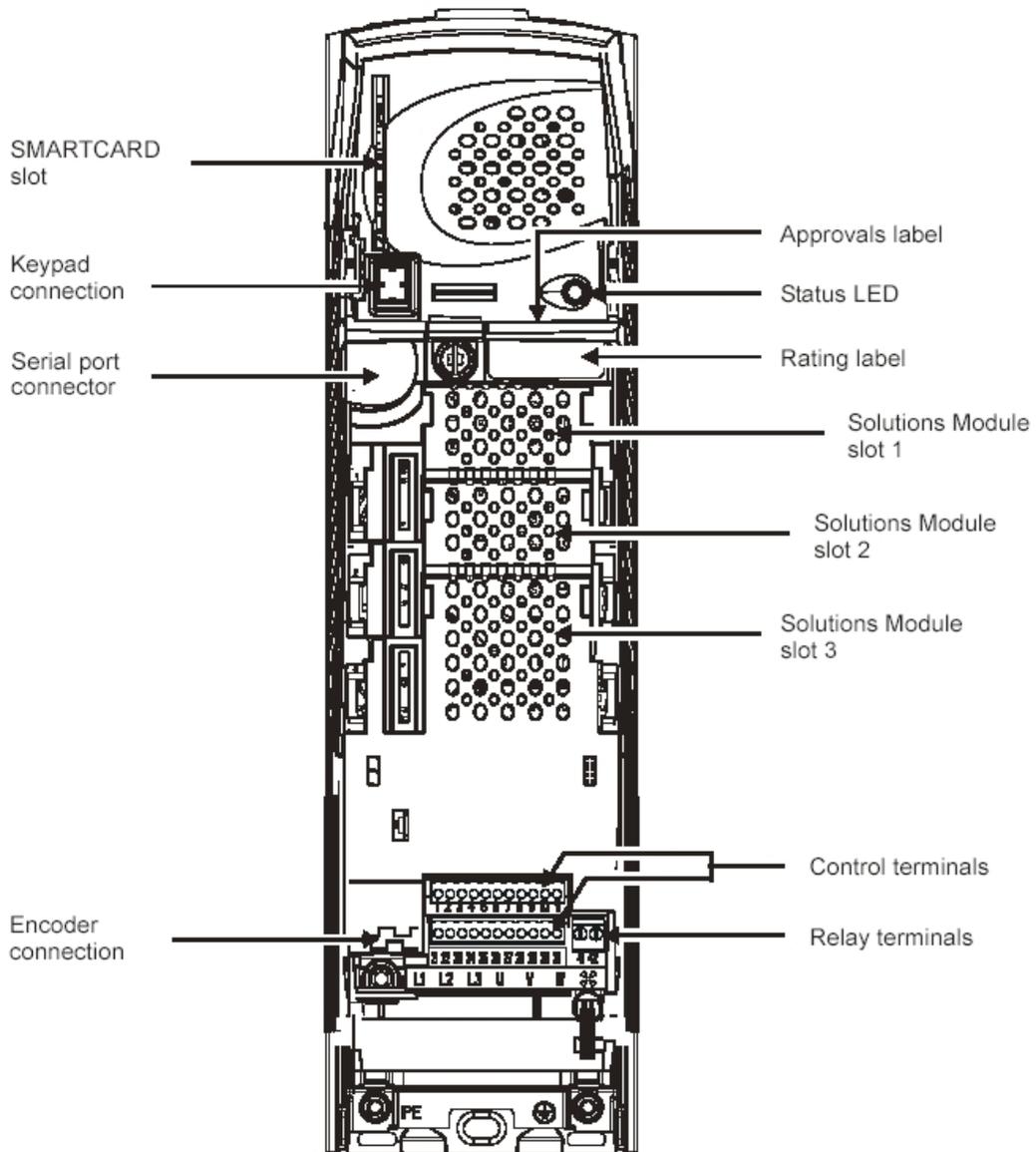# HIDRA CRONO Controller
VVVF Control Techniques Unidrive SP
(**Asynchronous** motors)

⚠	*It is essential to carry out the autotuning procedure of the inverter-motor ensemble following the instructions described here. For further information about the autotuning process, please check the inverter manual.*

⚠	*This document is a short guide and DOES NOT REPLACE the frequency inverter manufacturer's manual, provided with the controller. Refer to the documentation from Control Techniques for further and more specific information.*

DC82503Q01

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ENGLISH

CONTENTS

ⓘ The elements and wiring that appear in the photographs included in this manual may not coincide with the equipment supplied.

ⓘ This document is a short guide and DOES NOT REPLACE the o frequency inverter manufacturer's manual which is provided with the material supplied. Consult the documentation from the manufacturer of FRENIC Lift equipment for further and more specific information.

MANUFACTURER'S NOTE:

Carlos Silva SA will accept no liability for claims concerning damage or costs derived from non-fulfilment of the indications of this manual, or giving a use beyond what is described here.

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HIDRA CRONO is a product owned by *Carlos Silva S.A.*

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1. UNIDRIVE SP ACCESSORIES

A.- **SM-Keypad**

The SM keypad is an optional accessory that is required for viewing the list of parameters and being able to change and view the values stored. It has an indicator for viewing the operation and the error values.

It is fitted directly on the drive or if it is placed in the shaft, using the supplied RJ45 loom to connect the keypad remotely.
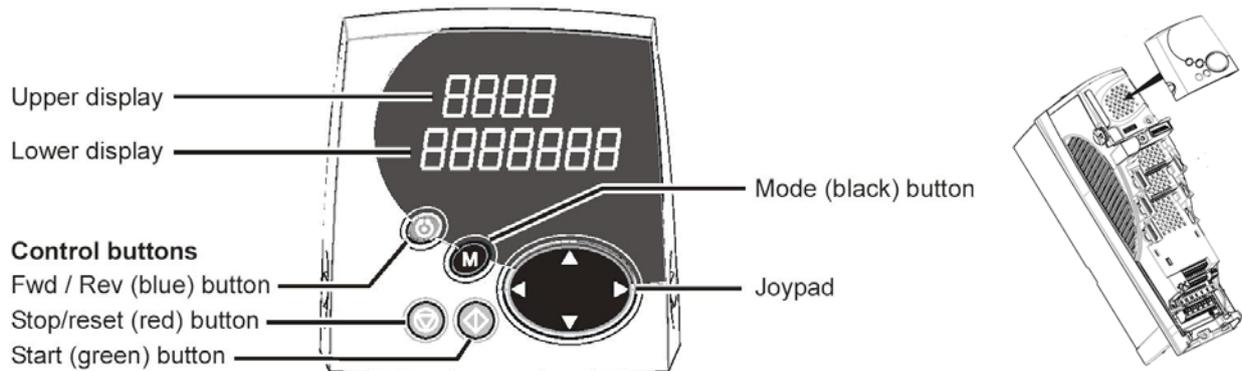
> *Modifying a parameter value does not mean that it will remain definitely memorized.*
> *After modifying the values, they have to be saved in memory using the following procedure:*
> - *Find a **#x.00** parameter from any menu*
> - *Press **M** button*
> - *Set the value to **1000***
> - *Press **M** button*
> - *Press red button* ⊗

B.- **SMARTCARD**

This card allows loading, unloading and saving the inverter parameters. Likewise, it makes it possible to transfer data from one inverter to another and compare values. Refer to the inverter manual for further information.

Instalación de SMARTCARD   SMARTCARD instalada
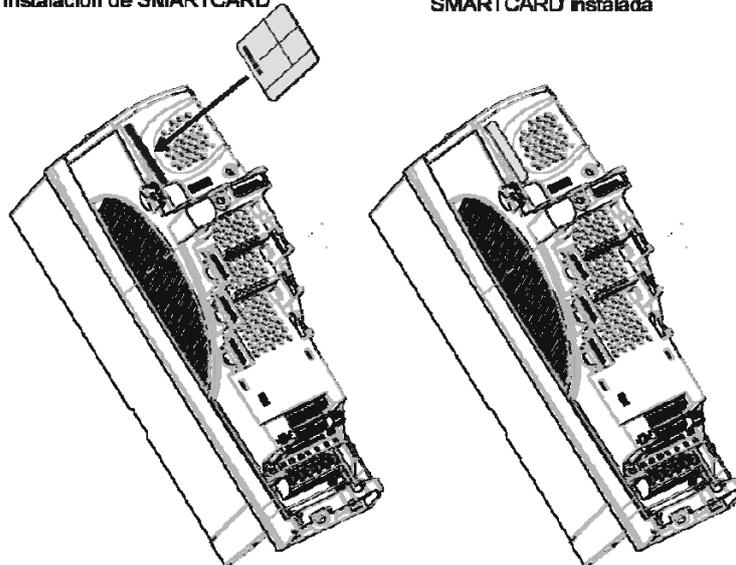
The card provided by Carlos Silva contains the recommended parameter values and the *PLC On Board* program for closed loop control. For transferring the parameters values from the card to the inverter and vice versa, execute the following commands:

	SMARTCARD → VVVF	VVVF → SMARTCARD[1]
PLC On Board *program for closed loop*	**6300**	**5300**
Open loop parameters	**6310**	**4310**
Closed loop parameters	**6320**	**4320**
User parameters (block xxx*)*	**6xxx**	**4xxx**
[1] Overwriting of a memory block is not allowed. It has to be previously erased:		
Block yyy erase	**7yyy**	

> *Remember that these commands should be executed at any **#x.00** parameter.*
> *The number of the blocks used in the SMARTCARD appears in parameter **#11.37**.*
> *Parameter **#11.38** contains the name of the block selected in parameter **#11.37**.*

Parameter **#19.30** contains the identifying code for the configured parameter set:

$$\#19.30 = \begin{cases} 0101 \rightarrow \text{Parameters for an asyncrhonous motor with open loop control} \\ 0102 \rightarrow \text{Parameters for an asyncrhonous motor with closed loop control} \end{cases}$$

Ensure that the inverter configuration is compatible with the installation.

2. PARAMETER ADJUSTMENT FOR ASYNCHRONOUS MOTORS

The inverter provided is already configured with the parameters recommended by Carlos Silva and loaded with the *PLC On Board* program for closed loop control. To finish the installation, the installer should only configure the parameters corresponding to the machine and the ride of the lift and carry out and autotuning procedure.

> *In closed loop control: if the inverter has to be replaced or reset to default values, the* PLC On Board *program should be loaded BEFORE any parameter configuration. For additional information, look up the point referring to the SMARTCARD.*

> *The default values of speed correspond to a 4-pole motor. For 6-pole motors, speed values MUST be changed.*

3.   MENU 'F' (FILTER VALUES)

> **SM-KEYPAD PLUS supplied until June 2009 does not have the software to display the new menu F.**
> *Installations with **Asynchronous Machine in Open Loop** (Without Encoder) are not able to work with parameters in F menu.*
> *If for some reason you need to change some parameter that is not in the F menu, simply set the parameter **F51 to NORMAL.***
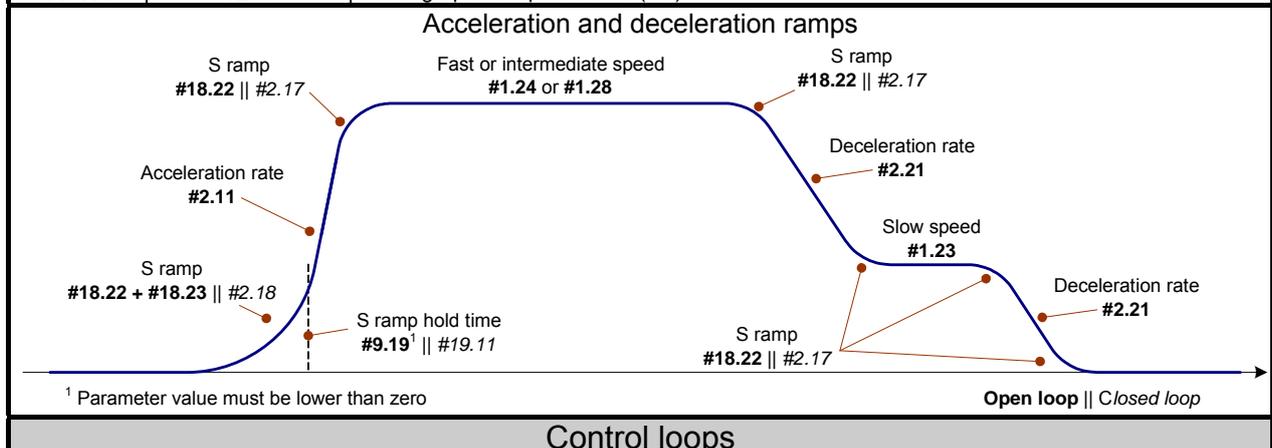
The parameters likely to be altered by technical people during the installation are shown in the following tables:

Changing drive work mode			
Parameter	**Open loop**	**Closed loop**	**Function**
#0.00	1253		Enabling the inverter to change the work mode
#0.48	OPEn LP	CL VECt	Selects work mode: open loop or closed loop. After modifying, press red key ⨂ to reset the drive
#0.49	L2		Allows all menu access
#x.00	1000		Saves into memory modified parameters. After modifying, press red key ⨂ to reset the drive

Motor values			
Parameter	**Open loop**	**Closed loop**	**Function**
#0.41 (#5.18)	8		Maximum Switching Frequency (kHz) – Recommended 8kHz
#0.42 (#5.11)	Auto		Number of Motor Poles
#0.43 (#5.10)	See motor plate		Motor Rated Power Factor (cos φ)
#0.44 (#5.09)	See motor plate		Motor Rated Voltage (V)
#0.45 (#5.08)	See motor plate		Motor Rated Speed (rpm)
#0.46 (#5.07)	See motor plate		Motor Rated Current (A)
#0.47 (#5.06)	See motor plate		Motor Rated Frequency (Hz)
#5.17	0.6		Motor stator resistance (Ω). Modified during autotuning
#5.23	1.5	-----	Motor offset voltage (V). Modified during autotuning

Speed references					
Parameter	**Open loop**		**Closed loop**		**Function**
	50Hz	**60Hz**	**4 poles**	**6 poles**	
#1.06	50.0	60.0	1500.0	1000.0	Maximum allowed speed (Hz || rpm)
#1.21	0.0	0.0	0.0	0.0	Zero speed in normal operation (Hz || rpm)
#1.22	20.0	24.0	600.0	400.0	Inspection speed (Hz || rpm)
#1.23	5.0	6.0	150.0	100.0	Slow / approximation speed (Hz || rpm)
#1.24	50.0	60.0	1500.0	1000.0	Fast speed (Hz || rpm)
#1.25	0.0	0.0	0.0	0.0	Zero speed in rescue operation (Hz || rpm)
#1.26	10.0	12.0	300.0	200.0	Rescue speed (Hz || rpm)
#1.27	5.0	6.0	150.0	100.0	Centring speed (Hz || rpm)
#1.28	30.0	36.0	900.0	600.0	Intermediate speed (only for speeds over 1.5m/s) (Hz || rpm)

Ramps		
Parameter	**Open loop**	**Function**
#2.11	3.5	Acceleration rate (s/100Hz)
#2.21	1.5	Deceleration rate (s/100Hz)
#9.19	-2	Starting-up jerk application time (s)
#18.22	200	Trip jerk (m/s^3)
#18.23	200	Starting-up jerk (m/s^3)
Parameter	**Closed loop**	**Function**
#2.11	1.2	Acceleration rate (s/1000rpm)
#2.17	0.7	S ramp acceleration change during trip (s/1000rpm)
#2.18	1.3	S ramp acceleration change during starting-up (s/1000rpm)
#2.21	1.5	Deceleration rate (s/1000rpm)
#19.11	1200	Starting-up S ramp hold time (ms)

Acceleration and deceleration ramps

S ramp **#18.22** \|\| *2.17*
Fast or intermediate speed **#1.24** or **#1.28**
S ramp **#18.22** \|\| *2.17*
Acceleration rate **#2.11**
Deceleration rate **#2.21**
Slow speed **#1.23**
S ramp **#18.22 + #18.23** \|\| *2.18*
S ramp hold time **#9.19**[1] \|\| *19.11*
S ramp **#18.22** \|\| *2.17*
Deceleration rate **#2.21**

[1] Parameter value must be lower than zero   **Open loop** \|\| C*losed loop*

Control loops

Parameter	Open loop	Closed loop	Function
Control strategy			
#11.47	2		Enables PLC On Board program
#14.08	ON	OFF	Enables PID control
Open loop PID control			
#14.10	1	-----	PID proportional gain
#14.11	0	-----	PID integral gain
Speed loop			
#3.10	-----	0.1000	Speed PID proportional gain
#3.11	-----	6.00	Speed PID integral gain
Current loop			
#4.05	175%		Motoring current limit
#4.06	175%		Regeneration current limit
#4.07	175%		Symmetrical current limit
#4.12	-----	2	Current demand filter (ms)
#4.13	-----	100	Current loop proportional gain. Modified in autotuning
#4.14	-----	1600	Current loop integral gain. Modified in autotuning
Position loop			
#13.09	-----	25	Position loop proportional gain

Parameter	Closed loop	Function
Encoder		
#3.34	See encoder	Drive encoder lines per revolution (ppr)
#3.36	See encoder	Drive encoder supply voltage (V)
#3.38	Ab	Drive encoder type: Line Driver. These work modes do not allow Push-Pull encoders

Parameter	Open loop	Closed loop	Function
Brake			
#12.42	30%	-----	Upper current threshold for releasing the brake
#12.43	10%	30%	Lower current threshold for applying the brake
#12.44	0	-----	Brake release frequency (Hz)
#12.45	2		Threshold for brake close (Hz || rpm)
#12.46	0.5	-----	Delay after brake release signal (s)
#12.46	-----	0.5	Delay after brake apply signal (s)
#12.47	0	0.5	Time for brake releasing (s)
#12.48	-----	0.2	Time for brake applying (s)

Braking diagram in open loop control

Braking diagram in closed loop control
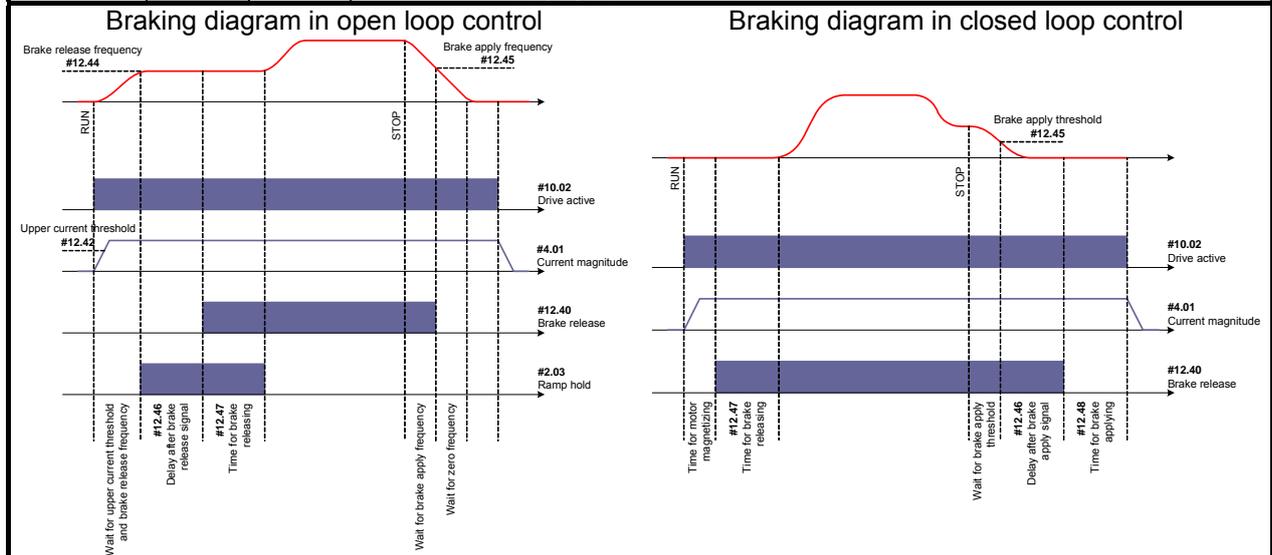
4. AUTOTUNING PROCEDURE

The autotuning process enables the inverter to measure the characteristics of the motor, which are not shown on the motor plate and vary from one motor to another, even though they are the same model or power.

> *For a complete auto tune of the motor, a DYNAMIC AUTOTUNING, off the ropes, is strongly recommended. If it is impossible to rotate the motor without load, at least a STATIC AUTOTUNING must be completed.*

To perform the autotuning, the inspection box must be connected to the controller.

> *If the Inspection Box it is fitted to the car roof, a second person will be required to assist.*
> *If the Inspection Box is provisionally wired in the machine room or a Provisional Operating Kit panel is used, the autotuning can be carried out by one person.*

4.1 Static autotuning

Step 1: Setting up the controller and the machine

Once the machine and the control cabinet have been assembled in their definitive locations, the wiring between the controller and the machine has to be fitted: power loom, brake loom and encoder loom.

See HIDRA-CRONO Installation Manual.
See Motor manufacturer Manual.
See encoder documentation provided by the manufacturer for encoder wiring.

- Configure the parameters related to the machine, which are shown in motor's plate. Firstly, write down the values in the following table:

Motor Rated Power Factor (cos φ)		**#0.43**
Motor Rated Voltage	V	**#0.44**
Motor Rated Speed	rpm	**#0.45**
Motor Rated Current	A	**#0.46**

- Power up the controller and check that 230Vac reach the primary winding of the controller transformer.
- Connect the inspection box or a Provisional Operating Kit.
- Check that the limit switches at the extremes (CVI/CVS) are switched to close.
- Check that the rescue switch is in **Normal** position.
- Enter the controller menu to activate it. No operation is required on it.

Step 2: Static autotuning process

- To start the autotuning process follow next steps:
    - Find a #0.40 parameter
    - Press **M** button
    - Set the value to **1**
    - Press **M** button

- Start up the inverter using the push buttons in the inspection box or in the provisional operating panel. If the inspection box is used, the switch should be set to the INSPECTION position.

> *During the entire process, the push buttons should remain activated.*

- The process lasts between 3 and 5 seconds. In the end, the parameter **#0.40** returns to **0**, indicating that the process has been completed correctly.

This process measures the motor's stator resistance and offset voltage; hence the parameters **#5.17** and **#5.23** are modified. Look up optimisation section to improve their value and obtain an ideal performance.

Step 3: Finish the autotuning

After the autotuning, the parameters must be saved in memory using the following procedure:
  − Find F00 / #x.00 parameter
  − Press **M** button
  − Set the value to **1000**
  − Press **M** button
  − Press red button ⊘

> ⚠ *If either the motor or the inverter is replaced, the autotuning process must be executed again.*

4.2 Dynamic autotuning

> ⚠ *To carry out the dynamic autotuning, the motor must be able to rotate without load. Thus, it should be performed without suspending the car to enable the motor to spin free of cables, counterweight and car.*

Step 1: Setting up the controller and the machine

Once the machine and the control cabinet have been assembled in their definitive locations, the wiring between the controller and the machine has to be fitted: power loom, brake loom and encoder loom.

See HIDRA-CRONO Installation Manual.
See Motor manufacturer Manual.
See encoder documentation provided by the manufacturer for encoder wiring.

- Configure the parameters related to the machine, which are shown in motor's plate. Firstly, write down the values in the following table:

Motor Rated Power Factor (cos φ)		**#0.43**
Motor Rated Voltage	V	**#0.44**
Motor Rated Speed	rpm	**#0.45**
Motor Rated Current	A	**#0.46**

- Power up the controller and check that 230Vac reach the primary winding of the controller transformer.
- Connect the inspection box or a Provisional Operating Kit.
- Check that the limit switches at the extremes (CVI/CVS) are switched to close.
- Check that the rescue switch is in **Normal** position.
- Raise the RF brake relay lever (see photo) and confirm that the motor is able to rotate turning manually the flying wheel.
- Enter the controller menu to activate it. No operation is required on it.
- If the machine includes an encoder, configure encoder-referring parameters. Look up encoder's documentation and write down the following table.
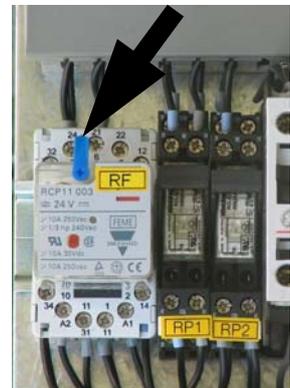
Encoder type		**#3.38**
Encoder supply voltage	V	**#3.36**
Pulses per revolution	ppr	**#3.34**

Step 2: Dynamic autotuning process

- To start the autotuning follow this formula:
  - Find **#0.40** parameter
  - Press **M** key
  - Set value to **2**
  - Press **M** key

- Start up the inverter using the push buttons in the inspection box or in the provisional operating panel. If the inspection box is used, the switch should be set to the INSPECTION position.

- The motor will start to rotate and the inverter display will alternate parameter **#0.40** with the word **AutoTune**.

> *During the entire process, the push buttons should remain activated.*

- The process lasts between 15 and 30 seconds. In the end, the parameter **#0.40** returns to **0**, indicating that the process has been completed correctly.

If the **Trip TuneX** error message appears, it means that the motor is not free to move or the brake is not released. Check that the motor can rotate freely and repeat the autotuning. If the error persists, contact the Carlos Silva technical service.

If the **Trip EncX** error message appears, it means that the motor is spinning in the opposite direction to that expected. Change two output phases of the motor and repeat the autotuning.

Step 3: Finish the autotuning

- After the autotuning, the parameters must be saved in memory using the following procedure:
  - Find a **#x.00** parameter from any menu
  - Press **M** key
  - Set the value to **1000**
  - Press **M** key
  - Press red key ⬤

- In closed loop control, look up the value of current gains, parameters **#4.13** y **#4.14**, and write them down in the table. Consult the next point to optimise their value and get a perfect performance.

Parameter **#4.13** =	
Parameter **#4.14** =	

> *LOWER RF BRAKE RELAY LEVER in the controller, allowing the controller to manage the brake.*

> *If either the motor or the inverter is replaced, the autotuning process must be executed again.*

4.3 Parameter optimisation

The values obtained with the autotuning process fulfil most motor's requirements. Nevertheless, in some cases it may be necessary to decrease the noise generated by the machine or improve its performance.

In <u>open loop control</u>, if there are perceptible vibrations on decelerations or a higher torque is required, change parameter **#5.17** value to **0.6**. If the result is not satisfactory, increase parameter **#5.17** value getting nearer to the value drawn in the autotuning.

In <u>closed loop control,</u> an excessive gain may cause that the motor makes an unexpected noise. Decrease current loop gains, parameters **#4.13** and **#4.14**, in 10% steps until get a satisfactory performance.

> *If the current loop gains are excessively decreased, the motor torque may be insufficient.*

> To avoid the Rollback effect and/or Demagnetizing Blow of the machine, it must be adjust the next parameters at HIDRA CRONO Menu*:*
>
> **_HIDRA CRONO Menu_**
>   **02 -** *Configuration*
>   **02.05 -** *Machine Control*
>   **02.05.01 -** *Mechanical brake drop time → 0.2 sec.*
>   **02.05.02 -** *Drive Disable mode for VF → 0 (Control Techniques).*
>   **02.05.03 -** *Demagnetizing Time → 2 sec.*

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5. BINARY TABLE FOR SPEED SELECTION

The following table shows the speed selection according to the binary signal in the terminals of the inverter:

Binary table of speeds	Terminal 5	Terminal 26	Terminal 29
Zero speed in normal operation	0	0	0
Inspection speed	0	0	1
Slow speed / approximation	0	1	0
Nominal speed	0	1	1
Zero speed in rescue operation	1	0	0
Rescue speed	1	0	1
Centering speed	1	1	0
Medium speed (only for speeds over 1.5m/s)	1	1	1

6.   FIXED PARAMETERS

The following table shows the parameters configured in the inverter during the controller manufacture. These parameters seldom have to be modified.

Parameter	Open loop	Closed loop	Function
Motor values			
#5.14	Ur	-----	*Voltage mode select*
Speed references			
#1.14	Pr		*Reference selector*
#1.15	0		*Preset selector*
Parameters set version			
#19.30	See installation		*Version of the parameters set charged*
Ramps			
#2.03	OFF	ON	*Ramp hold*
#2.04	Fast		*Ramp mode select*
#2.06	ON		*S ramp enable*
#9.14	2.03	-----	*Start up jerk control logic function source #1*
#9.15	ON	-----	*Start up jerk control logic function source #1 invert*
#9.16	12.40	-----	*Start up jerk control logic function source #2*
#9.17	OFF	-----	*Start up jerk control logic function source #2 invert*
#9.18	ON	-----	*Start up jerk control logic function output invert*
Open loop PID control			
#14.02	18.22	-----	*PID #1 reference source*
#14.03	18.23	-----	*PID #2 reference source*
#14.09	9.02	-----	*PID optional enable source*
#14.15	1	-----	*PID scaling*
#14.16	2.07	-----	*PID destination*
Closed loop control gains			
#18.48	-----	OFF	*Disables variable speed gains*
Digital inputs and outputs			
#7.10	1.47		*T5 analogue input destination as "bit #2" as speed selection*
#7.15	Th.disp		*Disables thermistor fault "th"*
#7.32	47.7		*Enable Thermistor AutoReset (reset < 1800 ohms)*
#8.39	ON		*Addressing of terminals 28 and 29*
#8.11	OFF		*T24 I/O terminal selection*
#8.21	6.29		*Digital output source on terminal 24 for door pre-opening control*
#8.31	OFF		*Configuration of terminal 24 as output*
#8.32	ON		*Configuration of terminal 25 as output*
#8.27	10.01		*Addressing "Inverter OK" relay between terminals 41-42*
#8.26	1.45		*T29 analogue input destination as "bit #0" as speed selection*
#8.25	6.32	19.44	*Addressing of terminal 28 as the signal to going up*
#8.24	6.30	18.44	*Addressing of terminal 27 as the signal to going down*
#8.23	1.46		*T26 analogue input destination as "bit #1" as speed selection*
#8.22	12.40		*Addressing of terminals 25 (brake control bit)*
Brake			
#10.30	0		*Full power braking time*
#10.31	0		*Full power braking period*
#12.41	User		*Braking controller in user mode*
#12.49	-----	ON	*Position controller activated during braking*
#13.04	-----	Local	*Brake position controller reference*
#13.10	-----	1	*Position controller mode*

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