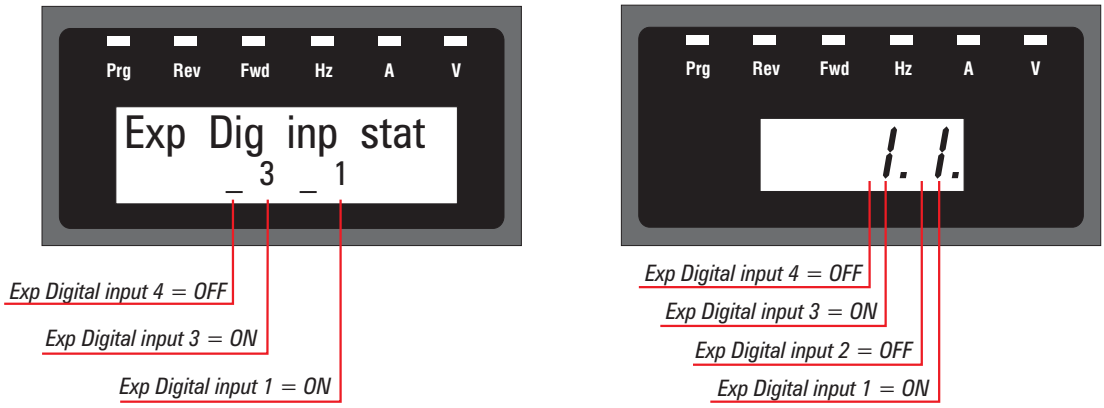
Status of the digital inputs terminal of the drive regulation board.
See example d.100

d.102 Vir dig inp stat (Virtual digital inputs status)

Status of the virtual digital inputs received by serial link or field bus card.
See example d.100

d.120 Exp dig inp stat (Expansion board digital inputs status)

Status of the expansion digital inputs acquired by the drive, from the expansion board terminal inputs or expansion virtual inputs (ex.: by serial or field bus cards).
Example of displaying expansion digital inputs with alphanumeric LDC display and 7 segments display:



NOTE! For LCD display example all the other expansion digital inputs are OFF.

d.121 Exp term inp (Expansion board terminal inputs status)

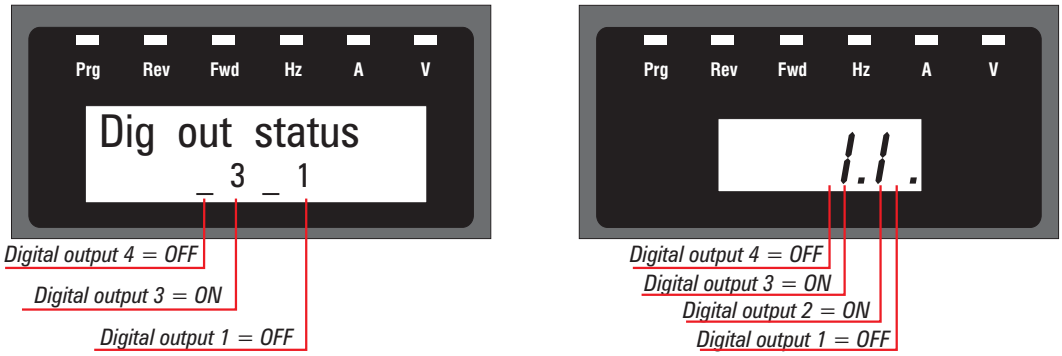
Status of the expansion digital inputs terminal of the drive expansion board.
See example d.120

d.122 Vir exp dig inp (Expansion Board virtual digital inputs status)

Status of the expansion virtual digital inputs received by drive serial link or field bus card.
See example d.120

d.150 Dig out status (Digital outputs status)

Status of the digital outputs executed by the drive, on the drive regulation terminal outputs or virtual outputs (ex.: by serial or field bus cards).
Example of displaying, of digital outputs with alphanumeric LDC display and 7 segments display:



NOTE! For LCD display example all the other digital output are OFF.

d.151 Term dig out sta (Terminal digital outputs status)

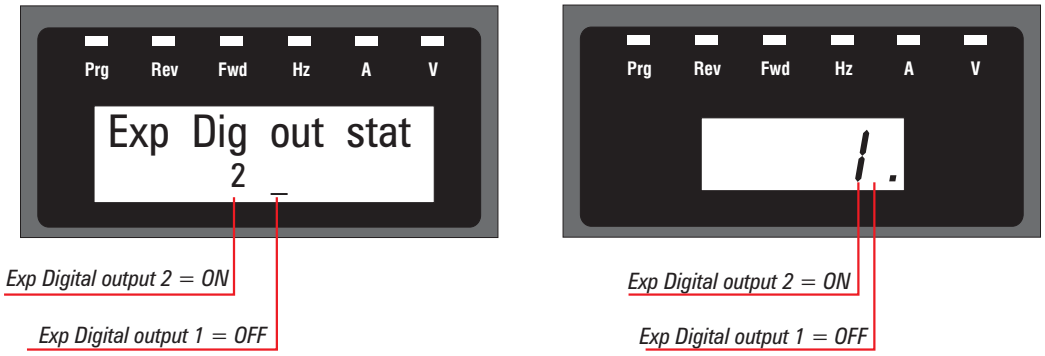
Status of the digital outputs terminal of the drive regulation board.
See example d.150

d.152 Vir dig out stat (Virtual digital outputs status)

Status of the virtual digital outputs executed by the drive serial link or field bus card.
See example d.150

d.170 Exp dig out stat (Expansion board digital outputs status)

Status of the expansion digital outputs executed by the drive, on the expansion terminal outputs or virtual outputs (example: by serial or field bus cards).
Example of displaying of expansion digital outputs with alphanumeric LDC display and 7 segments display:



d.171 Exp term out sta (Expansion board terminal outputs status)

Status of the expansion digital outputs terminal.
See example d.170

d.172 Exp vir dig out (Expansion board virtual digital outputs status)

Status of the expansion virtual digital outputs, executed via serial link or field bus card.
See example d.170

d.200 An in 1 cnf mon (Analog input 1 configuration monitor)

It monitors the analog input 1 signal destination; it is possible to know which function is associated to this input:

[0] Null funct	None function programmed	
[1] Freq ref 1	Frequency reference 1	chapter **FREQ & RAMPS,** section ***Reference sources (F.050)***
[2] Freq ref 2	Frequency reference 2	chapter **FREQ & RAMPS**, section ***Reference sources (F.051)***
[3] Boost lev fac	Level of voltage boost	chapter **PARAMETERS**, section ***Boost (P.121)***
[4] OT level fact	Level of over torque	chapter **PARAMETERS**, section ***OT level factor src (P.242)***
[5] V red lev fac	Output voltage reduction level	chapter **PARAMETERS**, section ***Voltage Red Config P.422)***
[6] DCB level fac	DC braking current level	chapter **PARAMETERS**, section ***DC brake Config (P.301)***
[7] Ramp ext fact	Ramp extension factor	chapter **PARAMETERS**, section ***Ramp Config (F.260)***

d.201 An in 1 monitor (Analog input 1 monitor)

Analog input 1 - output block (% value).

d.202 An in 1 term mon (Analog input 1 terminals monitor)

Analog input 1 input block % value (regulation board).
It monitors the input signal depending on the selection of ***An inp 1 Type (I.200)*** parameter:

- selection: **[0] +/- 10V**: 0V = 0%, -10V = -100%, +10V = +100%
- selection: **[1] 0-10V/0-20mA**: 0V = 0%, +10V = +100%

d.210 An in 2 cnf mon (Analog input 2 configuration monitor)

It monitors the analog input 2 signal destination; it is possible to know which function is associated to this input (see list of parameter ***d.200***).

d.211 An in 2 monitor (Analog input 2 monitor)

Analog input 2 - output block (% value).

d.212 An in 2 term mon (Analog input 2 terminals monitor)

Analog input 2 - input block (% value).
It monitors the input signal depending on the selection of ***An inp 2 Type (I.210)*** parameter:

- selection: **[0] +/- 10V**: 0V = 0%, -10V = -100%, +10V = +100%
- selection: **[1] 0-10V/0-20mA**: 0V = 0%, +10V = +100%

d.220 An in 3 cnf mon (Analog input 3 configuration monitor)

It monitors the analog input 3 signal destination; it is possible to know which function is associated to this input (see list of parameter ***d.200***).

d.221 An in 3 monitor (Analog input 3 monitor)

Analog input 3 - output block (% value).

d.222 An in 3 term mon (Analog input 3 terminals monitor)

Analog input 3 - input block (% value).
It monitors the input signal depending on the selection of ***An inp 3 Type (I.220)*** parameter:

- selection: **[1] 0-10V/0-20mA**: 0mA = 0%, 20mA = +100%
- selection: **[2] 4-20mA**: 4mA = 0%, 20mA = +100%

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
d.100	Dig inp status							014
d.101	Term inp status							015
d.102	Vir dig inp stat							016
d.120	Exp dig inp stat							017
d.121	Exp term inp							018
d.122	Vir exp dig inp							019
d.150	Dig out status							020
d.151	Term dig out sta							021
d.152	Vir dig out stat							022
d.170	Exp dig out stat							023
d.171	Exp term out sta							024
d.172	Exp vir dig out							025
d.200	An in 1 cnf mon							026
d.201	An in 1 monitor					%		027
d.202	An in 1 term mon					%		028
d.210	An in 2 cnf mon							029
d.211	An in 2 monitor					%		030
d.212	An in 2 term mon					%		031
d.220	An in 3 cnf mon							032
d.221	An in 3 monitor					%		033
d.222	An in 3 term mon					%		034

Encoder

d.300 EncPulses/Sample (Encoder Pulses / Sample)

Number of encoder pulses recorded in a single encoder sampling period (I.504).

d.301 Encoder freq (Encoder frequency)

Encoder frequency (Motor frequency) [Hz]

d.302 Encoder speed

Encoder speed (d.000)*(P.600).

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
d.300	EncPulses/Sample						1 / 100	035
d.301	Encoder freq					Hz	0,01	036
d.302	Encoder speed						0.01 / 1	037

Option

d.350 Option 1 state

It monitors the drive option 1 state; it is possible to know the expansion board type programmed.

d.351 Option 2 state

It monitors the drive option 2 state; it is possible to know the expansion board type programmed.

d.352 Par port state (Parallel port state)

It monitors the 16-bit parallel port state (option).

d.353 SBI State

Communication state between SBI and Master.

d.354 SBI Baude rate

Communication speed between SBI and Master

Code	LCD display	[Code] & LCD select.		Default	MIN	MAX	Unit	Variation	IPA
d.350	Option 1 state								038
d.351	Option 2 state								039
d.352	Par port state								040
d.353	SBI State	0	Wait parametrization						059
		1	Wait configuration						
		2	Data exchange						
		3	Error						
d.354	SBI Baude rate	0	12 Mbit / s						060
		1	6 Mbit / s						
		2	3 Mbit / s						
		3	1.5 Mbit / s						
		4	500 Mbit / s						
		5	187.5 kbit / s						
		6	93.75 kbit / s						
		7	45.45 kbit / s						
		8	19.2 kbit / s						
		15	unknowk						

Pid

d.400 PID reference

PID reference signal.

d.401 PID feedback

PID feedback signal.

d.402 PID error

PID error signal.

d.403 PID integr comp (PID integral component)

PID integral component.

d.404 PID output

PID output signal.

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
d.400	PID reference					%	0.1	041
d.401	PID feedback					%	0.1	042
d.402	PID error					%	0.1	043
d.403	PID integr comp					%	0.1	044
d.404	PID output					%	0.1	045

Alarm list

d.800 1st alarm-latest

Last alarm memory stored by the drive alarm list.

d.801 2nd alarm

Second to last alarm memory stored by the drive alarm list.

d.802 3rd alarm

Third to last alarm memory stored by the drive alarm list.

d.803 4th alarm

Fourth to last alarm memory stored by the drive alarm list.

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
d.800	1st alarm-latest							046
d.801	2nd alarm							047
d.802	3rd alarm							048
d.803	4th alarm							049

Drive Identification

d.950 Drive rated curr (Drive rated current)

Drive rated current (it is dependent on the drive size).

d.951 SW version (1/2) (Software version - part 1)

Display example: **03.00**
03 = index of software identification
00 = index of software revision (new functions or parameters)

d.952 SW version (2/2) (Software version - part 2)

Display example: **00.00**
00 = index of revision (fixing bugs)
00 = index of identification (special version)

NOTE! to be considered as reference for SIEI personell

d.953 Power ident code (Power identification code)

Reserved.

d.954 Param ident code (Parameters identification code)

Reserved.

d.955 Regul ident code (Regulation identification code)

Reserved.

d.956 Startup id code (Startup identification code)

Reserved.

d.957 Drive size

Drive size code; display example: 130.

d.958 Drive cfg type

Drive configuration type: 0 = Standard configuration 400V, 1 = American configuration 460V and 575V

Code	LCD display	[Code] & LCD select.		Default	MIN	MAX	Unit	Variation	IPA
d.950	Drive rated curr							0,1	050
d.951	SW version (1/2)							0,01	051
d.952	SW version (2/2)							0,01	052
d.953	Power ident code								053
d.954	Param ident code								054
d.955	Regul ident code								055
d.956	Startup id code								056
d.957	Drive size	32	0.75 kW - 230/400/480V		130	2.0 Hp - 575 V			057
		33	1.5 kW - 230/400/480V		131	3.0 Hp - 575 V			
		34	2.2 kW - 230/400/480V		132	5.0 Hp - 575 V			
		35	3 kW - 230/400/480V		133	7.5 Hp - 575 V			
		36	4 kW - 230/400/480V		134	10 Hp - 575 V			
		37	5.5 kW - 230/400/480V		135	15 Hp - 575V			
		38	7.5 kW - 230/400/480V		136	20 Hp - 575 V			
		39	11 kW - 230/400/480V		167	25 Hp - 575 V			
		40	15 kW - 230/400/480V		168	30 Hp - 575 V			
		41	22 kW - 230/400/480V		169	40 Hp - 575 V			
		42	30 kW - 230/400/480V		170	50 Hp - 575V			
		43	37 kW - 230/400/480V		171	60 Hp - 575 V			
		44	45 kW - 230/400/480V		172	75 Hp - 575 V			
		45	55 kW - 230/400/480V						
		46	75 kW - 230/400/480V						
		47	90 kW - 230/400/480V						
		48	110 kW - 230/400/480V						
		49	132 kW - 230/400/480V						
d.958	Drive cfg type	0							061
		1							

Utility

d.999 Display Test

Drive display test

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
d.999	Display Test	Drive display test						099

7.3 Menu S - START-UP

NOTE! The **START UP** menu is a set of parameters and functions that allow a quick start of the motor.These parameters are duplicated in other menus of the drive, Therefore, their modification can be performed in any of the menus where the parametes are present.

Power Supply

S.000 Mains voltage

Rated value of the main voltage [V].
The undervoltage trip function is based on this value (see chapter **PARAMETER**, section **Undervoltage configuration**).

S.001 Mains frequency

Rated value of the line voltage frequency [Hz].

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
S.000	Mains voltage	230 (Only for "AGy...-4" type)	(****)	220	575	V		404
		400 (Only for "AGy...-4" type)						
		460 (Only for "AGy...-4" type)						
		575 (Only for "AGy...-5" type)						
S.001	Mains frequency	50	(****)	50	60	Hz		405
		60						

(****) parameter value dependent on drive type.

V/F Ratio

S.100 Max out voltage (Maximun output voltage)

Maximum value of the voltage applied to the motor (normally set as the nameplate, see figure 7.3.2).

S.101 Base frequency

Rated frequency of the motor (given on the nameplate, see figure 7.3.2)
It means the working frequency of the drive, at which the ***Max out voltage*** is associated ***(S.100).***

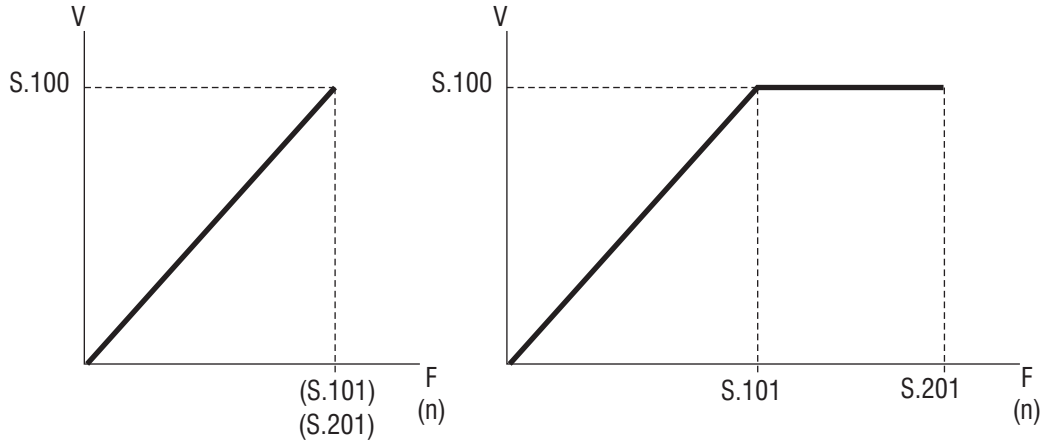


Figure 7.3.1: V/F Ratio

NOTE! For further setting of the V/F ratio, see the chapter **PARAMETER**, section **V/F Curve**

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
S.100	Max out voltage		(**)	50	(**)	V	1	413
S.101	Base frequency		(**)	25	500	Hz	0,1	414

(**) parameter value dependent on drive nominal main voltage and main frequency.

Motor Data

S.150 Motor rated curr (Motor rated current)

Rated current of the motor at rated kilowatt/horsepower and voltage (given on the nameplate, see figure7.3.2).

In case of control with multiple motors, enter a value equal to the sum of the rated currents of all the motors. Do not perform any self tune.

S.151 Motor pole pairs

Pole pairs of the motor.
The setting of this data, can be easily calculated with the following formula:

$$N[rpm] = \frac{60\ [s] \times f\ [Hz]}{2p\ [polepairs]}$$

where: p = motor pole pairs
f = rated frequency of the motor (***S.101***)
n_N = rated speed of the motor (see figure 7.3.2).

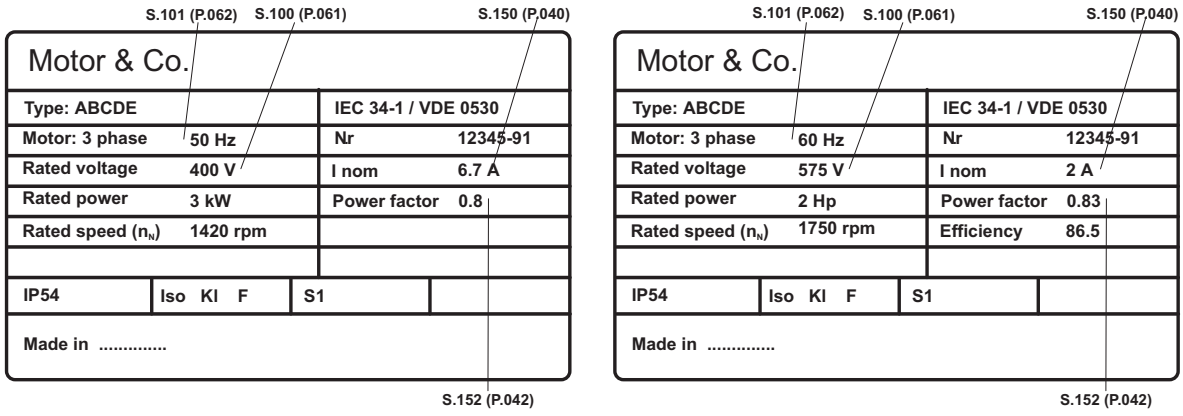


Figure 7.3.2: Motor Nameplate (Example: kW rating for 400V motor and Hp rating for 575V motor)

Example: calculation of the pole pairs of a motor having the data shown in the above 575V label:

$$p\ [polepairs] = \frac{60\ [s] \times f\ [Hz]}{n_N\ [rpm]} = \frac{60\ [s] \times 60\ [Hz]}{1750\ [rpm]} = 2$$

the value to set in the parameter ***S.152*** is "2"

S.152 Motor power factor

Motor power factor (given on the nameplate, see figure7.3.2).

S.153 **Motor stator R** (Motor stator Resistance)

Measurements of the stator resistance of the motor.
This value will be automatically updated, by performing the self tune procedure.

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
S.150	Motor rated curr		(*)	(*)	(*)	A	0.1	406
S.151	Motor pole pairs		(*)	1	60			407
S.152	Motor power fact		(*)	0.01	1		0.01	408
S.153	Motor stator R		(*)	0	99.99	ohm	0.01	409

(*) parameter value dependent on drive size.

Commands & Referencies

S.200 **Cmd source sel** (Command source selection)

It defines the use of the main commands START and STOP .

S.200 = 0 START & STOP via keypad

In this configuration the commands are active through the keypad buttons.

The Digital Input 7, factory programmed as RUN (terminal 5), must be connected to a specific logic level (high level or low level) in order to allow the motor START.
For this connection refer to figure 5.3.2.1.

If this connection is removed, the motor will STOP with the set deceleration ramp time.

S.200 = 1 START & STOP via terminals

In this configuration the commands are active through the drive terminals.
The motor START command can be performed by applying the specific logic level (high level or low level), to the Digital Input 7 (terminal 5), factory set as RUN If this connection is removed, the motor will STOP with the set ramp time.
For this connection refer to figure 5.3.2.1.

NOTE! After a cycle of main supply voltage, the drive can be started only according to the settings of ***P.003 Safety*** parameter, which allows the Start/Stop commands to respond to **Edge** or **Level** sensitive signals (see chapter 7.6 for more details).

NOTE! Other configurations for the setting of the "main commands" are described in the chapter **PARAMETERS**, section **Commands**.

Main Commands Logic Control:

"START & STOP"

- The START & STOP function configuration is correlated to other functions and parameters as well as the mode to REVERSE the motor speed.

These functions allow additional control logic and safety control.
For further information, see chapter **PARAMETER,** section **Commands** .

"MOTOR SPEED REVERSAL"

- There are several way to REVERSE the speed direction of the motor.

As a default factory setting, the Digital Input 8 (terminal 4) is programmed to this purpose.

All of the frequency references or other variables controlled with digital setting or analog signal, can be programmed either with positive or negative values. The polarity of the value (Digital or Analog) will determine the motor rotation direction, without the use of any external HW commands.
Despite the polarity of the reference, the REVERSE command, if programmed on a digital input, will always reverse the speed direction of the motor.

S.201 Max ref freq (Maximun reference frequency)

It is the threshold for the analog or digital reference and the maximum speed for both directions.
This parameter applies to the sum of the two references value available on the drive.

S.202 Ref 1 Channel (Reference 1 channel)

It defines the source from where the Reference 1 is provided and controlled.
For further details please refer to chapter **FREQ & RAMPS**, section **Reference Source**.

S.203 Frequency ref 0 (Frequency reference 0)

Digital speed reference.
It is also the first digital frequency of the Multispeed selection (***F.100…F.116***).
It is possible to set setting with positive or negative values.
The polarity will determine the sense of rotation of the motor.
In either polarity the setting the HW Reverse command is active (when enabled).

The maximum settable value is correlated to ***Max ref freq (S.201).***

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
S.200	Cmd source sel	[0] Keypad	1	0	4			400
		[1] Terminals						
		[2] Virtual						
		[3] FoxLink						
		[4] Control word						
S.201	Max ref freq		(****)	25	500	Hz	0.1	305
S.202	Ref 1 channel	[0] Null	3	0	8			307
		[1] Analog inp 1 (setting through ***I.200…I.204***)						
		[2] Analog inp 2 (setting through ***I.210…I.214***)						
		[3] Freq ref x (setting through ***S.203*** or ***F.100***)						
		[4] Multispeed (setting through ***F.100…F.116***)						
		[5] Motorpotent (setting through ***F.000…F013***)						
		[6] Analog inp 3 (setting through ***I.220…I.224***)						
		[7] Encoder (setting through ***I.500…I.505***)						
		[8] Profidrive Reference by Profibus						
S.203	Frequency ref 0		0	-S.201	S.201			311

(****) parameter value dependent on drive type.

S.300 Acc time 1 (Acceleration time 1)

S.301 Dec time 1 (Deceleration time 1)

The ramp control can be set to allow a programmable delay (in seconds), for the acceleration and deceleration times of the drive reference.
This delay time will have to be set on the final system (motor and load), being strictly dependant from the inertia of the load machine.
The ramps time delay, are calculated in accordance with the ***Max ref freq (S.201).***
The setting can be carried out as follows, according to the setting of the parameter ***F.200***.

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
S.300	Acc time 1		5	1	999.9	sec	0.1 (***)	329
S.301	Dec time 1		5	1	999.9	sec	0.1 (***)	330

S.400 Manual boost [%]

The resistive impedance of the stator windings causes a voltage drop within the motor, which result in a reduction in torque in the lower speed range.
Compensation can be made for this effect by boosting the output voltage.
This compensation is carried out continuously across the whole speed range in proportion to the output current but it is most effective at low speed.

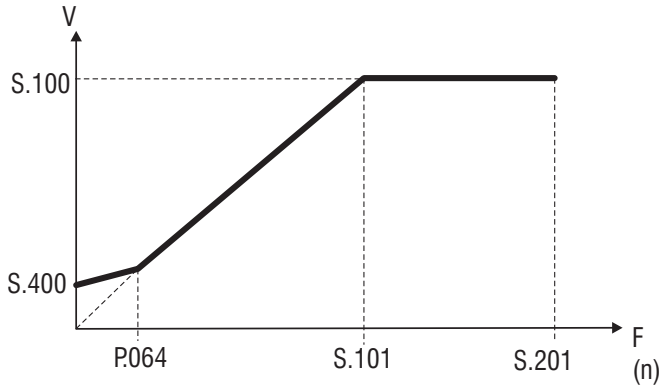


Figure 7.3.3: Manual Boost Voltage

The setting is in percentage of the ***Max out voltage (S.100)***.

NOTE! When custom V/f shape is selected (***P.060*** = 0):

P.064 parameter represents the return point of the output voltage, on the linear characteristic of V/f ratio (see figure 7.3.3).

S.401 Auto boost en (Automatic boost enabling)

The boost can be automatically controlled by the enabling of this parameter. The control is continuously carried out in the whole speed range.
The Auto boost must be disabled when a multiple motor connection is being used.

NOTE! The automatic boost is automatically calculated during the execution of drive/motor self tuning (***S.901*** parameter).

It is anyway possible to obtain an "Oveboost" at low speed, increasing the value of the manual boost (***S.400*** parameter).

S.450 Slip compensat (Slip compensation)

If an induction motor is being used, the mechanical speed will vary with the load due to the slip of the motor.
In order to adjust for this speed error the slip compensation can be used.

During this calibration, make sure that the drive is not in a current limit condition.
If this compensation is set too high it can cause instability.
The changing will be carried out as a percentage of the nominal slip, calculated when set the motor plate date.

The Slip compensation will act directly on the output frequency of the drive. To this purpose the parameter ***Max output freq (P.080)*** expressing the percentage of the ***Max ref freq (F.020)***, has to be set to a value including:
Max ref freq value + ***Slip compensat*** value.
(See also chapter **PARAMETER**, section **Output Frequency Limit**).

The Slip compensation must be disabled when a multiple motor connection is being used.

S.451 Slip comp filter (Slip compensation filter)

It is the response time (in seconds) for the reaction of the function.
Increasing this value helps damping oscillations that may arise with load steps (especially negative ones).

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
S.400	Manual boost [%]		1	0	25	% of S.100		421
S.401	Auto boost en	[0] Disable [1] Enable	0	0	1			423
S.450	Slip compensat		0.1	0	10	%		419
S.451	Slip comp filter		0.1	0	10	sec	0.1	420

Utility

S.900 Measure stator R (Measurement of stator resistance)

It measures the stator resistance of the motor connected.
This will help to provide a smooth and uniform value of the output torque through the whole speed range.
The control is assisted by the use of the ***Automatic boost (P.401).***

Do not perform any tune when a multiple motor connection is being used.

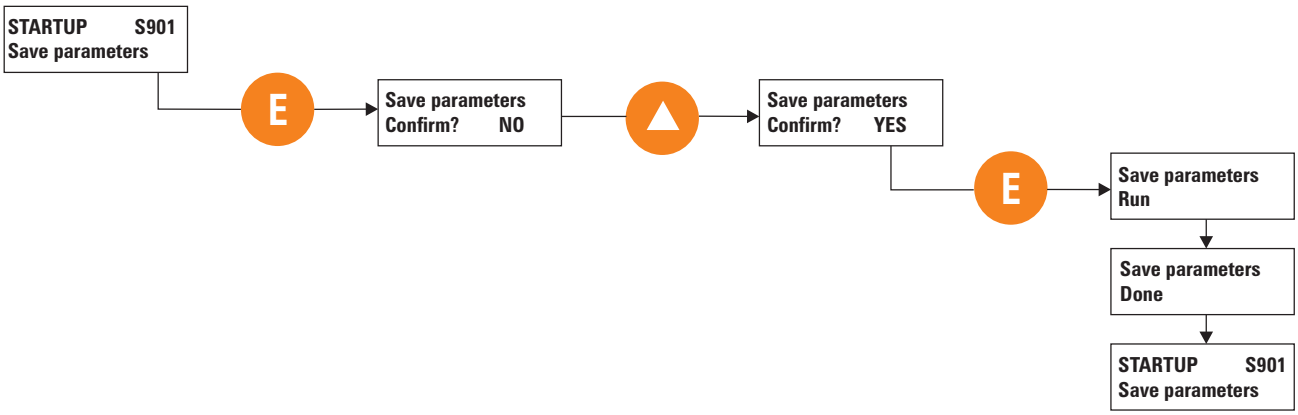
S.901 Save parameters

Every changing of each parameter, is accepted and executed by the drive.
However, the permanent storage of them, is performed only by the execution of this command.

The lack of this operation will cause the loss of every changed parameter when the power is disconnected from the drive.

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
S.900	Measure stator R	Confirm ? NO Confirm ? YES	NO	NO	YES			806
S.901	Save parameters	Confirm ? NO Confirm ? YES	NO	NO	YES			800

Here below is an example of how to execute the Save parameters command. It is also valid for ***Measure stator R (S.900)*** command.



7.4 Menu I - INTERFACE

Digital Inputs Regulation Board

I.000 Dig input 1 cfg (Digital input 1 configuration)

I.001 Dig input 2 cfg (Digital input 2 configuration)

I.002 Dig input 3 cfg (Digital input 3 configuration)

I.003 Dig input 4 cfg (Digital input 4 configuration)

I.004 Dig input 5 cfg (Digital input 5 configuration)

I.005 Dig input 6 cfg (Digital input 6 configuration)

I.006 Dig input 7 cfg (Digital input 7 configuration)

I.007 Dig input 8 cfg (Digital input 8 configuration)

The regulation board provides as standard 8 opto-coupled digital inputs. A PNP or NPN logic level, can be selected according to figure 5.5.1. Every input is programmable with a specific code and function, as shown in the list below.

***DIGITAL INPUTS SELECTION LIST**:*

Code	*LCD display*	*Description*
0	**None**	Not active
1	**Run**	RUN command for the motor START
2	**Reverse**	Speed REVERSE command
3	**Ext Fault NO**	External fault with NO (Normal Open) contact
4	**Ext Fault NC**	External fault with NC (Norm. Closed) contact
5	**Alarm reset**	Alarm reset command
6	**Jog**	JOG frequency reference enabling
7	**Freq sel 1**	Binary selection for Multispeed
8	**Freq sel 2**	Binary selection for Multispeed
9	**Freq sel 3**	Binary selection for Multispeed
10	**Freq sel 4**	Binary selection for Multispeed
11	**Ramp sel 1**	Binary selection for Multiramp
12	**Ramp sel 2**	Binary selection for Multiramp
13	**Enable NO**	Drive Enable with NC (Norm. Closed) contact
14	**Enable NC**	Drive Enable with NO (Normal Open) contact
15	**DCBrake en**	Enabling of the DC braking function
16	**DCBrake**	Command for execution of DC braking
17	**Autocapture**	Execution of the flying restart
18	**Ramp enable**	Enabling / Disabling of the Ramp block
19	**Zero ref**	Ramp to 0Hz & main commands active
20	**PID enable**	Enabling of the PID regulation
21	**PID freeze**	Enabling PID freeze output signal.
22	**PID gain sel**	Initilizing of the Integral value of PID
23	**Motorpot Up**	Motorpotentiometer reference increasing
24	**Motorpot Dn**	Motorpotentiometer reference decreasing
25	**Reset Motorp**	Reset of Motorpotentiometer reference
26	**Fast stop**	Emergency stop (with Dec time 3 delay)
27	**Zero freq**	Enabling output freq. to zero.

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
I.000	Dig input 1 cfg	*See Digital inputs selection list*	7	0	27			100
I.001	Dig input 2 cfg	As for I.000	8	0	27			101
I.002	Dig input 3 cfg	As for I.000	9	0	27			102
I.003	Dig input 4 cfg	As for I.000	6	0	27			103
I.004	Dig input 5 cfg	As for I.000	5	0	27			104
I.005	Dig input 6 cfg	As for I.000	1	0	27			105
I.006	Dig input 7 cfg	As for I.000	1	0	27			106
I.007	Dig input 8 cfg	As for I.000	2	0	27			107

The digital inputs are FACTORY set as follow:

Dig input 1 cfg (Terminal 22) = **7 Freq sel 1**
Dig input 2 cfg (Terminal 23) = **8 Freq sel 2**
Dig input 3 cfg (Terminal 24) = **9 Freq sel 3**
Dig input 4 cfg (Terminal 25) = **6 JOG**
Dig input 5 cfg (Terminal 7) = **5 Alarm reset**
Dig input 6 cfg (Terminal 6) = **13 External fault NO**
Dig input 7 cfg (Terminal 5) = **1 Run**
Dig input 8 cfg (Terminal 4) = **2 Reverse**

Digital Inputs Expansion Board

I.050 Exp dig in 1 cfg (Expansion digital input 1 configuration)

Reserved.

I.051 Exp dig in 2 cfg (Expansion digital input 2 configuration)

Reserved.

I.052 Exp dig in 3 cfg (Expansion digital input 3 configuration)

Reserved.

I.053 Exp dig in 4 cfg (Expansion digital input 4 configuration)

Reserved.

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
I.050	Exp dig in 1 cfg	As for I.000	0	0	27			108
I.051	Exp dig in 2 cfg	As for I.000	0	0	27			109
I.052	Exp dig in 3 cfg	As for I.000	0	0	27			110
I.053	Exp dig in 4 cfg	As for I.000	0	0	27			111

Digital Ouputs Regulation Board

I.100 Dig output 1 cfg (Digital output 1 configuration)

I.101 Dig output 2 cfg (Digital output 2 configuration)

I.102 Dig output 3 cfg (Digital output 3 configuration)

I.103 Dig output 4 cfg (Digital output 4 configuration)

The regulation board provides as standard, 2 static opto-coupled digital outputs in Open Collector configuration and 2 relays with commutation contacts (see figure 5.5.1).

Every output is programmable with a specific code and function, as shown in the list below.

***DIGITAL OUTPUTS SELECTION LIST**:*

Code	*LCD display*	*Description*
0	**Drive Ready**	Drive ready to start
1	**Alarm state**	Positive logic for alarm signalling
2	**Not in alarm**	Negative logic for alarm signalling
3	**Motor running**	Direction command active
4	**Motor stopped**	Direction command not active and frequency = 0Hz
5	**REV rotation**	Anti-clockwise rotation of the motor
6	**Steady state**	Motor is running in steady state
7	**Ramping**	Acceleration or Deceleration Ramp in progress
8	**UV running**	Undervoltage detection during motor running
9	**Out trq>thr**	Output torque higher than the value of ***P.241***
10	**Current lim**	Current limit (during ramp or at steady state)
11	**DC-link lim**	DC Bus limit (during ramp or at steady state)
12	**Limit active**	General signalling of drive limit condition
13	**Autocapt run**	Autocapture on progress
14	**BU overload**	Overload of the braking resistor
15	**Neg pwrfact**	Negative condition of the power factor
16	**PID err ><**	PID error is >***A.058*** & <=**A.059**
17	**PID err>thr**	PID error is >***A.058***
18	**PID err<thr**	PID error is <=***A.059***
19	**PIDer><(inh)**	PID error is >***A.058*** & <=***A.059*** (*)
20	**PIDerr>(inh)**	PID error is >***A.058*** (*)
21	**PIDerr<(inh)**	PID error is <=***A.059*** (*)
22	**FWD enc rot**	Clockwise rotation of the encoder
23	**REV enc rot**	Anti-clockwise rotation of the encoder
24	**Encoder stop**	Encoder stop rotation
25	**Encoder run**	Encoder rotation general signalling
26	**Extern fault**	Positive logic for Ext. fault alarm signalling
27	**No ext fault**	Negative logic for Ext. fault alarm signalling
28	**Serial TO**	Serial link communication time out
29	**freq=thr1**	Output frequency = to ***P.440*** & ***P.441*** values
30	**freq!=thr1**	Output frequency ≠ of ***P.440*** & ***P.441*** values
31	**freq>thr1**	Output frequency > than ***P.440*** & ***P.441*** values
32	**freq<thr1**	Output frequency < than **P.440** & ***P.441*** values
33	**freq=thr2**	Output frequency = to ***P.442*** & ***P.443*** values
34	**freq!=thr2**	Output frequency ≠ of ***P.442*** & ***P.443*** values
35	**freq>thr2**	Output frequency > than ***P.442*** & ***P.443*** values
36	**freq<thr2**	Output frequency < than ***P.442*** & ***P.443*** values
37	**HS temp=thr**	Heatsink temp = to ***P.480*** & ***P.481*** values
38	**HS temp!=thr**	Heatsink temp ≠ of ***P.480*** & ***P.481*** values
39	**HS temp>thr**	Heatsink temp > than ***P.480*** & ***P.481*** values
40	**HS temp<thr**	Heatsink temp < than ***P.480*** & ***P.481*** values
41	**Output freq**	Frequency in synchronism with output frequency
42	**Out freq x 2**	Frequency value x 2 in synchronism with output frequency
43	**OutCoastThru**	Coast Through stopping
44	**OutEmgStop**	Emergency stop

(*) see chapter 7.7, section PID Limit.

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IP
I.100	Dig output 1 cfg	*See Digital Outputs selection list*	0	0	44			112
I.101	Dig output 2 cfg	As for I.100	6	0	44			113
I.102	Dig output 3 cfg	As for I.100	3	0	44			114
I.103	Dig output 4 cfg	As for I.100	1	0	44			115

The digital outputs are FACTORY set as follow:

Dig output 1 cfg - opto coupled type (Terminal 16) **= 0 Drive ready**
Dig output 2 cfg - opto coupled type (Terminal 17) **= 6 Steady state**
Dig output 3 cfg - relay type (Terminal 18 - 19 - 20) **= 3 Motor running**
Dig output 4 cfg - relay type (Terminal 1 - 2 - 3) **= 1 Allarm state**

Digital Outputs Expansion Board

I.150 **Exp DigOut 1 cfg** (Expansion Digital Output 1 configuration)

Reserved.

I.151 **Exp DigOut 2 cfg** (Expansion Digital Output 2 configuration)

Reserved.

I.152 **Exp DigOut 3 cfg** (Expansion Digital Output 3 configuration)

Reserved.

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IP
I.150	Exp DigOut 1 cfg	*See Digital Outputs selection list*	0	0	44			116
I.151	Exp DigOut 2 cfg	As for I.100	0	0	44			117
I.152	Exp DigOut 3 cfg	As for I.100	0	0	44			180

Analog Inputs Regulation Board

The drawing below, describes the block diagram of the standard "Analog Inputs" of the drive.

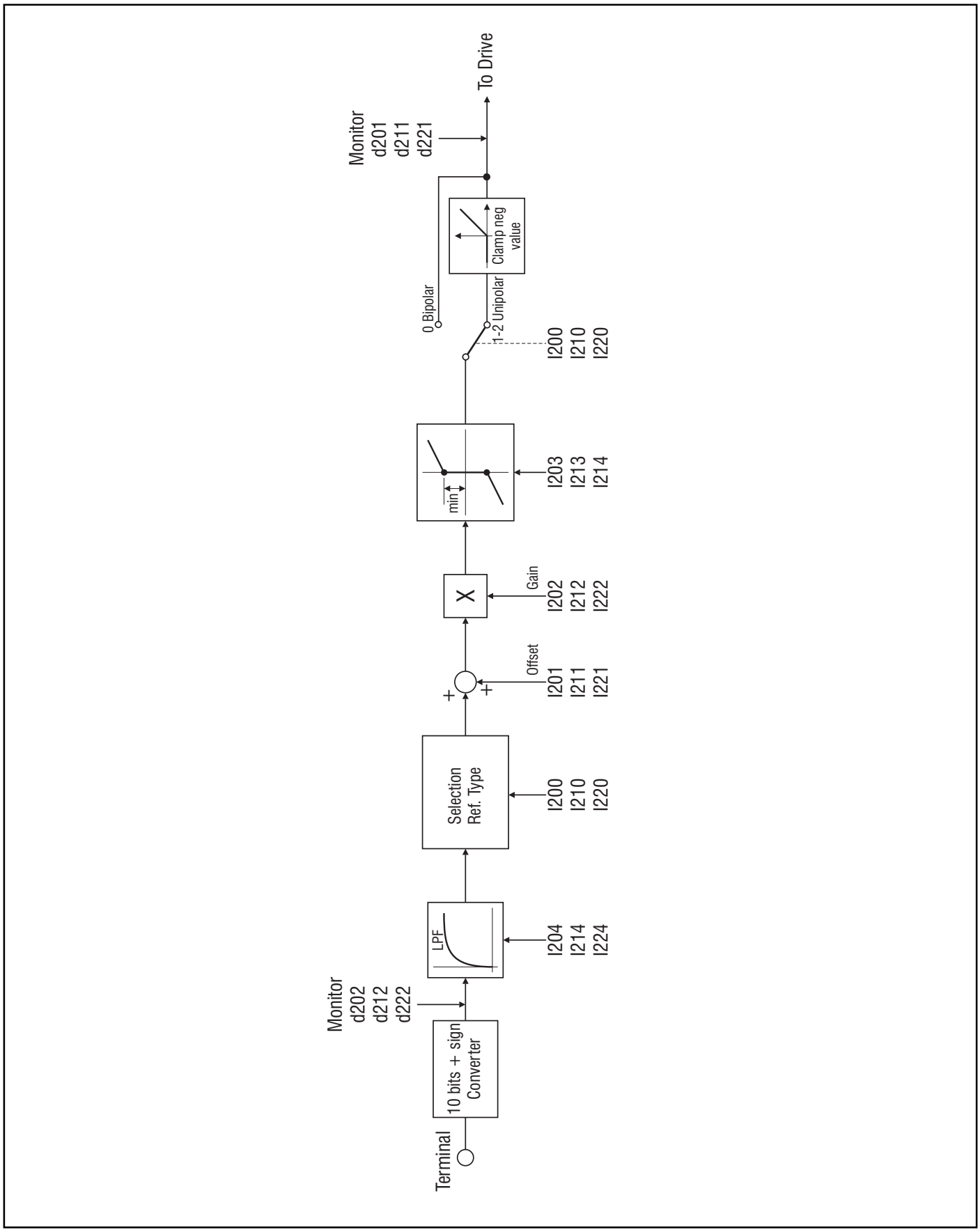


Figure 7.4.1: Analog Inputs

The regulation board provides as standard 3 analog inputs.
Analog inputs resolution:
voltage input setting: 11 bits (10 bits + sign)
current input setting: 10 bits

A typical basis connection is reported in the figure 5.5.1.1.

The assignment of the Analog Inputs for a specific function, is described in the figure 7.5.1 at the menu **FREQ** and **RAMPS.**

I.200 **An In 1 type** (Analog Input 1 type)

Setting of the Analog Input 1, in accordance with the type of reference control, available on its HW.
I.200 = 0 Bipolar -/+10V
I.200 = 1 Unipolar +10V
I.200 = 2 Not used

I.210 **An In 2 type** (Analog Input 2 type)

Setting of the Analog Input 2, in accordance with the type of reference control, available on its HW.
I.210 = 0 Bipolar -/+10V
I.210 = 1 Unipolar +10V
I.210 = 2 Not used

I.220 **An In 3 type** (Analog Input 3 type)

Setting of the Analog Input 3, in accordance with the type of reference control, available on its HW.
I.220 = 0 Not used
I.220 = 1 0…20mA
I.220 = 2 4…20mA

The functions that can be controlled through the analog inputs are listed below:

[1] Freq ref 1	Frequency reference 1	chapter **FREQ & RAMPS,** section ***Reference sources (F.050)***
[2] Freq ref 2	Frequency reference 2	chapter **FREQ & RAMPS**, section ***Reference sources (F.051)***
[3] Boost lev fac	Level of voltage boost	chapter **PARAMETERS**, section ***Boost (P.121)***
[4] OT level fact	Level of over torque	chapter **PARAMETERS**, section ***OT level factor src (P.242)***
[5] V red lev fac	Output voltage reduction level	chapter **PARAMETERS**, section ***Voltage Red Config P.422)***
[6] DCB level fac	DC braking current level	chapter **PARAMETERS**, section ***DC brake Config (P.301)***
[7] Ramp ext fact	Ramp extension factor	chapter **PARAMETERS**, section ***Ramp Config (F.260)***

Through the parameters ***d.200***, ***d.210*** and ***d.220*** is displayed the configuration of the analog inputs, when they have been programmed to execute one of the functions listed above.

I.201 **An In 1 offset** (Analog Input 1 offset)

I.211 **An In 2 offset** (Analog Input 2 offset)

I.221 **An In 3 offset** (Analog Input 3 offset)

It can be used to compensate an eventual offset, contained in an analog signal or when the variable assigned to the to input has already a value, also not being connected any signal.
Each parameters acts on the relative analog input.

I.202 **An In 1 gain** (Analog Input 1 gain)

I.212 **An In 2 gain** (Analog Input 2 gain)

I.222 **An In 3 gain** (Analog Input 3 gain)

Gain of the analog input.
It can be used to amplify or reduce the ratio between signal and controlled variable, or also to set different types of control curves via analog reference, as described in the figures 7.4.2, 7.4.3 and 7.4.4.
Each parameters acts on the relative analog input.

I.203 **An In 1 minimum** (Analog Input 1 minimun)

I.213 **An In 2 minimum** (Analog Input 2 minimun)

I.223 **An In 3 minimum** (Analog Input 3 minimun)

It represents the minimum value of the parameter, on which the analog input is programmed (see figure 7.4.3).
Example: if the analog input 1 is programmed as speed reference, in this case ***I.203*** represents the minimum speed reference.
Each parameters acts on the relative analog input.

I.204 **An In 1 filter** (Analog Input 1 filter)

I.214 **An In 2 filter** (Analog Input 2 filter)

I.224 **An In 3 filter** (Analog Input 3 filter)

It is the response time of the signal reaction to the reference variations.
Each parameters acts on the relative analog input.

The use of the Analog Inputs parameters set, can be useful to customize the analog reference ratio.
In the figures below are reported some samples.

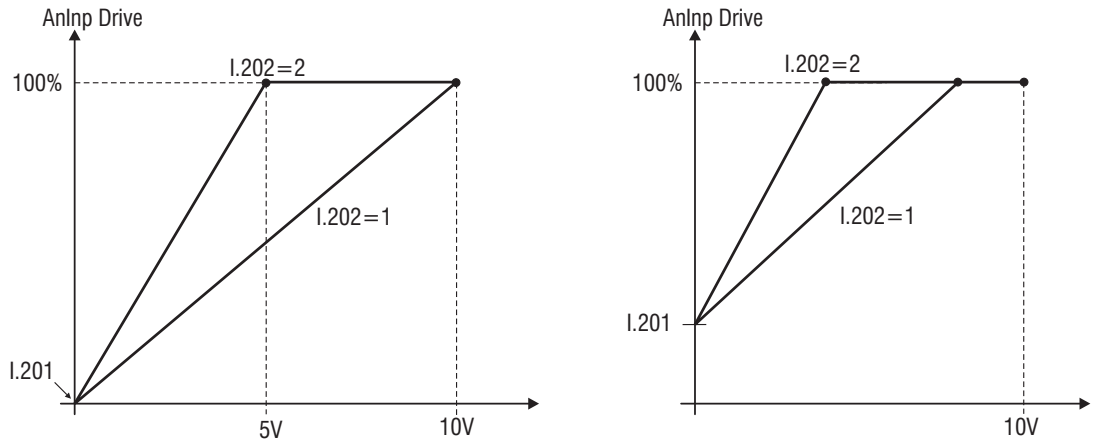


Figure 7.4.2: Analog Input Scaling 1

$$\text{An Inp Drive [\%]} = \text{I.202} \times \left(\text{An Inp [\%]} + \frac{\text{I.201}}{10} \times 100\right)$$

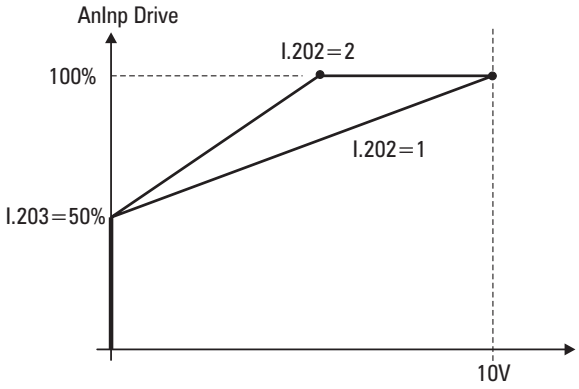


Figure 7.4.3: Analog Input Scaling 2

$$\text{An Inp Drive [\%]} = \text{I.203} + \frac{100 - \text{I.203}}{100} \times \text{I.202} \times \left(\text{An Inp [\%]} + \frac{\text{I.201}}{10} \times 100\right)$$

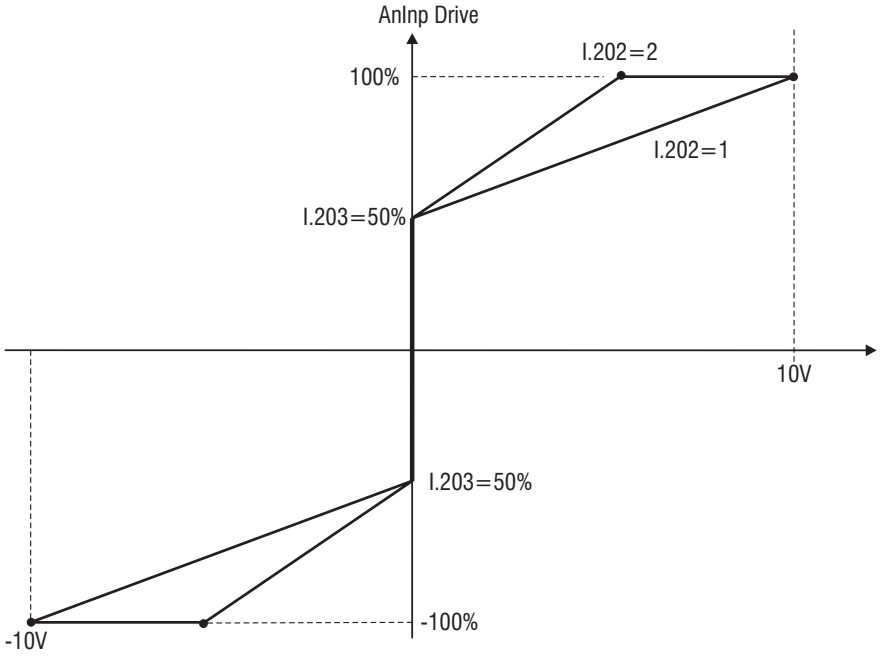


Figure 7.4.4: Analog Input Scaling 3

NOTE! When the analog input reference is set at 0V, an eventual "noise" can cause undesired speed oscillation between positive and/or negative values of ***I.203*** parameter.

$$\text{An Inp Drive [\%]} = \text{I.203} \times \text{signum}\left[\text{I.202} \times \left(\text{An Inp [\%]} + \frac{\text{I.201}}{10} \times 100\right)\right] + \frac{100 - \text{I.203}}{100} \times \text{I.202} \times \left(\text{An Inp [\%]} + \frac{\text{I.201}}{10} \times 100\right)$$

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
I.200	An in 1 Type	[0] +/- 10V [1] 0-10V / 0-20mA	1	0	1			118
I.201	An in 1 offset		0	-99.9	99.9	%	0.1	119
I.202	An in 1 gain		1	-9.99	9.99	%	0.01	120
I.203	An in 1 minimum		0	0	99.99	%	0.01	121
I.204	An in 1 filter		0.1	0.001	0.25	sec	0.001	122
I.210	An in 2 Type	[0] +/- 10V [1] 0-10V / 0-20mA	0	0	1			123
I.211	An in 2 offset		0	-99.9	99.9	%	0.1	124
I.212	An in 2 gain		1	-9.99	9.99		0.01	125
I.213	An in 2 minimum		0	0	99.99	%	0.01	126
I.214	An in 2 filter		0.1	0.001	0.25	sec	0.001	127
I.220	An in 3 Type	[1] 0-10V / 0-20mA [2] 4-20mA	1	1	2			128
I.221	An in 3 offset		0	-9.99	9.99	%	0.1	129
I.222	An in 3 gain		1	-99.9	99.9	%	0.01	130
I.223	An in 3 minimum		0	0	99.99	%	0.01	131
I.224	An in 3 filter		0.1	0.001	0.25	sec	0.001	132

Analog Outputs Regulation Board

The drawing below, describes the block diagram of the standard Analog Outputs of the drive

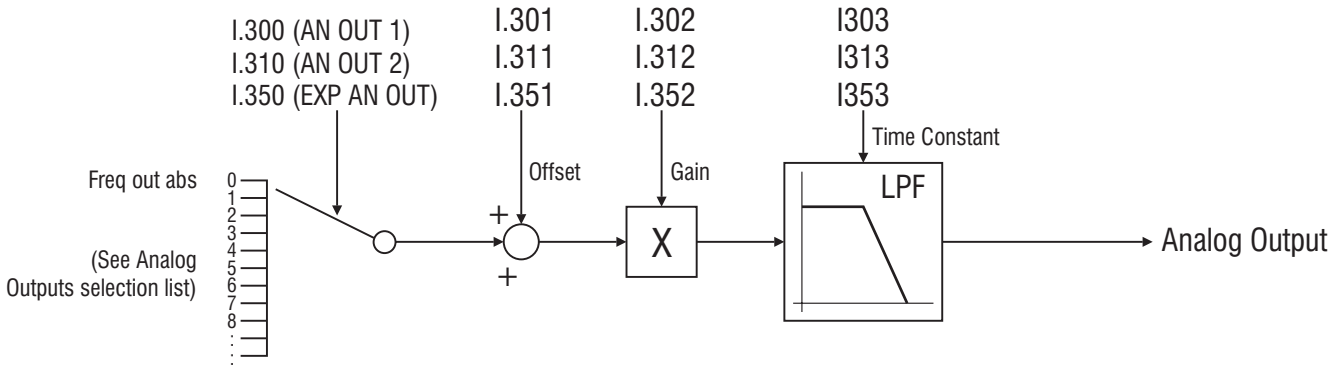


Figure 7.4.5: Analog Ouputs

The regulation board provides as standard 2 analog outputs.

Analog output resolution: 10 bits

A typical connection is reported in the figure 5.5.1.

Both the analog outputs, can provide a full scale signal **0V / +10Vdc** (absolute and positive) or **+/-10Vdc** (generic setting), according to the parameter assigned .

I.300 **Analog out 1 cfg** (Analog output 1 configuration)

I.310 **Analog out 2 cfg** (Analog output 2 configuration)

Every output is programmable with a specific code and function, as shown in the list below.

***ANALOG OUTPUTS SELECTION LIST**:*

Code	*LCD display*	*Description*
0	**Freq out abs**	Output Frequency absolute value
1	**Freq out**	Output Frequency
2	**Output curr**	Output Current
3	**Out voltage**	Output Voltage
4	**Out trq (pos)**	Output Torque positive value
5	**Out trq (abs)**	Output Torque absolute value
6	**Out trq**	Output Torque
7	**Out pwr (pos)**	Output Power positive value
8	**Out pwr (abs)**	Output Power absolute value
9	**Out pwr**	Output Power
10	**Out PF**	Output Power Factor
11	**Enc freq abs**	Encoder frequency absolute value
12	**Encoder freq**	Encoder frequency
13	**Freq ref abs**	Frequency reference absolute value
14	**Freq ref**	Frequency reference
15	**Load current**	Load Current
16	**Magn current**	Motor Magnetizing Current
17	**PID output**	PID regulator output
18	**DClink volt**	DC bus capacitors level
19	**U current**	Output phase U current signal
20	**V current**	Output phase V current signal
21	**W current**	Output phase W current signal

I.301 **An out 1 offset** (Analog output 1 offset)

I.311 **An out 2 offset** (Analog output 2 offset)

It can be used to compensate an eventual offset, coming from the external instrument connected to the output. This parameter can be used to regulate the set-point for a variable to be displayed, with different full scale values.
Each parameter acts on the relative analog output.

I.302 **An out 1 gain** (Analog output 1 gain)

I.312 **An out 2 gain** (Analog output 2 gain)

Gain of the analog output.
It can be used to amplify or reduce the variable full scale value.
The parameter allows for a different set-up of the analog output threshold, as reported in the figure 7.4.6.
Each parameter acts on the relative analog output.

I.303 **An out 1 filter** (Analog output 1 filter)

I.313 **An out 2 filter** (Analog output 2 filter)

It is the response time of signal reaction for the variable to be displayed.

Each parameters acts on the relative analog output.

Below are some samples of different threshold set-up.

NOTE! these samples are described as taking into account the parameters of the Analog ouput 1, but both the outputs are programmable in the same mode.

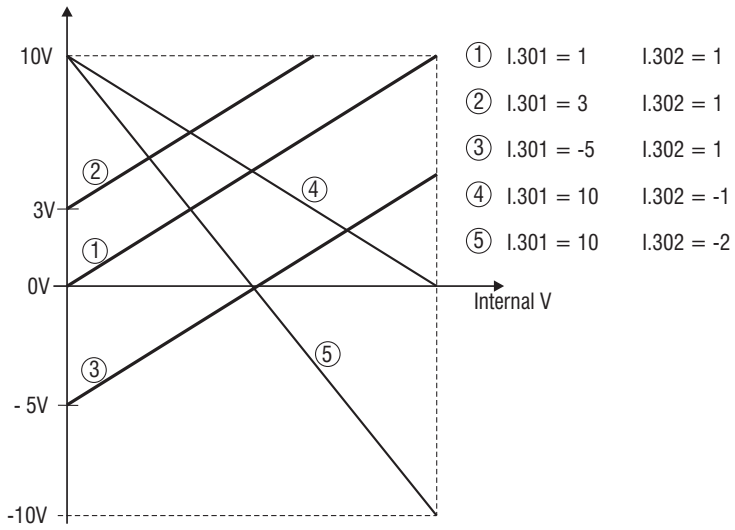


Figure 7.4.6: Scaling References and Minimum Values

$$Vout = 10 \times \left(\frac{Stp\ Var}{Fs\ Var} \times I.302 \right) + I.301$$

Where:

Vout setting of the threshold
Stp Var required set point of the variable threshold (units of the variable)
Fs Var full scale of the variable (units of the variable)

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
I.300	Analog out 1 cfg	*See Analog outputs selection list*	0	0	21			133
I.301	An out 1 offset		0	-9.99	9.99		0,01	134
I.302	An out 1 gain		1	-9.99	9.99		0.01	135
I.303	An out 1 filter		0	0	2,5	sec	0.01	136
I.310	Analog out 2 cfg	As for I.300	2	0	21			137
I.311	An out 2 offset		0	-9.99	9.99		0.01	138
I.312	An out 2 gain		1	-9.99	9.99		0.01	139
I.313	An out 2 filter		0	0	2.5	sec	0.01	140

The below table shows the analog outputs scaling.

CODE	Variable	Full scale value (+/-10V)
0	Freq out abs	F.020 x P.080/100 [Hz] (Maximum output frequency)
1	Freq out	Same as CODE 0
2	Output curr	2 x D.950 [Arms] (2 x Inverter rated current)
3	Out voltage	P.061 [Vrms] (Maximum output voltage)
4	Out trq (pos)	2 x Motor rated torque [Nm]
5	Out trq (abs)	Same as CODE 4
6	Out trq	Same as CODE 4
7	Out pwr (pos)	2 x Motor rated power [W]
8	Out pwr (abs)	2 x Motor rated power [W]
9	Out pwr	2 x Motor rated power [W]
10	Out PF	Power factor = 1
11	Enc freq abs	F.020 x P.080/100 [Hz] (Maximum output frequency)
12	Encoder freq	F.020 x P.080/100 [Hz] (Maximum output frequency)
13	Freq ref abs	F.020 x P.080/100 [Hz] (Maximum output frequency)
14	Freq ref	F.020 x P.080/100 [Hz] (Maximum output frequency)
15	Load current	Same as CODE 17
16	Magn current	Same as CODE 17
17	PID output	100% of the PID ouput
18	DClink volt	1111Vdc (QX2000) - 990Vdc (AGy 400…460Vac) - 1250Vdc (AGy 575Vac)
19	U current	Same as CODE 17
20	V current	Same as CODE 17
21	W current	Same as CODE 17

Analog Outputs Exp Board

I.350 **Exp An out 1 cfg** (Expansion analog output 1 configuration)

Reserved.

I.351 **Exp AnOut 1 offs** (Expansion Analog Output 1 offset)

Reserved.

I.352 **Exp AnOut 1 gain** (Expansion Analog Output 1 gain)

Reserved.

I.353 **Exp AnOut 1 filt** (Expansion Analog Output 1 filter)

Reserved.

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
I.350	Exp an out 1 cfg	As for I.300	3	0	21			141
I.351	Exp AnOut 1 offs		0	-9.99	9.99		0.01	142
I.352	Exp AnOut 1 gain		1	-9.99	9.99		0.01	143
I.353	Exp AnOut 1 filt		0	0	2.5	sec	0.01	144

Enabling Virtual I/O

Through a “virtual setting” via serial line or fieldbus, it is possible to use all the functions available on the digital inputs and perform a direct control of the digital and analog outputs.

The setting can be carried out in such configurations, where the digital commands are a mix of “virtual” and terminals and the outputs are a mix of “virtual” and drive function.

The virtual assignment can be performed through the parameters ***H.000…H.022*** in the **HIDDEN** menu (for further information please see this chapter).

Below are the reported the drawings describing the combination between the byte of the virtual I/Os and the drive terminals, with the relative decoder mask.

The switch between the “virtual” commands and the terminal ones and between the “virtual” output or the drive functions, is determined by programmable mask ***I.400…I.450.***

These parameters have to be managed bitwise. At each bit corresponds a switch, as follows.

Bit value	Inputs	Outputs
0	Terminal	Drive function
1	Virtual	Virtual control

The formula below describes the result of the virtual I/Os setting:

[Input/Output AND (NOT Mask)] OR (Virtual AND Mask)

VIRTUAL DIGITAL INPUTS CONFIGURATION

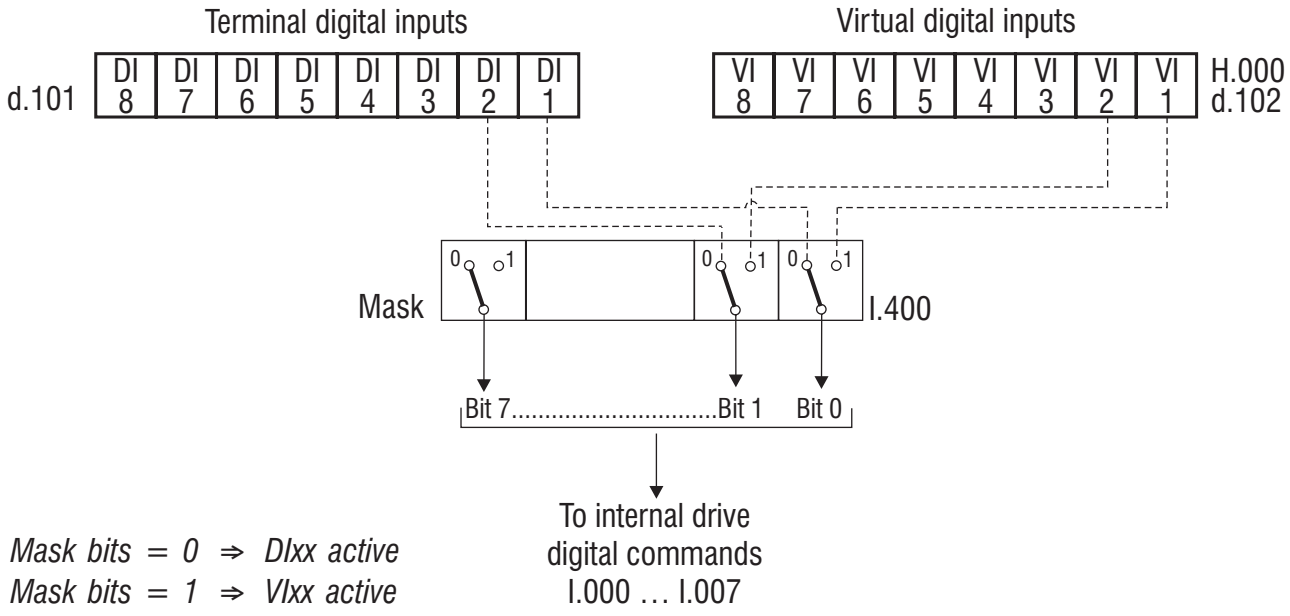


Figure 7.4.5: Virtual digital inputs configuration

VIRTUAL DIGITAL OUTPUTS CONFIGURATION

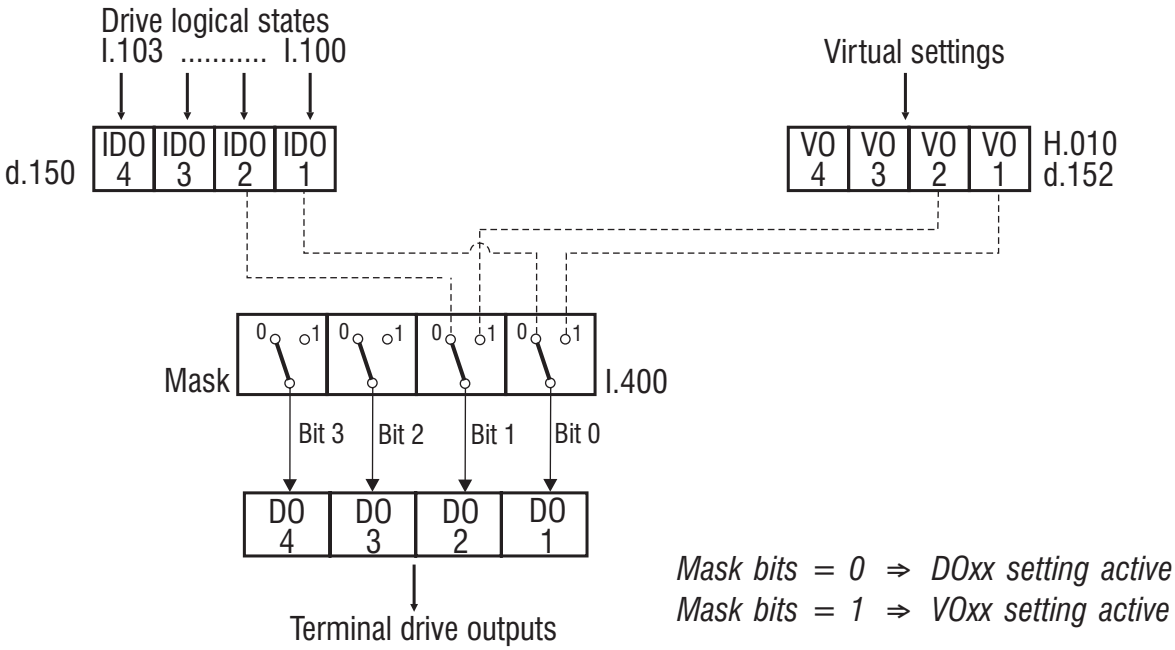


Figure 7.4.6: Virtual digital outputs configuration

VIRTUAL ANALOG OUTPUTS CONFIGURATION

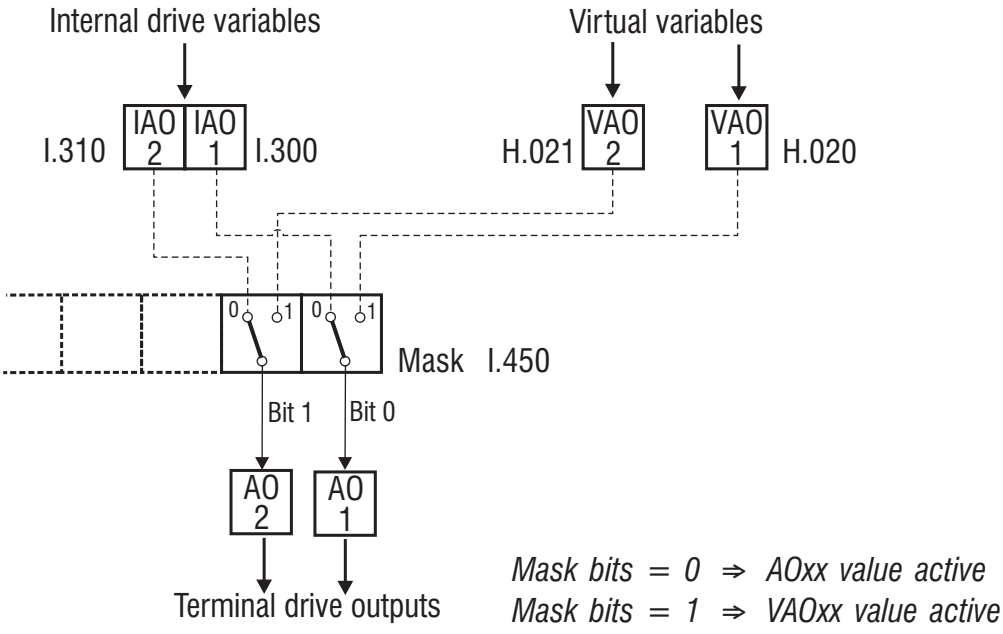


Figure 7.4.7: Virtual analog outputs configuration

Below are some examples about the programming of the basic function via virtual assignment.

A) DIGITAL INPUTS

Programming example for:

- RUN and REVERSE commands via “virtual mode”
- EXT FAULT command via “terminal”

P.000 = 2 Function mode enabled
I.400 = 3 bit 0 and bit 1 are high (1) and bit 5 is low (0)
I.000 = 1 RUN (programmed on digital input 1)
I.001 = 2 REVERSE (programmed on digital input 2)
I.005 = 3 EXTERNAL FAULT (programmed on digital input 6)

Writing ***H.000*** = 1 the motor will turn in FORWARD direction
Writing ***H.000*** = 3 the motor will turn in REVERSE direction
Writing ***H.000*** = 0 the motor will STOP

Refer to chapter 7.9 for more informations on ***H.000*** parameter.
The EXTERNAL FAULT command will be applied removing the potential at the terminal 6 (programmed as digital input 6).

B) DIGITAL OUTPUTS

Programming example for:

- ALARM STATE signalling on Digital output 1
- VIRTUAL FUNCTION signalling on Digital outputs

P.000 = 2 Function mode enabled
I.420 = 2 bit 1 is high (1) and bit 0 is low (0)
I.100 = 1 ALARM STATE (programmed on digital output 1)
I.101 = 2 ANY SELECTION (programmed on digital output 2)

Digital output 1 active in accordance with the drive alarm status
Digital output 2 active if bit 1 of ***H.010*** = 1
not active if bit 1 of ***H.010*** = 0

C) ANALOG OUTPUTS

Programming example for:

- OUTPUT FREQUENCY signalling on Analog output 1
- VIRTUAL SETTING on Analog output 2

P.000 = 2 Function mode enabled
I.450 = 2 bit 1 is high (1) and bit 0 is low (0)
I.300 = 0 OUTPUT FREQUENCY (programmed on analog output 1)
I.310 = 2 ANY SELECTION (programmed on analog output 2)

Analog output 1 signal proportional to the OUTPUT FREQUENCY of the drive

Analog output 2 signal proportional to the setting of ***H.021***

H.021: *+ 32767 output = +10V*

H.021: - 32767 output = - 10V

I.400 Inp by serial en

It defines the bits of the mask, that are active for the virtual assignment. A byte is available for the selection of 8 digital inputs, whose setting has to be carried out as decimal value.

Bit 0 = 1 Enabled
Bit 1 = 2 Enabled
Bit 2 = 4 Enabled
Bit 3 = 8 Enabled
Bit 4 = 16 Enabled
Bit 5 = 32 Enabled
Bit 6 = 64 Enabled
Bit 7 = 128 Enabled

I.410 Exp in by ser en (Expansion inputs by serial line enabling)

Reserved.

I.420 Out by serial en (Outputs by serial line enabling)

It defines the bits of the mask, that are active for the virtual assignment. A 4 bits structure is available for the selection of 4 digital outputs, whose setting has to be carried out as decimal value.

Bit 0 = 1 Enabled
Bit 1 = 2 Enabled
Bit 2 = 4 Enabled
Bit 3 = 8 Enabled

I.430 Exp OutBySer en (Expansion Outputs by serial line enabling)

Reserved.

I.450 An out by ser en (Analog outputs by serial line enabling)

It defines the bits of the mask, that are active for the virtual assignment. A 2 bits structure is available for the selection of 2 analog outputs, whose setting has to be carried out as decimal value.

Bit 0 = 1 Enabled
Bit 1 = 2 Enabled

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
I.400	Inp by serial en		0	0	255			145
I.410	Exp in by ser en		0	0	15			146
I.420	Out by serial en		0	0	15			147
I.430	Exp OutBySer en		0	0	3			148
I.450	An out by ser en		0	0	255			149

Encoder Configuration

The DS regulation terminals, include as standard the inputs for an encoder connection in order to provide feedback or an external frequency reference to the drive. The optional card **HSD-ENC** is required for this function to be enabled on the regulation card .

The HSD-ENC option has to be placed onto the regulation card , through two micro-connectors (JP16 and JP18, the insertion position is fixed). This card, is necessary to enable the encoder pulses reading.

Being possible to use encoders with **HTL** logic (+15Vc…+24Vdc) or **TTL** logic (+5Vdc), the HW has to be adapted for the proper signals level.

This setting has to be carried out on the optional card, setting the two micro-switches as follows:

Encoder with HTL logic: switch 1 OFF - switch 2 OFF (FACTORY SETTING)

Encoder with TTL logic: switch 1 ON - switch 2 ON

NOTE! - On the drive regulation terminal, it is available the +24Vdc, which can be used for a HTL encoder supply..
- Using a TTL encoder, the supply has to be externally provided, not being available on the drive the +5Vdc.

NOTE! Maximum encoder frequency input: 50 kHz.

NOTE! The setting of encoder feedback must have effected through the use of PID function.

For the encoder connection see figure 5.5.1.

I.500 Encoder enable (Encoder enabling)

Enabling of the encoder feedback management.

I.501 Encoder ppr (Encoder pulses)

Setting of the encoder nameplate pulses per revolution.

I.502 Enc channels cfg (Encoder channels configuration)

Setting of the encoder channels.
It is possible the reading of double or single channel encoders.

I.503 Enc spd mul fact (Encoder speed multiply factor)

Multiplier factor of the encoder pulses, set in the ***P.501.***
The setting can be useful when the encoder is mounted on the "slow shaft side" of a gearbox or in any case when it is not mounted directly on the motor shaft.

I.504 Enc update time (Encoder update time)

It sets the encoder pulses sampling time.
This affects both the measurement accuracy and the speed of the reading up-to-dating.
At the maximum drive speed, this setting must not exceed such a value, for which the number of pulses counted exceeded 32767.
Using a double channel encoder, the number of pulses counted is 4 times the one detected on a single channel.

The function is active only if the encoder control is enabled (***I.500***).

The following formulas are for the calculation of the encoder shaft frequency.

$$F_{mot}[Hz] = N_{imp}[ppr] \times \frac{P.041\ [polepairs]}{I.501\ [ppr] \times I.503\ [fact] \times I.504\ [s]} \times \frac{1}{Ec}$$

$$N_{imp}[ppr] = \frac{F_{mot}[Hz] \times I.501[ppr] \times I.503\ [fact] \times I.504\ [s]}{P.041\ [polepairs]} \times \frac{1}{Ec}$$

$$N[rpm] = \frac{60\ [s] \times f\ [Hz]}{2p\ [polepairs]} \qquad f\ [Hz] = \frac{n\ [rpm] \times 2p\ [polepairs]}{60\ [s]}$$

Where:

F_{mot} Motor frequency, detected by the encoder
N imp is the pulses number, measured in the period set in ***I.504*** (displayed as ***d.300***)
Ec = 1 (Ec = encoder channel) when a single channel encoder is selected in ***I.502***
Ec = ¼ (Ec = encoder channel) when a double channel encoder is selected in ***I.502***

The accuracy of **F_{mot}** depends on the number of pulses counted: its value is **1/N imp**. At low speed the accuracy could be reduced

NOTE! The setting ***N imp (I.504)*** depends on the encoder pulses and from the application to carry out.

When the pulses of the encoder used is low (200…600 pulses/rev), the ***I.504*** has to be set with a high value, in order to obtain a good average value of the signal (eg: when used for monitoring the speed on an analog output).

Using an encoder with an higher number of pulses (1000…4096 pulses/rev), the setting of ***I.504*** can be set to the minimum values, in order to increase the sampling speed (eg. for closing the speed loop with the PID function).

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
I.500	Encoder enable	[0] Disable [1] Enable	0	0	1			150
I.501	Encoder ppr		100	1	9999			151
I.502	Enc channels cfg	[0] One Channel [1] Two Channels	0	0	1			152
I.503	Enc spd mul fact		1	0.01	99.99		0.01	153
I.504	Enc update time		0.1	0	25	sec	0.1	154

Serial Configuration

The AGy provides as a standard an RS485 serial line.

For the connection of the serial line, a 9-pin SUB-D connector, named JP7 or an AMP connector named JP15 (see chapter 5.4.1 Serial Interface General). are available on the regulation card.

Through the serial line, all the parameters and variables can be written and read.

When control of the main command through serial line is needed, it is necessary to set the ***Cmd source sel (P.000)*** as follows:

P.000 = 2 Terminal or Virtual

P.000 = 3 Serial

Further information are reported at the chapter **PARAMETER**, section **Commands** .

I.600 **Serial link cfg** (Serial link configuration)

Selection of the serial line protocol.
Each protocol can be chosen through the setting of the following codes. The structure of them is below reported.
DEFAULT VALUE = 4 (Modbus protocol)

I.601 **Serial link bps** (Serial link bit per second)

It defines the Baud rate (bit per second) concerning the serial line communication speed.
The selection is through the following code:

I.602 **Device address**

Address at which the drive can be accessed if it is networked via the RS485 interface.
The range of the selectable addresses is between **0** and **99.**
As reported in the chapter 5.4.1 (Serial Line General), it is possible to perform a Multidrop configuration with a maximum of 20 devices.
Further information about are reported in this chapter.

I.603 **Ser answer delay** (Serial link answer delay)

Minimum delay setting between the reception of the last byte and the start of its answer.
The delay will help avoid conflicts on the serial line, when the RS485 interface is not preset for an automatic Tx/Rx communication.
The ***Ser answer delay (I.603)*** parameter is specific for the standard serial line RS485.

Eg: if on the master the Tx/Rx delay communication is 20ms max, the setting of ***Ser answer delay (I.603)*** parameter will have to be higher than 20ms: 22ms.

I.604 **Serial timeout** (Serial link timeout)

It sets the time that elapses between the sending/receiving of a byte and the next one.
If this time is longer than the setting and no byte is detected (sending/receiving), the action will be the one programmed in the parameter ***I.605***
The alarm won't be active when set at 0 second.

It will be displayed with the message "St".

NOTE! Even if the timeout control function is enabled at the drive power-on, the detection of "St" alarm is temporary non active.

The detection of the alarm will be automatically activated after the first restore of the communication between master and slave.

I.605 **En timeout alm** (Enabling serial link timeout alarm)

Setting of the behaviour for Serial time out alarm.

I.605 = 0 Signalling of the alarm on a digital output (programmed to this purpose)
I.605 = 1 Drive in alarm and signalling on a digital output (programmed to this purpose)

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
I.600	Serial link cfg	[0] FoxLink 7E1 [1] FoxLink 701 [2] FoxLink 7N2 [3] FoxLink 8N1 [4] ModBus 8N1 [5] JBus 8N1	4	0	5			155
I.601	Serial link bps	[0] 600 baud [1] 1200 baud [2] 2400 baud [3] 4800 baud [4] 9600 baud [5] 19200 baud [6] 38400 baud [7] 57600 baud [8] 76800 baud [9] 115200 baud	4	0	9			156
I.602	Device address		1	0	99		1	157
I.603	Ser answer delay		1	0	250	msec	1	158
I.604	Serial timeout		0	0	25	sec	0,1	159
I.605	En timeout alm	[0] Disable [1] Enable						160

Options Configuration

I.700 Option 1 type

Reserved.

I.701 Option 2 type

Reserved.

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
I.700	Option 1 type	[0] Board Off [1] Board master [2] IO Board [3] Board free [4] SBI Board	0	0	4			161
I.701	Option 2 type	[0] Board Off [1] Board master [2] IO Board [3] Board free [4] SBI Board	0	0	4			162

SBI Configuration

In this menu it is possible to perform the configuration of the SBI card.

Further detailed information about the filedbus interfacing, are reported in the specific instruction manuals of the SBI cards.

I.750 SBI Address

Setting of the different addresses of the slaves connected to the bus.

I.751 CAN baudrate

CAN Open baudrate.

I.752 SBI Profibus Mode

Definition of the data exchange structure, between the SBI card of the drive and the Profibus master.

The setting is possible in 5 different configurations: ***PP0-0….PP0-4***

PP0-0	**User defined structure**
PP0-1…PP0-4	Structures in accordance with ***Profidrive profile***

I.753 SBI CAN Mode

Selection of the fieldbus protocol for:

I.753 = 0 CANOpen
I.753 = 1 DeviceNet

I.754 Bus Flt Holdoff (Bus fault hold off)

A communication drop with the fieldbus master, is detected by the SBI card.
This parameter allows the setting of a delay for the intervention of the BUS FAULT alarm.

If the communication is restored within this time, the drive will continue working. If this time is elapsed and the communication is still missing, an alarm will occur stopping the drive.

During this stage, the information data (received and sent) are frozen at the status precedent the communication drop.
At the restoring of the transmission, the first data sent and received will be the one frozen.

I.760 SBI to Drv W 0 (SBI to Drive Word 0)

I.761 SBI to Drv W 1 (SBI to Drive Word 1)

I.762 SBI to Drv W 2 (SBI to Drive Word 2)

I.763 SBI to Drv W 3 (SBI to Drive Word 3)

I.764 SBI to Drv W 4 (SBI to Drive Word 4)

I.765 SBI to Drv W 5 (SBI to Drive Word 5)

I.770 Drv to SBI W 0 (Drive to SBI Word 0)

I.771 Drv to SBI W 1 (Drive to SBI Word 1)

I.772 **Drv to SBI W 2** (Drive to SBI Word 2)

I.773 **Drv to SBI W 3** (Drive to SBI Word 3)

I.774 **Drv to SBI W 4** (Drive to SBI Word 4)

I.775 **Drv to SBI W 5** (Drive to SBI Word 5)

Setting of the “word exchange” between drive and SBI card and vice versa.
The data exchanging structure is available as a 6 words format.

In each word the parameters reading or writing, has to be addressed setting the relative number of IPA.

Code	Name	Selection		Default	MIN	MAX	Unit	Variation	IPA
I.750	SBI address			3	0	255			163
I.751	CAN baudrate	[0]	10 KHz	5	0	6			164
		[1]	20 KHz						
		[2]	50 KHz						
		[3]	125 KHz						
		[4]	250 KHz						
		[5]	500 KHz						
		[6]	1000 KHz						
I.752	SBI Profibus mod	[0] Custom		2	0	4			165
		[1] PPO1							
		[2] PPO2							
		[3] PPO3							
		[4] PPO4							
I.753	SBI CAN mode	[0] OFF		0	0	2			166
		[1] CAN Open							
		[2] DeviceNet							
I.754	Bus Flt Holdoff			0	0	60	sec	0.1	179
I.760	SBI to Drv W 0			0	0	1999			167
I.761	SBI to Drv W 1			0	0	1999			168
I.762	SBI to Drv W 2			0	0	1999			169
I.763	SBI to Drv W 3			0	0	1999			170
I.764	SBI to Drv W 4			0	0	1999			171
I.765	SBI to Drv W 5			0	0	1999			172
I.770	Drv to SBI W 0			1	0	1999			173
I.771	Drv to SBI W 1			2	0	1999			174
I.772	Drv to SBI W 2			3	0	1999			175
I.773	Drv to SBI W 3			4	0	1999			176
I.774	Drv to SBI W 4			5	0	1999			177
I.775	Drv to SBI W 5			6	0	1999			178

7.5 Menu F - FREQ & RAMPS

The drawing below, describes the logic for the "Reference selection".

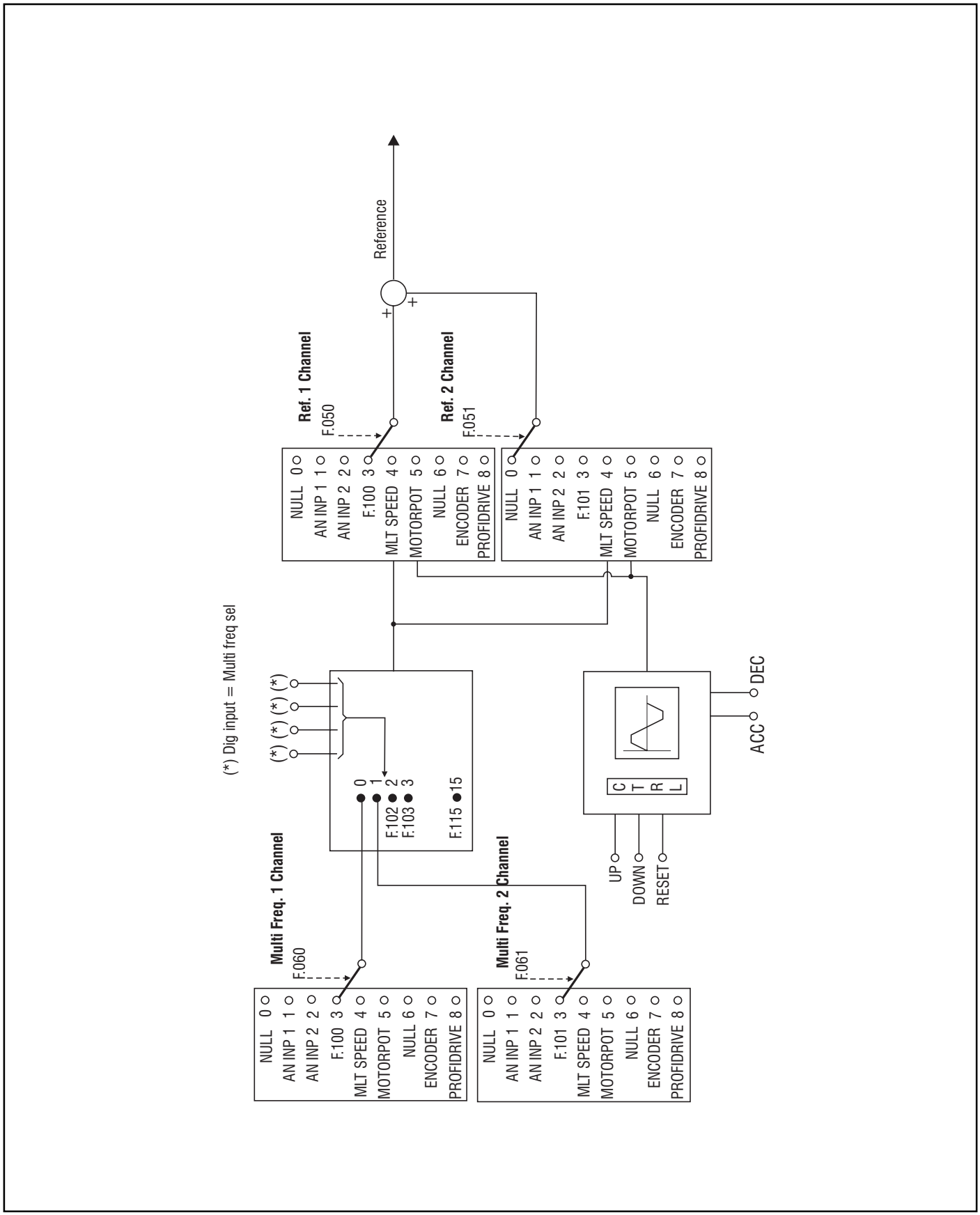


Figure 7.5.1: Reference Selection

Motorpotentiometer

F.000 **Motorpot ref** (Motorpotentiometer reference)

When this parameter is shown, the UP and DOWN keys are activated to increase or decrease the frequency value.
Pressing the UP and DOWN Keys will cause the motor to increase or decrease its speed respectively until the keys are released.
The maximum value settable is correlated to ***Max ref freq (F.020).***

To START the motor it is necessary a RUN command.

The Motorpotentiometer reference can also be changed via digital inputs, programmed as **Motorpot up** and **Motorpot down**.

The reset of the reference value, can be executed via digital input programmed as **Reset Motorpot.**

F.010 **Mp Acc / Dec time** (Motorpotentiometer Acceleration / Deceleration time)

It sets the acceleration and deceleration ramp time delay (in seconds), for the Motorpotentiometer function.
The delay times are equal for the acceleration and deceleration.

F.011 **Motorpot offset** (Motorpotentiometer offset)

Giving the RUN command, the motor will rich automatically the frequency set (offset) following the ramp time.
The **Motorpot up** command will be effect starting from this value, which represent the frequency minimum value attainable by **Morotpot down** command.

For further detail see also the section **Reference Limits** in this chapter.

F.012 **Mp output mode** (Motorpotentiometer output mode)

It defines positive and/or negative settings of the Motorpotentiometer reference value.
In either setting the HW Reverse command is active (when enabled).

F.013 **Mp auto save** (Motorpotentiometer auto save)

Enabling this function will cause the Motorpot reference to be continuously saved into non-volatile memory. At power on, the reference will start from the last saved value.
Disabling this function will cause the Motorpot reference to be always zero after power-on.
Saving drive parameters by command ***C.000*** (or ***S.901***) will not save the Motorpot ref value.

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
F.000	Motorpot ref		0	0	F.020	Hz	0.01	300
F.010	Acc/Dec time mp		10	0.1	999.9	sec	0.1	301
F.011	Motorpot offset		0	0	50	Hz	0.1	302
F.012	Mp output mode	[0] Unipolar [1] Bipolar	0	0	1			303
F.013	Mp auto save	[0] Disable [1] Enable	1	0	1			304

Reference Limits

F.020 **Max ref freq** (Maximun reference frequency)

It is the maximum speed for both directions.
This parameter applies to the sum of the different reference value available on the drive (***Reference 1*** and ***Reference 2***).

F.021 **Min ref freq** (Mimimun reference frequency)

It defines the minimum frequency value, under which any regulation with analog or digital references has no effect.
The START of the motor will be carried out (with the ramp delay) at this frequency value also with null reference.
As described in the following figure, this behaviour is correlated also to the setting of ***Min output freq (P.081).***

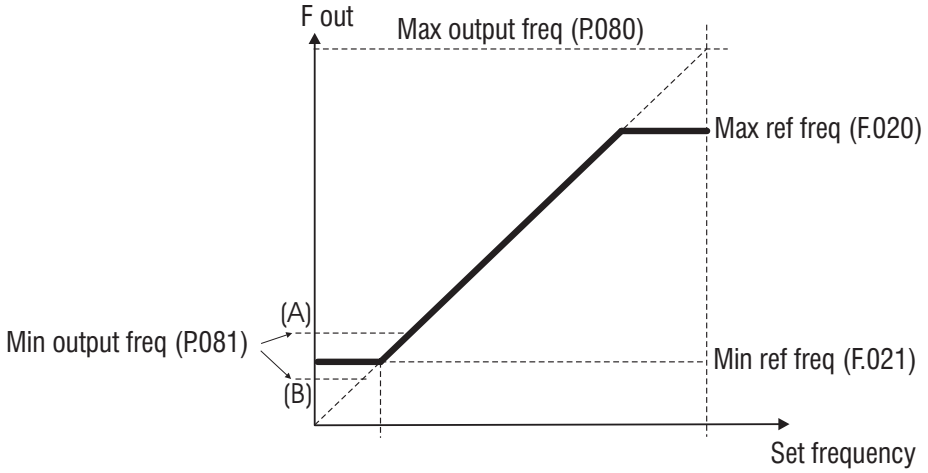


Figure 7.5.2: Min & Max Reference Frequency

Drive behaviour around minimum values

P.081 settings in A condition

• Giving the RUN command, the motor will rich the frequency set of ***P.081*** (A) without to follow the setting of acceleration ramp time.

• The reference action on the frequency curve, will have effect starting from the setting value of ***P.081*** parameter.

P.081 settings in B condition

• Giving the RUN command, the motor will rich the frequency set of ***P.081*** (B) without to follow the setting of acceleration ramp time.

• The increasing of the reference will have effect on the frequency output, starting from the setting value of ***F.021*** parameter (the variation will follow the setting of acceleration ramp time).

• The reference action on the frequency curve, will have effect starting from the setting value of ***F.021*** parameter.

The ***Max output freq (P.080)*** and the ***Min output freq (P.081)*** are expressed as percentage of the values of ***Max ref freq (F.020).***

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
F.020	Max ref freq		(****)	25	500	Hz	0.1	305
F.021	Min ref freq		0	0	F.020	Hz	0.1	306

(****) parameter value depending on drive type.

Reference Sources

F.050 Ref 1 Channel (Reference 1 channel)

F.051 Ref 2 Channel (Reference 2 channel)

As shown in the figure 7.5.1, the Sources from which the 2 speed references are provided and controlled, can be chosen by following the table below.
The value of the 2 references, will always be an algebric sum.

F.060 Mlt Frq Channel 1 (Multi frequency channel 1)

F.061 Mlt Frq Channel 2 (Multi frequency channel 2)

These parameters allow to select the source, from where the **First** and **Second** frequency reference of the ***Multispeed function,*** can be provided and controlled (See figure 7.5.1).

The source can be chosen the following parameters the table below.

Code	LCD display	[Code] & LCD select.		Default	MIN	MAX	Unit	Variation	IPA
F.050	Ref 1 channel	[0] Null		3	0	8			307
		[1] Analog inp 1	(setting through ***I.200…I.204***)						
		[2] Analog inp 2	(setting through ***I.210…I.214***)						
		[3] Freq ref x	(setting through ***S.203 or F.100***)						
		[4] Multispeed	(setting through ***F.100…F.116***)						
		[5] Motorpotent	(setting through ***F.000…F013***)						
		[6] Analog inp 3	(setting through ***I.220…I.224***)						
		[7] Encoder	(setting through ***I.500…I.505***)						
		[8] Profidrive	Reference by Profibus						
F.051	Ref 2 channel	[0] Null		0	0	8			308
		[1] Analog inp 1	(setting through ***I.200…I.204***)						
		[2] Analog inp 2	(setting through ***I.210…I.214***)						
		[3] Freq ref x	(setting through ***F.101***)						
		[4] Multispeed	(setting through ***F.100…F.116***)						
		[5] Motorpotent	(setting through ***F.000…F013***)						
		[6] Analog inp 3	(setting through ***I.220…I.224***)						
		[7] Encoder	(setting through ***I.500…I.505***)						
		[8] Profidrive	Reference by Profibus						
F.060	MltFrq channel 1	As for F.050, Ref 1 channel		3	0	7			309
F.061	MltFrq channel 2	As for F.051, Ref 2 channel		3	0	7			310

Multispeed Function

F.100 Frequency Ref 0 (Multi frequency channel 1)

. .
. .
. .

F.115 Frequency Ref 15 (Multi frequency channel 15)

It is possible to select up to 16 frequencies, whose value can be set in these parameters.
The selection of these frequencies can be performed through a binary setting of 4 programmable digital inputs.
The limit of the output frequency will be clamped by ***Max ref freq (F.020)***.
The following table describes the basis sequence of the binary setting, for a complete Multispeed selection.

Active Dig ref frequency	Freq sel 1	Freq sel 2	Freq sel 3	Freq sel 4
F.100 (Freq Ref 0)	0	0	0	0
F.101 (Freq Ref 1)	1	0	0	0
F.102 (Freq Ref 2)	0	1	0	0
F.103 (Freq Ref 3)	1	1	0	0
F.104 (Freq Ref 4)	0	0	1	0
F.105 (Freq Ref 5)	1	0	1	0
F.106 (Freq Ref 6)	0	1	1	0
F.107 (Freq Ref 7)	1	1	1	0
F.108 (Freq Ref 8)	0	0	0	1
F.109 (Freq Ref 9)	1	0	0	1
F.110 (Freq Ref 10)	0	1	0	1
F.111 (Freq Ref 11)	1	1	0	1
F.112 (Freq Ref 12)	0	0	1	1
F.113 (Freq Ref 13)	1	0	1	1
F.114 (Freq Ref 14)	0	1	1	1
F.115 (Freq Ref 15)	1	1	1	1

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DEFAULT SETTINGS:
I.000 - **Digital Input 1** (terminal 22) = 7 programmed as **Freq sel 1**
I.001 - **Digital Input 2** (terminal 23) = 8 programmed as **Freq sel 2**
I.002 - **Digital Input 3** (terminal 24) = 9 programmed as **Freq sel 3**

NOTE! "Freq sel 4" is one of the selection of the digital input, but it is not factory preset .

The following figure shows the setting of a 8 Multispeed control.

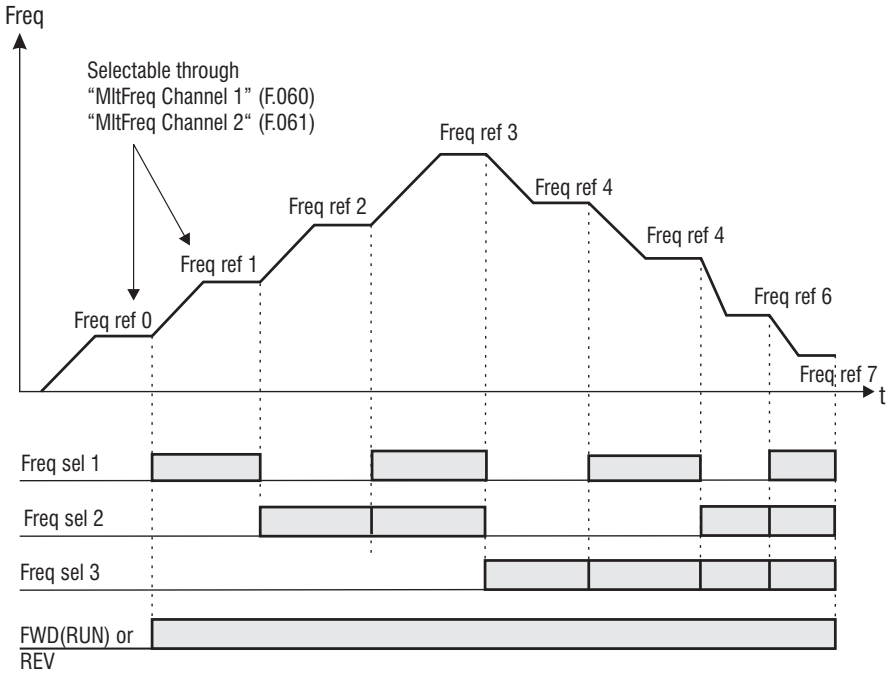

Figure 7.5.3: Multispeed Frequencies

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
F.100	Frequency ref 0		0	-F.020	F.020	Hz	0.1	311
F.101	Frequency ref 1		0	-F.020	F.020	Hz	0.1	312
F.102	Frequency ref 2		0	-F.020	F.020	Hz	0.1	313
F.103	Frequency ref 3		0	-F.020	F.020	Hz	0.1	314
F.104	Frequency ref 4		0	-F.020	F.020	Hz	0.1	315
F.105	Frequency ref 5		0	-F.020	F.020	Hz	0.1	316
F.106	Frequency ref 6		0	-F.020	F.020	Hz	0.1	317
F.107	Frequency ref 7		0	-F.020	F.020	Hz	0.1	318

F.108	Frequency ref 8	0	-F.020	F.020	Hz	0.1	319
F.109	Frequency ref 9	0	-F.020	F.020	Hz	0.1	320
F.110	Frequency ref 10	0	-F.020	F.020	Hz	0.1	321
F.111	Frequency ref 11	0	-F.020	F.020	Hz	0.1	322
F.112	Frequency ref 12	0	-F.020	F.020	Hz	0.1	323
F.113	Frequency ref 13	0	-F.020	F.020	Hz	0.1	324
F.114	Frequency ref 14	0	-F.020	F.020	Hz	0.1	325
F.115	Frequency ref 15	0	-F.020	F.020	Hz	0.1	326

F.116 Jog frequency

It is the frequency reference for the JOG speed.
This speed is activated through a programmed digital input.
The RUN command via terminal must not be given. This command will enable the main frequency reference.

The limit of the output frequency will be clamped by ***Max ref freq (F.020)***.

The setting of the JOG reference value, can be either positive or negative.
In both the setting the HW Reverse command is active (when enabled).

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
F.116	Jog frequency		1	-500	500	Hz	0.1	327

Ramp Configuration

F.200 Ramps resolution

It defines the range and the accuracy with which the ramps time will be set.

Code	LCD display	[Code] & LCD select.		Default	MIN	MAX	Unit	Variation	IPA
F.200	Ramp resolution	[0] 0.01s	(From 0.01s to 99.99s)	1	0	2			328
		[1] 0.1s	From (0.1s to 999.99s)						
		[2] 1s	From (1s to 9999s)						

F.201 Acc time 1 (Acceleration time 1)

F.202 Dec time 1 (Deceleration time 1)

F.203 Acc time 2 (Acceleration time 2)

F.204 Dec time 2 (Deceleration time 2)

F.205 Acc time 3 (Acceleration time 3)

F.206 Dec time 3 / FS (Deceleration time 3)

F.207 Acc time 4 (Acceleration time 4)

F.208 Dec time 4 (Deceleration time 4)

NOTE! When the JOG function is activated, ***Acc time 4 (F.207)*** and ***Dec time 4 (F.208)*** are selected automatically.

When the "FAST STOP" is activated (through digital input command), the function is executed with the DEC TIME 3 delay.

The ramp control can be set for a programmable delay for the acceleration and deceleration times of the drive reference. This delay time will have to be set on the final system (motor and load), being strictly dependant from the inertia of the load machine.
The time values are expressed in seconds. The ramps time delay are calculated in accordance with the ***Max ref freq (F.020).***
It is possible to select up to 4 different time, whose value can be set in these parameters.
The selection of these ramps can be performed through a binary setting of 2 digital inputs, programmed as **Ramp sel 1** and **Ramp sel 2**.

It is reported below the basis sequence for the full selection.

Active Ramp time	Ramp sel 1	Ramp sel 2
F.201 (Acc time 1) **F.202 (Dec time 1)**	0	0
F.203 (Acc time 2) **F.204 (Dec time 2)**	1	0
F.205 (Acc time 3) **F.206 (Dec time 3)**	0	1
F.207 (Acc time 4) **F.208 (Dec time 4)**	1	1

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Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
F.201	Acc time 1		5	0.1(***)	999.9(***)	sec	0.1 (***)	329
F.202	Dec time 1		5	0.1(***)	999.9(***)	sec	0.1 (***)	330
F.203	Acc time 2		5	0.1(***)	999.9(***)	sec	0.1 (***)	331
F.204	Dec time 2		5	0.1(***)	999.9(***)	sec	0.1 (***)	332
F.205	Acc time 3		5	0.1(***)	999.9(***)	sec	0.1 (***)	333
F.206	Dec time 3 / FS		5	0.1(***)	999.9(***)	sec	0.1 (***)	334
F.207	Acc time 4 / Jog		5	0.1(***)	999.9(***)	sec	0.1 (***)	335
F.208	Dec time 4 / Jog		5	0.1(***)	999.9(***)	sec	0.1 (***)	336

(***) value depends on the setting of ***F.200*** parameter.

F.250 Ramp S-shape

The S-shaped ramp can be useful to obtain a smooth behaviour of the system during the end of the acceleration or close to the zero speed during the deceleration.
The value (in seconds) of the S-shaped ramp is added to the ramp time of the linear profile.
The ramp time is thus lengthened by the value of the S-curve constant.

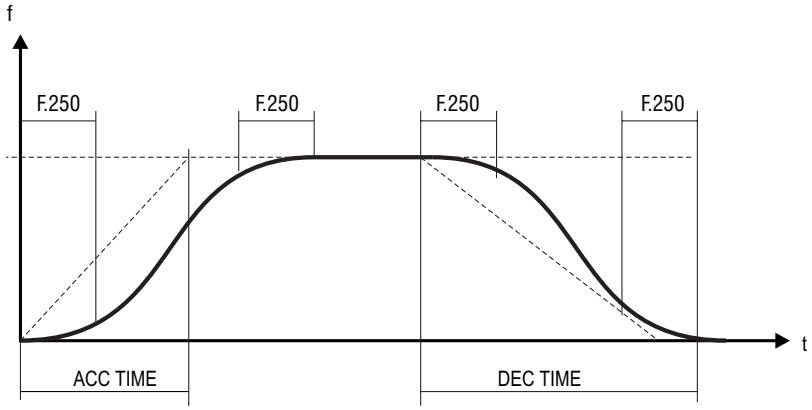


Figure 7.5.4: Ramp S-shape

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
F.250	Ramp S-shape		0	0	10	sec	0.1	337

F.260 **Ramp extens src** (Ramp extension source)

When an extension of the set ramps time is needed, it can be achieved through the Analog Inputs.
This extension will change linearly according to the value applied on the Analog Input.
The function allows the ramp times extension in a range includes between multiply factor 1 (0V, 0mA o 4mA) and multiply factor 10 (+/-10V o 20mA).

The parameter select the source from where this function is provided and controlled.

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
F.260	Ramp extens src	[0] Null	0	0	3			338
		[1] Analog inp 1 (setting through I.**200…I.204**)						
		[2] Analog inp 2 (setting through I.**210…I.214**)						
		[3] Analog inp 3 (setting through I.**220…I.224**)						

Jump Frequencies

F.270 Jump amplitude

F.271 Jump frequency1

F.272 Jump frequency2

In a system composed by motor and drive, at certain frequencies values, it is possible to meet the generation of noisy vibrations, characterized by mechanical resonances.

Through the parameters ***F.271*** and ***F.272***, it is possible to avoid the working of the inverter around the frequencies here set.
The parameter ***F.270*** defines the tolerance band of the critical zone.

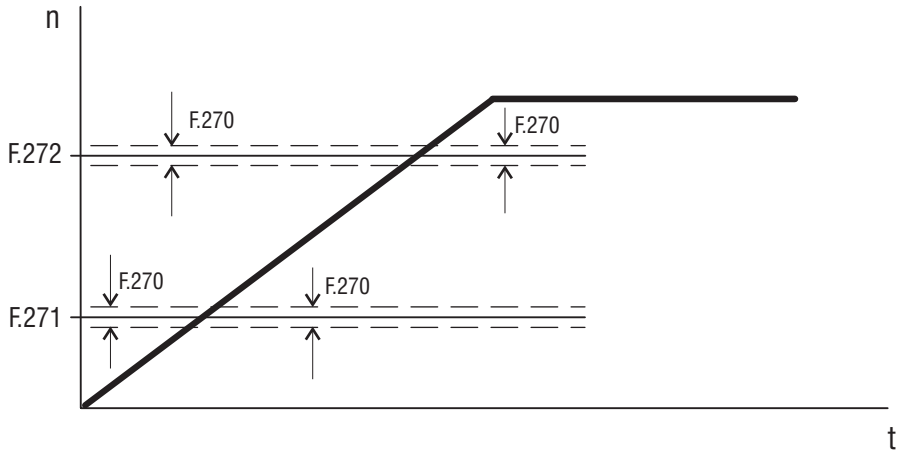


Figure 7.5.5: Jump Frequencies

When the frequency reference is set to a value within the tolerance band, the frequency output assumes the following behavior.

Example:
A) Increasing the reference from lower value of ***F.271*** or ***F.272***

F.271 = 30Hz (first forbidden frequency threshold)
F.270 = 1Hz (tolerance band: 29Hz….31Hz)
Setting of frequency reference = 29,5Hz
Frequency output = 29Hz

Setting of frequency reference = 30,5Hz
Frequency output = 29Hz

B) Decreasing the reference from higher value of ***F.271*** or ***F.272***

F.271 = 30Hz (first forbidden frequency threshold)
F.270 = 1Hz (tolerance band: 29Hz….31Hz)

Setting of frequency reference = 30,5Hz
Frequency output = 31Hz

Setting of frequency reference = 29,5Hz
Frequency output = 31Hz

The user can set any frequency reference, but if its value is within the forbidden range, the inverter will maintain automatically the speed out the limit of the tolerance band.

During the ramp execution the forbidden frequencies have not any influence, so the output frequency will be linearly generated.

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
F.270	Jump amplitude		0	0	100	Hz	0.1	339
F.271	Jump frequency 1		0	0	100	Hz	0.1	340
F.272	Jump frequency 2		0	0	100	Hz	0.1	341

7.6 Menu P - PARAMETERS

Commands

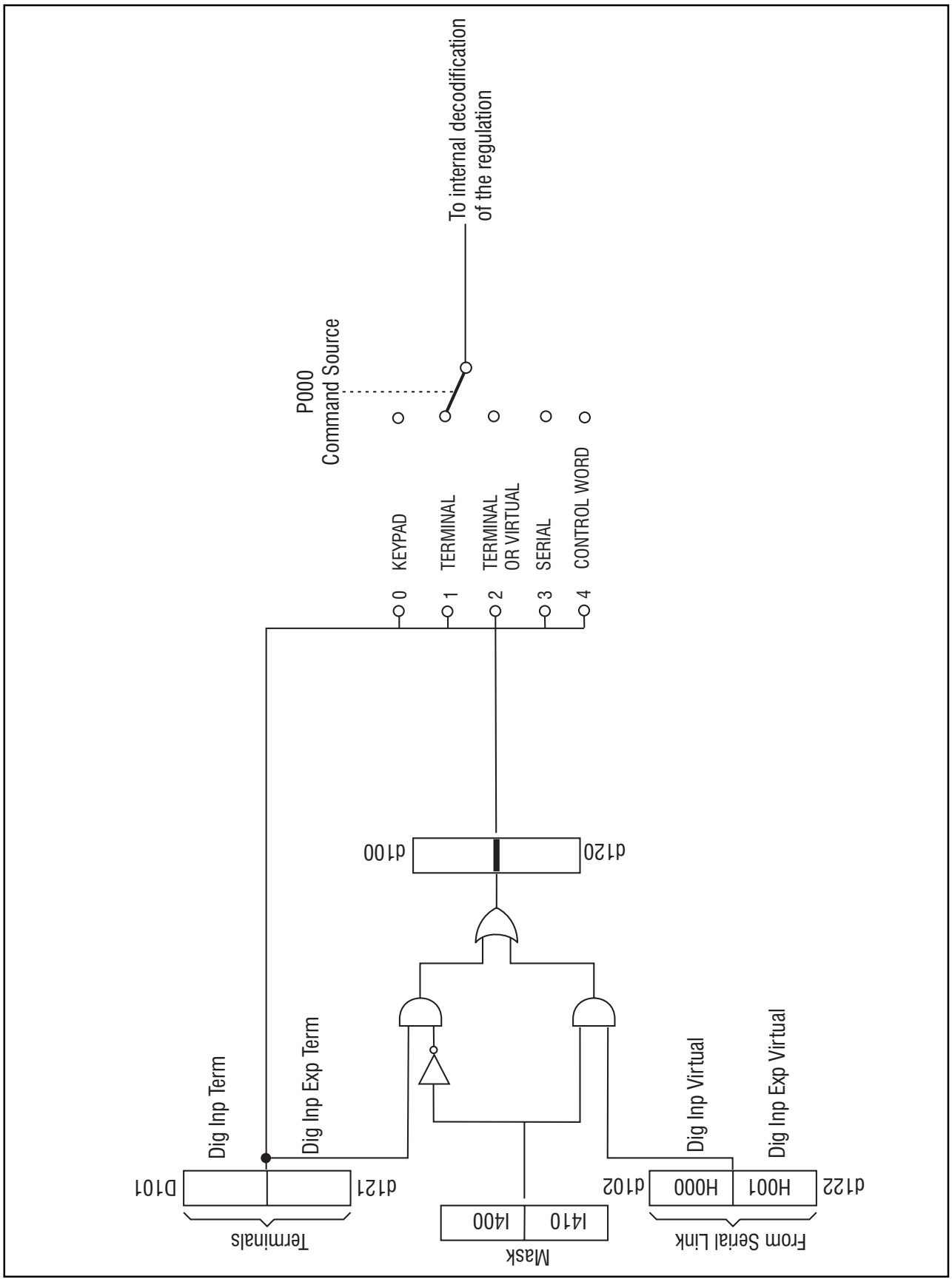


Figure 7.6.1: Basic Commands Logic Selection

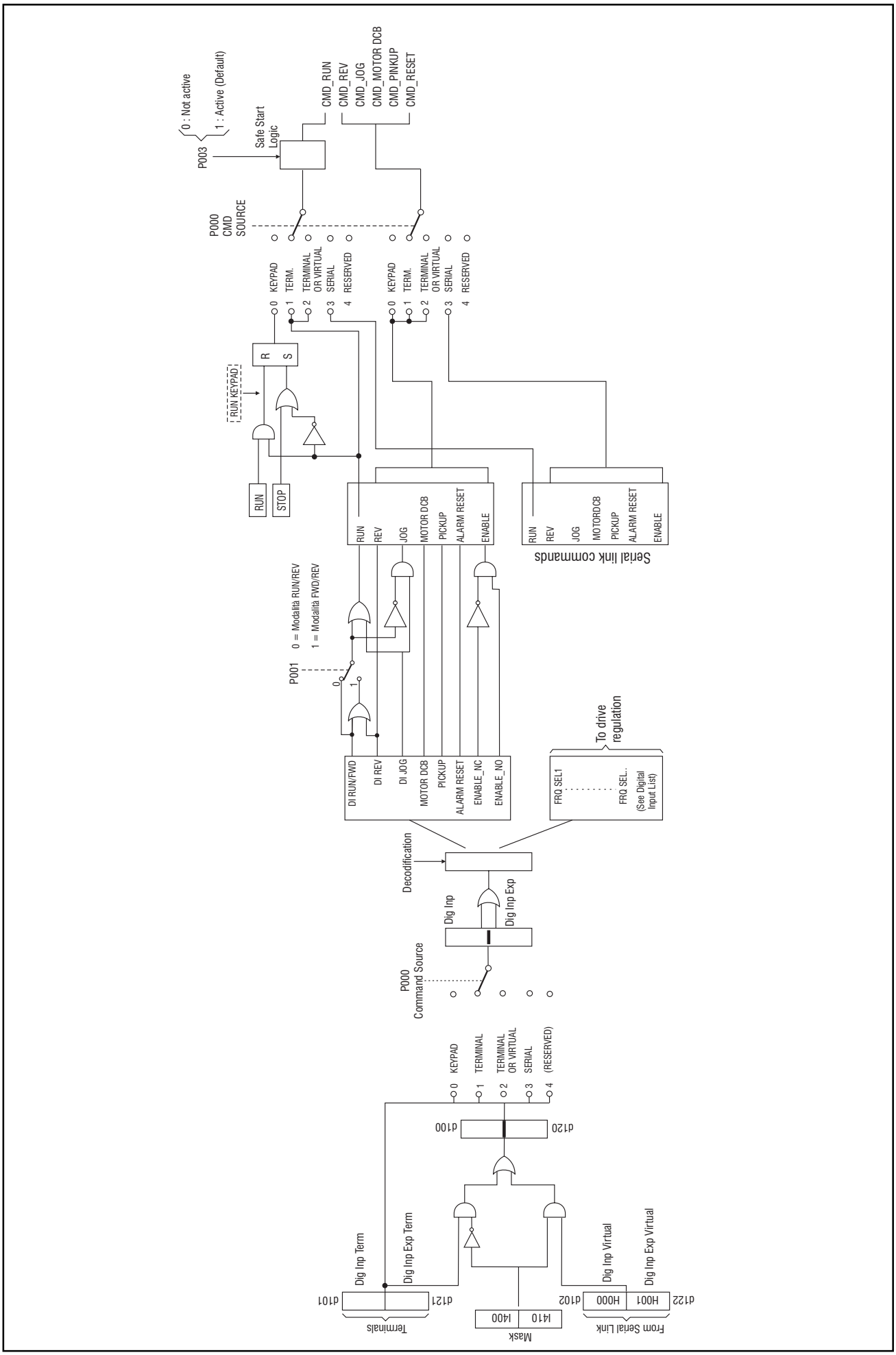


Figure 7.6.2: Main Commands Logic Selection

P.000 Cmd source sel (Command source selection)

It defines the selection mode for the main commands START and STOP.

P.000 = 0 START & STOP via keypad
In this configuration the commands are active through the keypad buttons.

 START button  STOP button

The Digital Input 7, factory programmed as RUN (terminal 5), must be connected to a specific logic level (high level or low level) in order to allow the motor START.
For this connection refer to figure 5.5.1.2.

If this connection is removed, the motor will STOP with the set ramp time.

P.000 = 1 START & STOP via terminals
In this configuration the commands are active through the terminals.

The motor START can be performed applying the specific logic level (high level or low level), to the Digital Input 7 (terminal 5), factory set as RUN.
If this connection is removed, the motor will STOP with the set ramp time.

NOTE! After a cycle of main supply voltage, the drive can be started only according to the settings of ***P.003 Safety*** parameter, which allows the Start/Stop commands to respond to **Edge** or **Level** sensitive signals.

NOTE! The command **Drive enable** available as a selection of the digital inputs, adds additional safety logic for the motor running sequences.
The releasing of it, will produce a coast to stop of the motor. (see chapter **INTERFACE**, section **Digital inputs**).

P.000 = 2 Main commands & I/Os setting via virtual channels or terminals
In this configuration, the commands programmable on the digital inputs or the signalling of the digital and analog outputs, can be assigned as follows:

- **Complete selection via serial line or fieldbus as "Virtual setting "**
- **Complete selection via "Terminals setting"**
- **Mix of "Virtual and Terminal selection"**

NOTE! The requirements of commands via terminal strip is depending by virtual I/O settings.

Further information about this function, can be found in the chapters:
INTERFACE section **Enabling Virtual I/O**
Commands addressing is described in the chapter **HIDDEN**

P.000 = 3 START & STOP & main commands via Serial line (SERIAL)
It define the selection of the main commands exclusively via serial line or filedbus.

NOTE! Commands via terminal strip are not required.

Further information about the serial line, can be found in the chapters:
INTERFACE section **Serial configuration**
Commands addressing is described in the chapter **HIDDEN,** section **Commands** for serial link.

P.000 = 4 Main commands & I/Os setting through Control word bits of Profidrive
It allows the selection of the main commands exclusively via Profidrive (optional field bus).

P.001 **RUN input config** (RUN input configuration)

Definition of the RUN and Reverse logic control.

P.001 = 0
FWD (clockwise direction) with terminal **RUN = ON**
REV (anti-clockwise direction) with terminal **RUN = ON** and terminal **REV = ON**
P.001 = 1
FWD (clockwise direction) with terminal **RUN = ON**
REV (anti-clockwise direction) with terminal **RUN = OFF** and terminal **REV = ON**

P.002 Reversal enable

Block of the command direction of the motor.

P.002 = 0
REV (anti-clockwise direction) **DISABLED**
P.002 = 1
REV (anti-clockwise direction) **ENABLED**
The function will be applied at any kind of REV logical command (digital input, negative reference and serial line).

P.003 Safety

The parameter defines the RUN (or REVERSE) command behavior at the drive power on:

P.003 = 0 RUN command via a Level sensitive signal.
At the drive power on, the starting of the motor is allowed when the RUN command is already present on terminal strip.

P.003 = 1 RUN command via an Edge sensitive signal.
At the drive power on, the starting of the motor is not allowed when the RUN command is already present on terminal strip.
The starting of the motor can be execute cycling RUN command.

Mapping a digital output as "Ready", the drive state condition can be displayed according to the above parameter setting.

P.004 Stop mode

Motor stop control function.
P.004 = 0 The control sets the motor ramp deceleration up to 0 Hz.
P.004 = 1 The control cuts off the output voltage, so the motor coasts to stop.

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
P.000	Cmd source sel	[0] Keypad [1] Terminals [2] Virtual [3] Serial [4] Control word	1	0	4			400
P.001	RUN input config	[0] Run / Rev [1] Fwd / Rev	0	0	1			401
P.002	Reversal enable	[0] Disable [1] Enable	1	0	1			402
P.003	Safety	[0] OFF [1] ON	1	0	1			403
P.004	Stop mode	[0] In ramp [1] Ramp to stop	0	0	1			493

Power Supply

P.020 Mains voltage

Rated value of the line voltage [V_{rms}].
The undervoltage trip function is based on this value (see also chapter **PARAMETERS,** function **Undervoltage configuration**).

P.021 Mains frequency

Rated value of the line voltage frequency [Hz].

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
P.020	Mains voltage	230 (Only for "AGy...-4" type) 400 (Only for "AGy...-4" type) 460 (Only for "AGy...-4" type) 575 (Only for "AGy...-5" type)	(****)	230	575	V		404
P.021	Mains frequency	50 60	(****)	50	60	Hz		405

(****) parameter value depending on drive type.

Motor Data

P.040 Motor rated curr (Motor rated current)

Rated current [A_{rms}] of the motor at rated kilowatt/horsepower and voltage (given on the nameplate, see figure 7.6.3).
In case of control with multiple motors, enter a value equal to the sum of the rated currents of all the motors.
Do not perform any self tune.

P.041 Motor pole pairs

Pole pairs of the motor. The setting of this data, can be easily calculated with the following formula:

$$N[rpm] = \frac{60\ [s] \times f\ [Hz]}{2p\ [polepairs]}$$

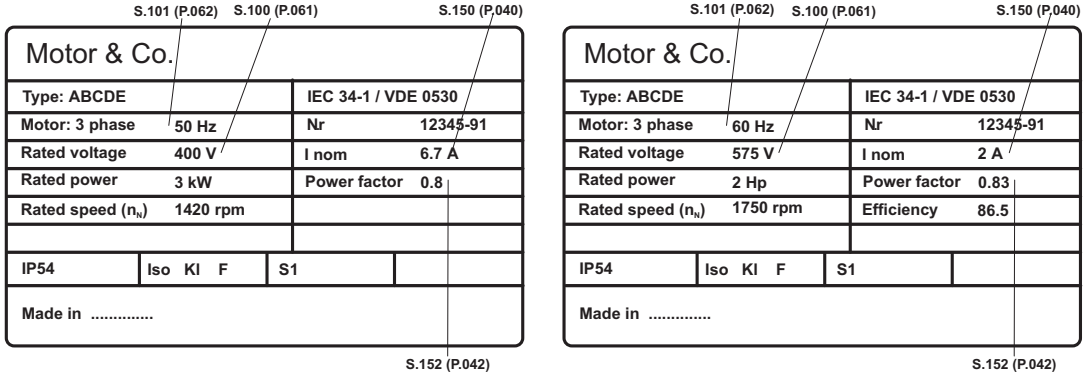


Figure 7.6.3: Motor Nameplate (Example: kW rating for 400V motor and Hp rating for 575V motor)

Example: calculation of the pole pairs of a motor having the data shown in the above label:

$$p\ [polepairs] = \frac{60\ [s] \times f\ [Hz]}{n_N\ [rpm]} = \frac{60\ [s] \times 60\ [Hz]}{1750\ [rpm]} = 2$$

the value to set in the parameter ***P.041*** is "2".

Where: p = motor pole pairs; f = rated motor frequency (***P.062***); n_N = rated motor speed (see figure 7.6.3)

P.042 **Motor power fact** (Motor power factor)

Motor power factor (given on the nameplate, see figure 7.6.3).

A signalling of the "negative power factor" condition is available on the digital output as "***Neg pwr fact*** ".

P.043 **Motor stator R** (Motor stator Resistance)

Measurements of the stator resistance of the motor.
This value will be automatically updated, after performing the self tune procedure.

P.044 **Motor cooling**

Setting of the type of cooling of the motor connected.

P.045 **Motor thermal K** (Motor thermal costant)

Thermal characteristic of the motor connected.
The data is normally provided by the motor manufacturer, as the time needed to reach the maximum temperature at rated current.

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
P.040	Motor rated curr		(*)	(*)	(*)	A	0.1	406
P.041	Motor pole pairs		(*)	1	60			407
P.042	Motor power fact		(*)	0.01	1		0.01	408
P.043	Motor stator R		(*)	0	99.99	ohm	0.01	409
P.044	Motor cooling	[0] Natural [1] Forced	0	0	1			410
P.045	Motor thermal K		30	1	120	min		411

V/F Curve

P.060 V/f shape

Selection of the curve for the V/F ratio.
P.060 = 0 (Custom)
The intermediate values of voltage and frequency, are defined by the parameters ***P.063*** and ***P.064*** as well as the link of the manual Boost on the characteristic.

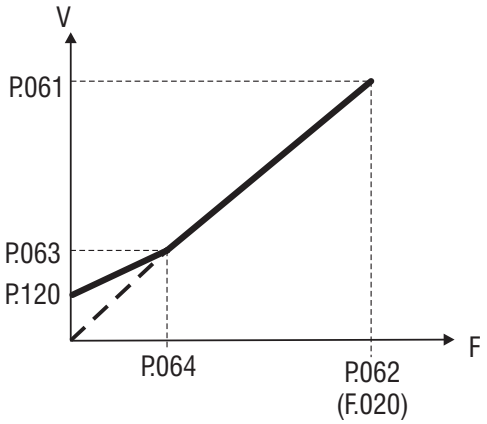


Figure 7.6.4: Custom V/F shape

P.060 = 1 (Linear)
The factory setting provides a Linear V/F ratio, having the middle points fixed by the half value of ***P.063*** and ***P.064***.

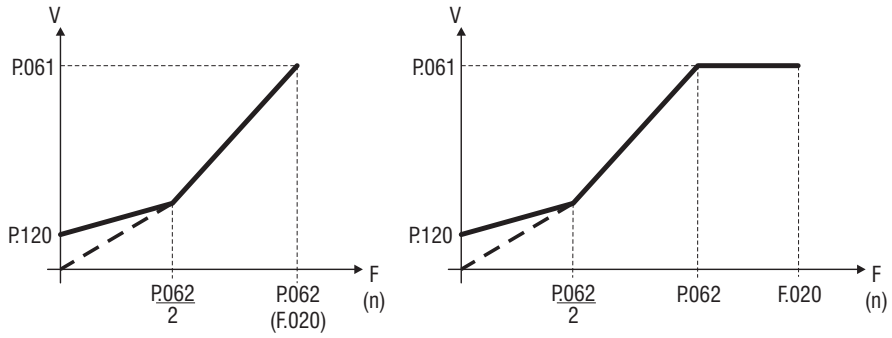


Figure 7.6.5: Linear V/F shape

P.060 = 2 (Quadratic)
The Quadratic characteristic is useful when a pump or fan has to be controlled (load where the torque is proportional to the speed squared).
The factory setting, when this ratio is selected, provides a setting of ***P.063*** equal to the 0,25% the Max output voltage, at a frequency equal to 50% of ***P.062***.

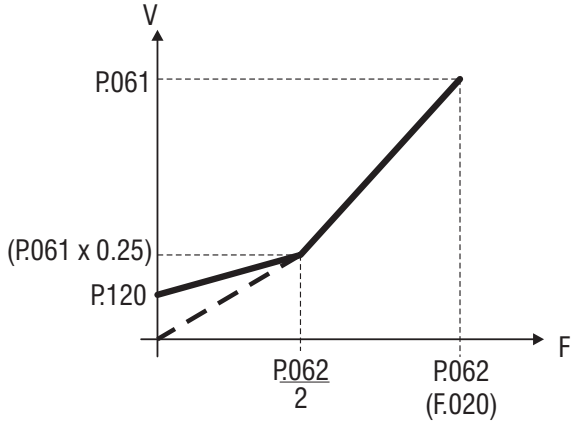


Figure 7.6.6: Quadratic V/F shape

P.061 Max out voltage (Maximum output voltage)

Maximum value of the voltage applied to the motor (normally set as the nameplate, see figure 7.6.3).

P.062 Base frequency

Rated frequency of the motor (given on the nameplate, see figure 7.6.3).
It represents the working frequency of the drive, at which the Max out voltage is associated (***P.061***).

P.063 V/f interm volt (V/f intermediate voltage)

Intermediate "voltage" value of the V/F characteristic selected.

P.064 V/f interm freq (V/f intermediate frequency)

Intermediate "frequency " value of the V/F characteristic selected.

NOTE! When custom V/f shape is selected (***P.060*** = 0):

P.064 parameter represents the return point of the output voltage, on the linear characteristic of V/f ratio (see figure 7.6.4).

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
P.060	V/f shape	[0] Custom [1] Linear [2] Quadratic	1	0	2			412
P.061	Max out voltage		(**)	50	(**)	V	1	413
P.062	Base frequency		(**)	25	500	Hz	0.1	414
P.063	V/f interm volt		(**)	0	P.061	V		415
P.064	V/f interm freq		(**)	1	P.062	Hz	0.1	416

Ouput Frequency Limit

P.080 **Max output freq** (Maximun output frequency)

It is the maximum level of the output frequency, expressed as percentage of ***Max ref freq (F.020)***.

This parameter takes into account the sum of all the reference frequencies and frequency variables of the drive, deriving by :

Speed references, Slip compensation, PID regulator

P.081 **Min output freq** (Minimun output frequency)

Minimum value of output frequency, under which no reference regulation has effect.
It is expressed as percentage of **Max output freq (*P.080*).**

The parameter is correlated to the ***Min ref freq (F.021)***, as reported in the figure below.

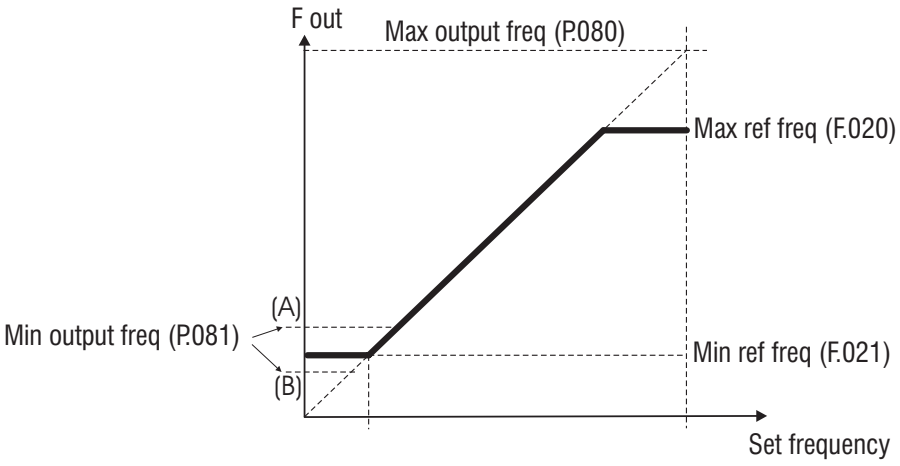


Figure 7.6.7: Min & Max Reference Frequency

A signalling of the "output frequency" status is available on the digital output as ***"Out freq<set***".

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
P.080	Max output freq		100	0	110	% of F.020		417
P.081	Min output freq		0.0	0.0	25.0	% of F.020	0.1	418

Slip Compensation

P.100 Slip compensat (Slip compensation)

If an induction motor is being used, the mechanical speed will vary with the load due to the slip of the motor. In order to adjust for this speed error the slip compensation can be used.

During this calibration, make sure that the drive is not in a current limit condition.

If this compensation is set too high it can cause instability.

The changing will be carried out as a percentage of the nominal slip, calculated when set the motor plate date.

The Slip compensation will act directly on the output frequency of the drive. For this purpose the parameter ***Max output freq (P.080)*** expressing the percentage of the ***Max ref freq (F.020)***, has to be set to a value including:

Max ref freq value + **Slip compensat** value.

See chapter "**PARAMETERS**", section "**Output Frequency Limit**".

The Slip compensation must be disabled when a multiple motor connection is being used.

P.101 Slip comp filter (Slip compensation filter)

It is the response time (in seconds) for the reaction of the function.
Increasing this value helps damping oscillations that may arise with load steps (especially negative ones).

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
P.100	Slip compensat		0	0	250	%		419
P.101	Slip comp filter		0.1	0	10	sec	0.1	420

Boost

P.120 Manual boost [%]

The resistive impedance of the stator windings causes a voltage drop within the motor, which result in a reduction in torque in the lower speed range.
Compensation can be made for this effect by boosting the output voltage.
This compensation is carried out continuously across the whole speed range in proportion to the output current but it is most effective at low speed.

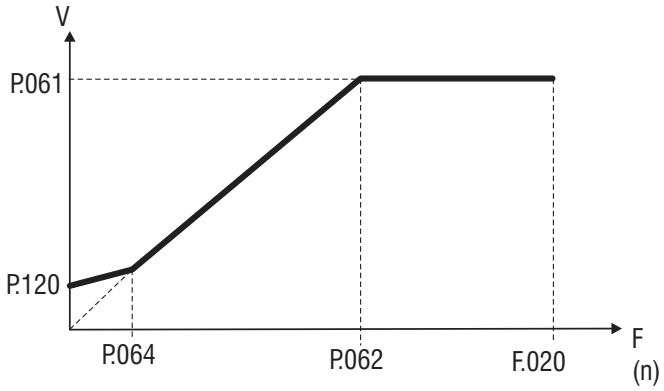


Figure 7.6.8: Manual Boost Voltage

The setting is in percentage of the ***Max out voltage (P.061)***.

P.121 **Boost factor src** (Factor extension source of manual Boost)

The manual Boost level can be linearly regulated through an analog reference signal.
The regulation of the Boost level will be between 0% (setting the inputs at 0V - 0mA - 4mA) and 100% of the percentage value set in ***P.120*** (+/- 10V - 20mA).

This parameter selects the source from where this function is provided and controlled.

P.122 **Auto boost en** (Automatic boost enabling)

The boost can be automatically controlled by the enabling of this parameter. The control is continuously carried out in the whole speed range.

NOTE! The automatic boost is automatically calculated during the execution of drive/motor self tuning (***P.043*** parameter). It is anyway possible to obtain an "Oveboost" at low speed, increasing the value of the manual boost (***P.120*** parameter).

The Auto boost must be disabled when a multiple motor connection is being used.

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
P.120	Manual boost [%]		1	0	25	% of P.061	0.1	421
P.121	Boost factor src	[0] Null	0	0	3			422
		[1] Analog inp 1 (setting through I.200…I.204)						
		[2] Analog inp 2 (setting through I.210…I.214)						
		[3] Analog inp 3 (setting through I.220…I.224)						
P.122	Auto boost en	[0] Disable	1	0	1			423
		[1] Enable						

Automatic Flux Regulation

P.140 **Magn curr gain** (Magnetizing current gain)

The magnetizing current of the motor, has approximately the no load current value at rated voltage and frequency.
A control of this variable is performed with the changing of its gain. .
The benefit is substantially an availability of motor higher torque at low speeds, obtained with a modality similar to the "boost voltage" function.
A too high setting can cause undesired oscillation.

NOTE! It is not reconmmended to use this function if sustained operation below 1 Hz is required.

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
P.140	Magn curr gain		0	0	100	%	0.1	424

Anti Oscillation Function

P.160 **Osc damping gain** (Anti Oscillation damping gain)

The parameter (current symmetry) is used to eliminate any oscillation or beat in the motor current resulting from tolerances or configurations capable of generating oscillations within the Inverter/cable/ motor system.
The "0" value set at the factory is effective in many cases.
If necessary this value can be altered (0...100) to provide adaptation to the application in question.
During the calibration of the optimum value it is recommended to set the variations of this parameter with slight increases.
The frequency operation range is around 10Hz…30Hz .

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
P.160	Osc damping gain		0	0	100			425

SW Current Clamp

P.180 SW clamp enable (Software current clamp enabling)

To optimize the performance of the inverter, it is necessary to be able to accelerate and decelerate during the whole ramp time with the maximum current that the inverter can supply to the motor.
The setting of very short ramp times, that would cause an exceeding of the allowable current limits of the drive, activates the "Current Clamp"circuit avoiding to reach the overcurrent limits and the consequent "OC" trip.

The intervention of the "Current Clamp" circuit, has as consequence an increase of the real time in which the final speed is obtained.
It is anyway possible the disabling of the function, setting this parameter at zero.

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
P.180	SW clamp enable	[0] Disable (not active) [1] Enable (active)	1	0	1			426

Current Limit

The drive is provided with an active current limited function.

It is possible to select different current limits, during the ramps or at steady state.

Current limitation is achieved by a PI regulator effect on speed reference (see ***P.206*** parameter).

P.200 En lim in ramp (Enabling limit in ramp)

P.200 = 0 Function disabled.

P.200 = 1 Enabling of the current limit control during the ramps.

P.200 = 2 Ramp-curr ctrl
During speed acceleration or deceleration, if the current value exceeds the setting of ***P.201*** (Current limit during the ramp), the ramp stage will be momentary blocked and the speed kept at the value reached in this moment.
When the current will decrease again below this limit, the ramp will be restarted with the profile set.
The ramp time is thus lengthened by the execution of this control.

P.201 Curr lim in ramp (Current limit in ramp)

Value of the current limit during the ramps.
It is as percentage of the nominal current of the drive (see also parameter ***d.950***, chapter **DISPLAY**).

P.202 En lim in steady (Enabling limit in steady)

Enabling of the current limit control during the ramps.

P.203 Curr lim steady (Current limit in steady)

Value of the current limit during steady state.
It is as percentage of the nominal current of the drive (see also parameter ***d.950,*** chapter **DISPLAY**).

P.204 Curr ctrl P-gain (Current control proportional gain)

Proportional gain of the current regulator.

- a setting too low could have a slow reaction on the regulation response.
- a setting too high could can have a too fast reaction with consequent oscillations of the system.

P.205 Curr ctrl I-gain (Current control integral gain)

Integral gain of the current regulation.

- a setting too low could have a slow reaction on the regulation response.
- a setting too high could can have a too fast reaction with consequent oscillations of the system.

P.206 Curr ctr feedfwd (Current control feed forward)

As described in the figure below, the setting of the feed-forward, allows to avoid the drive trip for overcurrent (OC) during fast acceleration of the load.
When the current exceeds the value of ***Curr lim in ramp***, a quick frequency step (percentage of the motor rated slip), is automatically sutracted to the reference.
In this case the ramp is extended in order to keep the current level under this limit.
A shortening of the extended ramp time, can be of course achieved excluding the load.

This function operates only during the ramp time (not in steady state).

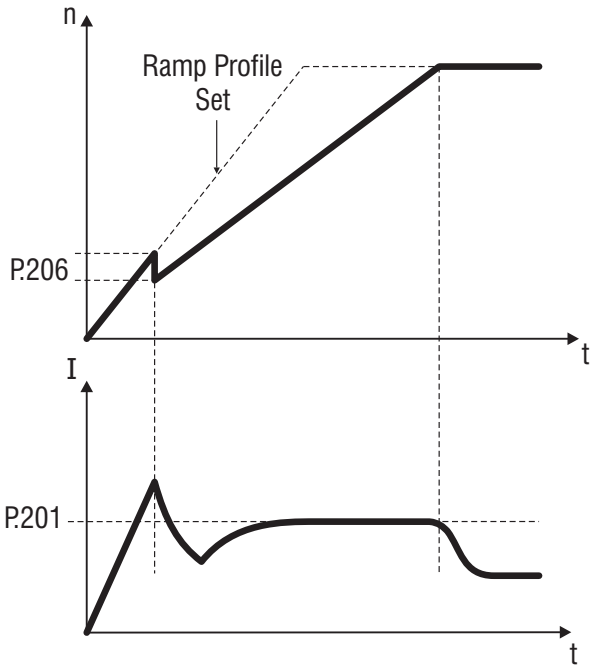


Figure 7.6.9: Current Limit Control in Ramp

A signalling of the "current limit" condition is available on the digital output as "***Current limit***".
A signalling of the "overcurrent" condition is available on the digital output as "***Alarm state***".

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
P.200	En lim in ramp	[0] None [1] PI Limiter [2] Ramp freeze	0	0	2			427
P.201	Curr lim in ramp		170	20	170	% I nom		428
P.202	En lim in steady	[0] Disable [1] Enable	0	0	1			429
P.203	Curr lim steady		170	20	170	% of I nom		430
P.204	Curr ctrl P-gain		30.0	0.1	100	%	0.1	431
P.205	Curr ctrl I-gain		10.0	0.1	100	%	0.1	432
P.206	Curr ctr feedfwd		0	0	250	%		433

DC Link Limit

The function when enabled, performs a control on the voltage level of the DC link bus capacitor.

During fast deceleration if the load has a big inertia, the DC link value can suddenly increase close to the alarm threshold. In this case the ramp is controlled keeping the voltage level within safety values.

Consequently the deceleration ramp time is automatically extended, in order to achieve the deceleration of the load, trying to avoid an eventual block for "overvoltage" (OV alarm).

As for the current limiter, the DC-Link controller is PI-based, with the addition of a programmable feed forward term.

P.220 En DC link ctrl (Enabling DC link control)

P.220 = 0 Function disabled.

P.220 = 1 Enabling of the DC link control function.

P.220 = 2 ***DC-Ramp ctrl***

During fast deceleration, if the DC link level increase close to the alarm threshold, the ramp stage will be momentary blocked and the speed kept at the value reached in this moment.
When the DC link level, will decrease again within the internal safety values, the ramp will be restarted with the profile set. The ramp time is thus lengthened by the execution of this control.

P.221 DC-lnk ctr Pgain (DC link control proportional gain)

Proportional gain of the DC link control regulation.
- a setting too low could have a slow reaction on the regulation response.
- a setting too high could have a too fast reaction with consequent oscillations of the system.

P.222 DC-lnk ctr Igain (DC link control integral gain)

Integral gain of the DC link control regulation.
- a setting too low can have a slow reaction on the regulation response.
- a setting too high can have a too fast reaction with consequent oscillations of the DC link.

P.223 DC-link ctr FF (DC link control feed forward)

As described in the figure beow, this is the setting of the feed-forward for the DC control function.
At the increasing of the DC link level, a quick frequency step (percentage of the motor slip), is automatically added to the reference. The voltage level decreases toward its rated value.

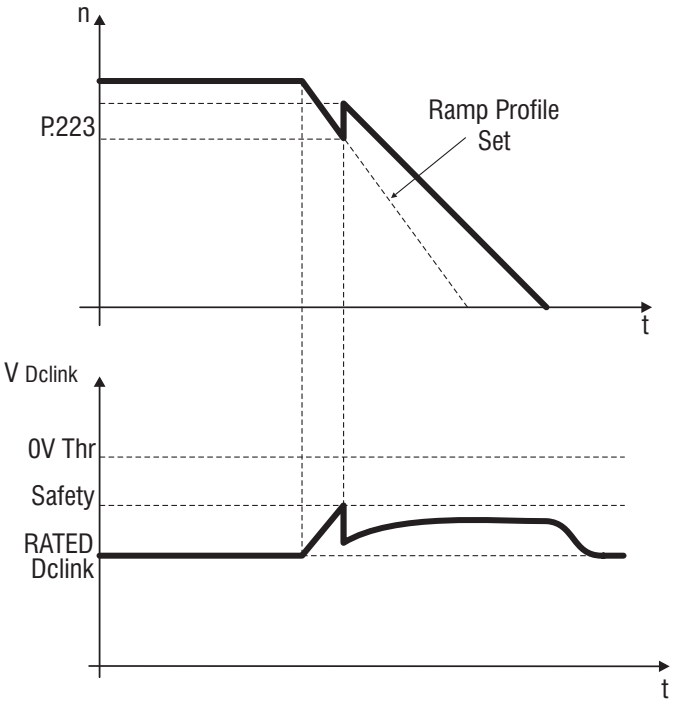


Figure 7.6.10: DC Link Voltage Control

The "overvoltage " alarm will be displayed with the message "OV".
A signalling of the "DC link" status is available on the digital output as "***DC bus limit***".

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
P.220	En DC link ctrl	[0] None [1] PI Limiter [2] Ramp freeze	0	0	2			434
P.221	DC-lnk ctr Pgain		20.0	0.1	100	%	0.1	435
P.222	DC-lnk ctr Igain		2.0	0.1	100	%	0.1	436
P.223	DC-link ctr FF		0	0	250	%		437

Over Torque Alarm Configuration

The torque of the motor (active current) can be monitored through this function.

In particular the overtorque condition and the behaviour of the drive itself, are manageable by these parameters.

P.240 OverTorque mode

It defines the status of the drive during its overtorque condition.

P.240 = 0 Overtorque signalling during ramps and at steady state. No alarm will be generated.
P.240 = 1 Overtorque signalling only at steady state. No alarm will be generated.
P.240 = 2 Overtorque alarm and signalling during ramps and at steady state.
P.240 = 3 Overtorque alarm and signalling only at steady state.

P.241 OT curr lim thr (Overtorque current limit threshold)

Overtorque signalling threshold.
It is a percentage of the ***Motor rated curr (P.040).***

P.242 OT level fac src (Overtorque level factor source)

The overtorque level can be linearly regulated through an analog reference signal.
The regulation of this level will be performed between 0% (setting the inputs at 0V - 0mA - 4mA) and 100% of the percentage value setted with ***P.241*** (+/- 10V - 20mA).

This parameter selects the source from where this function is provided and controlled.

P.242 = 0 OFF
P.242 = 1 Analog Inp 1 (setting through I.200…I.204)
P.242 = 2 Analog Inp 2 (setting through I.210…I.214)
P.242 = 3 Analog Inp 3 (setting through I.220…I.224)

P.243 OT signal delay (Overtorque signalling delay)

Delay time for the alarm signalling.

The alarm will be displayed with the message "**Ot**"
A signalling of the "overtorque" condition is available on the digital output as "***Out trq>thr***".

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
P.240	OverTorque mode	[0] No Alm,Chk on 0 [1] No Alm,Chk ss [2] Alm always [3] Alm steady st	0	0	3			438
P.241	OT curr lim thr		110	20	200	%		439
P.242	OT level fac src	[0] Null [1] Analog inp 1 [2] Analog inp 2 [3] Analog inp 3	0	0	3			440
P.243	OT signal delay		0.1	0.1	25	sec	0.1	441

Motor Overload Configuration

P.260 Motor OL prot en (Motor overload protection enabling)

Enabling of the motor thermal protection.
The control is performed as an I2t, calculated on the basis of the setting of ***Motor rated curr (P.040)*** and ***Motor thermal K (P.045).***
An overload of the motor, will cause the intervention of the alarm "Motor overload".

The parameter ***d.052*** (menu **DISPLAY**), is the monitoring of the motor overload level.
A value of 100% represent the threshold for the alarm.

The alarm will be displayed with the message "**OLM**"
A signalling of the "overcurrent" condition is available on the digital output as "***Alarm state***".

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
P.260	Motor OL prot en	[0] Disable [1] Enable	1	0	1			444

BU Configuration

P.280 Brake res OL en (Braking resistor overload protection enabling)

Enabling of the thermal protection of the braking resistance.
The protection efficiency is dependant on the accuracy of the parameters concerning the rated value of the braking resistance.
An overload of the braking resistor, will cause the intervention of the alarm "Braking resistor overload".

P.281 Brake res value (Braking resistor value)

Rated Ohm value of the braking resistance connected.

P.282 Brake res power (Braking resistor power)

Rated power of the braking resistance connected.

P.283 Br res thermal K (Braking resistor thermal costant)

Thermal constant of the braking resistance connected.
This data is expressed in seconds, and it is normally provided by the manufacturer of the device, as the time that the resistor takes to reach its nominal working temperature while dissipating its rated power.

Further information on the use of the braking resistance and braking devices, can be see in chapter 5.8.

The parameter **d.053** (menu **DISPLAY**), is the monitoring of the braking resistor overload level.
A value of 100% represent the threshold for the alarm.

The alarm will be displayed with the message "**OLr**".

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
P.280	Brake res OL en	[0] Disable [1] Enable	0	0	1			445
P.281	Brake res value		(*)	1	250	ohm		446
P.282	Brake res power		(*)	0.01	25	kW	0.01	447
P.283	Br res thermal K		(*)	1	250	sec		448

DC Brake Configuration

The drive provides as a standard a set of parameters for the DC braking management.
With this function the drive injects a DC current into the motor windings, arousing in this way a braking torque.
The DC braking can be useful to brake the motor around the zero speed, either at the START and at the STOP stage, maintaining also the motor shaft locked for a short time.
It should not be used to obtain an intermediate braking.

The function parameters, allow a full control of the function.

At every DC braking command, the message "**DCB**" will appear on the display.

P.300 DC braking level

Setting of the DC current level to be injected on the motor phases.
It is a percentage of the ***Motor rated current (P.040).***

P.301 DCB lev fac src (DC Braking level factor source)

The DC braking level can be linearly regulated through an analog reference signal.
The regulation of the DC braking level will be between 0% (setting the inputs at 0V - 0mA - 4mA) and 100% of the value setted with ***P.300*** (+/- 10V - 20mA).

This parameter selects the source from where this function is provided and controlled.

P.302 DC braking freq (DC Braking frequency)

It defines the frequency threshold, at which will be activated the DC braking at the STOP.

P.303 DC braking start

Defines the DC braking duration in seconds, at the START (RUN or Reverse).
The motor will be locked until this time is elapsed.

P.304 DC braking stop

Defines the DC braking duration in seconds, at the STOP (RUN or Reverse commands released).

NOTE!

- a DC brake command can be carried out also via digital inputs (see chapter **INTERFACE**, section **Digital inputs**). In this case a **DC brake** will be possible at every speed and independently if the drive is in STOP or START condition (digital input as **DC brake**).
- the injection of direct current remanin active for all the transition time of the DC Brake command.
- a DC brake while the drive is controlled with a JOG command, can be obtained by the setting of a digital input as **DC brake**.
- a momentary disabling of the DC braking function, is possible via digital input (digital input as **DC brake en**).

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
P.300	DC braking level		0	0	100	% of I nom		449
P.301	DCB lev fac src	[0] Null	0	0	3			450
		[1] Analog inp 1 (setting through I.200…I.204)						
		[2] Analog inp 2 (setting through I.210…I.214)						
		[3] Analog inp 3 (setting through I.220…I.224)						
P.302	DC braking freq		0	0	500	Hz	0.1	451
P.303	DC braking start		0	0	60	sec	0.1	452
P.304	DC braking stop		0	0	60	sec	0.1	453

Autocapture function

The Autocapture function, allows to engage a motor already running.

An engaging of a motor already running, without the aid of this function, may cause the drive to trip in overvoltage (OV alarm) or overcurrent (OC alarm) when the drive is started.

Enabling the function, the inverter frequency output will be forced to match the motor speed, according to the command type selected in the Autocapture mode and the setting of the other regulation parameters of this function.

The main uses are:

- case of pumps with flow present
- restart after a fault alarm
- engage of a motor running directly under the mains

P.320 Autocapture mode

P.320 = 0 Function disabled

P.320 = 1 1st RUN Only
The engaging of the motor is carried out only once, when the first valid RUN command is given after drive power on.

P.320 = 2 Always
The engaging of the motor is carried out at every valid RUN command.

NOTE! The function can be enabled also through the digital inputs (see chapter **INTERFACE**, section **Digital inputs**).
In this case it will be possible to have a Autocapture at any time the command is applied (independent by the setting of ***P.320***).

P.321 Autocapture Ilim (Autocapture current limit)

Current limit threshold for the utocapture function.
For current operation, this limit must be higher than the no-load current of the motor in use.
% of inverter nominal current (***d.950***).

P.322 Demagnetiz time (Autocapture demagnetizzation time)

Delay for the beginning of the Autocapture function.
It is the time necessary for the demagnetization the motor. Times too longer can cause the tripping of "Overcurrent" alarm.

P.323 Autocap f scan t (Autocapture frequency scanning time)

Ramp time for the frequency scanning.
The initial scanning frequency type, must be chosen via the selection of parameter ***P.325.***

P.324 Autocap V scan t (Autocapture voltage scanning time)

Ramp time for the voltage recovering.
The function is correlated to the parameter ***P.323.***
The output voltage will be restored, controlling automatically the current limit set in ***P.321***.

P.325 Autocap spd src (Autocapture speed source)

Selection of the source for the initial scanning frequency.

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
P.320	Autocapture mode	[0] Disable [1] 1st run only [2] Always	0	0	2			454
P.321	Autocapture Ilim		120	20	170	% of I nom		456
P.322	Demagnetiz time		1	0.01	10	sec	0.01	457
P.323	Autocap f scan t		1	0.1	25	sec	0.1	458
P.324	Autocap V scan t		0.2	0.1	25	V	0.1	459
P.325	Autocap spd src	[0] Frequency ref 0 [1] Max freq ref [2] Last freq ref [3] Encoder	0	3			460	

A signalling of the "Autocapture" status is available on the digital output as "***Autocapture run"*** .

Undervoltage Configuration

A temporary phase loss of line input voltage, can be detected by the inverter intermediate circuit (DC-bus) as variation of its low voltage threshold level.

This condition will cause the tripping of inverter "Undervoltage" (UV) alarm.

A correct configuration of the inverter parameters, can avoid undesired system alarms caused by main dip or instability of the line voltage.

Therefore, considering the above points the inverter will have the following behaviour:

- detection of undervoltage threshold setted with ***Undervoltage thr (P.340)*** parameter
- disabling of output control voltage: the motor will coast to stop
- enabling of **Autocapture** function, if the main dip of the line voltage is lower than the time sets with ***Max pwrloss time (P.341)*** parameter; an higher value will cause a tripping of undervoltage inverter alarm (UV)

The enabling of the function depends by the configuration of the following parameters:

P.321 Autocapture Ilim ***P.322 Demagnetiz time***
P.323 Autocap f scan t ***P.323 Autocap V scan t***

NOTA! La configuration above described is refered to the setting of UV Trip mode (P.343) = 0 parameter.

P.340 **Undervoltage thr** (Undervoltage threshold)

"Undervoltage" alarm (UV) threshold detection.
The undervoltage threshold can be set in a range, within the minimum value allowed and its nominal input voltage selected.
See the table below for more details.
Here below an example:
S.000 (P.020) Mains voltage parameter = 380Vac

AC main supply	*Minimum UV threshold*	*Nominal DC-Bus*
230Vac	230Vdc	310Vdc
400Vac	380Vdc	537Vdc
460Vac	415Vdc	648Vdc
575Vac	565Vdc	810Vdc

DC UV minimum threshold = 380Vdc
Nominal DC Link = 537Vdc.

P.340 = 0% UV = 380Vdc

P340 = 50% $UV = 380 + \frac{(537 - 380) \times 50}{100} = 458Vdc$

P.341 Max pwrloss time (Maximun power loss time)

It defines the time before the drive trip for undervoltage alarm.
If the main dip lasts a time longer than the one here set, the undervoltage alarm is issued.

P.342 UV alarm storage (Undervoltage alarm storage)

This parameter defines wheter UV alarms have to be stored into the alarm stack during the counting of ***Max pwrloss time*** (see chapter **DISPLAY,** section Alarm list). The alarm will be displayed with the message "**UV**". A signalling of the "undervoltage" condition is available on the digital output as "**UV running**".

P.343 UV Trip mode (Undervoltage tripping mode)

This function allows the controlled stop of a single drive/motor configuration, in case of a.c. mains power loss. Its working is correctly carried out, only if the load has a sufficient quantity of kinetics energy (eg. inertial loads). When the DC link voltage drops under the power loss detection threshold, the function is activated. Automatically an internal threshold is detected and selected, to be higher than the undervoltage level.
The drive will act in accordance with the setting of the function and the behaviour of the mains. This is described in the drawings below.

P.343 = 0	Disable	A mains power loss, will trip the drive for undervoltage alarm (UV)
P.343 = 1	Coast Through	See figure 7.6.11
P.343 = 2	Emg Stop	See figure 7.6.12

COAST THROUGH

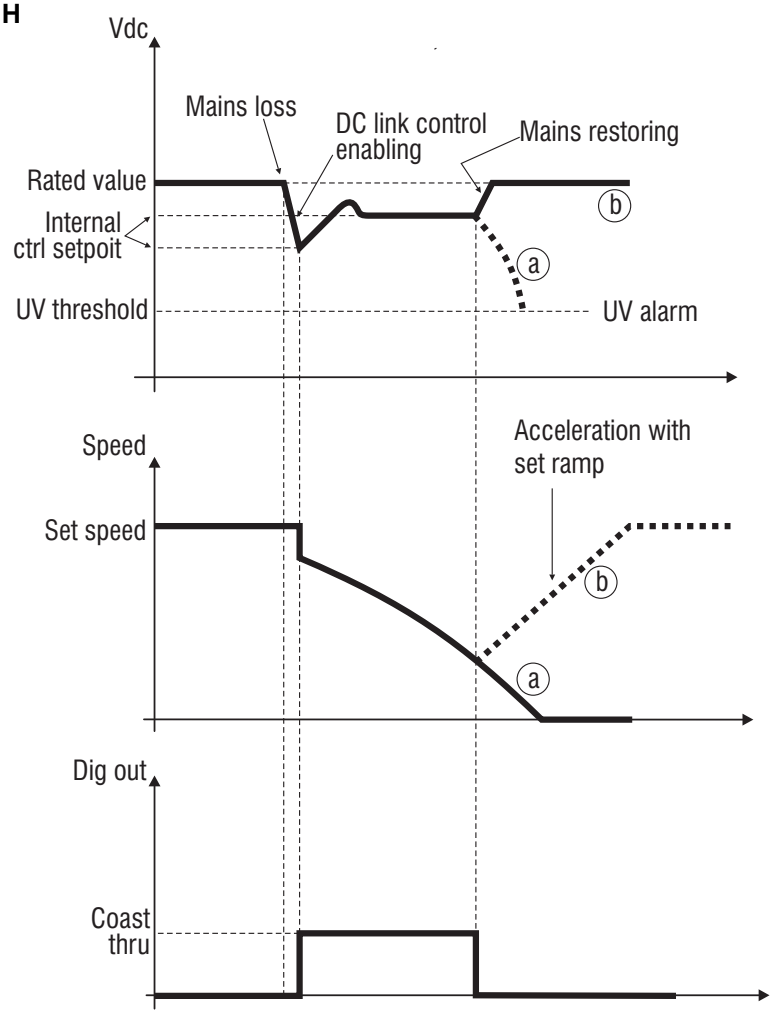


Figure 7.6.11: Coast through

a) the load energy exhausts before the mains is recovered
b) the mains is recovered before the load exhausts its energy

• At the mains power loss, the drive will lead the motor to zero speed, with a ramp internally defined and depending by the load inertia (not the one set).

• If used, the braking device will provide the advantage to achieve as more as possible the specified deceleration fast stop time ***(F.208 - Dec time 4***).

• When reached the zero speed and exhausted the load energy, if the mains is not recovered, the DC link will drop under the UV threshold.

• Recovering the mains power, the motor will be led back to its original speed, with the defined acceleration ramp.

The status of the "Coast Trough" function, is available on digital output, programmed as "***Coast Thru***".

EMG STOP (Emergency Stop)

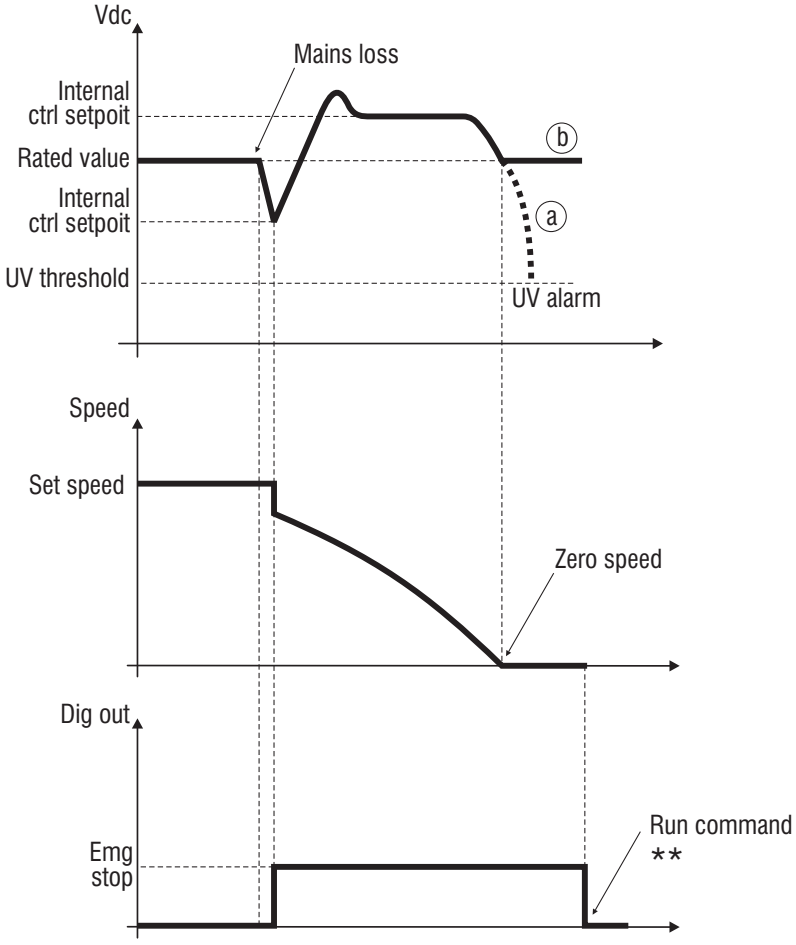


Figure 7.6.12: Emergency Stop

a) the mains power has not been recovered during the stop procedure
b) the mains power has been recovered during the stop procedure

• At the mains power loss, the drive will lead the motor to zero speed, with a ramp internally defined and depending by the load inertia (not the one set).

• If used, the braking device will provide the advantage to achieve as more as possible the specified deceleration n fast stop time ***(F.208 - Dec time 4***).

• When reached the zero speed and exhausted the load energy, if the mains is not recovered, the DC link will drop under the UV threshold.

• This setting doesn't offer the possibility to lead back the motor to the original speed.

** Once at zero speed if the mains power is recovered, to restart the motor will be necessary to release the RUN command and then apply it again.

The status of the "Emergency Stop" function, is available on digital output, programmed as "***Emg Stop***" (programming code: 49).

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
P.340	Undervoltage thr		0	0	80	% of P.061		462
P.341	Max pwrloss time		0	0	25	sec	0,1	463
P.342	UV alarm storage	[0] Disable [1] Enable	1	0	1			464
P.343	UV Trip mode	[0] Disabled [1] CoastThrough [2] Emg Stop	0	0	2			491

Overvoltage Configuration

P.360 OV prevention (Overvoltage prevention)

During fast deceleration or in case of deceleration with high inertia load, it is possible to prevent the drive trip for overvoltage alarm, by the enabling of this function.

Performing this control, the drive will act as follows:

- detection of the overvoltage level, without storing and displaying the alarm.
- disabling the inverter output bridge; the motor will coat to stop and DC-link will decrease toward safe values.
- automatic enabling of the Autocapture function, and engaging of the motor at the last frequency value, detected before the alarm.

For corrent operations it is necessary to enter the proper settings of the **Autocapture** parameters:

P.321 Autocapture Ilim
P.322 Demagnetiz time
P.323 Autocap f scan t
P.324 Autocap V scan t

- normal operation is rersumed and the motor will be stopped following the programmed ramp.
- if during the stop, the load inertia leads again the DC bus at the limit level, the procedure described above will be iterated.

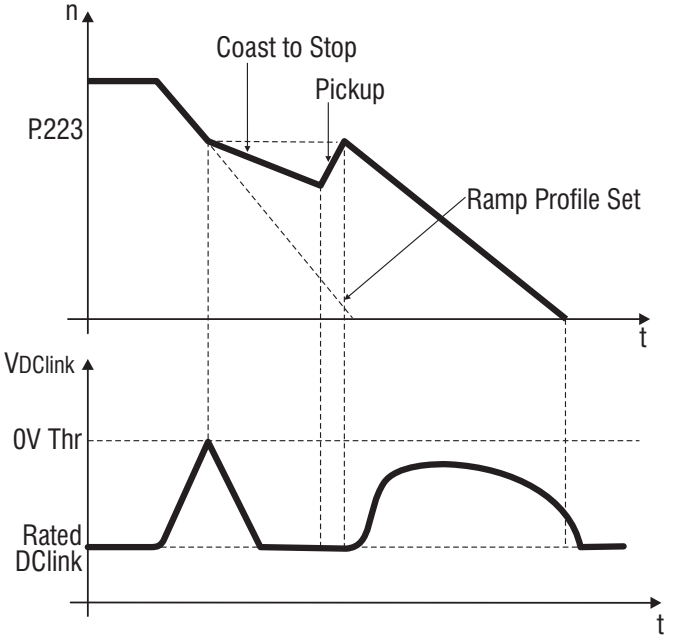


Figure 7.6.13: Overvoltage Prevention

The "overvoltage " alarm will be displayed with the message "**OV**".
A signalling of the "overvoltgae" condition is available on the digital output as "***Alarm state***".

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
P.360	OV prevention	[0] Disable [1] Enable	0	0	1			465

Autoreset Configuration

The Autoreset function allows the automatic restoring of the working of the drive, after the detection of some alarms.

It will be active only with an appropriate setting of the following parameters and if these alarms have been caused by :

- undervoltage (UV)
- overvoltage (OV)
- overcurrent (OC)
- overcurrent desat (OCH)
- external fault (programmable) (EF)
- serial time out (St)

P.380 Autoreset attmps (Autoreset attemps)

Setting of the maximum number of attempts for the restarting, after the detection of the alarms.

P.381 Autoreset clear

When enabled, it clears the number of events setted with ***Autoreset attmps (P.380)*** parameter, if for 10 minutes no alarm has been detected.

P.382 Autoreset delay

Delay that elapses between the failure detection and the beginning of the autoreset sequence.

P.383 Autores flt rly (Autoreset fault relay)

Definition of the status for the relays and digital outputs, during the autoreset function, when programmed as follows:

Parameters	"Relays & Dig Out" programming		
P.383	*Drive OK*	*Alarm state*	*No alarm state*
0	ON	OFF	ON
1	OFF	ON	OFF

tgy0340

NOTE! a normal "Reset" can be enabled also through the digital inputs (see chapter **INTERFACE**, section **Digital inputs**). The reset command will be executed only if the drive is blocked (no RUN or Reverse commands) and the cause of the alarm has been eliminated.

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
P.380	Autoreset attmps		0	0	255			466
P.381	Autoreset clear		10	0	250	min		467
P.382	Autoreset delay		5	0.1	50	sec	0.1	468
P.383	Autores flt rly	[0] OFF [1] ON	1	0	1			469

External Fault Configuration

P.400 Ext fault mode (External fault mode)

Configuration of signalling for the "**External fault alarm**".

As per factory setting the function is programmed on the digital input 6 (terminal 6).

P.400 = 0 Always signalled - Autoreset not possible
P.400 = 1 Signalling only when applied the RUN command - Autoreset not possible
P.400 = 2 Always signalled - Autoreset possible
P.400 = 3 Signalling only when applied the RUN command - Autoreset possible

The alarm will be displayed with the massage **"EF"**.
A signalling of the "external fault" condition is available on the digital output as "**Extern fault**".

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
P.400	Ext fault mode		0	0	3			470

Phase Loss Detection

P.410 Ph Loss detec en (Phase Loss detection enabling)

The enabling of this function allows to detect the missing of any phase of the input supply.

P.410 = 0 Disabled Phase loss control detection disabled.
P.410 = 1 Enabled Phase loss control detection enabled.

The alarm will be displayed with the message "***PH***".
A signalling of the "phase loss " condition is available on the digital output as "***Alarm state***".

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
P.410	Ph Loss detec en	[0] Disable [1] Enable	1	0	1			492

Voltage Reduction Configuration

When a motor is found to use only partial power during normal running conditions, enabling this function reduces the motor flux current to save energy coast.

P.420 Volt reduc mode (Voltage reduction mode)

Definition of the mode for the output voltage reduction.
P.420 = 0
The output voltage reduction is always applied.
P.420 = 1
The output voltage reduction is not applied during the ramp, providing in this way the availability of the full torque up to the achieving of the maximum setup of the V/F ratio.
The voltage reduction will be activated only at constant speed (end of ramp).

P.421 V reduction fact (Voltage reduction factor)

Level of the output voltage, that will be applied on the motor terminals.
It is percentage of the voltage, resulting from the V/F ratio (see figure 7.6.14).

P.422 V fact mult src (Voltage reduction factor multiply source)

The output voltage level reduction, can be linearly regulated through an analog reference signal.
Its regulation will be performed in a range between 10% (setting the input at 0V - 0mA - 4mA) and 100% of the value setted with ***P.421*** parameter (+/- 10V - 20mA).
The figure below describes this regulation.

NOTE! The level of voltage reduction, will be applied in accordance to the output voltage value, based on the characteristic of the V/F ratio.

Example:
P.421 = 30%
V/f motor characteristic = 380V / 50Hz
Motor supply voltage = 380V / 50Hz
The value of ***P.422*** will be the following:

$$380 - \frac{380 \times 30}{100} = 266V$$

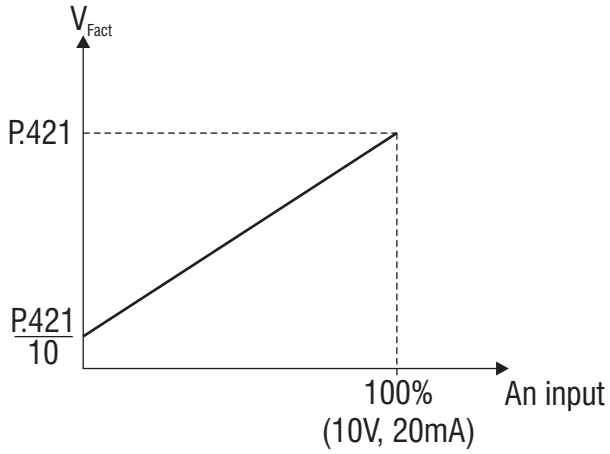


Figure 7.6.14: Voltage reduction factor multiply

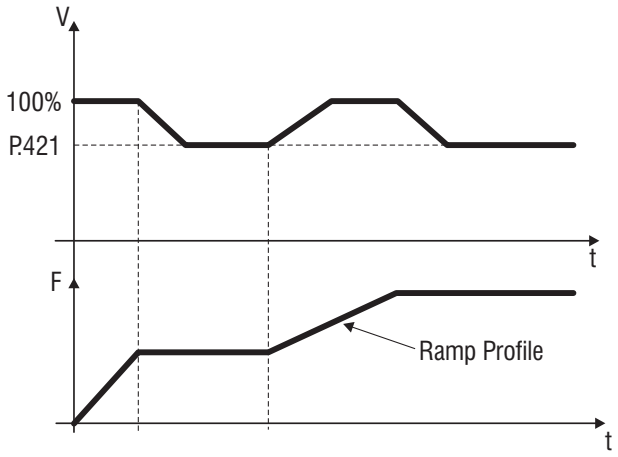


Figure 7.6.15: Output Voltage Reduction with P.420 = 1

NOTE! the function can be enabled also through the digital inputs (see chapter **INTERFACE**, section **Digital inputs**). In this case it will be possible to have the Output Voltage reduction and vice versa, at any time the command is applied.

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
P.420	Volt reduc mode	[0] Always	0	0	1			471
		[1] Steady state						
P.421	V reduction fact		100	10	100	% of P.061		472
P.422	V fact mult src	[0] Null	0	0	3			473
		[1] Analog inp 1 (setting through I.200…I.204)						
		[2] Analog inp 2 (setting through I.210…I.214)						
		[3] Analog inp 3 (setting through I.220…I.224)						

Frequency Threshold

P.440 Frequency prog 1 (Frequency programmed 1)

Set point for the detection of the first frequency threshold.
The signalling of the frequency level detection, can be programmed on the digital outputs.

P.441 Freq prog 1 hyst (Frequency programmed 1 hysterisis)

Defines a tolerance band around the ***Frequency prog 1 (P.440).***

P.442 Frequency prog 2 (Frequency programmed 2)

Set point for the detection of the second frequency threshold.
The signalling of the frequency level detection, can be programmed on the digital outputs.

P.443 Freq prog 2 hyst (Frequency programmed 2 hysterisis)

Defines a tolerance band around the ***Frequency prog 2 (P.442).***

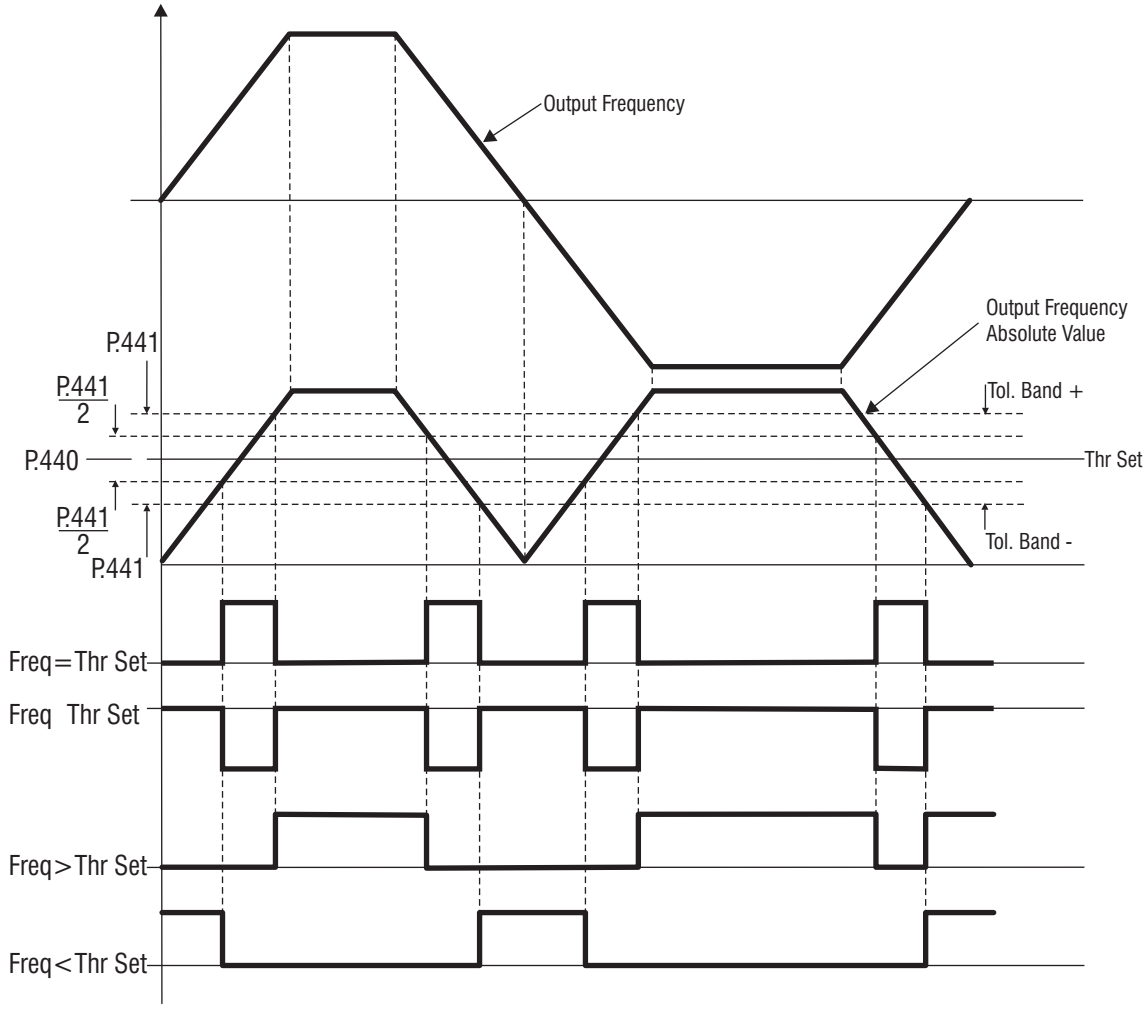


Figure 7.6.16: Program Frequency Tresholds (example of P.440 and P.441)

A signalling of the "frequency threshold" status is available on the digital output as "***Freq thr 1***" and "***Freq thr 2***".

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
P.440	Frequency prog 1		0	0	50	Hz	0.1	474
P.441	Freq prog 1 hyst		0,5	0	50	Hz	0.1	475
P.442	Frequency prog 2		0	0	50	Hz	0,1	476
P.443	Freq prog 2 hyst		0,5	0	50	Hz	0,1	477

Steady State Signalling

The signalling of a speed variation when running in steady state, is possible with this parameters.

P.460 Const speed tol (Constant speed tollerance)

It defines the tollerance band of the speed variation.

P.461 Const speed dly (Constant segnalling delay)

Delay time for the signalling.

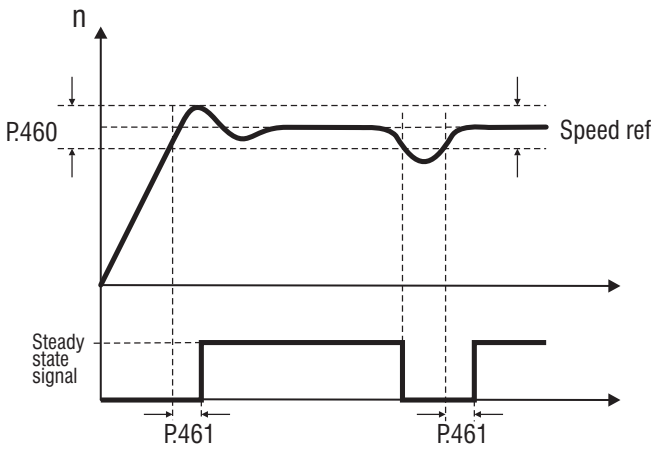


Figure 7.6.17: Constant Speed Control

A signalling of the "steady state" condition is available on the digital output as "***Steady state***".

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
P.460	Const speed tol		0	0	25	Hz	0.1	478
P.461	Const speed dly		0,1	0	25	sec	0.1	479

Heatsink Temperature Threshold

Control and monitoring of the drive heatsink temperature.

P.480 Heatsnk temp lev (Heatsink temperature level)

Setting of the temperature threshold in °C.

P.481 Heatsnk temp hys (Heatsink temperature hysterisis)

Tolerance band for he signalling of the temperature threshold.
The parameter **d.050** (menu **DISPLAY**), is the monitoring of the heatsink temperature level .

The alarm will be displayed with the massage "**OHS**".
A signalling of the "heatsink temperature" status is available on the digital output as "***Hs temp thr***".

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
P.480	Heatsnk temp lev		70	10	110	°C		480
P.481	Heatsnk temp hys		5	0	10	%		481

PWM Setting

P.500 **Switching freq** (Switching frequency)

Setting of the modulation frequency of the drive.

P.501 **Sw freq reduc en** (Switching frequency reduction enabling)

When enabled, the modulation frequency is automatically reduced, when the output frequency of the drive is below 5Hz.
This in particular, can avoid the overheating of the motor at low speed ,caused by high commutation in its winding. Furthermore it improves the output sinuswave form, providing a smoother rotation.

P.520 **Overmod max lev** (Overmodulation maximun level)

Setting of the overmodulation maximum level.
This function increases the output voltage, providing as consequence a higher torque availability.
A setting too high of the parameter could be increases the distortions of the output voltage and create undesired vibrations of the system.

P.540 **Out Vlt auto adj** (Output voltage automatic adjustement)

The voltage applied to the motor terminal is defined by the parameter ***Max output voltage (P.061)***, and it is strictly correlated to the value of the mains voltage.

This function can make independent the motor output voltage from eventual fluctuation of the mains, through an automatic adjustment of the first.

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
P.500	Switching freq	[0] 1kHz	(*)	0	10			482
		[1] 2kHz						
		[2] 3kHz						
		[3] 4kHz						
		[4] 6kHz						
		[5] 8kHz						
		[6] 10kHz						
		[7] 12kHz						
		[8] 14kHz						
		[9] 16kHz						
		[10] 18kHz						
P.501	Sw freq reduc en	[0] Disable	0	0	1			483
		[1] Enable						
P.520	Overmod max lev		0	0	100	%		484
P.540	Out Vlt auto adj	[0] Disable	1	0	1			485
		[1] Enable						

Dead Time Compensation

The "dead time compensation" fucnction allows for compensation of the output voltage distorsion due to IGBT voltage drop and its switching characteristics.

Distorsion of output voltage may cause non uniform, non smooth shaft rotation in open loop control.

Throgh the two parameters it is possible to set a voltage value and the compensation variation, called Gradient.

P.560 Deadtime cmp lev (Dead time compensation level)

Dead time compensation level.

P.561 Deadtime cmp slp (Dead time compensation slope)

Compensation gradient value.

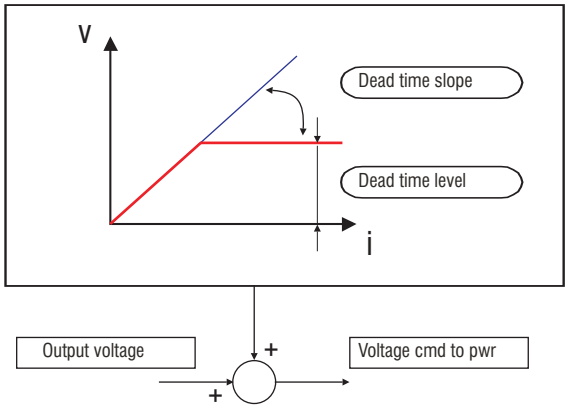


Figure 7.6.18: Dead Time Compesation

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
P.560	Deadtime cmp lev		(*)	0	255			486
P.561	Deadtime cmp slp		(*)	0	255			487

Display Setting

P.580 Startup display

It is possible to define the first parameter that will be displayed at every power-on of the drive.
The choice can be carried out by the setting of the corresponding "IPA", reported in the parameters list table.

P.600 Speed dsply fact (Startup display factor)

Costant conversion for variables displaying, as speed and speed reference .
The parameters can be applied at the variable reported at the chapter DISPLAY, section Basic and Encoder.

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
P.580	Startup display		1	1	1999			488
P.600	Speed dsply fact		1	0.01	99.99		0.01	489

Protection

P.999 Param prot code (Parameters protection code)

Protection against undesired modification of the parameters.

P.999 = 0 No protection and storage of the parameters with motor stopped
P.999 = 1 All the parameters are protected a part the digital frequencies **F.100…F.116**
P.999 = 2 All the parameters are protected
P.999 = 3 No protection and storage of the parameters with the motor running (NOT RECCOMENDED).

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
P.999	Param prot code		0	0	3			490

PID Setting

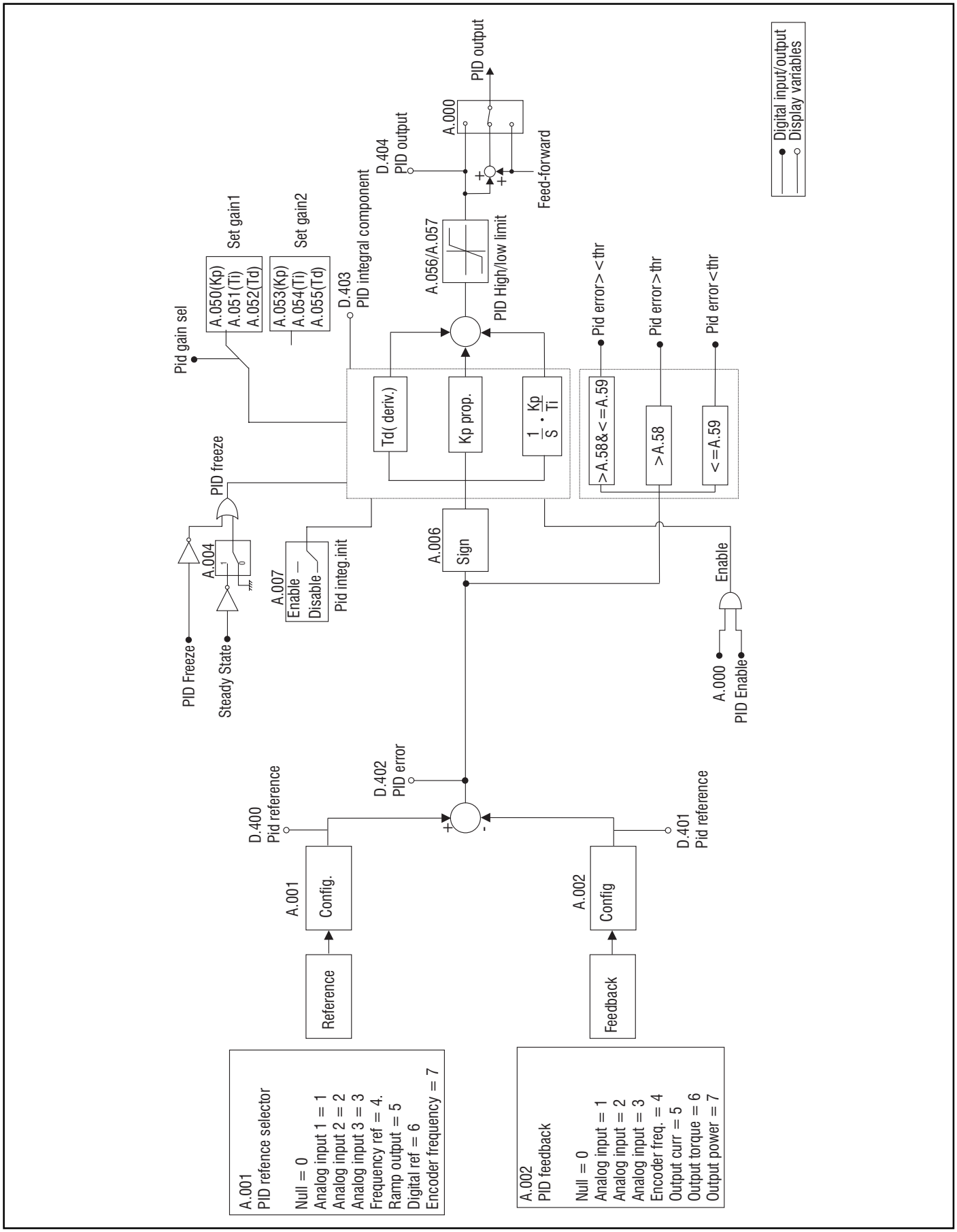


Figure 7.7.1: PID Function Block

In the PID menu are contained all the parameters concerning the setting of the function.

The AGy drive provides a PID function, engineered on purpose for the following controls:

– nip rolls with dancer or load cell
– pressure regulation for pumps and extruders
– speed loop control with encoder

A use of the PID block as stand-alone is also possible, correlated (or not) to the RUN status of the drive.

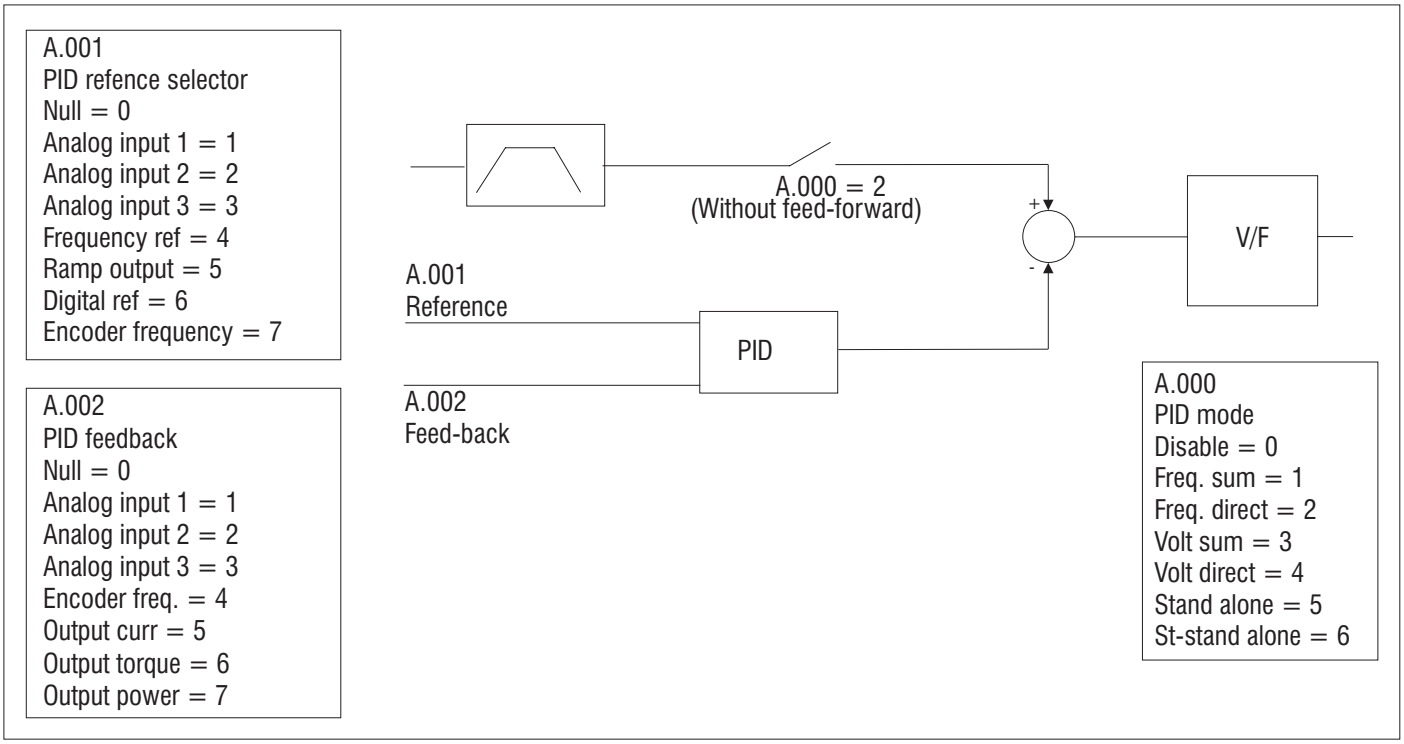


Figure 7.7.2: PID Mode as Frequency Sum or Direct

A.000 PID Mode

This parameter allows to define the regulation mode of the PID function.

A.000 = 0 Disable	The function is disabled.
A.000 = 1 Freq.sum	The output of the PID regulator is added to the ramp output reference value (with feed-forward).
A.000 = 2 Freq.direct	The PID regulator output is directly input to the V/f profile generator. Frequency ramp output is not used.
A.000 = 3 Volt sum	The PID regulator output is added to the voltage reference, calculated in accordance with the setting of the V/F ratio (with feed-forward).
A.000 = 4 Volt direct	The PID regulator output is the voltage to be applied to the motor. V/f curve is not used.
A.000 = 5 Stand alone	The PID function can be used as generic control. The regulator will be active only when the drive will be in RUN.
A.000 = 6 St-Al always	The PID function can be used as generic control. The regulator is not correlated to the drive status.

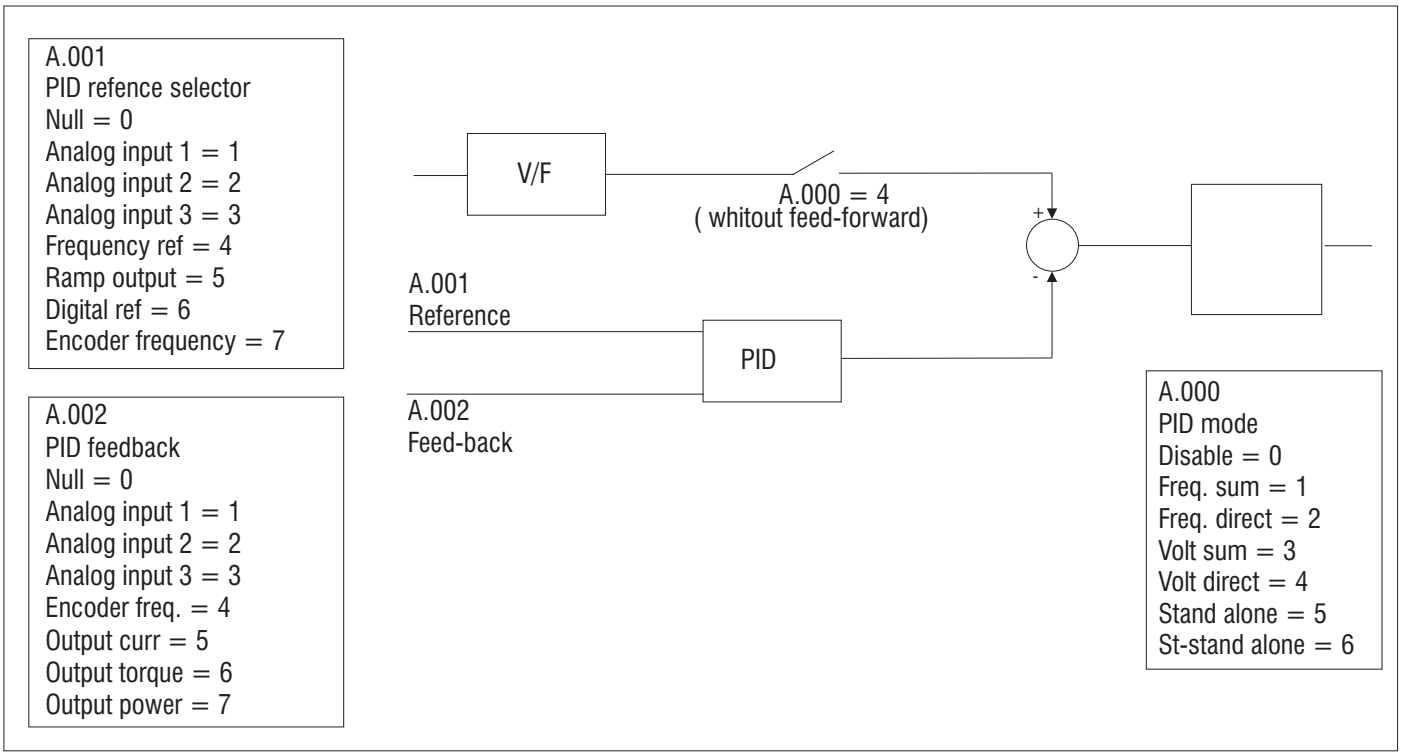


Figure 7.7.3: PID Mode as Voltage Sum or Direct

A.001 PID reference selector

It defines and selects the source, from where the PID reference signal is provided and controlled.

A.001 = 0 Null	Null
A.001 = 1 Analog inp 1	PID Reference connected to Analog input 1
A.001 = 2 Analog inp 2	PID Reference connected to Analog input 2
A.001 = 3 Analog inp 3	PID Reference connected to Analog input 3
A.001 = 4 Frequency ref	PID Reference connected to Frequency reference
A.001 = 5 Ramp output	PID Reference connected to Ramp output signal
A.001 = 6 Digital ref	PID Reference connected to “PID digital ref”parameter
A.001 = 7 Encoder freq	PID Reference connected to Encoder frequency

A.002 PID Fbk sel (PID feedback selector)

It defines and selects the source, from where the PID feed-back signal is provided and controlled.

A.001 = 0 Null	Null
A.001 = 1 Analog inp 1	PID Feed-back connected to Analog input 1
A.001 = 2 Analog inp 2	PID Feed-back connected to Analog input 2
A.001 = 3 Analog inp 3	PID Feed-back connected to Analog input 3
A.001 = 4 Encoder freq	PID Feed-back connected to Encoder frequency
A.001 = 5 Output curr	PID Feed-back connected to Output current signal
A.001 = 6 Output torque	PID Feed-back connected to Output torque signal
A.001 = 7 Output power	PID Feed-back connected to Output power signal

A.003 PID digital ref (PID digital reference)

Setting of the reference for the PID function.
It will be active only if ***PID Fbk sel (A.002)*** is set as “6”

A.004 PID activate mode

It defines if the PID function has to always be enabled or if it has active in steandy state only.

A.004 = 0 Always	The PID function is always enabled.
A.004 = 1 Steady state	The PID function is enabled only at steady state.

A.005 PID-Encoder Sync (PID encoder syncronism)

The function syncronizes the updating time of the PID regulator, with the ones of the encoder feedback reading.

A.005 = 0 Disable The function is not enabled. Setting to parameter ***PID update time (A.008).***

A.005 =1 Enable The function is enabled. Setting of parameter ***A.008*** has no effect PID regulation will be updated according to ***I.504***.

A.006 PID err sign rev (PID error signal reverse)

It allows to invert the polarity of the error signal between the reference and the feed-back (as consequence also the regulation effect is modified).

A.007 PID Integ Init en (PID integral initializzation enabling)

The function allows to initialize the “integral parts” at the RUN command or during the passage from “gains setting 1” to “gains setting 2”. This allows to avoid abrupt oscillation of the regulator output.
When the function is active, the value of the integral component, will take on a value equal to:
Iinit = Pid output - ((Kp x err) + (Kd x D**err)**.

A.008 PID update time

It defines the updating time of the PID regulator. The value 0.00 means minimum updating time (5ms).

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
A.000	PID mode	[0] Disable	0	0	6			1200
		[1] Freq sum						
		[2] Freq direct						
		[3] Volt sum						
		[4] Volt direct						
		[5] Stand alone						
		[6] St-Al always						
A.001	PID ref sel	[0] Null	0	0	7			1201
		[1] Analog inp 1						
		[2] Analog inp 2						
		[3] Analog inp 3						
		[4] Frequency ref						
		[5] Ramp output Ramp output						
		[6] Digital ref						
		[7] Encoder freq						
A.002	PID fbk sel	[0] Null	0	0	7			1202
		[1] Analog inp 1						
		[2] Analog inp 2						
		[3] Analog inp 3						
		[4] Encoder freq						
		[5] Output curr						
		[6] Output torque						
		[7] Output power						
A.003	PID digital ref		0	-100	100	%	0,1	1203
A.004	PID activat mode	[0] Always	0	0	1			1204
		[1] Steady state						
A.005	PID-Encoder sync	[0] Disable	0	0	1			1205
		[1] Enable						
A.006	PID err sign rev	[0] Disable	0	0	1			1206
		[1] Enable						
A.007	PIDInteg init en	[0] Disable	0	0	1			1207
		[1] Enable						
A.008	PID update time		0	0	2.5	sec	0,01	1208

PID Gains

The enabling of the PID regulator and the selection of two different gains setting, can be carried out via programmable digital inputs. Below are reported the parameters concerning the gains regulation.

A.050 PID Prop gain 1 (PID proportional gain 1)

Proportional part gain (set 1).

A.051 PID Int t const1 (PID integral constant 1)

Integral action time (set 1).

A.052 PID Deriv gain 1 (PID derivative gain 1)

Derivative action time (set 1).

A.053 PID Prop gain 2 (PID proportional gain 2)

Proportional part gain (set 2).

A.054 PID Int t const2 (PID derivative gain 2)

Integral action time (set 2).

A.055 PID Deriv gain 2 (PID integral constant 2)

Derivative action time (set 2).

Digital input configuration to select parameter set 1 and set 2.
I.100=21 PID gain sel

Abrupt oscillation caused by the gains selection, can be avoided enabling the function.
PID Integ. Init en (A.007)

The selection of the two gains setting, is possible programming the digital input as **Pid gain sel** (code 21).
The PID function enabling, is possible programming the digital inputs as **PID Enable** (code 20).

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
A.050	PID Prop gain 1		0	0	99.99		0.01	1209
A.051	PID Int tconst 1		99.99	0	99.99		0.01	1210
A.052	PID Deriv gain 1		0	0	99.99		0.01	1211
A.053	PID Prop gain 2		0	0	99.99		0.01	1212
A.054	PID Int tconst 2		99.99	0	99.99		0.01	1213
A.055	PID Deriv gain 2		0	0	99.99		0.01	1214

PID Limits

A.056 PID high limit

Setting of the maximum allowed PID output.

A.057 PID low limit

Setting of the minimum allowed PID output.

A.058 PID max pos err (PID maximun positive error)

Setting of the maximum positive limit of the regulator error. It is expressed as percentage of the full scale value. It defines the threshold for the digital output signalling.

A.059 **PID min pos err** (PID minimun positive error)

Setting of the maximum negative limit of the regulator error. It is expressed as percentage of the full scale value
It defines the threshold for the digital output signalling.
Digital output signalling:

18	**PID err><**	PIP error is >A.058 &<=A.059
19	**PID err>thr**	PID error is >A.058
20	**PID err<thr**	PID error is <=A.059
21	**PID er ><(inh)**	PID error>A.058 &<=A.059 (*)
22	**PID er >(inh)**	PID error is >A.058 (*)
23	**PID er <(inh)**	PID error is <=A.059 (*)

(*) The control through the digital output, can become active only when the error returns the first time in the preset interval.

Variable monitoring in the DISPLAY MENU
The PID variables can be monitored in the following parameters:

D.400	**PID reference**	Reference signal
D.401	**PID feedback**	Feedback signal
D.402	**PID error**	Signalling of the error between reference and feedback
D.403	**PID integral comp**	Actual value of the integral component
D.404	**PID output**	Actual value of the PID regulator output

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
A.056	PID high limit		100	-100	100	%	0.1	1215
A.057	PID low limit		-100	-100	100	%	0.1	1216
A.058	PID max pos err		5	0.1	100	%	0.1	1217
A.059	PID min neg err		5	0.1	100	%	0.1	1218

APPLICATION SAMPLE : PRESSURE CONTROL

Use of the PID function for the pressure control for pumps and extruder.

At the inverter that controls the extruder speed, must be send the analog signals relative to the setting and to the pressure transducer. If needed also the digital command for the PID enabling.

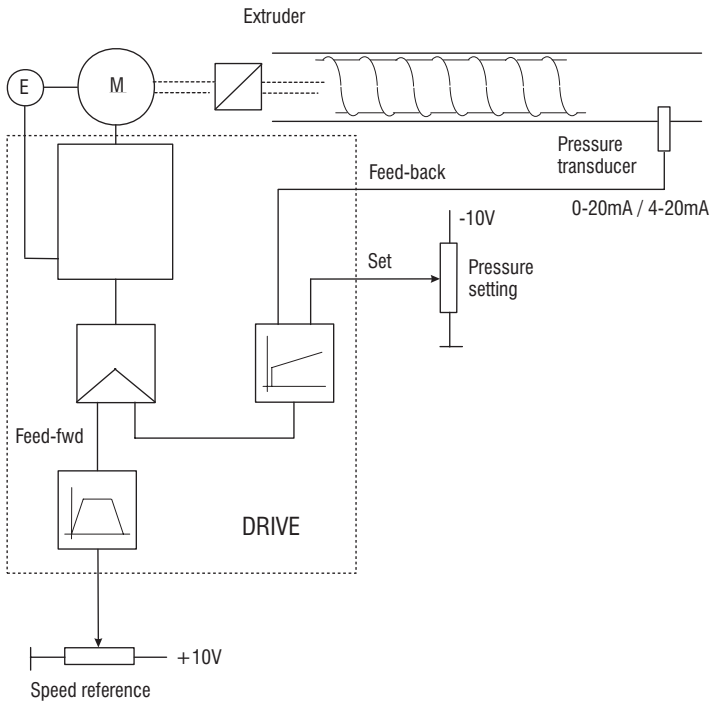


Figure 7.7.4: PID Pressure Control for Pumps and Extruders

Configuration of the ***Digital input 1*** for the PID regulator enabling.
I.000 = 20 (PID enable)

Configuration of the ***Ref 1 channel*** for the the main frequency reference.
F.050 = 1 (Analog input 1 as main SPEEDreference)

Configuration of the ***PID mode*** parameter.
A.000 = 1 (PID enabled as "Frequency sum")

Configuration of the ***PID reference selector*** parameter for the reference of the PID function.
A.001 = 2 (Analog input 2 as pressure setpoint)

Configuration of the ***PID fbk selector*** parameter for the feedback of the PID function.
A.002 = 3 (Analog input 3, only current type 0-20mA / 4-20mA, for the pressure transducer)

- In the **DISPLAY** menu, verify the correct reading of the PID reference (parameter ***d.400***) and of the PID feedback (parameter ***d.401***).
- Set the PID regulators gain as follow:
  - ***A.050 = 2*** Proportional part
  - ***A.051 = 1*** Integral part
  - ***A.052 = 0*** Derivative part

In case of it is necessary to set a limit correction on PID regulator, use ***A.056*** and ***A.057*** parameters.

Enable the PID function using the digital input 1 and execute a drive save parameters.

ENCODER SETTINGS SAMPLE

Use of the PID function for the speed control via encoder (closed loop).

For the closed loop control, the PID function has to be enabled.

The drive must be equipped with the optional card HSD ENC, necessary for the encoder signals reading.

The position switch of the HSD-ENC (S1-1 and S1-2) must to be set according to encoder power supply.

For further information on the derive configuration, when uswed in closed loop, please see the chapter **INTERFACE**, section **Encoder configuration**.

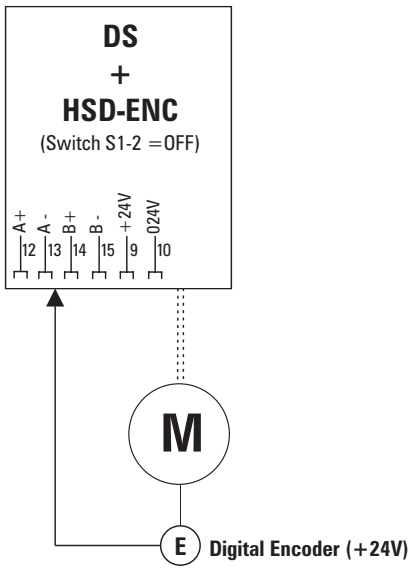


Figure 7.7.5: PID Function as Speed Feed-back

Example:

motor 1500rpm, 2 pole pairs, 400V, 50Hz.

encoder 1024 ppr, supply +24V, 2 channel (A+, A-, B+, B-)

Before to carry on with the setting of the closed loop configuration, it is necessary to execute the initial start-up of the motor.

• **"Drive parameter setting" and "Parameters setting for enabling the encoder reading"**

Menu I (INTERFACE):

I.500 = 1 Encoder enabling

I.501 = 1024 Encoder pulses per revolution

I.502 = 1 Encoder channels configuration **(0)** 1channel, **(1)** 2 channels.

PID parameter settings in the **APPLICATION** menu.

Menu A (APPLICATION):

A.001 - ***PID ref sel*** = [5] Ramp output

A.002 - ***PID Fbk sel*** = [4] Encoder freq

• Verify in the **DISPLAY** parameters, the correct monitoring of the frequency detected y the encoder (parameter ***d.301***).

• Set the speed reference (analog or digital), for example 25Hz.

• Verify the **Reference frequency** (parameter ***d.001***) and compare it with the encoder frequency detection (parameter ***d.301***)

• The two values must be equal or differ by a small amount given by the motor slip.

In case of relevant difference, control the encoder wiring or the pulses number setting.

PID regulator gains setting:

A.050 = 2 Proportional part

A.051 = 1 Integral part

A.052 = 0 Derivative part

NOTE! Initially start with low values and then increase them in accordance with the response needed by the system.

PID regulator enabling:

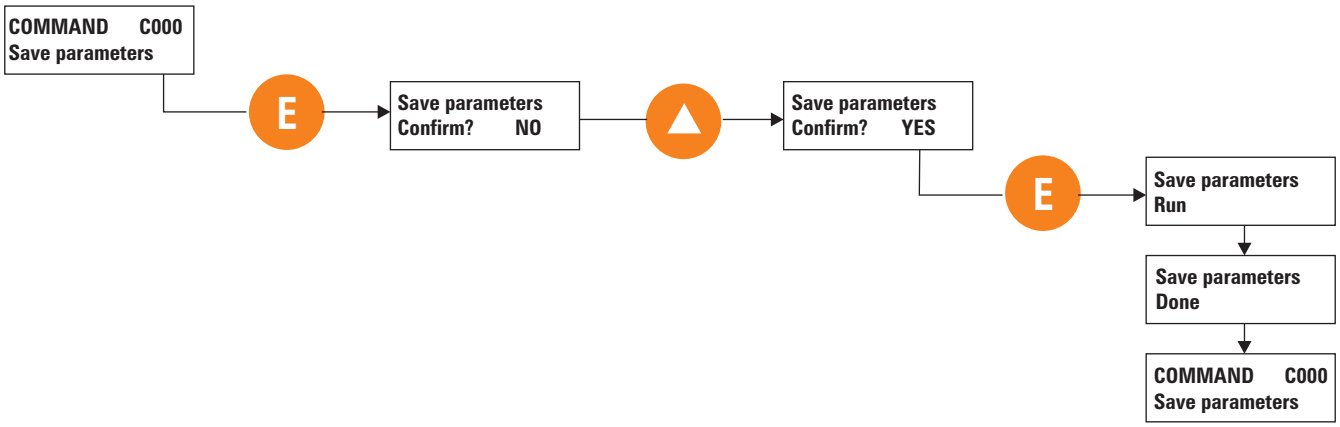
A.000 = 1 PID Mode as **Freq.sum** (PID output added to the ramp output)

Verify the correct working controlling the parameter ***D.402 (PID error)*** in the menu **DISPLAY**.

7.8 Menu C - COMMANDS

All the parameters of the COMMAND menu require to be executed according to the procedure listed below.

Save parameters command is used as example.



Basic

C.000 Save parameters

Every changing of each parameter, is immediately accepted and executed by the drive.
However, permanent storage of them, is performed only by the execution of this command.

Unsaved modifications to any parameter will be lost when the drive is turned off.

C.001 Recall param

The function recalls the parameters that were previously stored, replacing the ones currently in use.

C.002 Load Deafult

Recall of the factory parameters.
The storage of them is a choice of the user.

Alarm Register Reset

C.020 Alarm clear

The function reset completely the ***Alarm List*** register (***D.800…D.803***).

External Key

C.040 Recall key prog

Recalling and storage of the parameters contained in the optional external key **HSDM-PRG.**
The key has to be set in the connector JP10 on the regulation board.

C.041 Save pars to key

Storage of the inverter parameter on the optional external key **HSDM-PRG.**

C.100 Measure stator R

It measures the stator resistance of the motor connected.
This will help to provide a smooth and uniform value of the output torque through the whole speed range.
The control is helped by the use of the Automatic boost (***P.401***).

Do not perform any tune when a multiple motor connection is being used.

7.9 Menu H - HIDDEN

This menu is not available on the keypad. The setting and the reading of the parameters here contained, can be performed exclusively via serial line or through SBI card.

Virtual I/O Commands

H.000 Virtual digital command

Setting of the bits for the virtual commands assignment.

A byte is available for the selection of 8 digital commands, whose setting will interact with the “decoder mask”. The status of this mask will determine the switch for a virtual command (high status) or terminal command (low status).

Defining the mask for a virtual command, the function programmed on the digital inputs (***I.000…I.007***), will be executed by this parameter in accordance with the setting of its bits.

Bit 1 = 1 *Virtual command 1 Enabled*
Bit 2 = 2 *Virtual command 2 Enabled*
Bit 3 = 4 *Virtual command 3 Enabled*
Bit 4 = 8 *Virtual command 4 Enabled*
Bit 5 = 16 *Virtual command 5 Enabled*
Bit 6 = 32 *Virtual command 6 Enabled*
Bit 7 = 64 *Virtual command 7 Enabled*
Bit 8 = 128 *Virtual command 8 Enabled*

The setting of the bits at “0”, will mean the disabling of the respective function.

For further information about the function programming, see chapter **INTERFACE** section **Enabling Virtual I/O**.

H.001 Exp virtual digital command

Reserved

H.010 Virtual digital state

Setting of the bits for the virtual digital output function assignment.

A structure of 4 bits is available for the selection of the 4 digital outputs, whose setting will interact with the “decoder mask”. The status of this mask will determine the switch for a virtual digital output function (high status) or the function of the drive (low status).

Defining the mask as virtual, the digital outputs function will be executed by this parameter, in accordance with the setting of its bits.

Bit 1 = 1 *Virtual function digital output 1* *Enabled*
Bit 2 = 2 *Virtual function digital output 2* *Enabled*
Bit 3 = 4 *Virtual function digital output 3* *Enabled*
Bit 4 = 8 *Virtual function digital output 4* *Enabled*

The setting of the bits at “0”, will mean the disabling of the respective function.

For further information about the function programming, see chapter **INTERFACE** section **Enabling Virtual I/O**.

H.011 Exp Virtual digital state

Reserved

H.020 Virtual An Output 1

H.021 Virtual An Output 2

Setting of the value of the virtual analog outputs.

According to the status of the “decoder mask”, is determined if the analog outputs will provide a signalling deriving from the drive function (low status) or from a setting of the virtual control (high status).

Defining the mask as virtual, the value on the analog outputs can be regulated by the setting of these parameters.

H.020 and ***H.021*** = 0 analog outputs value = 0V
H.020 and H.021 = +32767 analog outputs value = +10V
H.020 and ***H.021*** = -32767 analog outputs value = -10V

For further information about the function programming, see chapter **INTERFACE** section **Enabling Virtual I/O**.

H.022 Exp Virtual An Output 1

Reserved

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
H.000			0	0	255			1000
H.001			0	0	255			1001
H.010			0	0	255			1002
H.011			0	0	255			1003
H.020			0	-32768	32767			1004
H.021			0	-32768	32767			1005
H.022			0	-32768	32767			1006

Profidrive Parameters

H.030 Profidrive Control word

Drive control word in accordance with the ***Profidrive profile.***

For further information please refer to the instruction manual of the SBI card (Profibus).

H.031 Profidrive Status word

Drive status word in accordance with the ***Profidrive profile.***

For further information please refer to the instruction manual of the SBI card (Profibus).

H.032 Profidrive Reference

Using a Profibus SBI card, the speed reference of the drive has to be set through this parameter, in accordance with the ***Profidrive profile.***

H.031 = 0 Reference = 0Hz
H.031 = +4000 hex Reference = ***Max ref freq (F.020)***
H.031 = -4000 hex Reference = ***Max ref freq (F.020)***

For details how program the functions, see chapter **INTERFACE**, section **Enabling Virtual I/O**.

H.033 Profidrive Actual Frequency

Reading of the drive output frequency, in accordance with the ***Profidrive profile.***
For details how program the functions, see chapter **INTERFACE**, section **Enabling Virtual I/O**.

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
H.030			0	0	65535			1007
H.031			0	0	65535			1008
H.032			0	-16384	16383			1040
H.033			1	-16384	16383			1041

Drive Status

H.034 Drive Status

A structure of 4 bits, allows to monitor the drive status.
The meaning of them is the following:

Bit 0 Drive ready
Bit 1 Alarm state
Bit 2 Motor running
Bit 3 Steady state

H.040 Progress

It is the indication in percentage of the progress about the “Save parameters” function.
A displaying of 100% means that the function has been completed.

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
H.034			0	0	65535			1042
H.040			0	0	100			1009

Parameters Reading Extension

When used a high conversion factor (***P.600***), the speed parameters reading must not exceed the values included between +32767 and –32767.

Over this threshold, it is possible to monitor the variables through this parameters, whose structure allows a reading extension structure at 32 bits.

H.050 Drive output frequency 16 bit low (d.000)

H.051 Drive output frequency 16 bit high (d.000)

H.052 Drive reference frequency 16 low (d.001)

H.053 Drive reference frequency 16 high (d.001)

H.054 Output speed (d.000)*(P.600) 16 bit low (d.007)

H.055 Output speed (d.000)*(P600) 16 bit high (d.007)

H.056 Speed Ref (d.001)*(P.600) 16 bit low (d.008)

H.057 Speed Ref (d.001)*(P.600) 16 bit high (d.008)

H.058 Encoder freq 16 bit low (d.301)

H.059 Encoder freq 16 bit high (d.301)

H.060 Encoder speed (d.000)*(P.600) 16 bit low (d.302)

H.061 Encoder speed (d.000)*(P.600) 16 bit high (d.302)

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
H.050			0	- 2 31	2 31 -1			1010
H.051			0	- 2 31	2 31 -1			1011
H.052			0	- 2 31	2 31 -1			1012
H.053			0	- 2 31	2 31 -1			1013
H.054			0	- 2 31	2 31 -1			1014
H.055			0	- 2 31	2 31 -1			1015
H.056			0	- 2 31	2 31 -1			1016
H.057			0	- 2 31	2 31 -1			1017
H.058			0	- 2 31	2 31 -1			1018
H.59			0	- 2 31	2 31 -1			1019
H.060			0	- 2 31	2 31 -1			1044
H.061			0	- 2 31	2 31 -1			1045

Remote I/Os Control

H.100 Remote Digital Inputs (0..15)

H.101 Remote Digital Inputs (16..31)

H.110 Remote Digital Outputs (0..15)

H.111 Remote Digital Outputs (16..31)

H.120 Remote Analog input 1

H.121 Remote Analog input 2

H.130 Remote Analog output 1

H.131 Remote Analog output 2

All the parameters are reserved

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
H.100			0	0	65535			1021
H.101			0	0	65535			1022
H.110			0	0	65535			1023
H.111			0	0	65535			1024
H.120			0	-32768	32767			1025
H.121			0	-32768	32767			1026
H.130			0	-32768	32767			1027
H.131			0	-32768	32767			1028

Serial Link Commands

As reported at the chapter **PARAMETERS** section **Commands**, setting the ***P.000 =3 (SERIAL),*** the main commands are selectable exclusively via serial line or fieldbus.

The parameters listed below, are all the commands available when this function is selected.

H.500 Hardware Reset

Hardware reset

H.501 Alarm Reset

Alarm reset

H.502 Coast to stop

Coast to stop

H.503 Stop with ramp

Ramp to stop

H.504 Clockwise Start

Clockwise Start

H.505 Anti-clockwise Start

Anti-clockwise Start

H.506 Clockwise Jog

Clockwise Jog

H.507 Anti-clockwise Jog

Anti-clockwise Jog

H.508 Clockwise Flying restart

Clockwise Flying restart

H.509 Anti-clockwise Flying restart

Anti-clockwise Flying restart

H.510 DC Brake

DCBrake

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
H.500			0	0	1			1029
H.501			0	0	1			1030
H.502			0	0	1			1031
H.503			0	0	1			1032
H.504			0	0	1			1033
H.505			0	0	1			1034
H.506			0	0	1			1035
H.507			0	0	1			1036
H.508			0	0	1			1037
H.509			0	0	1			1038
H.510			0	0	1			1039

Chapter 8 - Modbus RTU Protocol for HSD drives

8.1 Introduction

In the chapter the Drive parameters are referred to as 16-bit Modbus registers; a 32-bit Drive parameter covers therefore two Modbus registers.

See chapter 7 for the following correspondences: parameter index and Modbus register.

8.2 The MODBUS Protocol

The MODBUS protocol defines the format and the communication modes between a system controlling “master” and one or more “slaves” aimed at answering to the master requests. The protocol states how the master and the slaves start and stop their communication, how the messages can be exchanged and how the errors can be detected. A common line can host one master and 247 slaves; this is a protocol logic limit, the device number can be further limited by the physical interface; the present implementation foresees a maximum number of 64 slaves to be line-connected.

A transaction can be started exclusively by the master. A transaction can have a direct demand/response format or a broadcast format. The former is addressed to a single slave, the latter to all the line slaves, which, on their turn, give no response. A transaction can have a single demand/single response frame or a single broadcast message/no response frame.

Some protocol features have not been defined. They are: interface standard, baud rate, parity, stop bit number. The protocol allows also to choose between two communication “modes”: ASCII and RTU (Remote Terminal Unit). The RTU mode, which is the most efficient, is implemented in the Drives.

The JBUS protocol is similar to the MODBUS protocol; the only difference is given by the address numbering system: in MODBUS the numbering system starts from zero (0000 = 1st address) while in JBUS it starts from one (0001 = 1st address); this variance is maintained throughout the whole system. The following descriptions, if not otherwise stated, refer to both protocols.

8.3 Message format

In order to communicate between the two devices, the message has to be contained into a “casing”. The casing leaves the transmitter via a “port” and it is “brought” along the line to a similar “port” on the receiver. MODBUS states the format of the casing, which, both for the master and for the slave, contains:

- The slave address for the master stated transaction (the address 0 corresponds to a broadcast message sent to all the slaves).
- The code of the function (already performed or to be performed).
- The data to be exchanged.
- The error control according to the CRC16 algorithm.

If a slave detects an error in the received message (a format, parity or CRC16 error), the message is invalid and therefore rejected; when a slave detects an error in the message, it does not perform the required action and does not answer to the demand as if the address does not correspond to an on-line slave.

8.3.1 The address

As stated above, the MODBUS transactions always involve the master (which controls the line) and one slave at the time (with the exception of broadcast messages). In order to detect the message receiver, the first sent character is a byte containing the numeric address of the selected slave. Each slave owns therefore a different address number for its identification. The legal addresses go from 1 to 247, while a master message starting with the address 0 means that this is a “broadcast” message simultaneously addressed to all the slaves (the address 0 can not be allocated to a slave). Broadcast messages are those messages which do not need a response to perform their function, i.e. the allocations.

8.3.2 The function code

The second character of the message states the function to be performed by the master message; the slave response contains the same code, thus stating that the function has been performed.

An implemented subset of the MODBUS functions contains:

- 01 Read Coil Status (Not used for DS drives)
- 02 Read Input Status (Not used for DS drives)
- 03 Read Holding Registers
- 04 Read Input registers
- 05 Force Single Coil (Not used for DS drives)
- 06 Preset Single register
- 07 Read Status
- 15 Force multiple Coils (Not used for DS drives)
- 16 Preset Multiple Registers

The 01 and 02 functions, so as the 03 and 04 functions, are similar and interchangeable. See chapter 3 for a complete and detailed description of the functions.

8.3.3 CRC16

The last two characters of the message contain the cyclic redundancy code (Cyclic Redundancy Check) calculated according to the CRC16 algorithm. As for the calculation of these two characters, the message (address, function code and data thus rejecting the parity and the start and stop bits) is considered as a single and continuous binary number whose most significative bit (MSB) is transmitted as first. The message is multiplied by x^{16} (it undergoes a 16-bit shift on the left) and then it is divided by $x^{16}+x^{15}+x^2+1$; it is stated as a binary number (1100000000000101). The integer quotient is rejected and the 16-bit remainder (it is initialized with FFFFh in order to avoid a zero made message) is added to the sent message. The obtained message, when the receiver slave has divided it by the same polynomial ($x^{16}+x^{15}+x^2+1$), must have a zero remainder if no error occurred (if not the slave calculates the CRC again).

Considering that the data serializing device (UART) transmits first the less significative bit (LSB) instead of the MSB as required by the CRC calculation, such calculation is performed by inverting the polynomial. Furthermore, as the MSB polynomial influences only the quotient and not the remainder, the remainder is deleted by making it equal to 1010000000000001.

The step by step procedure for the CRC16 calculation is the following:

1) Load a 16-bit register with FFFFh (the bit value is 1).
2) Perform the exclusive OR of the first character with the highest byte in the register; place the result in the register.
3) Perform a one-bit shift of the register on the right.
4) If the bit outcoming the register right side (flag) is 1, perform the exclusive OR between the 1010000000000001 generating polynomial and the register.
5) Repeat the steps 3 and 4 for eight times.
6) Perform the exclusive OR of the following character with the highest byte in the register; place the result in the register.
7) Repeat the steps from 3 to 6 for all the message characters.
8) The content of the 16-bit register is the CRC redundancy code to be added to the message.

8.3.4 Message synchronization

The message synchronization between the transmitter and the receiver is obtained by interposing a pause between the messages, such pause being equal to 3.5 times the character period. If the receiver does not receive for a period equal to 4 characters, the message is considered to be over; as a consequence the following received byte is treated as the first byte of a new message: an address.

8.3.5 Serial line setting

The communication foresees the following settings:

- 1 start bit
- 8 data bits (RTU protocol)
- 1 stop bit
- no parity

The baud rate can be selected among the following values:

Baudrate	Timeout byte-byte
1200	33 ms
2400	16 ms
4800	8 ms
9600	4 ms
19200	2 ms
38400	1 ms
57600	668 s
76800	501 s
115200	334 s

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8.4 Modbus functions for the drive

Here following is a detailed description of the MODBUS functions implemented for the Drive. All the values listed in the tables are hexadecimal.

8.4.1 Read Output Registers (03)

This function allows to require the value of 16-bit (word) registers containing Drive parameters. The broadcast mode is not allowed.

Request

Together with the Drive address and the function code (03), the message contains the register starting address (starting Address) and the number of the registers to be read; they are both stated on two bytes. The maximum number of registers which can be read is 125. The register numbering system starts from zero (word1 = 0) for the MODBUS and from one (word1 = 1) for the JBUS.

Example: Modbus

- Drive address 25 (19hex)
- Registri from 0069 (0045_{hex}) to 0071 (0003_{hex}).

ADDR	FUNC	DATA start Addr HI	DATA start Addr LO	DATA word# HI	DATA word# LO	CRC HI	CRC LO
11	01	00	04	00	03	46	06

Response

Together with the Drive address and the function code (03), the message includes a character containing the data byte number and some other characters containing the data. The registers require two bytes where the first one contains the most significative section.

Example: Response to the above mentioned request.

ADDR	FUNC Byte	DATA word Count	DATA word 69 HI	DATA word 69 LO	DATA word 70 HI	DATA word 70 LO	DATA word 71 HI	DATA 71 LO	CRC HI	CRC LO
19	03	06	02	2B	00	00	00	64	AF	7A

NOTE! in case the register selected range includes some reserved or missing registers, the value of these registers is set with 0.

8.4.2 Read Input Registers (04)

This function is similar to the previous one.

8.4.3 Preset Single Register (06)

This function allows to set the value of a single 16-bit register. The broadcast mode is allowed.

Request

Together with the Drive address and the function code (06), the message contains the register address (parameter) on two bytes and the value to be allocated. The numbering system of the register addresses starts from zero (word1 = 0) for the MODBUS and from one (word1 = 1) for the JBUS.

Example: Modbus

- Drive address 38 (26_{hex})
- Register 26 ($001A_{hex}$)
- Value 926 ($039E_{hex}$)

ADDR	FUNC	DATA bit# HI	DATA bit# LO	DATA WORD HI	DATA WORD LO	CRC HI	CRC LO
26	06	00	19	03	9E	DF	82

Response

The response is given by transmitting again the received message after the register has been modified.

Example: Response to the above mentioned request.

ADDR	FUNC	DATA bit# HI	DATA bit# LO	DATA WORD HI	DATA WORD LO	CRC HI	CRC LO
26	06	00	19	03	9E	DF	82

8.4.4 Read Status (07)

This function allows to read the status of eight predefined bits with a compact message. The broadcast mode is not allowed.

Request

The message contains only the Drive address and the function code (07).

Example: Modbus

- Drive address 25 (19_{hex})

ADDR	FUNC	CRC HI	CRC LO
19	07	4B	E2

Response

Together with the Drive address and the function code (07), the message includes a character containing the status bits.

Example: Response to the above mentioned request.

ADDR	FUNC	DATA status byte	CRC HI	CRC LO
19	07	6D	63	DA

The bit meaning is the following:

Bit number	Bit meaning
0	Digital Output 1
1	Digital Output 2
2	Digital Output 3
3	Digital Output 4
4	Run
5	Steady state
6	Drive limit state
7	Not used

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8.4.5 Preset Multiple Registers (16)

This function allows to set the value of a consecutive block made of 16-bit registers. The broadcast mode is allowed.

Request

Together with the Drive address and the function code (16), the message contains the starting address of the registers to be written (starting Address), the number of registers to be written, the number of bytes containing the data and the data characters. The register numbering system starts from zero (word1 = 0) for the MODBUS and from one (word1 = 1) for the JBUS.

Example: Modbus

- Drive address 17 (11_{hex})
- Starting Register 35 (0023_{hex})
- Number of registers to be written 1 (0001_{hex})
- Value 268 ($010C_{hex}$)

ADDR	FUNC	DATA start Addr HI	DATA start Addr LO	DATA word# HI	DATA word# LO	DATA word Count	DATA word 35 HI	DATA 35 LO	CRC HI	CRC LO
11	10	00	22	00	01	02	01	0C	6C	87

Response

Together with the Drive address and the function code (16), the message contains the starting address (starting Address) and the number of written registers.

Example: Response to the above mentioned request.

ADDR	FUNC	DATA start Addr HI	DATA start Addr LO	DATA word# HI	DATA word# LO	CRC HI	CRC LO
11	10	00	22	00	01	A3	53

8.5 Error management

In MODBUS there are two kinds of errors which are managed in different ways: transmission errors and operating errors. The transmission errors change the format, the parity (if used) or the CRC16 of the message. When the Drive detects such errors, it considers the message invalid and gives no response. If the message format is the right one but its function can not be performed, the error is an operating one. The Drive answers to this error with a particular message. This message contains the Drive address, the code of the required function, an error code and the CRC. In order to underline that the response is aimed at stating the presence of an error, the function code is returned with the most significative bit set with “1”.

Example: Modbus

- Drive address 10 ($0A_{hex}$)
- Coil 1186 ($04A2_{hex}$)

ADDR	FUNC	DATA start Addr HI	DATA start Addr LO	DATA bit# HI	DATA bit# LO	CRC HI	CRC LO
0A	01	04	A1	00	01	AC	63

Response

The request refers to the content of the Coil 1185 which does not exist in the Drive slave. The slave answers with the error code “02” (ILLEGAL DATA ADDRESS) and goes back to the function code 81h (129).

Example: Exception to the above mentioned request.

ADDR	FUNC	DATA Except. Code	CRC HI	CRC LO
0A	81	02	B0	53

8.5.1 Exception codes

This protocol implementation foresees only four exception codes:

Code	Name	Meaning
01	ILLEGAL FUNCTION	The received function code does not correspond to a function allowed on the addressed slave.
02	ILLEGAL DATA ADDRESS	The address number, which the data field refers to, is not a register allowed on the addressed slave.
03	ILLEGAL DATA VALUE	The value to be allocated, which the data field refers to, is not allowed for this register.
07	NAK - NEGATIVE ACKNOWLEDGEMENT	The function can not be performed with the present operating conditions or attempt to write an only-reading parameter.

8.6 System configuration

In order to select the configuration of the serial line, the DS drives of are supplied in the main INTERFACE menu with a submenu called “Serial config”; some parameters are common to the different kinds of implemented protocols (fOX LINK, Modbus, etc); the menu contains the following parameters:

Code	LCD display	[Code] & LCD select.	Default	MIN	MAX	Unit	Variation	IPA
I.600	Serial link cfg	[0] FoxLink 7E1 [1] FoxLink 701 [2] FoxLink 7N2 [3] FoxLink 8N1 [4] ModBus 8N1 [5] JBus 8N1	4	0	5			155
I.601	Serial link bps	[0] 600 baud [1] 1200 baud [2] 2400 baud [3] 4800 baud [4] 9600 baud [5] 19200 baud [6] 38400 baud [7] 57600 baud [8] 76800 baud [9] 115200 baud	4	0	9			156
I.602	Device address		0	0	99		1	157
I.603	Ser answer delay		1	0	250	msec	1	158
I.604	Serial timeout		0	0	25	sec	0,1	159
I.605	En timeout alm	[0] Disable [1] Enable						160

Chapter 9 - Troubleshooting

9.1 Drive Alarm Condition

The drive keypad will show on the 2nd line of alphanumeric display a blinking message with code and name of the alarm occurred.

The figure below shows an example of ***OV Overvoltage*** alarm condition during ***Output frequency (d.300)*** parameter displaying.

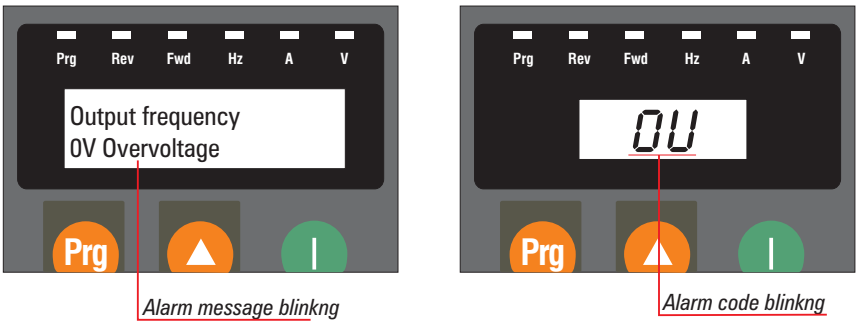

Figure 9.1.1: Alarm Displaying for LDC and 7 segments display

9.2 Alarm Reset

The alarm reset operation can be executed following three possibilities:

- *Alarm reset by keypad buttoms*: pressing simultaneously Up and Down; the reset action will take effect when the buttons when released.
  Reset allowed only with drive disabled.

- *Alarm reset by digital input*: it can be performed through a programmable digital input as "[5] Alarm reset", factory defaulted to **Digital Input 5** (terminal 7).
  Reset allowed only with drive disabled.

. *Alarm reset by Autoreset function*: it allows an automatic reset of some drive alarms (see table 8.3.1), by the settings of ***P.380***, ***P.381***, ***P.382*** and ***P.383*** parameters.
  Autoreset allowed with drive enabled too.

The figure below shows how to reset an alarm by keypad bottoms.

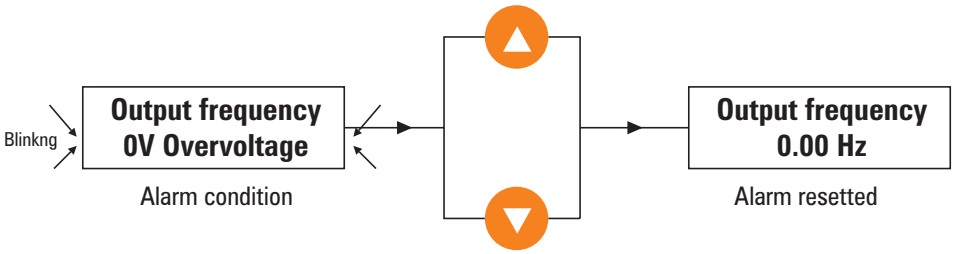

Figure 9.2.1: Alarm Reset

9.3 List of Drive Alarm Events

Table 9.3.1 provides a description regulation alarm events occurred during a drive alarm situation.

Table 9.3.1 Alarm List Event

ALARM		DESCRIPTION	AUTORESET
Code	LCD display		
EF	**EF Ext Fault**	It trips when External fault input is active	YES
OC	**OC OverCurrent**	It trips when an Overcurrent value is detected by output current sensor	YES
OU	**OV OverVoltage**	It trips when the drive DC Bus voltage is higher than the maximun threshold for the given main voltage setting	YES
UU	**UV UnderVoltage**	It trips when the drive DC Bus voltage is lower than the maximun threshold for the given main voltage setting	YES
OH	**OH OverTemperat**	It trips when the drive heatsink temperature detected by the **switch** sensor exceeds its threshold	NO
OL1	**OLi Drive OL**	It trips when the drive overload accumulator exceeded the trip threshold	NO
OLM	**OLM Motor OL**	It trips when the drive overload accumulator exceeded the trip threshold	NO
OLr	**OLr Brake res OL**	It trips when the motor overload accumulator exceeded the trip threshold	NO
Ot	**Ot Inst OverTrq**	It trips when the torque delivered by the motor exceeds the programmed level for the preset time	NO
PH	**PH Phase loss**	It trips when the supply phase lack: enabled 30 seconds after one of the supply phases has been disconnected	NO
FU	**FU Fuse Blown**	It trips when the in case of inner fuse breakage (fuses on the drive inputs)	NO
OCH	**OCH Desat Alarm**	IGBT desaturation or instantaneous overcurrent have been detected	YES
St	**St Serial TO**	It trips when the serial link time out exceeds the programmed level	YES
OP1	**OP1 Opt 1 Alm**	Communication failure between drive regulation board and option 1 expantion board	NO
OP1	**OP2 Opt 2 Alm**	Communication failure between drive regulation board and option 2 expantion board	NO
bF	**bF Bus Fault**	Drive comunication Bus failure	NO
OHS	**OHS OverTemperat**	It trips when the drive heatsink temperature detected by the **analog** sensor exceeds its threshold; only for: 4220 and higher (230V…480V) - 4025 and higher (575V)	NO
LF	**Limiter fault**	It trips when drive is a limit state caused by the output current or the DC link voltage. It can be origin by wrong settings of regulator gains or by the motor load.	NO
SHC	**SHC Short Circ**	Short Circuit between output phases or Ground fault	NO

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NOTE! OH switch sensor threshold and OHS analog sensor threshold are depending by the drive size (75 °C ... 85 °C)

EMC DIRECTIVE

The possible Validity Fields of the EMC Directive (89/336) applied to PDS

"**CE marking**" summarises the presumption of compliance with the
Essential Requirements of the EMC Directive, which is formulated in the **EC Declaration of Conformity**
Clauses numbers [.] refer to European Commission document "Guide to the Application of Directive 89/336/EEC"
1997 edition. ISBN 92-828-0762-2

	Validity Field	Description
Relates to PDS or CDM or BDM directly	**-1-** **Finished Product/** **Complex component** available to general public [Clauses: 3.7, 6.2.1, 6.2.3.1 & 6.3.1] A PDS (or CDM/BDM) of the Unrestricted Distribution class	Placed on the market as a single commercial unit for distribution and final use. Free movement based on compliance with the EMC Directive **- EC Declaration of conformity required - CE marking required** **- PDS or CDM/BDM should comply with IEC 1800-3/EN 61800-3** The manufacturer of the PDS (or CDM/BDM) is responsible for the EMC behaviour of the PDS (or CDM/BDM), under specified conditions. EMC measures outside the item are described in an easy to understand fashion and could actually be implemented by a layman in the field of EMC. The EMC responsiblity of the assembler of the final product is to follow the manufacturer's recommendations and guidelines. Note: The manufacturer of the PDS (or CDM/BDM) is not responsible for the resulting behaviour of any system or installation which includes the PDS, see Validity Fields 3 or 4.
	-2- **Finished Product/** **Complex component** only for professional assemblers [Clauses: 3.7, 6.2.1, 6.2.3.2 & 6.3.2] A PDS (or CDM/BDM) of the Restricted Distribution class sold to be included as part of a system or installation	Not placed on the marked as a single commercial unit for distribution and final use. Intended only for professional assemblers who have a level of technical competence to correctly install. **- No EC Declaration of conformity - No CE marking** **- PDS or CDM/BDM should comply with IEC 1800-3/EN 61800-3** The manufacturer of the PDS (or CDM/BDM) is responsible for the provision of installation guidelines that will assist the manufacturer of the apparatus, system or installation to achieve compliance. The resulting EMC behaviour is the responsibility of the manufacturer of the apparatus, system, or installation, for which its own standards may apply.
Relates to application of PDS or CDM or BDM	**-3-** **Installation** [Clause: 6.5] Several combined items of system, finished product or other components brought together at a given place. May include PDSs (CDM or BDM), possibly of different classes -Restricted or Unrestricted	Not intended to be placed on the market as a single functional unit (no free movement). Each system included is subject to the provisions of the EMC Directive. **- No EC Declaration of conformity - No CE marking** **- For the PDSs or CDM/BDMs themselves see Validity Fields 1 or 2** **- Responsibility of the manufacturer of the PDS may include commissioning** The resulting EMC behaviour is the responsibility of the manufacturer of the installation in cooperation with the user (e.g. by following an appropriate EMC plan). Essential protection requirements of EMC Directive apply regarding the neighbourhood of the installation.
	-4- **System** [Clause: 6.4] Ready to use finished item(s). May include PDSs (CDM or BDM), possibly of different classes - Restricted or Unrestricted	Has a direct function for the final user. Placed on the market for distribution as a single functional unit, or as units intended to be easily connected together. **- EC Declaration of conformity required - CE marking required for the system** **- For the PDSs or CDM/BDMs themselves see Validity Fields 1 or 2** The resulting EMC behaviour, under specified conditions is the responsibility of the manufacturer of the system by using a modular or system approach as appropriate. Note: The manufacturer of the system is not responsible for the resulting behaviour of any installation which includes the PDS, see Validity Field 3.

Examples of application in the different Validity Fields:

1 **BDM to be used anywhere:** (example in domestic premises, or BDM available from commercial distributors), sold without any knowledge of the purchaser or the application. The manufacture is responsible that sufficient EMC can be achieved even by any unknown customer or layman (snap-in, switch-on).

2 **CDM/BDM or PDS for general purpose:** to be incorporated in a machine or for industrial application This is sold as a subassembly to a professional assembler who incorporates it in a machine, system or installation. Conditions of use are specified in the manufacturer's documentation. Exchange of technical data allows optimisation of the EMC solution.. (See restricted distribution definition).

3 **Installation:** It can consist of different commercial units (PDS, mechanics, process control etc.). The conditions of incorporation for the PDS (CDM or BDM) are specified at the time of the order, consequently an exchange of technical data between supplier and client is possible. The combination of the various items in the installation should be considered in order to ensure EMC. Harmonic compensation is an evident example of this, for both technical and economical reasons. (E.g. rolling mill, paper machine, crane, etc.)

4 **System:** Ready to use finished item which includes one or more PDSs (or CDMs/BDMs); e.g. household equipment, air conditioners, standard machine tools, standard pumping systems, etc.

HSD

HSD S.p.A.
TECNOLOGICAL-EQUIPEMENT
FOR AUTOMATION

Via della Meccanica 16
Loc. Chiusa di Ginestreto
61100 Pesaro (Italy)

Tel. 0721.439638
Fax 0721.441606

Web: http//www.hsd-hitec.com