Motors I Automation I Energy I Transmission & Distribution I Coatings

Vector inverter for Hybrid injection molding machines

ADP200

Pressure/Flow Control for Hybrid Injection Molding Machines

Quick Start Installation Manual

Language: English

Changes Index	Data	Author	Description
V0_0_1x	23-9-2016	Macaccaro Brugali	First release In Progress. Single pump with analog references.
V0_0_2x	28-11-2016	Macaccaro Brugali	Add. Startup with Keypad and Basic ThroubleShooting and text
V0.0	1-12-2016	Brugali	Coded and released
V0.1	3-5-2017	Brugali	Page 5: replaced saving diagram; page 6: update Data plate and Firmware and card revision plate; page 52: mod. Description alarms 9-10-11.
V0.2	9-3-2018	Brugali	Upd fw 2.22.37.0 Changes on ch. 3.1 and 3.3.1 (default ADP200-...-24 models). Add text on ch 4.4 Machine Test.
V0.3	13-11-2018	Brugali	ADP200 Version V4_0_0 Add sel 4 PT1000 to par 4532 MotorOT sensor
V0.4	20-4-2020	Brugali	Pagg. 16-20, mod sequence of Basic Startup Wizard: Motor overtemperature setting to Step 2. Pag. 51: mod Alarm 36 PRESSURE SENSOR, add new Condition and solution to Alarm 12 MOTOR OT. Pag 52: add DIG CHECK, NEGSPEED and ISA PRESSURE SENSOR application alarms.
V0.5	8-6-2020	Brugali	ADP200 Version V4.x.2 and PID-IMM Application V 3.x.37.5. Add IO2 = optional I/O card EXP-IO-D8A4R2-S-ADP
V0.6	17-1-2022	Brugali	ADP200 Version V4.x.3

This manual applies to the hardware and software configurations of the following drives:

ADP200 Version V4.x.3

PID-IMM Application V 3.x.37.5

Thank you for choosing this WEG product.

If you have any information that might help us to improve this manual, do not hesitate to contact us at tecnohelp@weg.com.

Before using the product, read the safety instructions section carefully.

Keep the manual in a safe place and available to technical personnel during the product functioning period.

TABLE OF CONTENTS

1 Introduction

This manual contains the Quick Start Guide for the Installation of an Hybrid Energy Saving System with WEG ServoDrive ADP200 and servo oil pump (ADP200 drive with PID-IMM application and ServoPump).
In the first version there is the simplest machine configuration: single pump and machine PLC interface via Analog and Digital I/O.
Configurations with Multi-Pump and CANopen communication with machine PLC will be inserted in a future release.

Chapter 2 - "General description" provides a short information about system characteristics and functions.

Chapter 3 - "Connection diagrams and wiring procedure" illustrates typical connection diagrams and the command interface for controlling the application via digital I/O.

Chapter 4 - "Fast Start Up" provides information about the most simple sequence to start up an Hybrid IMM with servo-pump using a WEG ADP200 drive.

Chapter 5 - “Throubleshooting and Application Alarm” there are the most important alarms of PID-IMM application fault messages.

Note that this document is a Quick guide to the installation. All the information relating to WEG ADP200 family with PID-IMM application are in the following manuals:

- 1S9PQSEN_..._**ADP200-QS_EN** (Quick start up guide Specification and installation)
- 1S9PFPEN_..._**ADP200FP-SYN_EN** (ADP200 Function description and parameter list)
- **ADP200_PID-IMM**_..._EN (PID Pressure/Flow Control for Hybrid IMM user manual)

ATTENTION: you have to refer to the manual ADP200-QS for precaution and safety instruction, transport, storage, mechanical and electrical installation and also the navigation and use of the integrate and optional keypad. The same for mechanical and electrical specifications, Fuses, choke …. , mentioned in the diagrams.

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2 General description

The aim of hybrid machines is to regulate the flow and pressure of the oil generated by a fixed-displacement gear pump driven by a brushless motor controlled by a drive, as shown in the diagram below, without the need for a proportional valve but using On/Off wave.
The pressure in the hydraulic circuit is measured by a transducer and regulated according to a user-defined value by means of a specific PID controller.
The flow rate is proportional to the rotational speed and displacement of the pump.

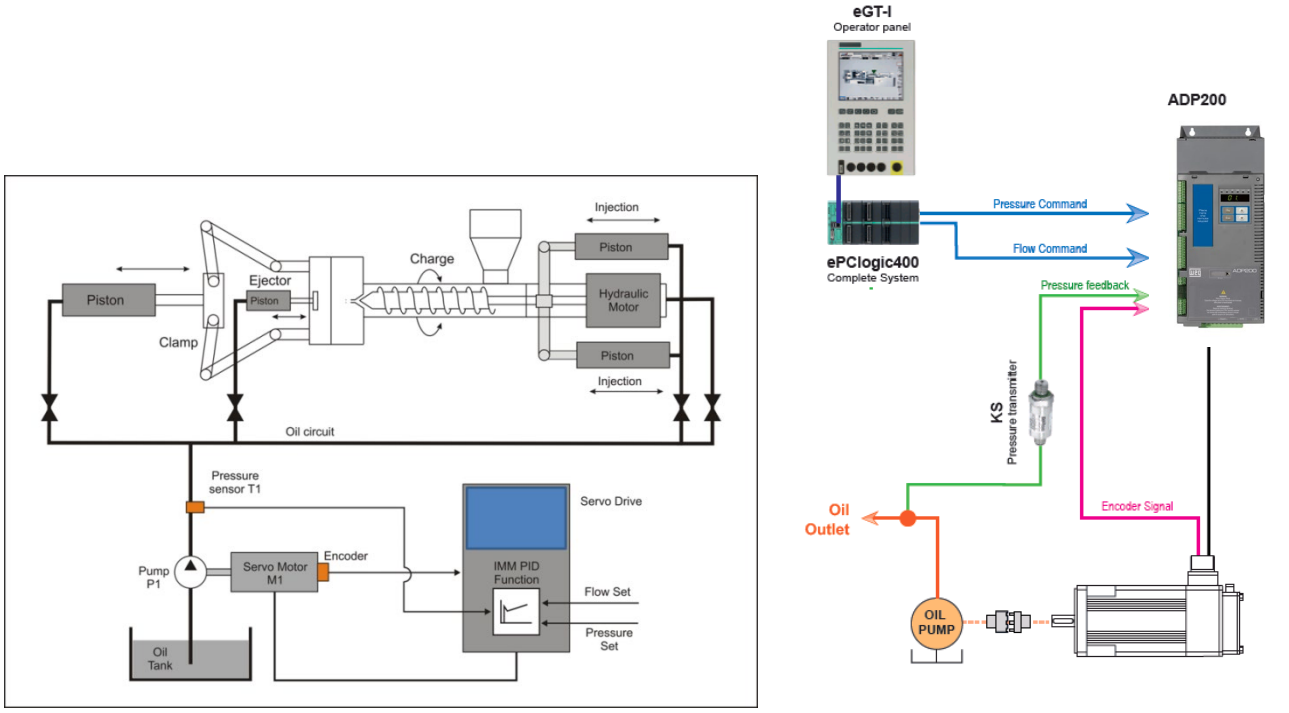
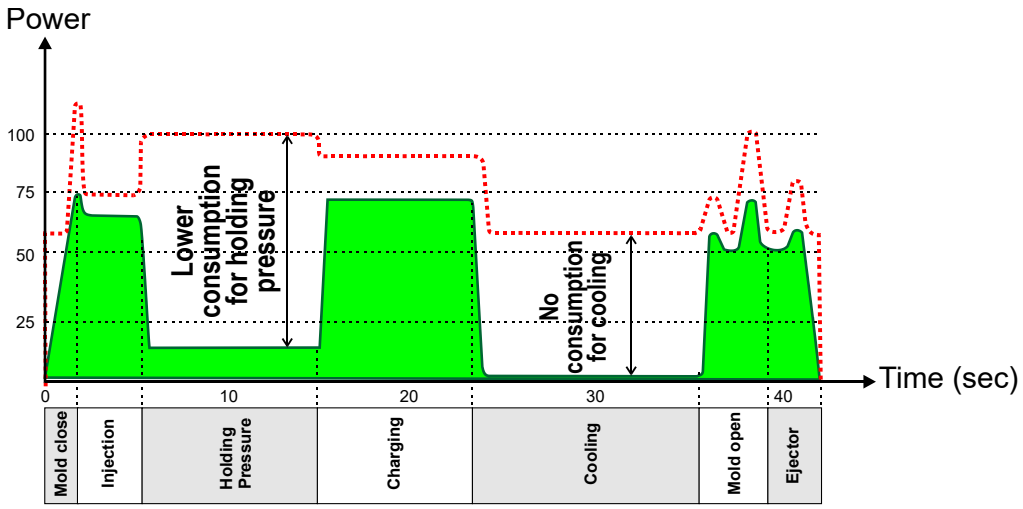


Figure 1 Single Hydraulic Pump Control

The drive receives Flow and Pressure references and the Pressure feedback from machine PLC, as shown in picture above.
The **flow rate and pressure settings are mutually exclusive,** i.e. if the pressure generated is below requested value the motor is driven at the requested speed, otherwise speed is modulated to limit the pressure to the set value.
The advantage of hybrid machines is that they **save energy**. The oil flow and pressure can be adjusted exactly as required by the machine rather than at higher levels, without having to discharge oil as in conventional hydraulic machines.



3 Connection diagrams and wiring procedure

In this chapter there are a brief description of the product identification (for each module type), cabling and typical connection diagrams.

3.1 Product Identification

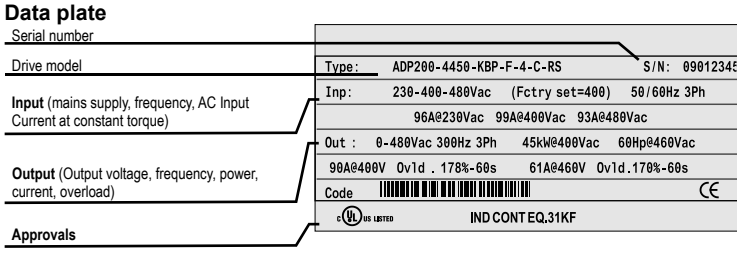
The basic technical data of the inverter are included in the product code and data plate.

Name of model (code)

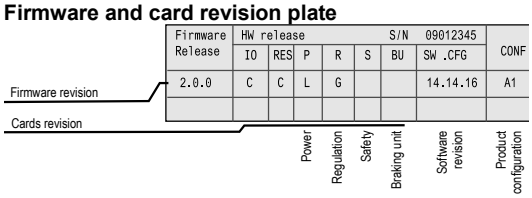
ADP200 2 075 -K B P -F -4 -C -RS -24

I/O card version:	[Empty] = I/O card EXP-IO-D8A4R2-ADP (standard) IO1 = optional I/O card EXP-IO-D10A3R2-ADP IO2 = optional I/O card EXP-IO-D8A4R2-S-ADP
24 VDC external power supply:	24 = included.
Encoder Repetition:	[Empty] = not included (standard) ER = with encoder repetition
Encoder card: RS = Resolver (standard) ED = EnDat; SI = Sinusoidal Encoder;	DE = Digital Encoder; HI = Hiperface; SC = Sinusoidal SinCos Encoder;
CANbus:	C = included
Rated voltage:	4 = 400Vca, three-phase
EMI Filter:	F = included
PID IMM application:	P = included
Braking unit: X = not included	B = included
Keypad: K = included	(1-line x 4-character alphanumerical LED display)
Inverter power in kW: 075 = 7.5kW 110 = 11kW 150 = 15kW 185 = 18.5kW 220 = 22kW	300 = 30kW 370 = 37kW 450 = 45kW 550 = 55kW 750 = 75kW
Mechanical dimensions of the drive: 2 = size 2 3 = size 3	4 = size 4 5 = size 5 5S = size 5 slim
Servodrive, ADP200 series	

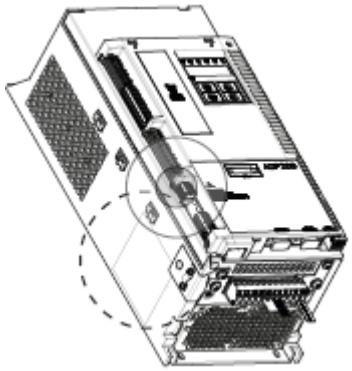
Data plate



Firmware and card revision plate



Position of plates on the drive



3.2 Specifications

Here a summary of the ADP200 specifications. The complete information are in the ADP200-QS manual.

3.2.1 Input electrical data

Connection to TT and TN networks_____ yes
Choke _____ Sizes 2...3: Optional (AC side), sizes 4-5 : integrated (DC side)

Size	Input voltage U_{LN}	Input frequency	Overvoltage threshold	Undervoltage threshold	I_N AC input current for continuous operation			DC-Link Capacity
					@ 230 Vac	@ 400 Vac	@ 480 Vac	
	(Vac)	(Hz)	(Vdc)	(Vdc)	(Arms)	(Arms)	(Arms)	(μF)
2075	three-phase 230-400-480Vac -15%+10%	50/60 Hz, ± 5%	820 Vdc	@ 480 Vac = 470 Vdc @ 460 Vac = 450 Vdc @ 400 Vac = 391 Vdc @ 230 Vac = 225 Vdc	24	24	21	680
2110					28	28	25	1020
3150					40	40	35	1500
3185					48	48	43	2250
3220					51	51	46	2700
4300 (1)					64	65	61	2350
4370 (1)					79	80	75	2350
4450 (1)					96	99	93	2800
5550 (1)					112	116	109	4700
5750 (1)					158	161	148	5600
5S550 (2)					113 (3)	120 (3)	114 (3)	4700
5S750 (2)					158 (3)	161 (3)	148 (3)	5600

(1) With integrated DC input choke, in accordance with EN 61800-3.

(2) ADP200-5S550 and 5S750 models: AC input external choke is mandatory.

(3) Input current is with AC input choke.

3.2.2 Output electrical data

Motor type _____ Synchronous
Maximum output voltage U2 _____ 0.98 x U_{LN} (U_{LN} = AC input voltage)
Maximum output frequency f2 _____ 300 Hz

Size	IN Rated output current (fSW = default)			PN mot (Recommended motor power, fSW = default)				fSW (4) Switching frequency		Reduction factor				IGBT braking unit
	@ULN = 230VAC	@ULN = 400VAC	@ULN = 460VAC	@ULN = 230VAC	@ULN = 230VAC	@ULN = 400VAC	@ULN = 460VAC	Other	Default	KT	KALT	KV	KF	
	(A)	(A)	(A)	(kW)	(Hp)	(kW)	(Hp)	(kHz)	(kHz)	(1)	(2)	(3)	(5)	
2075	18.5	18.5	16.7	4	5	7.5	10	8	4	0.9	1.2	0.9	0.7	Standard internal (with external resistor); braking torque 150% MAX External optional on 5750 size.
2110	22	22	19.8	5.5	7.5	11	15	8	4	0.9	1.2	0.9	0.7	
3150	32	32	28.8	7.5	10	15	20	8	4	0.9	1.2	0.9	0.7	
3185	39	39	35.1	9	15	18.5	25	8	4	0.9	1.2	0.9	0.7	
3220	42	42	37.8	11	15	22	30	8	4	0.9	1.2	0.9	0.7	
4300	60	60	54	15	20	30	40	8	4	0.9	1.2	0.9	0.7	
4370	75	75	67.5	18.5	25	37	50	8	4	0.9	1.2	0.9	0.7	
4450	90	90	81	22.0	30	45	60	8	4	0.9	1.2	0.9	0.7	
5550 / 5S550	105	105	94	30	40	55	75	8	4	0.9	1.2	0.9	0.7	
5750 - 5S750	150	150	135	37	50	75	100	8	4	0.9	1.2	0.9	0.7	

The derating factors shown in the table are applied to the rated DC output by the user. They are not automatically implemented by the drive: Idrive = In x Kalt x Kt x Kv

(1) KT: Derating factor for ambient temperature of 50°C (1% every °C above 40°C)

(2) KALT: Derating factor for installation at altitudes above 1000 meters a.s.l. Value to be applied = 1.2% each 100 m increase above 1000 m (up to a maximum of 2000 m).
E.g.: Altitude 2000 m, Kalt = 1.2% * 10 = 12% derating; IN derated = (100 - 12) % = 88 % IN

(3) Kv : Derating factor for mains voltage at 460/480Vac.

(4) There is also the possibility to set a variable switching frequency through parameter setting.

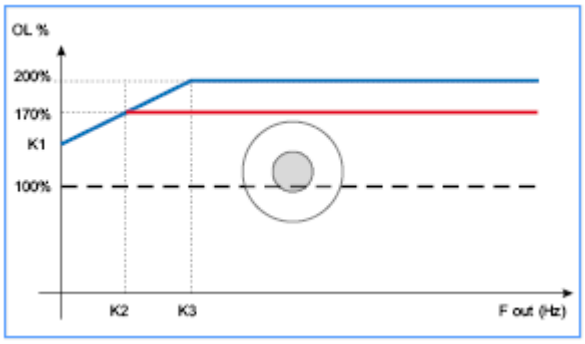
(5) For fixed Switching frequency fSW = 8 kHz.

3.2.2.1 Derating values in overload condition

In overload conditions the output current depends on the output frequency, as shown in the figure below.

Size	Tambient [°C]	K1 [%OL]	K2 [Hz]	K3 [Hz]
2075	40	169	0,1	1,5
2110	40	199	0	0,1
3150	40	191	0	0,6
3185	40	200	0	0
3220	40	180	0	1,1
4300	40	176	0	2
4370	40	200	0	0
4450	40	189	0	0,9
5550 / 5S550	40	200	0	0
5750 / 5S750	40	200	0	0

Figure 4.5.1-A: Current derating curves according to the variation of the output frequency

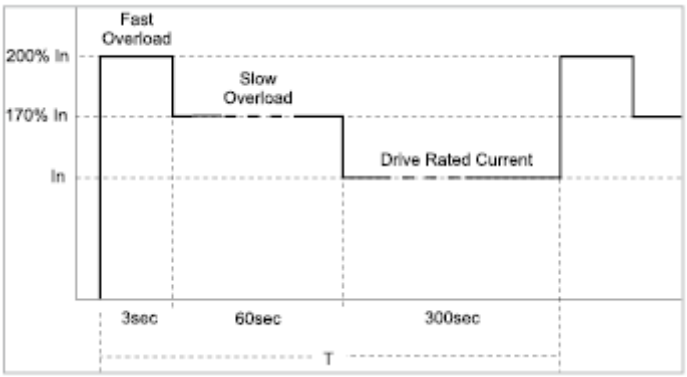


K1, K2 and K3 are 3 values identifying current derating curves according to the variation of the output frequency. These values depend on the temperature of the heatsink.
The values of K1, K2 and K3 shown in the table refer to the ambient temperature of 40 ° C, with constant switching frequency of 4kHz and with drive used in continuous operation at nominal current plus fast and slow overload.
During operation at variable switching frequency, the drive automatically switches from working frequency of 8kHz to 4kHz, when the temperature of the heat sink exceeds the threshold **T heatsink th** (see Fig. 4.5.2).

Note I S Accessories (brake resistors, filters EMI and external AC input choke) are sized specifically for the injection molding machine application.

For other applications, refer to WEG customer service.

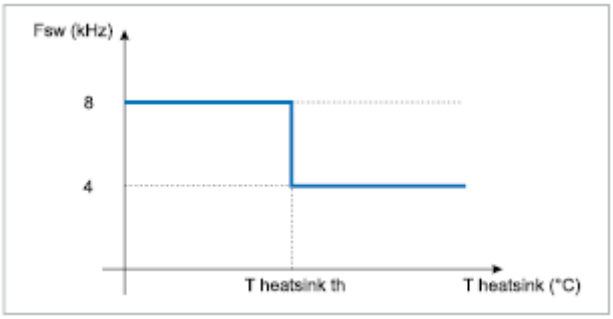
Figure 4.5.1-B: Overload cycles



3.2.2.2 Derating values for switching frequency

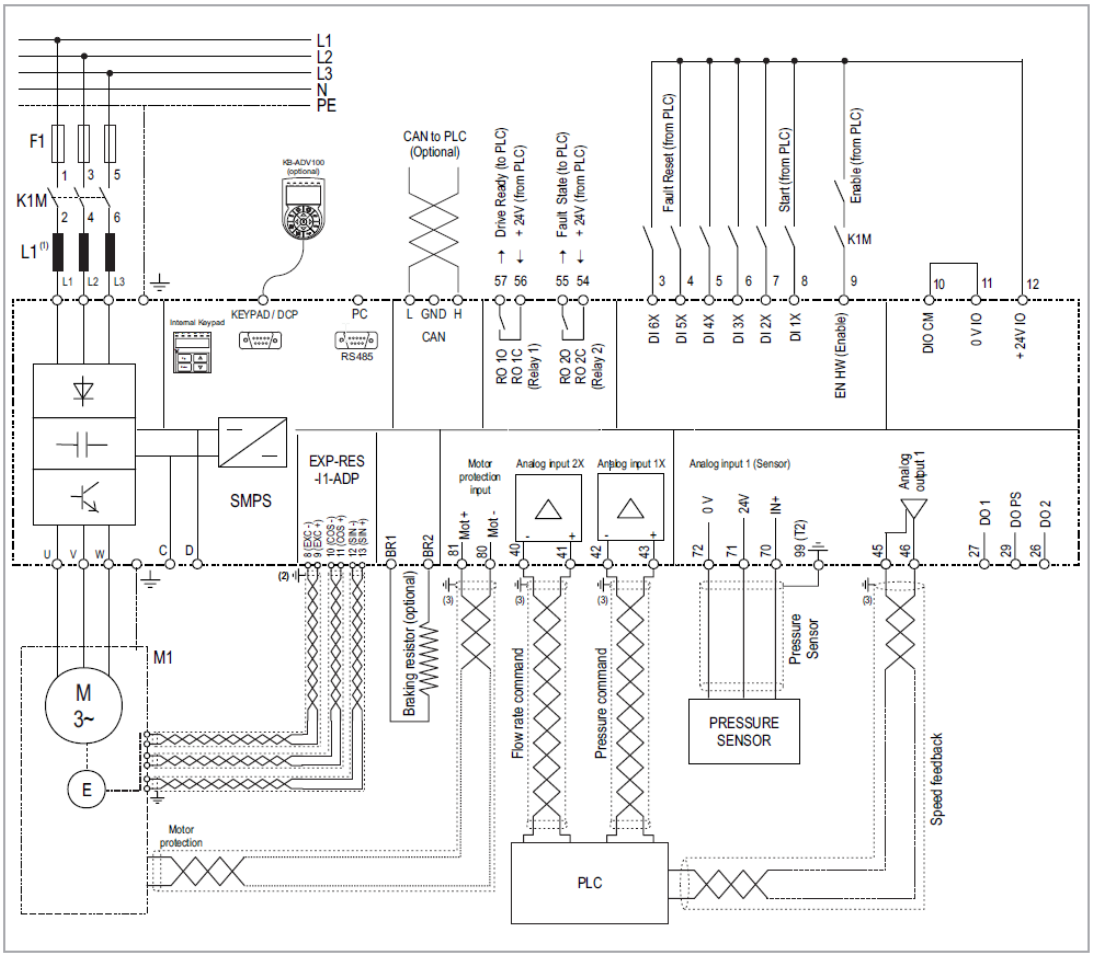
ADP200 is factory set to 4kHz constant switching frequency (PAR 568 **Switching freq mode** = [0] Constant).
The figure 4.5.2 is valid only when PAR 568 **Switching freq mode** = [1] Variable, refer to ADP200 FP manual for more details.
The switching frequency is modified according to the temperature of the drive (measured on the heat sink), as shown in the figure below.

Figure 4.5.2: Ratio between switching frequency/heat sink temperature



3.3 Wiring

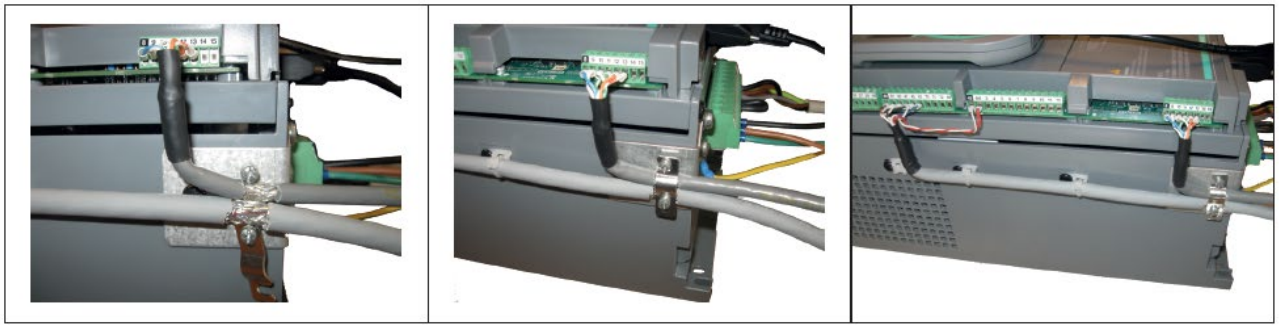
The figure below shows a typical connection with **machine PLC** and the **drive Master** communication via Analog and Digital I/O.



(1) ADP2075 ... 4300: Integrated choke on DC link.
(2) Connect resolver shield directly to chassis as shown on fig. 3
(3) Connect the shields of Motor protection, Analog Input 1/2X and Analog Output signals directly to chassis (or to terminal 99 of T3 strip) as shown on figure .

Figure 2: ADP200 Typical connection diagram

Flow and pressure reference coming from PLC enter in Analog Input 1x / 2x, pressure sensor enter in the Analog input 1 (reserved to sensor).
Enable and start command coming from PLC enter in EnHw input and DI1X input.
The recommended connection for **Resolver** is to connect shield in both sides (Motor and drive). On the drive side the connection is done via omega as in the figure below.
Also the **pressure sensor shield** connection is critical we suggest to connect via term.99 as in the figure below. In the scheme below see also shielding connection for the motor protection and the Flow & Pressure reference cables.



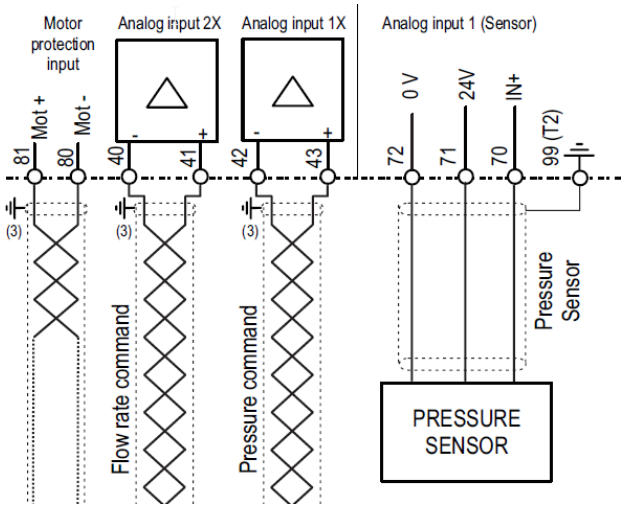


Figure 3: recommended connection of shielding

Be careful also to power (motor) cable shield connection.
Also here we recommend to connect shield in both sides (Motor and drive). On the drive side the connection is done via omega as in the figure below (see ADP200-QS_EN manual for more detail).

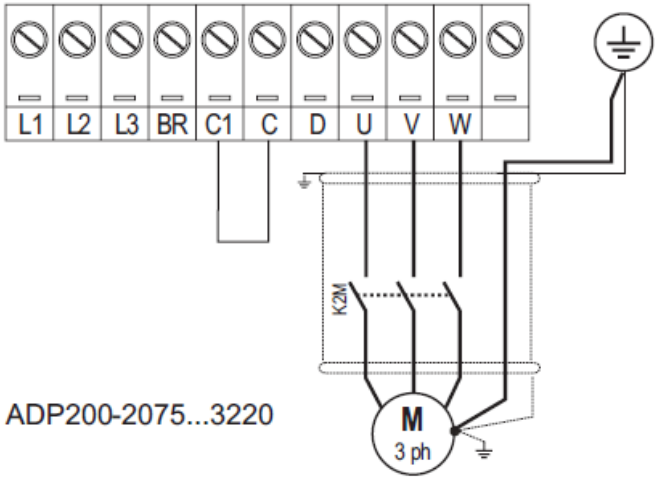


Figure 4: Shield Motor Connection

Best connection is done using optional Power Shield kit

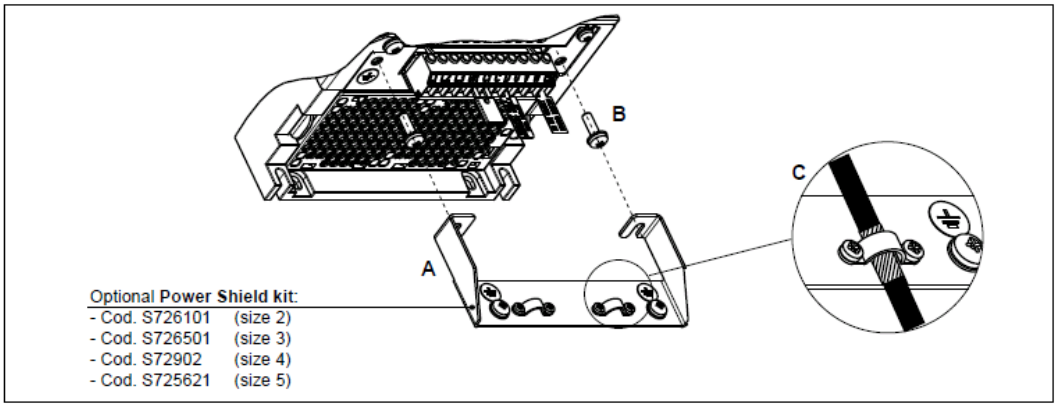


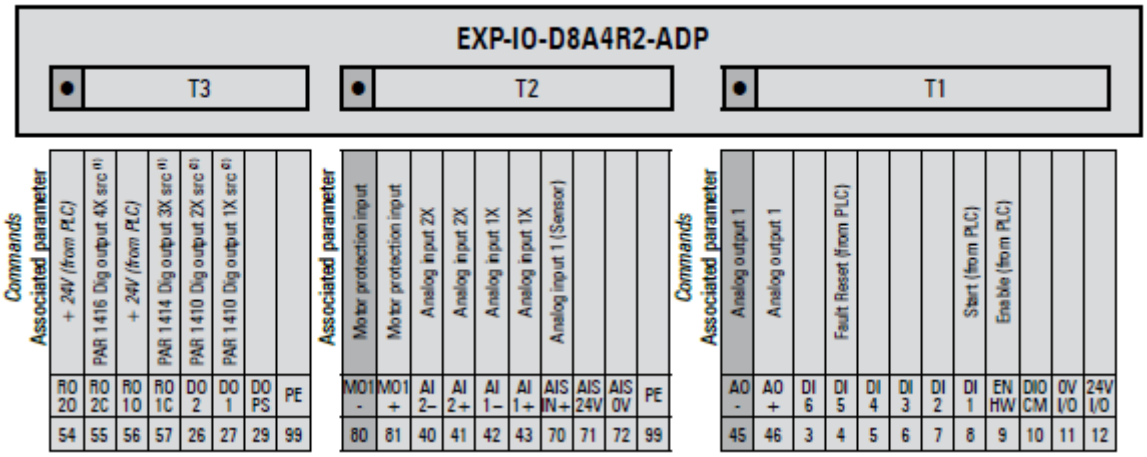
Figure 5: Power Shield Kit

A **good shield connection is mandatory** to reduce noise and achieve the minimum pressure and flow oscillation on pressure or flow control.

3.3.1 Terminal Strip Connections

Terminal strip and connection for ADP200 - …- 24 models are in the following figure:

Figure 6: I/O & Encoder Terminal strip



(1) Default value = PAR 6000 Null (meaning: open contact); (2) Default value = PAR 6000 Null (meaning: 0V for digital outputs).

Note!

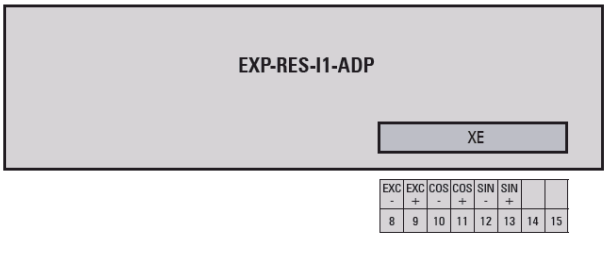
+24Vdc voltage, which is used to externally supply the regulation card has to be stabilized and with a maximum ±10% tolerance. The maximum absorption is 1A. It is not suitable to power supply the regulation card only through a unique rectifier and capacitive filter.

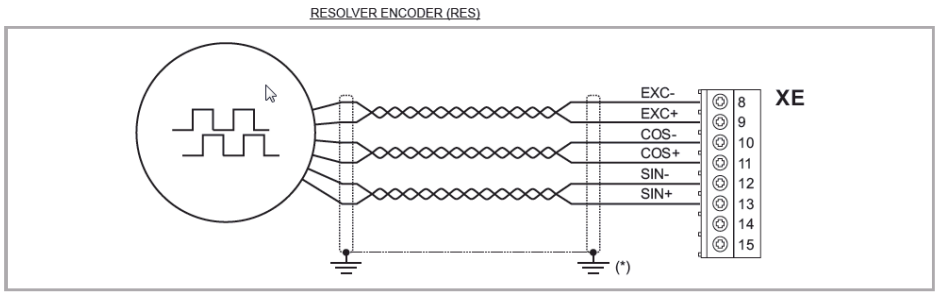
If the control is powered with a +24V external, you have to insert a protective diode as described in "Figure 7.3.1.6: External diode on +24V external".

If you use the ADP200-...-24-I01 or ADP200-...-24-I02 models refer to ADP200-QS_EN manual.

3.3.2 Resolver Connections

This section describes the feedback connections for the standard ADP200-...-RS series.



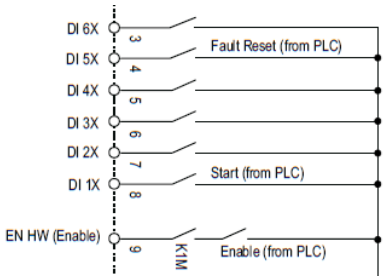


(*) Connection of shielding, see figure

3.3.3 Drive Commands

In the factory configuration there are only the following commands: Enable, Start and Fault Reset.

The command may be configured to digital input as shown in the following typical scheme:



4 Fast Start-Up

The Fast Start-up procedure operations there are the typical startup sequence step by step.
Before start with the operation, it's possible verify the correct Firmware and Application version.

4.1 Preliminary operations for PID-IMM application startup (Guided Procedure)

The operations in detail are also in the **ADP200 Quick Start-Up Guide Manual** for Basic Firmware and in the **PID Pressure/Flow Control for Hybrid IMM User Manual** for the PID-IMM Application.
In particular in the Quick Start Guide there are in **detail all the warning and caution information** (chapter 9 Commissioning …).

The STARTUP WIZARD is a guided procedure used for quick start-up of the drive that helps to set the main parameters. It consists of a series of questions, relating to the various sequences for entering and calculating the parameters necessary for correct drive and PID_IMM application operation. After the Startup wizard only few operations are necessary complete the test on the machine.
The order of these sequences is as follows:

- *Electrical connections* *Step 1*

BASIC STARTUP WIZARD

- *Setting motor parameters* *Step 2*
- *Autotune with rotating motor / at stand-still or coupled to the load* *Step 3*
- *Setting encoder parameters* *Step 4*
- *Encoder phasing (rotating or still)* *Step 5*
- *Setting speed parameters* *Step 6*
- *Motor overload setting* *Step 7*
- *Motor overtemperature setting* *Step 8*
- *Braking resistor setting* *Step 9*

APPLICATION STARTUP WIZARD

- *Setting application parameters* *Step 10*
- *Analog input setting* *Step 11*
- *Saving parameters* *Step 12*

PUMP DIRECTION OF ROTATION

- *Find Pump direction of rotation* *Step 13*

PID-IMM TUNING *Step 14*

- *Seed loop tuning*
- *Pressure loop tuning*

MACHINE TEST *Step 15*

- *Check Speed and pressure performance*
- *Pressure Hold*
- *Final machine cycle test*

FINE TUNING

- *SAT LIMIT*
- *SWITCH GAIN*
- *GAIN SCH*

ALARMS & PROTECTIONS

- *PID-IMM protections*

Note! Check the connections, with particular attention to shieling (see wiring diagram) in order to reduce interference and noise. Take particular attention to the Resolver/Encoder shield connection for detail see. ADP200 QS manual.
See the ADP200 QS manual for details on steps 1….9, 11 and 12.

Note! If motor is already mechanically connected to gear pump, check motor direction of rotation and operate at limited speed in order to avoid irreversible damage to gear pump itself. Correct motor direction of rotation can be detected following procedure at section 4.2.3.

Step 1 - Electrical connections

Make the connections as described in paragraph 7.3.2. of **ADP200-QS manual**.

Checks to be performed before powering the drive

- Check that the supply voltage is correct and that the input terminals on the drive (L1, L2 and L3) are connected correctly.
- Check that the output terminals on the drive (U, V and W) are connected to the motor correctly.
- Check that all the drive control circuit terminals are connected correctly. Check that all control input are open.
- Check the encoder connections, see ADP200 QS manual, Appendix section A.3.

Powering the drive

- After completing all the checks described above, power the drive and proceed to step 2.

To perform the other steps from step 2 up to set 12 it's possible use the local or remote keypad in the startup menu (see ADP200 QS manual) or the PC Configurator WEG_eXpress.

4.2 Commissioning via Local / Alphanumerical KeyPad

This section describes a standard application commissioning procedure using the Local Keypad or the optional alphanumerical Keypad.

To avoid increase the number of pages of this quick manual (else become a "big" manual), here it is assumed that the operator knows and knows to use the two keypads.
Learning how to use the two keypad is described in detail in the "***ADP200 Quick Start-Up Guide Manual***" where there are also many example.

Following the sequence in this chapter is possible to install ADP200 via local (Menu Number and IPA Parameter Number or alphanumerical KeyPad with menù name and parameter name). Unless otherwise specified, the following table contain all the information that you need for local o alphanumerical keypad access.

Example:

Menù	Menù Name	IPA	Par. Name	Unit	Value	Note
5.22	REFERENCES	670	Speed Ref Top lim			

This table shows how to access (read or write) to the parameter 670 (Speed Ref Top Limit) in Menù 5.22 (REFERENCES)

==========

To distinguish IPA > 9999 (application parameters) on the integrated display a fix point is visualized on the bottom right.

The meaning of the point is that the IPA shown on the display is the number visualized + 10000.
In this way the user can:

- **distinguish FW and application parameters in the menu (for example into menu RECIPE)**
- **distinguish parameters with similar IPA (for example 1000 and 11000) due to the limits of the integrated 4 digit display.**

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4.2.1 Basic Startup Wizard

STARTUP WIZARD is in the Menù 3. The startup wizard menu suggests a procedure for commissioning the drive quickly with a reduced number of settings. Advanced customization requires the use of the single parameters relating to the specific performance levels. For complete detailed information, see the procedure described in the chapter **Startup wizard** on ADP200 QS manual.

To start the guided installation, press menù 3 “STARTUP WIZARD”.

Step 2 – Motor overtemperature setting

Motor OT protection management: selection of the source, threshold and sensor type setting, behavior of the drive in case of a motor overtemperature alarm.

Menù	Menù Name	IPA	Par. Name	Unit	Def.Value	Note
3	MtoT,SetMotorovertemp	4530	MotorOT probe		SRC	0=SRC 9=MotOTSensor
3	MtoT,SetMotorovertemp	4532	MotorOT thr	cnt	0	
3	MtoT,SetMotorovertemp	4538	MotorOT sensor		None	0=None 1=PTC 2=NC Contact 3=KTY84 4=PT1000
3	MtoT,SetMotorovertemp	4522	MotorOT activity		Warning	0=Ignore 1=Warning 2=Disable 3=Stop 4=FastStop

Go to the next step.

Step 3 – Setting the motor parameters

First step require to insert the motor parameters data that you can read in the motor type plate or motor datasheet. The motor parameters can be written in the following order:

Menù	Menù Name	IPA	Par. Name	Unit	Value	Note
3	Mot, SetMotorData	2000	Rated Voltage	V		
3	Mot, SetMotorData	2002	Rated Current	A		
3	Mot, SetMotorData	2004	Rated Speed	Rpm		
3	Mot, SetMotorData	2008	Pole Pairs	--		
3	Mot, SetMotorData	2010	Torque Constant	Nm/A		
3	Mot, SetMotorData	2012	EMF constant	Wb		

Set the plate data based on the type of motor connected by following the procedures described above

Rated voltage [V]: the rated voltage of the motor indicated on the data plate.
Rated current [A]: motor rated current; approximately, the value should not be less than 0.3 times the rated current of the drive, output current class 1 @ 400 V on the data plate of the drive.
Rated speed [rpm]: motor rated speed; see data plate.
Pole pairs: Number of motor pole pairs; see data plate.
Torque constant (KT): (KT) Ratio between the torque generated by the motor and the current required to supply it.
EMF constant: (KE = KT / √3) Electromotive force constant, which represents the ratio between motor voltage and motor rated speed. If set to zero calculate automatically from Kt.

Note ! When data entry is complete the **Take parameters** command is executed automatically (menu 16 MOTOR DATA, PAR: 2020). The motor data entered during the STARTUP WIZARD procedure are saved in a RAM memory to enable the drive to perform the necessary calculations.
These data are lost if the device is switched off. To save the motor data follow the procedure described in step 12.

At the end of the procedure proceed to step 4.

Step 4 – Self-tuning with rotating motor / at stand-still or coupled to the load

The drive carries out the motor autotune procedure (real measurement of motor parameters). Autotuning may take a few minutes.

Note ! If this operation generates an error message (e.g. Error code 1), check the connections of the power and control circuits (see step 1 - Connections), check the motor data settings (see step 2 - Setting motor parameters) and then repeat the guided Autotune procedure.

Note ! Autotuning command can be cancel at any time by pressing 

With Local Keypad

Step 4A - Self-tuning with rotating motor (Autotune rotation)

Use this procedure when the motor is not coupled or the transmission does not represent more than 5% of the load. This procedure obtains the most accurate data.

(1) Press the **Enter** key to proceed to the autotune procedure.

(2) Press the **Enter** key to start the autotune procedure.

(3) Enable the drive by connecting terminal 9 (Enable) to terminal 12 (+24 V). To abort this operation, press the **Prg** key.

(4) Once the drive is enabled the autotune procedure starts. This may take a few minutes, depending on the type of motor being used.

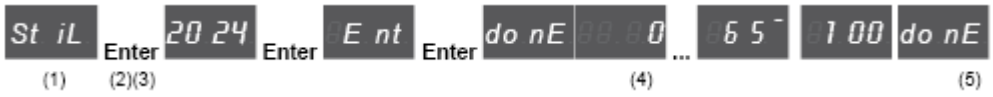
(5) At the end of the procedure the following screen is displayed. After opening the Enable contact, proceed to step 4. Press the **Prg** x2 and ▼keys.

Note! At the end of the autotune procedure there is a request to open the Enable contact (terminals 9 - 12); this results in the automatic execution of the **Take tune parameters** command (menu 16 MOTOR DATA, PAR: 2078).

The calculated parameters are saved in a RAM memory to enable the drive to perform the necessary calculations. These data are lost if the device is switched off. To save the motor data follow the procedure described in step 12.

Step 4B - Self-tuning with motor at stand-still or coupled to the load (Autotune still)

Use this procedure when the motor is coupled to the transmission and cannot rotate freely.



(1) Press the **Enter** key to proceed to the autotune procedure.

(2) Press the **Enter** key to start the autotune procedure.

(3) Enable the drive by connecting terminal 9 (Enable) to terminal 12 (+24 V). To abort this operation, press the **Prg** key.

(4) Once the drive is enabled the autotune procedure starts. This may take a few minutes, depending on the type of motor being used.

(5) At the end of the procedure the following screen is displayed. After opening the Enable contact, proceed to step 4. Press the **Prg** x2 and ▼keys **x2**.

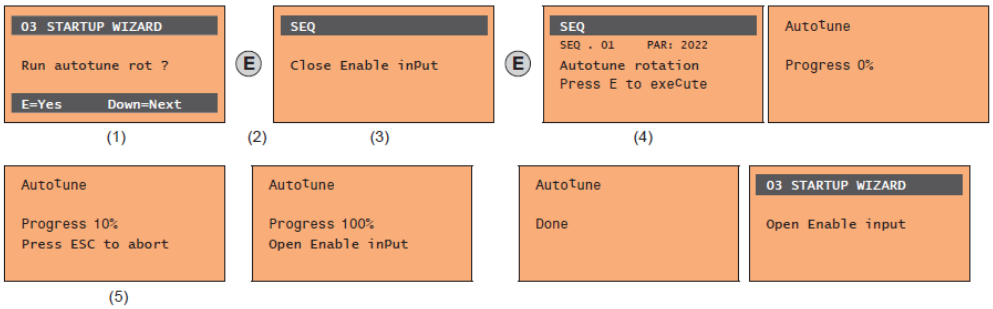
Note! At the end of the autotune procedure there is a request to open the Enable contact (terminals 9 - 12); this results in the automatic execution of the **Take tune parameters** command (menu 16 MOTOR DATA, PAR: 2078).

The calculated parameters are saved in a RAM memory to enable the drive to perform the necessary calculations. These data are lost if the device is switched off. To save the motor data follow the procedure described in step 12.

With Alphanumerical keypad:

Step 4A - Self-tuning with rotating motor (Autotune rotation)

Use this procedure when the motor is not coupled or the transmission does not represent more than 5% of the load. This procedure obtains the most accurate data.



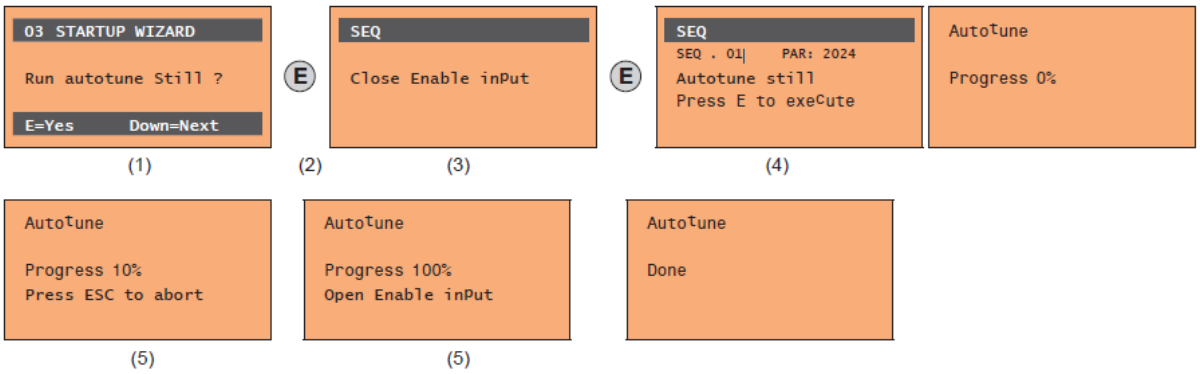
Step 4B - Self-tuning with motor at stand-still or coupled to the load (Autotune still)

Use this procedure when the motor is coupled to the transmission and cannot rotate freely.

Caution

May cause limited rotation of the shaft.

If you press the “Autotune rotation” or “Autotune still” button, the following message appears:



(1) Press the **E** key to proceed to the autotune procedure.

(2) Press the **E** key to start the autotune procedure.

(3) Enable the drive by connecting terminal 9 on the I/O card (Enable) to terminal 12 (+24 V). To abort this operation, press the **ESC** key.

(4) Once the drive is enabled the autotune procedure starts. This may take a few minutes, depending on the type of motor being used.

(5) At the end of the procedure the following screen is displayed. After opening the Enable contact, proceed to step 5.

Note!

At the end of the autotune procedure there is a request to open the Enable contact (terminals 9 - 12); this results in the automatic execution of the **Take tune parameters** command (menu 16 MOTOR DATA, PAR: 2078).

The calculated parameters are saved in a RAM memory to enable the drive to perform the necessary calculations. These data are lost if the device is switched off. To save the motor data follow the procedure described in step 9.

Step 5 – Setting encoder parameters (Standard card EXP-RES-I1-ADP)

Caution

The incorrect configuration of the encoder tension can permanently damage the device; therefore, it is advisable to check the values on the encoder's specification plate.

Menù	Menù Name	IPA	Par. Name	Unit	Def.Value	Note
3	Enc, SetEncoderParam	2100	Encoder1 Pulses	ppr	4	Do not Change
3	Enc, SetEncoderParam	2186	Poles/EncRev0=off	--	0	Do not Change
3	Enc, SetEncoderParam	2102	Encoder 1 Supply	V	5.2	
3	Enc, SetEncoderParam	2116	Resolver Pole Pairs	-	1	
3	Enc, SetEncoderParam	2108	ResolverFrequency	Hz	5000	
3	Enc ,SetEncoderParam	2120	ResolverTRatioK	-	0.5	

Enter the resolver / encoder parameters and then go to the next step.

Step 6 - Encoder phasing

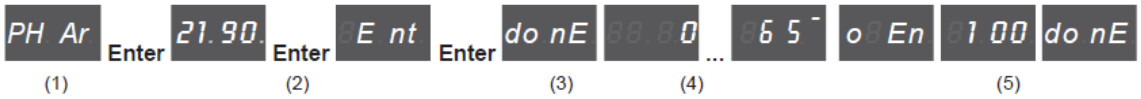
ADP200 drives have a command to start automatic phasing of the resolver.
Phasing must be repeated whenever:

- the drive is replaced (alternatively, download parameters taken from previous drive)
- the motor is replaced
- the encoder is replaced

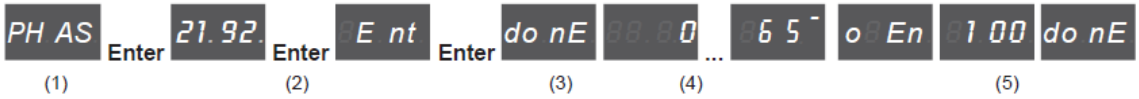
Note ! For more information see parameters 17.23 PAR 2190 **Autophase rotation** and 17.24 PAR 2192 **Autophase still** on "Functions description and parameters list" manual (ADP200 Vector inverter for Hybrid injection molding machines). See section A.3.2 Phasing in the Appendix for further information (ADP200 QS manual).

With Local Keypad

Step 6A - Encoder phasing with rotating motor



Step 6B - Encoder phasing with still motor



(1) Press the **Enter** key to proceed to the autotune procedure.

(2) Press the **Enter** key to start the autotune procedure.

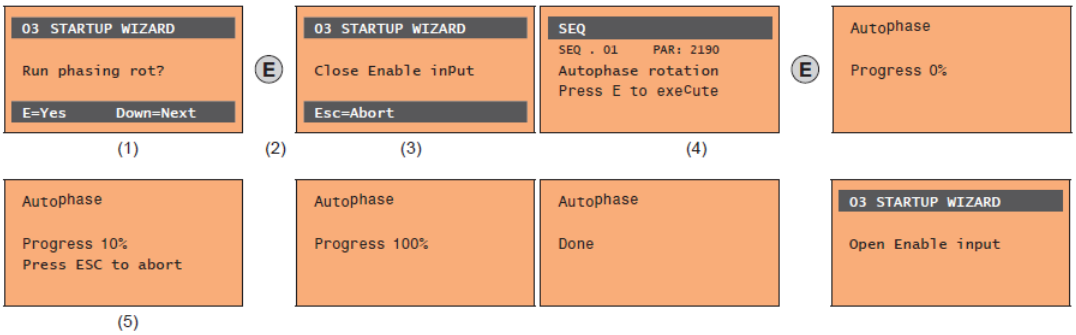
(3) Enable the drive by connecting terminal 9 on the I/O card (Enable) to terminal 12 (+24 V). To abort this operation, press the **Prg** key.

(4) Once the drive is enabled the autophase procedure starts. This may take a few minutes, depending on the type of motor being used.

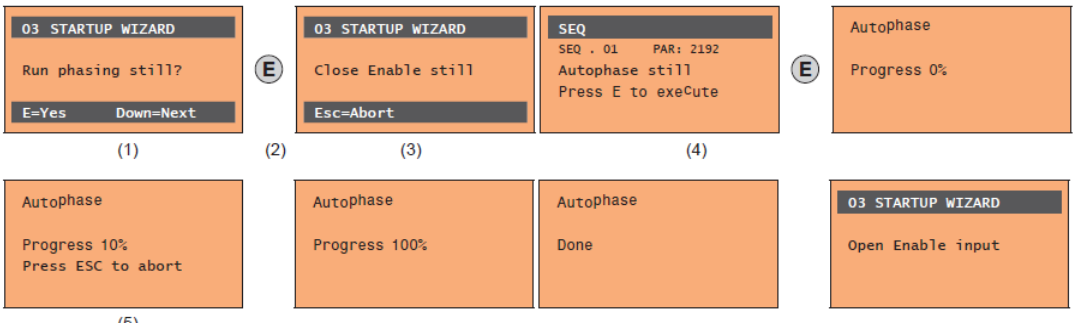
(5) At the end of the procedure the following screen is displayed. After opening the Enable contact, proceed to step 6. Press the **Prg** x2 and ▼keys.

With Alphanumerical keypad:

Step 6A - Encoder phasing with rotating motor



Step 6B - Encoder phasing with still motor



(1) Press the **E** key to proceed to the autotune procedure.

(2) Press the **E** key to start the autotune procedure.

(3) Enable the drive by connecting terminal 9 on the I/O card (Enable) to terminal 12 (+24 V). To abort this operation, press the **ESC** key.

(4) Once the drive is enabled the autophase procedure starts. This may take a few minutes, depending on the type of motor being used.

(5) At the end of the procedure the following screen is displayed. After opening the Enable contact, proceed to step 7.

Step 7 - Setting speed parameters

Setting the maximum speed reference value: this defines the maximum motor speed value (in rpm) that can be reached with each single reference signal (analog or digital).
Setting of the threshold above which the **Overspeed** alarm [23] is enabled.

Menù	Menù Name	IPA	Par. Name	Unit	Def.Value	Note
3	SdPM, SetMaxSpeed	680	FullScaleSpeed	rpm	2000	
3	SdPM, SetMaxSpeed	4540	OverspeedThreshold	rpm	2400	

Note! The factory (default) setting depends on the size of the drive that is connected. These values refer to the ADP200-2110-...

Go to the next step.

Step 8 – Motor overload setting

Enabling of the motor overload control, setting of the motor overload value (the value is expressed as a percentage of **Rated current** PAR 2002 * **Motor service factor** PAR 3206 and setting of the motor overload duration in seconds).

Menù	Menù Name	IPA	Par. Name	Unit	Def.Value	Note
3	MtoL,SetMotoroerload	3200	Motor ovld enable		OFF	Value: OFF - ON
3	MtoL,SetMotoroerload	3202	Motor ovld factor	%	150	
3	MtoL,SetMotoroerload	3204	Motor ovld time	S	30.0	

If used, enables entering of motor overload values.
Proceed to the next step.

Step 9 – Braking resistor setting

External braking resistor: enabling of the overload control, setting of the resistance value and of the power that can be continuously dissipated.

Menù	Menù Name	IPA	Par. Name	Unit	Def.Value	Note
3	br, SetBrakingres	3250	Bres control		OFF	0=OFF 1=ON
3	br, SetBrakingres	3252	Bres value	ohm		
3	br, SetBrakingres	3254	Bres cont power	kw		

Enable and enter plate values of the braking resistor connected to the drive.

Go to the next step.

4.2.2 Application Startup Wizard

Step 10 - Setting PID_IMM application parameters

Enter the nominal speed of the pump, the nominal pressure value, and the full-scale of the pressure sensor. Here we can set the PID IMM parameter starting from the basic machine settings.

Menù	Menù Name	IPA	Par. Name	Unit	Def.Value	Note
3	PlcP, SetApplicationPar	11004	NominalPumpSpeed	Rpm	2400	
3	PlcP, SetApplicationPar	11006	NominalPumpPress	bar	140	
3	PlcP, SetApplicationPar	11008	FullScalePresSens	bar	200	
3	PlcP, SetApplicationPar	11014	AutoSetup		OFF	0=OFF 1=ON

Machine Setting insert the machine parameters.
Example:

Ipa 11004	Nominal pump speed	2400 rpm
Ipa 11006	Nominal Pump pressure	140 bar
Ipa 11008	Full Scale Press Sens	200 bar

AutoSetup command

The application can automatically set the typical configuration with PID-IMM using analog and digital I/Os by using the IPA 11014 **AutoSetup** command.
Set Auto Setup -> ON, the application run automatically the setup and at the end bring it to OFF.

The recipe list on the default drive is empty, but is completed with preset parameters at the AUTO-SETUP command (IPA 11014), which normally must be enabled at this stage of commissioning of the drive. See the appendix for more information about the recipe list

Paragraph 5.1.1 “List of parameters for CONFIGURATION MENU” in the ADP PID-IMM manual shows more detail about the preset recipe at the Auto-Setup command.

Go to next step.

Step 11 – Analog input setting

Analog inputs (integrated and from optional expansion card): selection of the type of input (voltage or current) and self-tuning command for the relative analog inputs gain.

The analog input can be changed according the type of pressure sensor used. The application offset and gain tuning of the analog sensors are required.
For more detail about analog input tuning sequence and parameters see ADP200 FP (Function Parameter) Manual.
Here the most important information.
For the **pressure sensor** analog input (**AnInp1Std**) offset command can be done with zero pressure while Gain require the maximum pressure and should be done only when the machine is running.
For the **Pressure and Flow (speed) reference**, coming from the machine PLC.
Set the two reference to zero value and perform, offset command for the two analog input (**AnInp1Exp and AnInp2Exp**).
Set the two reference to 100% and perform, gain command for the two analog input (AnInp1Exp and AnInp2Exp).

Menù	Menù Name	IPA	Par. Name	Unit	Def.Value	Note
3	Ain, SetAnalogInput	1502	AnalogInp1type		8=0..10V	**0=** -10V…+10V

						1= 0.20mA … 10V **2=** 4..20mA **3=** 0..30mA **7=** 0.1V..10.1V **8=** 0..10.1V
3	Ain, SetAnalogInput	1506	AnInp1OffsetTune		OFF	0=OFF 1=ON
3	Ain, SetAnalogInput	1602	AnalogInp1xtype		0..10V	**0=** -10V…+10V **1=** 0.20mA … 10V **2=** 4..20mA **3=** 0..30mA **7=** 0.1V..10.1V **8=** 0..10.1V
3	Ain, SetAnalogInput	1606	AnInp1xOffsetTune		OFF	0=OFF 1=ON
3	Ain, SetAnalogInput	1608	AnInp1xGainTune		OFF	0=OFF 1=ON
3	Ain, SetAnalogInput	1652	AnalogInp2type		0..10V	**0=** -10V…+10V **1=** 0.20mA … 10V **2=** 4..20mA **3=** 0..30mA **7=** 0.1V..10.1V **8=** 0..10.1V
3	Ain, SetAnalogInput	1656	AnInp2OffsetTune		OFF	0=OFF 1=ON
3	Ain, SetAnalogInput	1658	AnInp1xGainTune		OFF	0=OFF 1=ON

Go to next step.

Step 12 - Save parameters

To save the new parameter settings, so that they are maintained also after power-off, proceed as follows:

Menù	Menù Name	IPA	Par. Name	Unit	Def.Value	Note
3	Save, SavePar	550	SaveParameters		OFF	0=OFF 1=ON

When the parameters have been saved correctly the drive displays the initial screen to show that the startup wizard is complete.

4.2.3 Pump direction of rotation

Step 13: pump direction

Gear pumps are able to generate pressure by rotating only in one direction. Wrong pump direction of rotation can lead to pump damage. User must identify pump direction of rotation correctly and setting the correct direction in the parameter **Ipa 11010 Pump Direction** NEGATIVE o POSITIVE in CONFIGURATION menu.

When correct direction of rotation is not known it is possible to check it with this procedure:

1) **Disable drive** (usually bring the enable terminal of regulation board to low level is enough)

2) Set following parameters in CONFIGURATION menu :

Menù	Menù Name	IPA	Par. Name	Unit	Def.Value	Note
26.1.1	PID_IMM/CONFIGURATION	11000	Control Selector		ADP200	1=SPEED 2=ADP200
26.1.6	PID_IMM/CONFIGURATION	11010	Pump Direction		NEGATIVE	0=NEGATIVE 1=POSITIVE

- **Ipa 11000 Control Selector** = SPEED
  Drive control will follow speed reference as from parameter **Ipa 11064 Flow Ref Source** on REFERENCEs menu, neglecting pressure reference; by setting Flow Ref Source to “Digital param”, speed reference can be locally set by **Ipa 11056 Manual Speed Ref** [rpm].
  If actual pressure raises above pressure reference selected by parameter **Ipa 11062 Pressure Ref Source** on REFERENCEs menu, application will trigger an alarm; user can set its own pressure threshold by setting Pressure Ref Source to “Digital param”, so that pressure reference can be locally set by **Ipa 11054 Manual Press Ref** [bar].
- **Ipa 11010 Pump Direction** = NEGATIVE (affects **Ipa 654 Speed ref invert src**)

3) After setting flow and pressure reference for local control, set(in REFERENCEs menu):
   - **Ipa 11054 Manual Pressure Ref** = 100 bar
   - **Ipa 11056 Manual Speed Ref** = 20 rpm

Menù	Menù Name	IPA	Par. Name	Unit	Def.Value	Note
26.3.1	PID_IMM/REFERENCEs	11054	ManualPresRef	bar	30	0=NEGATIVE 1=POSITIVE
26.3.2	PID_IMM/REFERENCEs	11056	ManualSpeedRef	rpm	100	1=SPEED 2=ADP200
26.3.5	PID_IMM/REFERENCEs	11062	PressureRefSource		AnalogInput1	0=DigitalPar 1600=AnalogInput1
26.3.6	PID_IMM/REFERENCEs	11064	FlowRefSource		AnalogInput2	0=DigitalPar 1650=AnalogInput2

In MONITORS menu:

- Check parameters **Ipa 12006 SpeedFbk** and **Ipa 12008 PressureFbk** on MONITORS menu (drag & drop parameters in WEG_Express monitor view)
-

Menù	Menù Name	IPA	Par. Name	Unit	Value	Note
26.18.5	PID_IMM/MONITORS	12006*	Speed Feedback	rpm		
26.18.6	PID_IMM/MONITORS	12008*	Pressure Feedback	rpm		

4) Enable Drive

Motor will turn at -20 rpm. Wait some seconds, if pressure increases it means that selected direction is correct, otherwise repeat same procedure starting from point 1) and changing the parameter **Ipa 11010 Pump Direction** to POSITIVE in CONFIGURATION menu

Menù	Menù Name	IPA	Par. Name	Unit	Def.Value	Note
26.1.6	PID_IMM/CONFIGURATION	11010	Pump Direction		NEGATIVE	0=NEGATIVE 1=POSITIVE

5) Disable Drive

6) Set **Ipa 11000 Control Selector** = ADP200 on CONFIGURATION menu**,** so that both pressure and speed references are processed by application.

7)

Menù	Menù Name	IPA	Par. Name	Unit	Def.Value	Note
26.1.1	PID_IMM/CONFIGURATION	11000	Control Selector		ADP200	1=SPEED 2=ADP200

8) Set pressure reference and flow reference sources (Ipa 11062 and Ipa 11064 respectively) to final assignment (analog inputs or fieldbus process data).

Menù	Menù Name	IPA	Par. Name	Unit	Def.Value	Note
26.3.5	PID_IMM/REFERENCEs	11062	PressureRefSource		AnalogInput1	0=DigitalPar 1600=AnalogInput1
26.3.6	PID_IMM/REFERENCEs	11064	FlowRefSource		AnalogInput2	0=DigitalPar 1650=AnalogInput2

9) Save parameters (DRIVE CONFIGURATION \ Ipa 550 Save parameters)

Menù	Menù Name	IPA	Par. Name	Unit	Def.Value	Note
4.1	DRIVE_CONFIG	550	SaveParameters		OFF	0=OFF 1=ON

4.2.4 PID-IMM tuning

Step 14: PID-IMM tuning
The parameters for the two regulation loops can be found on GAIN menu:

Menù	Menù Name	IPA	Par. Name	Unit	Def.Value	Note
26.5.1	PID_IMM/GAIN	11086	KpPressureControl		1.5	
26.5.2	PID_IMM/GAIN	11088	KiPressureControl		18	
26.5.3	PID_IMM/GAIN	11090	KdPressureControl		0	
26.5.4	PID_IMM/GAIN	11092	DerivativeFilter	hz	100	
26.5.5	PID_IMM/GAIN	11094	KpspeedControl		2.51	
26.5.6	PID_IMM/GAIN	11096	KiSpeedControl		64	
26.5.7	PID_IMM/GAIN	11098	AntiwindupGain		1	

- **Pressure PID Loop**
  - **Ipa 11086 Kp Pressure Control** is the proportional action gain for pressure control (bar -> rad/s)
  - **Ipa 11088 Ki Pressure Control** is the integral action gain for the pressure control (bar -> rad/s_2)
  - **Ipa 11090 Kd for Press Contr** is the derivative action gain for the pressure control (bar -> rad)
  - **Ipa 11092 Derivative filter** is the bandwidth of the filter applied to derivative action (Hz)

- **Speed PI Loop**
  - **Ipa 11094 Kp Speed Control** is the proportion action for speed control (rad/s -> Nm)
  - **Ipa 11196 Ki Speed Control** is the integral action for speed control (rad/s -> Nm/s)

For Speed (flow) loop and pressure loop there are two mode for tuning, **manual tuning** and **automatic tuning.**
In the ADP PID-IMM manual chapter “TUNING menu” there are all information related to speed/ pressure Automatic Tuning sequence. For additional information related how to tune these gains (Manual tuning) see chapter “Gain menu” on the “Application Function List of Parameters” of ADP200 PID-IMM manual.

Here the automatic tuning procedure:

The parameters in TUNING menu allow to perform an automatic calculation of the speed gains and of the pressure gains; then the value calculated can be copied to the working gains parameters.

Speed Loop Auto-Tuning:

The speed loop tuning is done by executing a speed profile. The profile is fixed and it starts from 500 RPM to 1500 RPM with 3s of Ramps.
During this profile, the algorithm will estimate the mechanical parameters of the system. Based on the Speed Loop Bandwidth set on IPA 11480, the algorithm will estimate the Speed Loop Kp (IPA 12150) and Speed Loop Ki (IPA 12152).

Menù	Menù Name	IPA	Par. Name	Unit	Def.Value	Note
26.12.1	PID_IMM/TUNING	11480	SpeedLoopBandwith		200	
26.12.2	PID_IMM/TUNING	11482	SpeedTuningEn		OFF	0=OFF 1=ON
26.12.3	PID_IMM/TUNING	11484	LoadSpLTunedValue		OFF	0=OFF 1=ON
26.12.5	PID_IMM/TUNING	11492	PressTuningEN		OFF	0=OFF 1=ON
26.12.6	PID_IMM/TUNING	11494	LoadPrLTunedValue		OFF	0=OFF 1=ON
26.12.7	PID_IMM/TUNING	12112*	PressLoopKp		0	
26.12.8	PID_IMM/TUNING	12114*	PressLoopKi		0	
26.12.9	PID_IMM/TUNING	12140*	SltTau	s	0	Expert Mode
26.12.10	PID_IMM/TUNING	12142*	SltGain		0	Expert Mode
26.12.11	PID_IMM/TUNING	12150*	SpeedLoopKp		0	
26.12.12	PID_IMM/TUNING	12152*	SpeedLoopKi		0	

In order to execute the **speed loop tuning:**

o) the IMM must be configured, by opening valve or set properly safety valve, in “open loop circuit”. This condition means that motor can rotate with low/no pressure.
o) the Speed reference and Pressure Reference must be set as digital parameter. The Pressure reference needs to be at least 50% more the pressure that is reached at 1500 RPM to avoid that during the speed tuning procedure there are constrain due Pressure Control. (i.e. (IPA 11054) Pressure ref = 100 bar)

To enable the speed loop tuning, the operator has to switch to ON the parameter Speed Tuning En (IPA 11482). After this command, the speed profile for auto-tuning is applied and motor will move from 500 to 1500 Rpm and from 1500 to 500 Rpm. At the end of the procedure the speed comes back to the original speed that operators has set to digital reference (IPA 11056).

The tuned parameters will be shown as:

Speed Loop Kp (IPA 12150) – that is the proportional gain
Speed Loop Ki (IPA 12152) – that is the integral gain
SLT Tau (EXP) (IPA 12140) – that is the time constant of the mechanical system
SLT Gain (EXP) (IPA 12142) – that is the gain of the mechanical system

The ratio between SLT Tau and SLT Gain gives an indication of the Inertia of the system.

Finally in order to apply the calculated value, the operator can switch to ON the parameter “Load SpL Tuned Value” (IPA 11484) that makes a copy and paste of the tuned value to the GAIN menu. As alternative the value can be copy and paste manually.

Pressure Loop Auto-Tuning:

The pressure loop auto tuning requires that the machines is working in “closed loop” and the system must be in pressure. The tuning should be done in the condition where the ratio between Pressure and Speed is higher, typically on IMM this condition is reached in the hold phase after the injection.
The operator must to take a fixed value of pressure reference (this can be done from Digital or Analog) and to put the system in pressure. After this, the operator has to Switch ON the parameter “Press Tuning EN” (IPA 11492). The algorithm will make a 1 Hz of pressure variation and the algorithm will calculate the value of Pressure Loop Kp and Ki (IPA 12112, IPA 12114). The procedure requires about 6 seconds, and at the end of the procedure the pressure reference variation is automatically disabled.
In order to make active the tuned value, the operator has to switch ON the parameter “Load PrL Tuned Value” (IPA 11494)

Note!	the automatic tuning procedure, both Speed and Pressure is based on “standard machine” and it has general hypothesis. The operator, prior to switch On the procedure that apply the tuned parameters (IPA 11484 and 11494) must check that value estimated are “reasonable” in the proper range. If operator is not sure about the calculated value, repeat the procedure or proceed by changing the value manually When IPA 11484 and 11494 are switched ON, the tuned parameters are immediately applied. As recommendation, this operation should be done when enable is OFF or at least operator must be ready about the change.

4.3 Commissioning via WEG_eXpress

This section describes a standard application commissioning procedure using a PC with WEG WEG-eXpress configurator.

The startup with a PC require WEG WEG-eXpress version 1.9.15 or higher and Catalog 2.38.0 or higher installed, the RS485 - PCI COM connection kit to the drive.

WEG-eXpress and Catalog setup files can be download from the WEG website: (https://www.weg.net/...).

In factory configuration ADP200 - PID-IMM application is in Application 1 that is Enabled (Menu DRIVE CONFIG Parameter IPA558 Application Select = 1 in expert mode).

When you connect the PC to the Modbus serial port of the drive and open WEG-eXpress, you will find and open this file:

If you press select you open ADP200 Fw4.x.1 with PID_IMM application FW V 3.x.37.3.

.

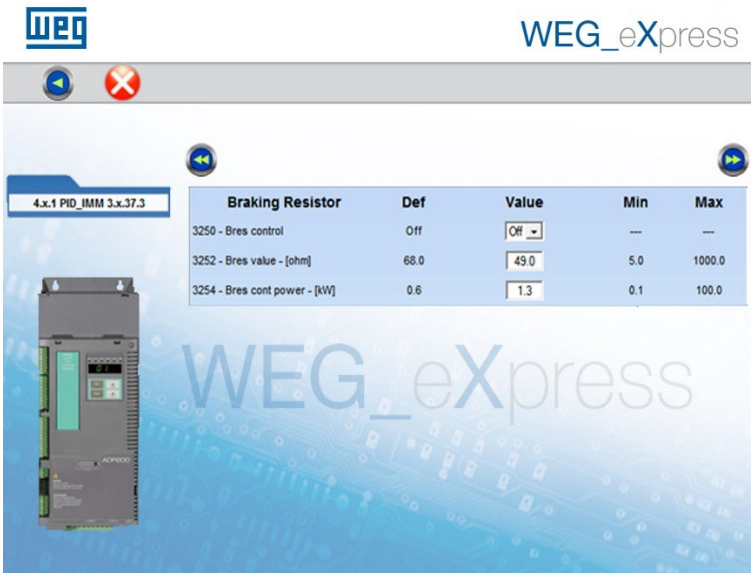
4.3.1 Basic Startup Wizard

Step 1 – Start wizard

To start the guided installation, press “WIZARD” The following page appears:

Step 2 – Motor overtemperature setting

Motor OT protection management: selection of the source, threshold and sensor type setting, behavior of the drive in case of a motor overtemperature alarm.



Next page.

Set the proper power supply voltage value from factory 400V.

Press the forward key to display the next page setting motor parameters.

Step 3 – Setting the motor parameters

Set the plate data based on the type of motor connected by following the procedures described above

Rated voltage [V]: the rated voltage of the motor indicated on the data plate.
Rated current [A]: motor rated current; approximately, the value should not be less than 0.3 times the rated current of the drive, output current class 1 @ 400 V on the data plate of the drive.
Rated speed [rpm]: motor rated speed; see data plate.
Pole pairs: Number of motor pole pairs; see data plate.
Torque constant (KT): (KT) Ratio between the torque generated by the motor and the current required to supply it.
EMF constant: (KE = KT / √3) Electromotive force constant, which represents the ratio between motor voltage and motor rated speed. If set to zero calculate automatically from Kt.

Note ! When data entry is complete the **Take parameters** command is executed automatically (menu 16 MOTOR DATA, PAR: 2020). The motor data entered during the STARTUP WIZARD procedure are saved in a RAM memory to enable the drive to perform the necessary calculations.
These data are lost if the device is switched off. To save the motor data follow the procedure described in step 12.

Press the forward key to display the next page for autotuning (step 4).

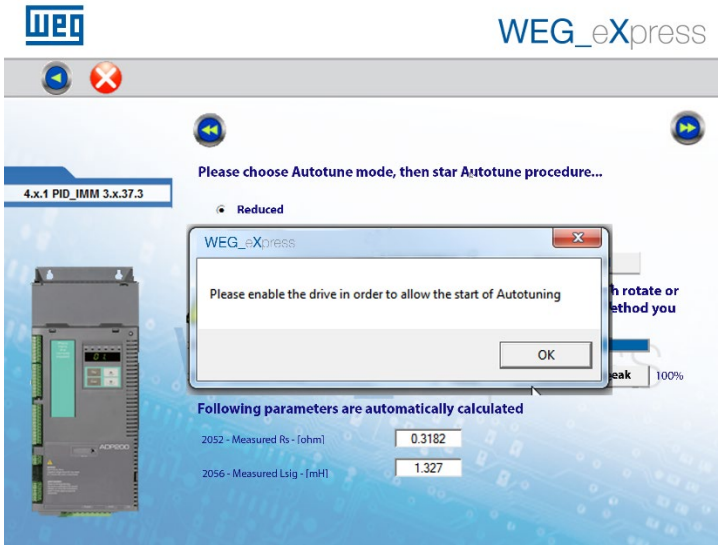
Step 4 – Self-tuning with rotating motor / at stand-still or coupled to the load

The drive carries out the motor autotune procedure (real measurement of motor parameters). Autotuning may take a few minutes.

Note !	If this operation generates an error message (e.g. Error code 1), check the connections of the power and control circuits (see step 1 - Connections), check the motor data settings (see step 3 - Setting motor parameters) and then repeat the guided Autotune procedure.

Note !	Autotuning command can be cancel at any time by pressing

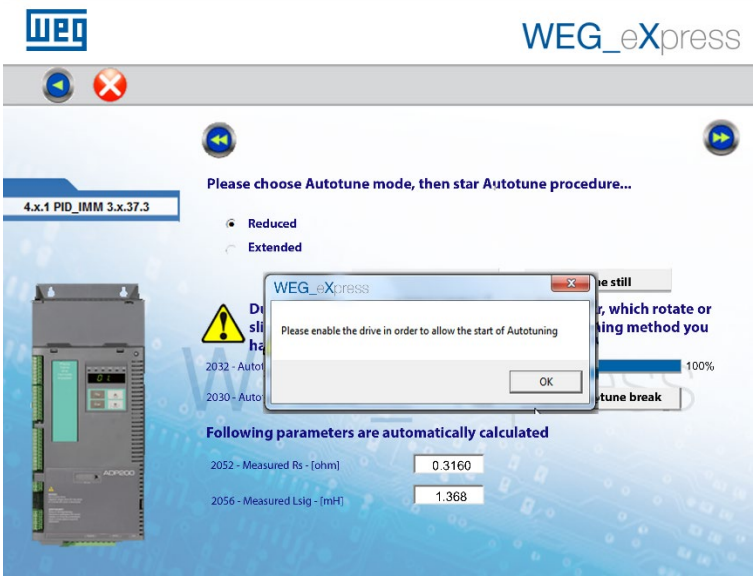
If you press the “Autotune rotation” or “Autotune still” button, the following message appears:



Bring the Enable input to 24V, then press the “Autotune rotation” or “Autotune still” button. The autotune sequence starts. The percentage of progress is shown on the “autotune progress” bar.

When autotuning is done the bar is at 100%. Autotune status is “Done,” as shown in the following figure:

If you press the forward button, the following message appears:



Return the Enable input to 0V and press the forward key to go to the next page.

Step 5 – Setting encoder parameters

Caution

The incorrect configuration of the encoder tension can permanently damage the device; therefore, it is advisable to check the values on the encoder's specification plate.

Enter the resolver / encoder parameters and then go to the next page.

Step 6 - Encoder phasing

ADP200 drives have a command to start automatic phasing of the resolver.
Phasing must be repeated whenever:

- the drive is replaced (alternatively, download parameters taken from previous drive)
- the motor is replaced
- the encoder is replaced

Note !	For more information see parameters 17.23 PAR 2190 **Autophase rotation** and 17.24 PAR 2192 **Autophase still** on "Functions description and parameters list" manual (ADP200 Vector inverter for Hybrid injection molding machines). See section A.3.2 Phasing in the Appendix for further information (ADP200 QS manual).

If you press the “Autophase rotation” or “Autophase still” button, the following message appears:

Bring the Enable input to 24V, then press the “Autophase rotation” or “Autophase still” button. The autophase sequence starts. The percentage of progress is shown on the “autophase progress” bar.

When autophasing is done the bar is at 100%. Autophase status is “Done,” as shown in the following figure:

Return the Enable input to 0V and press the forward key to go to the next page.

Step 7 - Setting speed parameters

Setting the maximum speed reference value: this defines the maximum motor speed value (in rpm) that can be reached with each single reference signal (analog or digital).
Setting of the threshold above which the **Overspeed** alarm [23] is enabled.

Enter the full-scale speed value. The overspeed threshold is automatically calculated.

Go to the next page.

Speed loop tuning values are on this page. With PID-IMM application leave the factory value; i**n the chapter PID-IMM Tuning there are the Auto-Tuning procedure that automatically calculate the Gains.**
See the “ADP200FP-SYN & ADP200 PID-IMM” manual for detailed information.

Next page.

Step 8 – Motor overload setting

Enabling of the motor overload control, setting of the motor overload value (the value is expressed as a percentage of **Rated current** PAR 2002 * **Motor service factor** PAR 3206 and setting of the motor overload duration in seconds).

If used, enables entering of motor overload values.

Next page.

Step 9 – Braking resistor setting

External braking resistor: enabling of the overload control, setting of the resistance value and of the power that can be continuously dissipated.

Enable and enter plate values of the braking resistor connected to the drive.

Next page.

4.3.2 Application Startup Wizard

Step 10 - Setting PID_IMM application parameters

Enter the nominal speed of the pump, the nominal pressure value, and the full-scale of the pressure sensor.

Here we can set the PID IMM parameter starting from the basic machine settings.

Basic Control Settings in menù PID_IMM \CONFIGURATION
Machine Setting insert the machine parameters.
Example:

Ipa 11132 Nominal pump speed	2400 rpm
Ipa 11134 Nominal Pump pressure	140 bar
Ipa 11136 Full Scale Press Sens	200 bar
Ipa 11094 Analog pressure gain	1.00

AutoSetup command

The application can automatically set the typical configuration with PID-IMM using analog and digital I/Os by using the IPA 11014 **AutoSetup** command.
Set Auto Setup -> ON, the application run automatically the setup and at the end bring it to OFF.

The recipe list on the default drive is empty, but is completed with preset parameters at the AUTO-SETUP command (IPA 11014), which normally must be enabled at this stage of commissioning of the drive. See the appendix for more information about the recipe list.

Paragraph 5.1.1 “List of parameters for CONFIGURATION MENU” in the ADP PID-IMM manual shows more detail about the preset recipe at the Auto-Setup command.

Step 10A – Setting PID_IMM parameters for multi-pump

In case of Multi-Pump application, set the following parameters according to the instructions given on the **MULTIPUMP** menu.

Next page:

In case of Multi-Pump application, set the following CAN config parameters according to the instructions given in the **MULTIPUMP** paragraph and on the **CAN** menu.

Next page.

Step 11 – Analog input setting

Analog inputs (integrated and from optional expansion card): selection of the type of input (voltage or current) and self-tuning command for the relative analog inputs gain.

The analog input can be changed according the type of pressure sensor used. The application offset and gain tuning of the analog sensors are required.
For more detail about analog input tuning sequence and parameters see ADP200 FP (Function Parameter) Manual. Here the most important information. For the pressure sensor analog input (AnInp1Std) offset command can be done with zero pressure while Gain require the maximum pressure and should be done only when the machine is running. For the Pressure and Flow (speed) reference, coming from the machine PLC. Set the two reference to zero value and perform, offset command for the two analog input (AnInp1Exp and AnInp2Exp). Set the two reference to 100% and perform, gain command for the two analog input (AnInp1Exp and AnInp2Exp).

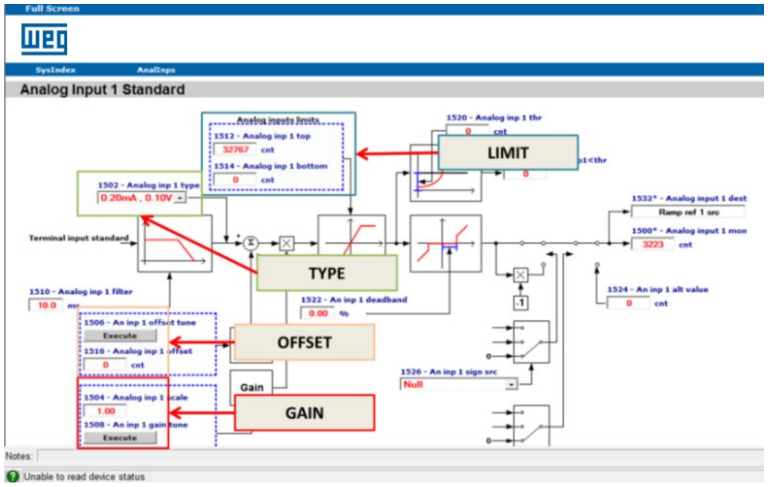


Figure : WEG_Express Analog Input Offset & Gain

Next page.

Step 12 - Save parameters

To save the new parameter settings, so that they are maintained also after power-off, proceed as follows:

When the parameters have been saved correctly the drive displays the initial screen to show that the startup wizard is complete.

4.3.3 Pump direction of rotation

Step 13: pump direction

Gear pumps are able to generate pressure by rotating only in one direction. Wrong pump direction of rotation can lead to pump damage. User must identify pump direction of rotation correctly and setting the correct direction in the parameter **Ipa 11010 Pump Direction** NEGATIVE o POSITIVE in CONFIGURATION menu.

When correct direction of rotation is not known it is possible to check it with this procedure:

10) **Disable drive** (usually bring the enable terminal of regulation board to low level is enough)

11) Set following parameters in CONFIGURATION menu :
- **Ipa 11000 Control Selector** = SPEED
  Drive control will follow speed reference as from parameter **Ipa 11064 Flow Ref Source** on REFERENCEs menu, neglecting pressure reference; by setting Flow Ref Source to "Digital param", speed reference can be locally set by **Ipa 11056 Manual Speed Ref** [rpm].
  If actual pressure raises above pressure reference selected by parameter **Ipa 11062 Pressure Ref Source** on REFERENCEs menu, application will trigger an alarm; user can set its own pressure threshold by setting Pressure Ref Source to "Digital param", so that pressure reference can be locally set by **Ipa 11054 Manual Press Ref** [bar].
- **Ipa 11010 Pump Direction** = NEGATIVE (affects **Ipa 654 Speed ref invert src**)

12) After setting flow and pressure reference for local control, set(in REFERENCEs menu):
- **Ipa 11056 Manual Speed Ref** = 20 rpm
- **Ipa 11054 Manual Pressure Ref** = 100 bar

In MONITORS menu:
- Check parameters **Ipa 12006 SpeedFbk** and **Ipa 12008 PressureFbk** on MONITORS menu (drag & drop parameters in WEG_Express monitor view)

Figure 25 Monitor view di WEG_Express

13) Enable Drive

Motor will turn at -20 rpm. Wait some seconds, if pressure increases it means that selected direction is correct, otherwise repeat same procedure starting from point 1) and changing the parameter **Ipa 11010 Pump Direction** to POSITIVE in CONFIGURATION menu

14) Disable Drive

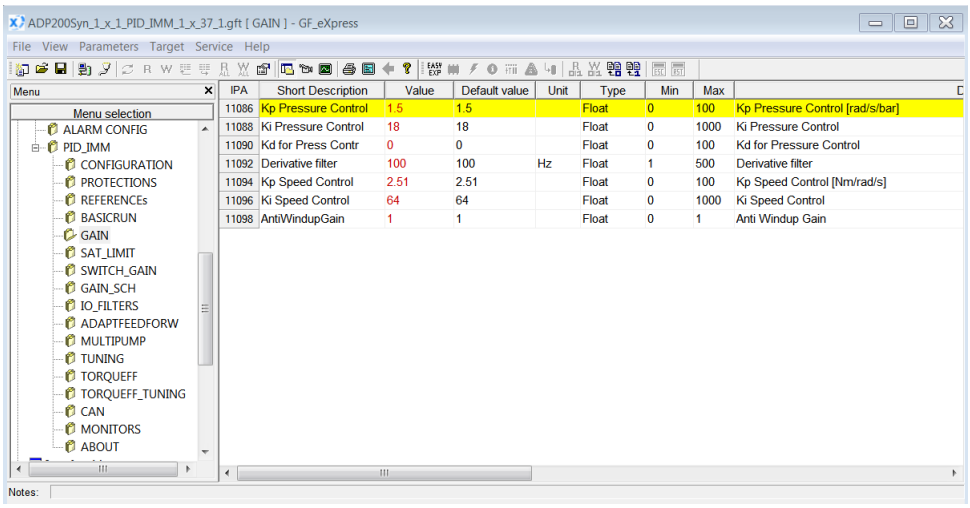
15) Set **Ipa 11000 Control Selector** = ADP200 on CONFIGURATION menu**,** so that both pressure and speed references are processed by application.

16) Set pressure reference and flow reference sources (Ipa 11062 and Ipa 11064 respectively) to final assignment (analog inputs or fieldbus process data).

17) Save parameters (DRIVE CONFIGURATION \ Ipa 550 Save parameters)

4.3.4 PID-IMM tuning

Step 14: PID-IMM tuning
The parameters for the two regulation loops can be found on GAIN menu:



IPA	Short Description	Value	Default value	Unit	Type	Min	Max	D
11086	Kp Pressure Control	1.5	1.5		Float	0	100	Kp Pressure Control [rad/s/bar]
11088	Ki Pressure Control	18	18		Float	0	1000	Ki Pressure Control
11090	Kd for Press Contr	0	0		Float	0	100	Kd for Pressure Control
11092	Derivative filter	100	100	Hz	Float	1	500	Derivative filter
11094	Kp Speed Control	2.51	2.51		Float	0	100	Kp Speed Control [Nm/rad/s]
11096	Ki Speed Control	64	64		Float	0	1000	Ki Speed Control
11098	AntiWindupGain	1	1		Float	0	1	Anti Windup Gain

Figure 25: PID_IMM Gain

- **Pressure PID Loop**
  - **Ipa 11086 Kp Pressure Control** is the proportional action gain for pressure control (bar -> rad/s)
  - **Ipa 11088 Ki Pressure Control** is the integral action gain for the pressure control (bar -> rad/s$_2$)
  - **Ipa 11090 Kd for Press Contr** is the derivative action gain for the pressure control (bar -> rad)
  - **Ipa 11092 Derivative filter** is the bandwidth of the filter applied to derivative action (Hz)

- **Speed PI Loop**
  - **Ipa 11094 Kp Speed Control** is the proportion action for speed control (rad/s -> Nm)
  - **Ipa 11196 Ki Speed Control** is the integral action for speed control (rad/s -> Nm/s)

For Speed (flow) loop and pressure loop there are two mode for tuning, **manual tuning** and **automatic tuning.**
In the ADP PID-IMM manual chapter “TUNING menu” there are all information related to speed/ pressure Automatic Tuning sequence. For additional information related how to tune these gains (Manual tuning) see chapter “Gain menu” on the “Application Function List of Parameters” of ADP200 PID-IMM manual.

Here the automatic tuning procedure:

The parameters in TUNING menu allow to perform an automatic calculation of the speed gains and of the pressure gains; then the value calculated can be copied to the working gains parameters.

Speed Loop Auto-Tuning:

The speed loop tuning is done by executing a speed profile. The profile is fixed and it starts from 500 RPM to 1500 RPM with 3s of Ramps.
During this profile, the algorithm will estimate the mechanical parameters of the system. Based on the Speed Loop Bandwidth set on IPA 11480, the algorithm will estimate the Speed Loop Kp (IPA 12150) and Speed Loop Ki (IPA 12152).

In order to execute the **speed loop tuning:**
o) the IMM must be configured, by opening valve or set properly safety valve, in “open loop circuit”. This condition means that motor can rotate with low/no pressure.
o) the Speed reference and Pressure Reference must be set as digital parameter. The Pressure reference needs to be at least 50% more the pressure that is reached at 1500 RPM to avoid that during the speed tuning procedure there are constrain due Pressure Control. (i.e. (IPA 11054) Pressure ref = 100 bar)

To enable the speed loop tuning, the operator has to switch to ON the parameter Speed Tuning En (IPA 11482). After this command, the speed profile for auto-tuning is applied and motor will move from 500 to 1500 Rpm and from 1500 to 500 Rpm. At the end of the procedure the speed comes back to the original speed that operators has set to digital reference (IPA 11056).

The tuned parameters will be shown as:

Speed Loop Kp (IPA 12150) – that is the proportional gain
Speed Loop Ki (IPA 12152) – that is the integral gain
SLT Tau (EXP) (IPA 12140) – that is the time constant of the mechanical system
SLT Gain (EXP) (IPA 12142) – that is the gain of the mechanical system

The ratio between SLT Tau and SLT Gain gives an indication of the Inertia of the system.

Finally in order to apply the calculated value, the operator can switch to ON the parameter “Load SpL Tuned Value” (IPA 11484) that makes a copy and paste of the tuned value to the GAIN menu. As alternative the value can be copy and paste manually.

Pressure Loop Auto-Tuning:

The pressure loop auto tuning requires that the machines is working in “closed loop” and the system must be in pressure. The tuning should be done in the condition where the ratio between Pressure and Speed is higher, typically on IMM this condition is reached in the hold phase after the injection.
The operator must to take a fixed value of pressure reference (this can be done from Digital or Analog) and to put the system in pressure. After this, the operator has to Switch ON the parameter “Press Tuning EN” (IPA 11492). The algorithm will make a 1 Hz of pressure variation and the algorithm will calculate the value of Pressure Loop Kp and Ki (IPA 12112, IPA 12114). The procedure requires about 6 seconds, and at the end of the procedure the pressure reference variation is automatically disabled.
In order to make active the tuned value, the operator has to switch ON the parameter “Load PrL Tuned Value” (IPA 11494)

Note!	the automatic tuning procedure, both Speed and Pressure is based on “standard machine” and it has general hypothesis. The operator, prior to switch On the procedure that apply the tuned parameters (IPA 11484 and 11494) must check that value estimated are “reasonable” in the proper range. If operator is not sure about the calculated value, repeat the procedure or proceed by changing the value manually When IPA 11484 and 11494 are switched ON, the tuned parameters are immediately applied. As recommendation, this operation should be done when enable is OFF or at least operator must be ready about the change.

4.4 Machine Test

Step 15: machine test

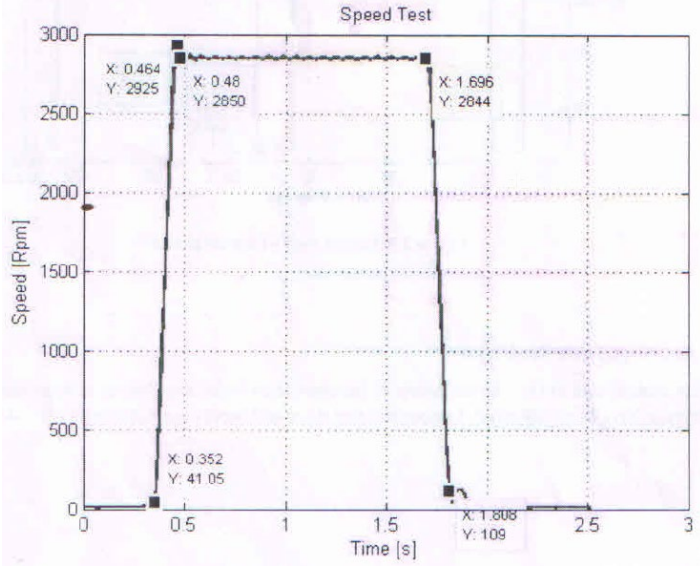
Aim of the test is to verify that WEG ADP200 PID-IMM drive can meet the customer requirement.
First it's very important to take all the machine information.
The following Table is one example of how to document all the information relating to the machine test:

System: Machine Duplomatic 160 Bar (Single Pump)											
Drive		**Motor**		**Sensor**		**Pumps**		**Pump System**		**Machine**	
Brand used	Gefran ADP200	Type	Gefran	Brand	GEFRAN	Brand	DUPLOMATIC	Single	X	Tons	
Size	18,5 kW	Brand	SBM	Connection	Voltage 0..10 V	Model	IGP4-020-R01 / 10	Convergent		Inverter Cabinet	
Braking Res.	no	Name plate code:	SBM84303542K257F	Number of sensors:	1	Nom Flow	60Lt/1' @ 3000rpm	Divergent			
Model	ADP200S-3185-KBX-C	Inertia	-	Model	KS-N-E-Z-B02C-N-Y-2130Z	Nom Press	160Bar			Nominal Flow	2400Rpm
		Nom Speed	3000Rpm	Pressure Range	0..200BAR	cc/Rev	20cc/giro			Nominal Pres.	160Bar
		Rat Current	33.09A			Number of pumps	1				
		Nom Power	15.6Kw			Speed Max	3200Rpm				
		Kt	1.5Nm/A								
		Voltage Vn	301V								
		FeedBack	Resolver LTN RE15_21_03_02								
		POLE	8P								
		Torque	49.8Nm								
Notes:											

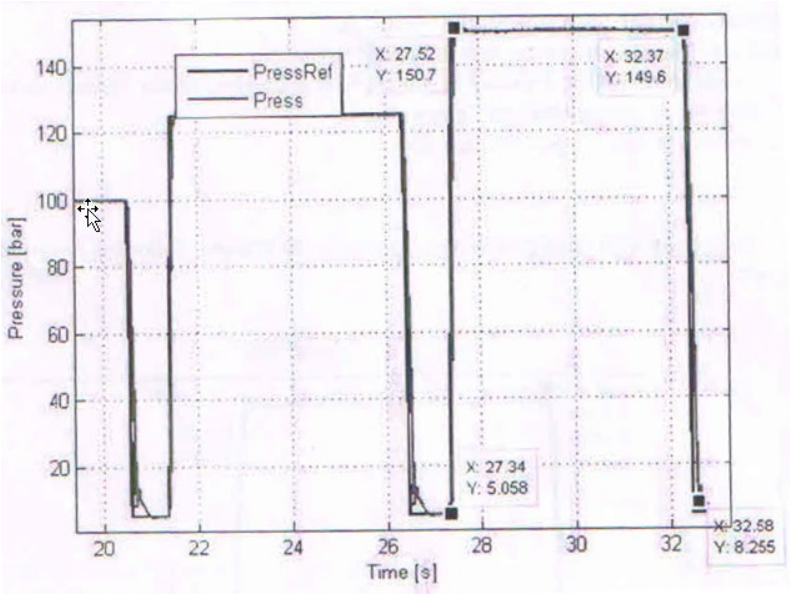
The complete checklist of the machine test are done in accordance with the customer (validation test). In this chapter there are some guidelines that can be helpful for this scope.

Test list:

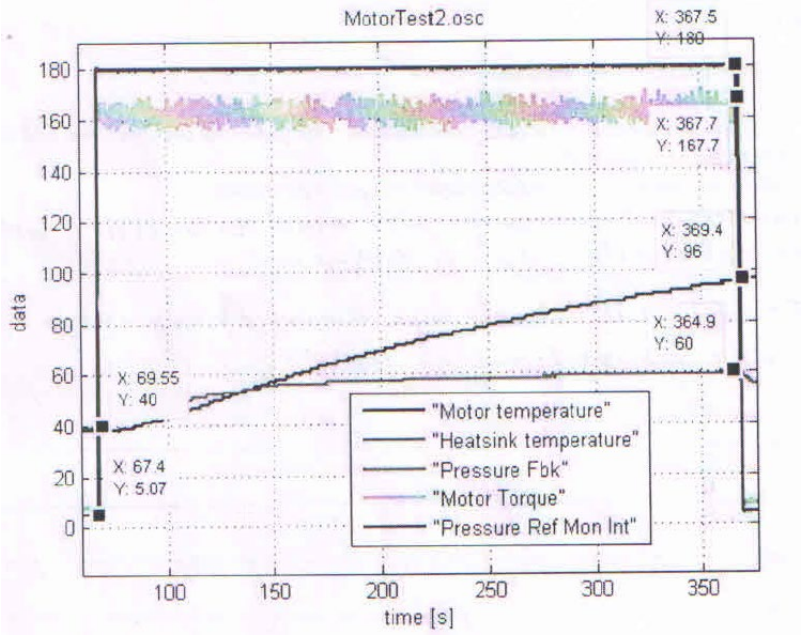
- Check the interface between PLC controller and ADP200 PID-IMM (Flow and Pressure reference signals, commands and ADP 200 status information).
- Check performance on flow (speed) profile. Speed feedback must follow the speed reference according to the PLC requirement.
- Check performance on pressure profile. Pressure feedback must follow the pressure reference according to the PLC reference minimizing the response time and avoiding overshoot.
- ADP200 must be able to maintain the pressure hold at the maximum pressure for a specified time
- Drive must be able to detect sensor fail
- Drive must be able to run in idle mode to maintain a minimum pressure when PLC reference are zero.
- Drive must be able to monitor the motor temperature and detect if motor temperature exceed the maximum allowed
- All movement of cycle must be performed considering the time target.
- Some example figure: **Speed Test**: test has be done with ramp profile 100mSec (0-3000rpm):



Pressure Test: following figure show pressure profile



Capability of drive overload:
Drive has been tested at 180bar pressure for more than 5 minutes. Motor and drive temperature have been measured. Motor temperature read by KTY84 sensor in the motor.



At the end of the test it is very useful to compile a **test report** that contains all the test data and result.
For more information contact *us at tecnohelp@weg.com*.

4.4.1 Fine tuning

Here some particular information that should be used for the machine fine tuning.
Fine tuning may be necessary only in particular conditions.

BASIC RUN:
By using this function the pump turns continuously with a basic speed or a basic pressure so the vane or the tooth of the pump are always filled by the oil. The user has to specify a minimum speed and pressure to activate the basic references.

SATURATION LIMIT:
Saturation limits fix maximum output capability of application's control loops in pressure control.

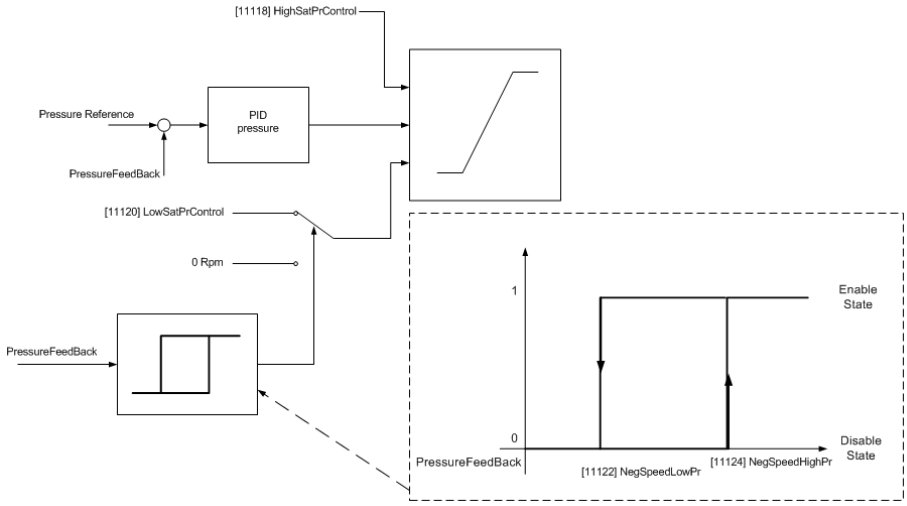


Figure:Saturation Limit

Relevant parameters can be found in SAT_LIMIT menu:

SWITCH GAIN:
The PID-IMM application automatically switches between speed and pressure loop. The switch gain menu allow the possibility to tune the switching logic in order to optimize the dynamic of the control.
If *IPA 11148 (Fixed Contr Enabler)* is disabled PID-IMM application switches properly the control or in pressure or in speed/flow. The system recognizes which is the target that must be followed according to the hydraulic circuit current pressure value, and pressure reference.

Pressure control is enabled if the pressure error % = [(Pressure Set Point - Pressure Feedback) / Pressure Set Point * 100.0] is above the specified value in *IPA 11150 (P_Cont_En_Thr)* and it is disabled if it is below *IPA 11152 (P_Cont_Dis_Thr)*.

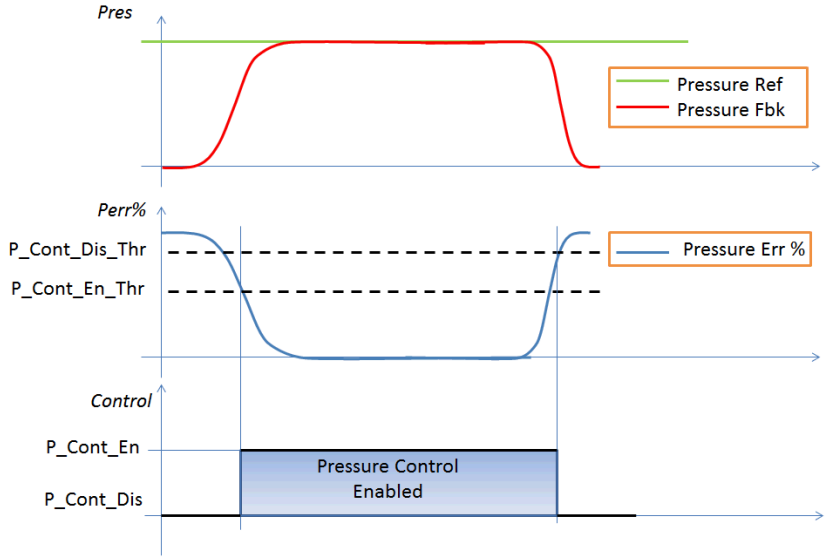


Figure : Switch Gain logic

GAIN SCH:

Gain scheduling is related to possibility to adapt **pressure control loop gains** to different operating conditions as a function of motor speed feedback.

See picture below for reference diagram:

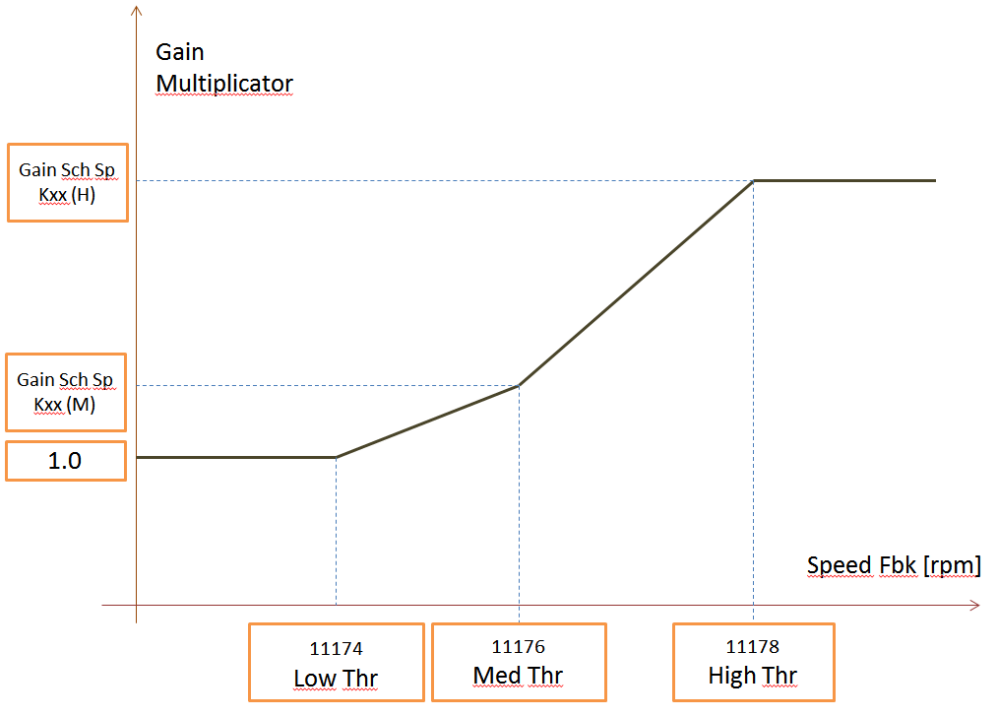


Figure 31: Gain Scheduling function

Each **pressure control PID parameter** (e.g. Kp) is multiplied by scheduled gain values according to the current speed feedback, resulting in:

Kxx = NOMINAL_Kxx * GAIN_SCHEDULING_MULTIPLICATOR

“NOMINAL_Kxx” is the nominal gain set for pressure control loop (see Ipa 11094 - 11098).

The “GAIN SCHEDULING MULTIPLICATOR” parameters can be changed in the GAIN_SCH menu

The following linearization strategy is applied:

- Below lower speed threshold (Ipa 11174): GAIN = 1.0
- Between lower speed threshold and medium speed threshold (Ipa 11176): GAIN is linearized from 1.0 to “Medium Gain” (Gain Sch Sp Kxx (M)).
- Between medium speed threshold and high speed threshold (Ipa 11178): GAIN is linearized from “Medium Gain” (Gain Sch Sp Kxx (M)) to “High Gain” (Gain Sch Sp Kxx (H)).
- Over high speed threshold (Ipa 11178): GAIN is equal to “High Gain” (Gain Sch Sp Kxx (H)).

Note that **speed loop scheduling** is available in the standard firmware Menu SPEED REG GAINS (expert mode).

Guideline about how to use the GAIN_SCH menu

The application PID-IMM for ADP200 drive allows the possibility to change the behavior of the pressure loop gain according to the actual motor speed. This function is known as Gain-Scheduling, below are reported some hints about how to set the parameters.

The Gain Scheduling function is useful to:
- adapt the pressure loop according to the type of hydraulic movement.
- reduce the overshoot during speed to pressure transition.

a) Adapt the pressure loop according to the type of hydraulic movement.

Aim of the PID-IMM application is to control pressure and speed in different situation, without any information about the status of valve and/or in general about the knowledge of the hydraulic model. An IMM machine is composed by a Machine with several hydraulic circuits that are commanded through PLC that make the switching of valves. The information of the valve commands is not transmitted to the drive. From the control point of view of the PID-IMM application the different hydraulic scenario means a different hydraulic model, and so to get a robust and fast control adaptive gains are required.

To be practices , in the IMM there is movement that requires high pressure with low speed, and vice versa there is other condition where there is high speed with low pressure. One example of the movement where is possible to see this effect is during the transition between injection and holding phase.

In the following picture is reported a P/Q (pressure, flow) diagram of this movement:

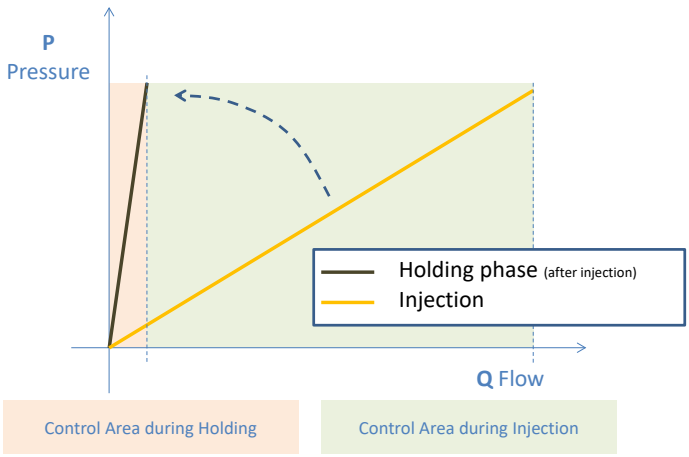


Figure 1: Example of Injection to holding phase transition

From the graph is possible to see that in injection phase the speed is higher than the holding phase at the same level pressure. In general, due to hydraulic model, in the injection phase the pressure gain during the injection phase should be higher than the holding phase. The gain scheduling works in this direction allowing the user to increase the gain of the pressure loop at high speed. So to get best performance the user can adapt the gain for these 2 condition (higher gains at higher speed).

b) Reduce overshoot during transition.

There is also a further benefits by using the gain scheduling that help to reduce the overshoot during the transition. The reason is the interaction between the gain scheduling and the internal variables of PI control. Higher value of the Proportional value at high/medium speed allow to create a fast response during the transition from speed control to pressure control.

So as suggestion, if there is issue about pressure overshoot during transition, one way to try to solve it is to increase the proportional gain (IPA 11162 and IPA 11168).

Variable gain (Multilevel PID)

In addition to existing parameters relating to gain-scheduling, flight control gains can also be changed using a digital control or fieldbus (through WDecomp).
For more information refer to ADP200_PID-IMM_...-UM_EN manual

ADAPT FEEDFORWARD:

A model based observer is acting as feed-forward control to prevent pressure overshoot and optimize control.
Function is **ON** by default.
User can disable this function by changing the parameter ***Ipa 11222 DynamicFFEnabler*** in ADAPTFEEDFORW menu.
Feedforward action can be regulated by parameter ***Ipa 11224 DynamicFFGain***.

5 Throubleshooting (Alarms)

5.1 Application Alarms

In this chapter there are a list and a short description about ADP200 PID-IMM application alarm. All the basic system drive alarms (Eg. OverVoltage…) are listed and described in the ADP200 QS (Quick Start) manual in the troubleshooting chapter and also in the next chapter.

As described in the ADP200 FP manual in the alarm chapter, for each alarm the possible activity (or Action) are:

0 = Ignore
1 = Warning
2 = Disable
3 = Stop
4 = Fast stop

For PID IMM the application alarm are:

Over Pressure: (AlmPlc1 - code 33)

This alarm occur only in Speed (Flow) mode (Mode 0) if actual speed is over the speed reference or the pressure feedback is over the pressure set-point, the application will stop the motor and trigger an **"Over Pressure" alarm.** This function can be used for motor and drive commissioning check the pump correct direction and speed loop tuning. This alarm do not have any activity parameter when occur generate an alarm.

Speed out of limit: (AlmPlc2 - code 34)

Reserved

Leakage Detection: (AlmPlc3 - code 35)

Leakage Alarm: minimum pressure level that is checked during the **Basic Run Mode**.
If the pump reaches pressure level below the threshold (parameter par 11032 **Min Press Leak Al**) for time longer than the time specified in par 11034 **Leakage Al Time Out**, **Leakage Detection alarm** is triggered.
Alarm action is defined with IPA 11036 **Leakage alarm Action.**
For a complete description of Basic Run mode see BASIC RUN Menù

Pressure Sensor: (AlmPlc4 - code 36)

Direct Sensor Alarm. Direct Alarm is possible if the machine has the sensor 0.1….10.1V or 4-20mAmp if the threshold are below 50% of the min. V.

CAN MP error: (AlmPlc5 - code 37)

This alarm is enabled if the parameter 11624 **CAN Alarm** is "ON"
Alarm **CAN MP** error is generated when the CAN MultiPump function is enabled, the communication is in Operational when on PDO monitored there is a timeout.
For the master Multi-Pump all the PDO send to the slave are monitored.
For the Slave Multi-Pump, is the PDO send by the Master.
The timeout time is controlled by the parameter 11618 **RPDO Timer**.

CAN DIV MP error: (AlmPlc6 - code 38)

This alarm is enabled if the parameter 11624 **CAN Alarm** is "ON"
Alarm **CAN DIV MP** error is generated when the CAN MultiPump function is enabled and the communication is in Operational and the drive is configured as a "Divergent Master" or "Divergent Slave".
The alarm come on when on PDO monitored there is a timeout.
The "divergent master" monitors the PDO from the "divergent slave" and vice-versa.
The timeout time is controlled by the parameter 11618 **RPDO Timer**.

NEGSPEED error: (AlmPlc7 - code 39)

The **NEGATIVE SPEED** alarm intervenes if the pressure sensor malfunctions or if the voltage or electrical current read by the sensor is not 0.
Or if the time of the alarm intervention may have been set too short.

In fact, it should be taken into consideration that normally the pump is only allowed to rotate in a negative direction for a short period of time, in order to stimulate depressurisation of the hydraulic circuit; see Chapter SAT_LIMIT.
In such cases, the setting of parameter 11050 **Max Neg Speed Time** should be checked.

DIG CHECK error: (AlmPlc8 - code 40)
The alarm occurs when parameter 11026 **Digital Check Action** = Disable and the digital data sent and that received by the drive are not consistent.

ISA Pressure Sensor: (AlmPlc9 - code 53)
Indirect Sensor Alarm (ISA): If pressure sensor is 0.1 to 10.1 V or 4 to 20 mA the drive is able to recognize malfunctioning of pressure sensor (ref. **Pressure Sensor**, AlmPlc4 - code 36).
In case of use of other types of pressure sensors, this alarm should be used to detect a malfunction or a not correct wiring of the pressure sensor.
The parameter 11046 **ISA Alarm Enable** is used to enable this function, more details on chapter 5.2.

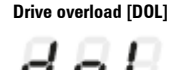
5.2 System Alarms

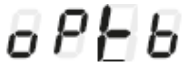
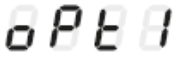
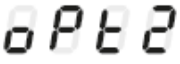
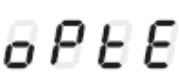
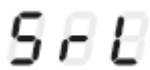
A complete description of the basic system drive alarms (Eg. OverVoltage…) are listed and described in the ADP200 QS (Quick Start) manual in the troubleshooting chapter.
Here the most important information.

Note ! To reset alarms, see **paragraphs** **"8.2.6 Displaying and resetting Alarms"** **and** **"8.3.10 Alarms".**

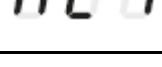
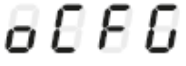
In the following table, the Code is visible only from serial line

Code	Error message shown on the display [on the integrated keypad]	Sub-code	Description
0	**No alarm**		**Condition:** No alarm present
1	**Overvoltage [OV]** 		**Condition: DC link overvoltage alarm due to energy recovered from the motor.** The voltage arriving at the drive power section is too high compared to the maximum threshold relating to the PAR 560 **Mains voltage** parameter setting.
			Solution: - Extend the deceleration ramp. - Use a braking resistor between terminals BR1 and BR2 to dissipate the recovered energy - Use the VDC Control function
2	**Undervoltage [UV]** 		**Condition:** DC link undervoltage alarm. The voltage arriving at the drive power section is too low compared to the minimum threshold relating to the 560 **Mains voltage** parameter setting due to: - the mains voltage being too low or overextended voltage drops. - poor cable connections (e.g. loose contactor terminals, inductance, filter, etc.).
			Solution: Check the connections.
3	**Ground fault [GNDF]** 		**Condition:** Ground short circuit alarm
			Solution: - Check drive and motor wiring. - Check that the motor is not grounded.
4	**Overcurrent [OC]** 		**Condition: Instantaneous overcurrent protection intervention alarm.** This may be due to the incorrect setting of current regulator parameters or a short circuit between phases or ground fault on the drive output.
			Solution: - Check the current regulator parameters (menu 17) - Check wiring towards the motor
5	**Desaturation [DES]** 		**Condition: Instantaneous overcurrent in the IGBT bridge alarm.**
			Solution: - Switch the drive off and then switch it on again. - If the alarm persists, contact the technical service centre.
6	**MultiUndervolt [MUV]**		**Condition:** The number of attempted automatic restarts after the **Undervoltage** alarm has exceeded the set PAR 4650 **UVRep attempts** value in the **PAR 4652 UVRep delay** time.

Code	Error message shown on the display [on the integrated keypad]	Sub-code	Description
			**Solution:** Too many Undervoltage alarms. Adopt the proposed solutions for the Undervoltage alarm.
7	**MultiOvercurr [MOC]** 		**Condition:** 2 attempted automatic restarts after the Overcurrent alarm within 30 seconds. If more than 30 seconds pass after the Overcurrent alarm was generated, the attempt counter is reset.
			Solution: Too many Overcurrent alarms. Adopt the proposed solutions for the Overcurrent alarm.
8	**MultiDesat [MDES]** 		**Condition:** 2 attempted at automatic restarts after the Desaturation alarm within 30 seconds. If more than 30 seconds pass after the Desaturation alarm was generated, the attempt counter is reset.
			Solution: Too many **Desaturation** alarms. Adopt the proposed solutions for the **Desaturation** alarm.
9	**Heatsink OT [HOT]** 		**Condition:** Heatsink temperature too high alarm
			Solution: - Verify the correct operation of the cooling fan. - Check that the heatsinks are not clogged - Check that the openings for the cabinet cooling air are not blocked.
10	**HeatsinkS OTUT [HSOT]** 		**Condition:** IGBT modules temperature too high or too low alarm
			Solution: - Verify the correct operation of the cooling fan. - Check that the heatsinks are not clogged - Check that the openings for the cabinet cooling air are not blocked.
11	**Intakeair OT [IOT]** 		**Condition:** Intake drive air temperature too high alarm.
			Solution: **-** Check correct fan operation - Check that panel cooling air openings are unobstructed. - Check temperature in electrical panel.
12	**Motor OT [MOT]** 		**Condition:** Motor overtemperature alarm. Possible causes: - Load cycle too heavy - The motor is installed in a place where the ambient temperature is too high - If the motor is provided with a blower: the fan is not working - If the motor is not provided with a blower: the load is too high at slow speeds. Cooling the fan on the motor shaft is not sufficient for this load cycle. - The motor is used at less than the rated frequency, causing additional magnetic losses. - Motor temperature probe not connected or incorrect setting of parameters 4530, 4538 and 4522.
			Solution: - Change the processing cycle. - Use a cooling fan to cool the motor. - Check the connection of the motor temperature probe or the settings of parameters 4530, 4538 and 4522.
13	**Drive overload [DOL]** 		**Condition:** Drive overload alarm. - The inverter output current has exceeded the allowed overload value. - The overload cycle has exceeded the allowed values.
			Solution: - Check that the load is not excessive. - Check that accelerations are not excessive. - Check that the overload cycle is within allowed limits.
14	**Motor overload [MOL]** 		**Condition:** Motor overload alarm. The current absorbed during operation is greater than that specified on the motor data plate.
			Solution: - Reduce the motor load. - Increase the size of the motor.
15	**Bres overload [BOL]** 		**Condition:** Braking resistor overload alarm. The current absorbed by the resistor is greater than the rated current. The overload threshold of the accumulator of the I^2t braking resistor thermal image has been exceeded. For standard external braking resistor the Max overload (factory set) is 1" service 10% (see Table 5.4.1 on ADP200 QS manual).
			Solution: - Check the size of the braking resistor. - Check the condition of the braking resistor

Code	Error message shown on the display [on the integrated keypad]	Sub-code	Description
		Use braking resistor with higher energy value and change the parameters on 22.5 - FUNCTIONS/BRES OVERLOAD menu.	
16	**Phase loss [PHL]** 	**Condition:** Power phase loss alarm.	
		Solution: Check the mains voltage and whether any protections upstream of the drive have been tripped.	
17	**Opt Bus fault [OPTB]** 	**Condition:** Error in the configuration stage or communication error.	
		XXX0H-X	If the first digit to the left of "H" in the alarm sub-code is equal to 0, the error relates to a communication problem.
		XXXXH-X	If the first digit to the left of "H" in the alarm sub-code is other than 0, the error relates to a configuration problem.
		Solution: For configuration errors, check the configuration of the Bus communication, Bus type, Baudrate, address. parameter setting For communication errors verify wiring, resistance of terminations, interference immunity, timeout settings. For further details, please refer to the user guide for the specific bus.	
18	**Opt 1 IO fault [OPT1]** 	**Condition:** Error in the communication between Regulation and I/O expansion card in slot 1.	
		Solution: Check that it has been inserted correctly, see **Appendix section A.1**.	
19	**Opt 2 IO fault [OPT2]** 	**Condition:** Error in the communication between Regulation and encoder expansion card in slot 2.	
		Solution: Check that it has been inserted correctly, see **Appendix section A.1**.	
20	**Opt Enc fault [OPTE]** 	**Condition:** Error in the communication between Regulation and Encoder feedback card.	
		Solution: Check that it has been inserted correctly, see **Appendix section A.1**.	
21	**External fault [EF]** 	**Condition:** External alarm present. A digital input has been programmed as an external alarm, but the +24V voltage is not available on the terminal.	
		Solution: Check that the terminal screws are tight	
22	**Speed fbk loss [SFL]** 	**Condition:** Speed feedback loss alarm. The encoder is not connected, not connected properly or not powered: verify encoder operation by selecting the **PAR 260 Motor speed** parameter in the MONITOR menu.	
		Solution: - Check encoder wiring for integrity. - Check that the encoder is connected to the power supply. - With the drive disabled, turn the motor clockwise (seen from the motor shaft side). A positive value must be displayed. - If the value does not change or values are indicated randomly, check the encoder power supply and cables. - If the value displayed is negative, invert the encoder connections. Change channel A+ and A- or B+ and B-. - Check that the encoder electronics are consistent with those of the relative expansion card. - Generated in case of an encoder fault. Each type of encoder generates a "Loss of feedback" alarm differently. See parameter 2172 **SpdFbkLoss code** for information about the cause of the alarm and chapter 10.2 **Speed fbk loss** [22] alarm	
23	**Overspeed [OS]** 	**Condition:** Motor overspeed alarm. The motor speed exceeds the limits set in the **PAR 4540** parameter.	
		Solution: - Limit the speed reference. - Check that the motor is not driven in overspeed during rotation.	
24	**Speed ref loss [SRL]** 	**Condition: Speed reference loss alarm;** occurs if the difference between the speed regulator reference and the actual motor speed is more than 100 rpm. This condition occurs because the drive is in the current limit condition. It is only available in the **Flux Vect OL** and **Flux Vect CL** mode (see PAR 4550).	
		Solution: - Check the drive load conditions - Check the number of encoder impulses	
25	**Emg_stop_alarm [EMGS]** 	**Condition:** Emergency stop alarm. The Stop key on the keypad was pressed with the PAR 1008 **Stop key mode** parameter set to **EmgStop&Alarm.** Active in remote control mode (PAR 1012=1) both by using "Terminals" command or "Digital" commands and, in local control mode (PAR 1012=0) by using "Terminals" command.	
		Solution: Eliminate the reason for which the Stop key on the keypad was pressed and reset the drive.	
26	**Power down [PD]**	**Condition:** The drive was enabled with no supply voltage at the power section.	
		Solution: Check the drive power supply	

Code	Error message shown on the display [on the integrated keypad]	Sub-code	Description
	Pd		
27-28-29	**Not Used**		
30	**Motor pre OT [PROT]** PrOt		**Condition:** Motor overtemperature prealarm. % value of threshold compared to PAR 4532 **MotorOT thr,**
			Solution: Value set too low for duty cycle
31	**Mot phase loss [PHLO]** PHLo		**Condition: Output phase loss.**
			Solution: Check Drive/motor connection.
32	**Not Used**		
33 ... 40	**Plc1 fault [PL01]** ... **Plc8 fault [PL08]** PLC1 PLC8		**Condition:** Enabled application developed in the IEC 61131-3 environment has found the conditions for generating this specific alarm to be true. The meaning of the alarm depends on the type of application. For more information, refer to the documentation concerning the specific application.
		XXXXH-X	The XXXXH-X code indicates the reason for the error: make a note of this to discuss it with the service centre.
			Solution: Refer to the documentation concerning the enabled application.
41	**Watchdog [WDT]** Ydt		**Condition:** this condition can occur during operation when the watchdog micro protection is enabled; the alarm is included in the list of alarms and alarm log. After this alarm: - the drive automatically runs a reset - motor control is not available.
		XXXXH-X	The XXXXH-X code indicates the reason for the error: make a note of this to discuss it with the service centre.
			Solution: If the alarm is the consequence of a change in the drive configuration (parameter setting, option installation, PLC application download) remove it. Turn the drive off and then on again.
42	**Trap error [TRAP]** trAP		**Condition:** this condition can occur during operation when the trap micro protection is enabled; the alarm is included in the list of alarms and alarm log. After this alarm: - the drive automatically runs a reset - motor control is not available.
		XXXXH-X	The XXXXH-X (SubHandler-Class) code indicates the reason for the error: make a note of this to discuss it with the service centre.
			Solution: If the alarm was a consequence of a variation to the drive configuration (parameter setting, installation of an option, downloading of a PLC application), remove it. Switch the drive off and then switch it on again.
43	**System error [SYS]** SYS		**Condition:** this condition can occur during operation when the operating system protection is enabled; the alarm is included in the list of alarms and alarm log. After this alarm: - the drive automatically runs a reset - motor control is not available.
		XXXXH-X	The XXXXH-X (Error-Pid) code indicates the reason for the error: make a note of this to discuss it with the service centre.
			Solution: If the alarm was a consequence of a variation to the drive configuration (parameter setting, installation of an option, downloading of a PLC application), remove it. Switch the drive off and then switch it on again.
44	**User error [USR]** USr		**Condition:** this condition can occur during operation when the software protection is enabled; the alarm is included in the list of alarms and alarm log. After this alarm: - the drive automatically runs a reset - motor control is not available.
		XXXXH-X	The XXXXH-X (Error-Pid) code indicates the reason for the error: make a note of this to discuss it with the service centre.
			Solution: If the alarm was a consequence of a variation to the drive configuration (parameter setting, installation of an option, downloading of a PLC application), remove it. Switch the drive off and then switch it on again.
45	**Param error [PRR]**		**Condition:** An error occurs during the enabling of the parameter database saved in the Flash memory; one parameter value is out of range.
		XXXH-X	Code XXXXH indicates the number of the parameter (Hex) that has caused the error when the database is enabled.

Code	Error message shown on the display [on the integrated keypad]	Sub-code	Description
		**Solution:** Set the parameter causing the error to a value within the range and run **Save parameter**. Switch the drive off and then switch it back on again. If the IPA of the parameter is not shown in the manual, contact the service centre.	
46	**Load default [LD]** 	**Condition:** this can occur during loading of the parameter database saved in the Flash memory it is normal if it appears in the following conditions: the first time the drive is switched on, when a new version of the firmware is downloaded, when the regulation is installed on a new size, when a new region is entered. If this message appears when the drive is already in use it means there has been a problem in the parameter database saved in the Flash memory. If this message is displayed the drive restores the default database, i.e. the one downloaded during production.	
		0001H-1	The database saved is not valid
		0002H-2	The database saved is not compatible
		0003H-3	The saved database refers to a different size and not to the current size
		0004H-4	The saved database refers to a different region and not to the current region
		Solution: Set the parameters to the desired value and execute **Save parameters**	
47	**Plc cfg error [PLCE]** 	**Condition:** this can occur during loading of the MDPLC application The Mdplc application present on the drive is not run.	
		0004H-4	The application that has been downloaded has a different Crc on the DataBlock and Function table.
		0065H-101	The application that has been downloaded has an invalid identification code (Info).
		0066H-102	The applciation that has been downloaded uses an incorrect task number (Info).
		0067H-103	The application that has been downloaded has an incorrect software configuration.
		0068H-104	The application that has been downloaded has a different Crc on the DataBlock and Function table.
		0069H-105	A Trap error or System error has occurred. The drive has automatically executed a Power-up operation. Application not executed. See the Alarm List for more information about an error that has occurred.
		006AH-106	The application that has been downloaded has an invalid identification code (Task).
		006BH-107	The application that has been downloaded uses an incorrect task number (Task).
		006CH-108	The application that has been downloaded has an incorrect Crc (Tables + Code)
		Solution: Remove the MDPLC application or download a correct MDPLC application.	
48	**Init_LdPlcPar [LDP]** 	**Condition:** this can occur during loading of the parameter database saved in the Flash memory of the MDPLC application it is normal if it appears the first time the drive is switched on, after downloading a new application. If this message appears when the drive is already in use it means there has been a problem in the parameter database saved in the Flash memory. If this message appears the drive automatically runs the **Load default** PAR 580 command.	
		0001H-1	The database saved is not valid
		Solution: Set the parameters to the desired value and run **Save parameter.**	
49	**Key failed [KEY]** 	**Condition:** this can occur at drive power-on if the wrong enabling key is entered for a given firmware function	
		0001H-1	Incorrect PLC key. PLC application not available.
		Solution: Contact WEG to request the key to enable the desired firmware function.	
50	**Encoder error [ENC]** 	**Condition:** this condition may occur when the drive is powered during encoder setup each time parameter 552 **Regulation mode** is set.	
		100H-256	**Cause**: An error occurred during setup; the information received from the encoder is not reliable. If the encoder is used for feedback the **Speed fbk loss** [22] alarm is also generated.
			Solution: Take the recommended action for the **Speed fbk loss** [22] alarm.
		200H-512	**Cause**: The firmware on the optional encoder card is incompatible with that on the regulation card. The information received from the encoder is not reliable
			Solution: Contact WEG in order to update the firmware on the optional encoder card.
51	**Opt cfg change [OCFG]** 	**Condition**: this may occur when powering the drive if an expansion card has been removed or replaced or the incorrect enable key is inserted for a given firmware function.	
		0064H-100	Card removed from slot 1.
		0014H-20	Card removed from slot 2
		0003H-3	Card removed from slot 3
		0078H-120	Card removed from slot 1 and from slot 2

Code	Error message shown on the display [on the integrated keypad]	Sub-code	Description
		0067H-103	Card removed from slot 1 and from slot 3.
		0017H-23	Card removed from slot 2 and from slot 3.
		007BH-123	Card removed from slot 1. from slot 2 and from slot 3
		Solution: Check the hardware configuration, then press ESC. Save the parameters (**Save parameters**, menu 04.01 par 550) to save the new hardware configuration.	
52	**Power config [PCFG]** 	**Condition:** It can occur at the power-on during recognition size phase.	
		Solution: Contact the WEG technical support centre.	
53 ... 60	**Plc9 fault [PL09]** ... **Plc16 fault [PL16]** 	**Condition:** Enabled application developed in the IEC 61131-3 environment has found the conditions for generating this specific alarm to be true. The meaning of the alarm depends on the type of application. For more information, refer to the documentation concerning the specific application.	
		XXXXH-X	The XXXXH-X code indicates the reason for the error: make a note of this to discuss it with the service centre.
		Solution: Refer to the documentation concerning the enabled application.	

Speed fbk loss alarm with resolver

Note !

For the correct interpretation of the cause of the alarm trigger, it is necessary to transform the hex code indicated in parameter 17.38 **SpdFbkLoss code**, PAR 2172 , in the corresponding binary and verify in the encoder table that the active bits and related description are used.

Example with encoder Endat:

PAR 2172 = A0H (hex value)

In the table "Speed fbk loss [22] alarm with absolute encoder EnDat" A0 is not indicated in the value column.

A0 should be contemplated as a bitword with meaning A0 -> 10100000 -> bit 5 and bit 7. The following causes simultaneously occours:

- Bit 5 = 20H Cause: the SSI signal interferences cause an error in the CKS or parity.

- Bit 7 = 80H Cause: The encoder has detected an incorrect operation and communicates it to the converter through the Error bit. Bits 16..31 present the type of incorrect encoder operation detected.

The value is displayed in hexadecimal format on the optional and standard keypad.

- **Speed fbk loss [22] alarm with Resolver**

Code	Name	Error description	Possible solution
0x00000001	D0 FAULT REGISTER	Configuration parity error	Reset Resolver card
0x00000002	D1 FAULT REGISTER	Phase error exceeds phase lock range	
0x00000004	D2 FAULT REGISTER	Velocity exceeds maximum tracking rate	
0x00000008	D3 FAULT REGISTER	Tracking error exceeds LOT (Loss of Signal) threshold	
0x00000010	D4 FAULT REGISTER	SIN/COS inputs exceed DOS (Degradation of signal) mismatch threshold	Check the connection of the Resolver input pins (SIN-,SIN+,COS-, COS+), check PAR 2128
0x00000020	D5 FAULT REGISTER	SIN/COS inputs exceed DOS (Degradation of signal) over range threshold	Check the connection of the Resolver input pins (SIN-,SIN+,COS-, COS+), check PAR 2126
0x00000040	D6 FAULT REGISTER	SIN/COS inputs below LOS (Loss of Signal) threshold	Check the connection of the Resolver input pins (SIN-,SIN+,COS-, COS+), check PAR 2124
0x00000080	D7 FAULT REGISTER	SIN/COS inputs clipped	Check if any of the Resolver input pins (SIN-,SIN+,COS-,COS+) are shorted with power input or ground of the resolver board

The following conditions occur while resetting the encoder following **Speed fbk loss** [22] activation

Bit	Value	Name	Description
6	**0x40**	**ACK_TMO**	**Cause:** SSI signals not present or disturbed cause an error on CRC.

<table>
<tr><th>Bit</th><th>Value</th><th>Name</th><th colspan="4">Description</th></tr>
<tr><td></td><td></td><td></td><td colspan="4">Solution: Check the connection of the clock and encoder-drive data, check the connection of the screen, check the encoder supply voltage, check parameter 2102 Encoder supply.</td></tr>
<tr><td rowspan="2">7</td><td rowspan="2">0x80</td><td rowspan="2">DT1_ERR</td><td colspan="4">Cause: Encoder has detected malfunction and signals this to the drive via bit DT1. Bits 16..31 contain the type of malfunction detected by the encoder.</td></tr>
<tr><td colspan="4">Solution: See the encoder manufacturer's technical guide.</td></tr>
<tr><td rowspan="10">16.31</td><td rowspan="10"></td><td rowspan="10"></td><td>Bit</td><td></td><td>=0</td><td>=1</td></tr>
<tr><td>0</td><td>Light source</td><td>OK</td><td>Failure (1)</td></tr>
<tr><td>1</td><td>Signal amplitude</td><td>OK</td><td>Erroneous (1)</td></tr>
<tr><td>2</td><td>Position value</td><td>OK</td><td>Erroneous (1)</td></tr>
<tr><td>3</td><td>Over voltage</td><td>NO</td><td>Yes (1)</td></tr>
<tr><td>4</td><td>Under voltage</td><td>NO</td><td>Under voltage supply (1)</td></tr>
<tr><td>5</td><td>Over current</td><td>NO</td><td>Yes (1)</td></tr>
<tr><td>6</td><td>Battery</td><td>OK</td><td>Change the battery (2)</td></tr>
<tr><td>7..15</td><td></td><td></td><td></td></tr>
<tr><td colspan="4">(1) Can also be set after the power supply is switched off or on.
(2) Only for battery-buffered encoders</td></tr>
</table>

Reset Speed fbk loss alarm

The reasons for activating the **Speed fbk loss** alarm and the information acquired by the encoder are shown in parameter 2172 **SpdFbkLoss code.**

If no card has been installed the **Speed fbk loss** [22] alarm is generated and no cause is displayed in parameter 2172 **SpdFbkLoss code**. Several causes may be present at the same time.
If no card is recognised, the system runs a routine that always returns **Speed fbk loss** [22] active without specifying a cause.

10.2.2 Encoder error alarm

Setup is performed each time the drive is turned on, regardless of the regulation mode that has been selected. If an error is detected during setup the **Encoder error** alarm is generated with the following codes:

Bit	Value	Name	Description
8	**0x100**	**Setup error**	**Cause:** An error occurred during setup. When this has been signalled the information obtained from the encoder is not reliable.
			Solution: Take the action recommended for **Speed fbk loss** [22] alarm according to the type of encoder.
9	**0x200**	**Compatibility error**	**Cause:** Firmware on option card incompatible with firmware on regulation card. When this has been signalled the information obtained from the encoder is not reliable.
			Solution: Contact WEG in order to update the firmware on the optional card.

Appendix 1: Application recipe

A recipe is a subset of parameters. This subset is a menu defined by application PID-IMM auto-setup command. It's also possible for the user create a custom recipe. If the most common parameters are in the recipe, it's very simple to monitor and adjust the parameters with WEG_eXpress, optional alphanumerical keypad but also with local simplest keypad.

From factory configuration, the recipe list on the default drive is empty, but is completed with preset parameters at the **Auto Setup** command (IPA 11014), which normally must be enabled at this stage of commissioning of the drive.
ADP200 PID-IMM manual Paragraph 5.1.1 "List of parameters for CONFIGURATION MENU" shows the preset recipe at the Auto- Setup command.

*Starting with version PID IMM V1_x_37_2, the **Auto-setup** command compiles the Recipe, i.e., the following default parameters are inserted in menu 29-Recipe:*

General settings
554 Access Mode
550 Save Par
582 Drive Reset
Monitor application signals
12008 Pressure Fbk
12012 Pressure Ref
12006 Speed Fbk
12010 Speed Ref
12004 Torque
Pressure references
11054 Manual Press Ref
11056 Manual Speed Ref
11062 Pressure Ref Source
11064 Flow Ref Source
11010 Pump Direction
Control
11086 Kp Pressure Control
11088 Ki Pressure Control
11094 Kp Speed Control
11096 Ki Speed Control
666 Speed Ref filter (*)
1510 Analog inp 1 filter (*)
Monitor overload
368 Drive Overload (*)
3212 Motor Overload (*)
Save and enable management
1012 Dig local/remote (*)
1016 Terminal Start src (*)
1018 Digital Enable src (*)
1020 Digital Start src (*)
1410 Dig output 1X src
1430 Dig out 1X inversion
596 Save Par To SD
598 Load Par From SD
(*) parameters visible on Expert mode only.

In the menù 28 – RECIPE CONFIG it's possible modify the auto-setup recipe or create a custom menu from the keypad (or from WEG_eXpress), composed of a maximum of 30 parameters (menu 29 - RECIPE).

Appendix 2: WEG_Softscope

WEG_SoftScope is a digital scope software designed to sample and display in real time drives parameter variables,
and it is particularly useful during drive test and commissioning. WEG_SotfScope can guarantee synchronization of
samples with a sampling time that depend on the target (eg. 1mSec).
WEG_SoftScope 3 is the evolution of the traditional WEG SoftScope (WEG_SoftScope 2) used before either with the
basic software (Factory Sw) and also with MDPLC applications and developed for the most important WEG Family.**WEG_SoftScope 3** add many new features and significantly improves the functionality of the previous WEG_SoftScope 2.
The completely new graphics and the full integration with the WEG_eXpress, make the use of WEG_SoftScope 3 very
easy and simple to install and use also with MDPLC applications.
The parameters list that can be monitored are included in the WEG_eXpress tools and selected directly with the
acquisition command of the program.
WEG_Softscope 3 tool allow performing calibration on both Pressure and Speed loop by using a single machine movement (See "1S9SFT3EN_26-7-16" WEG_Softscope 3 user manual).
Following signals need to be mapped for WEG_Softscope sampling:

- vSpeed_Fbk
- vSpeed_Ref_Mon
- vPressureFbk
- vPressure_Ref_Mon

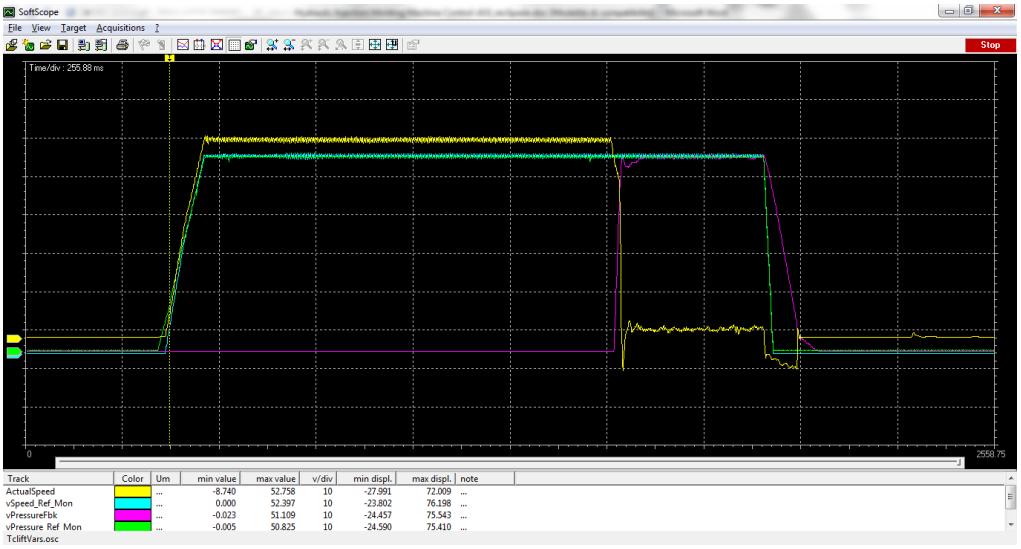


Figure : WEG_Softscope Acquisition during injection

As example on WEG_softscope it is possible to make comparison between the reference and feedback of Speed and Pressure. The following figure show a scope with Reference variation parameter.

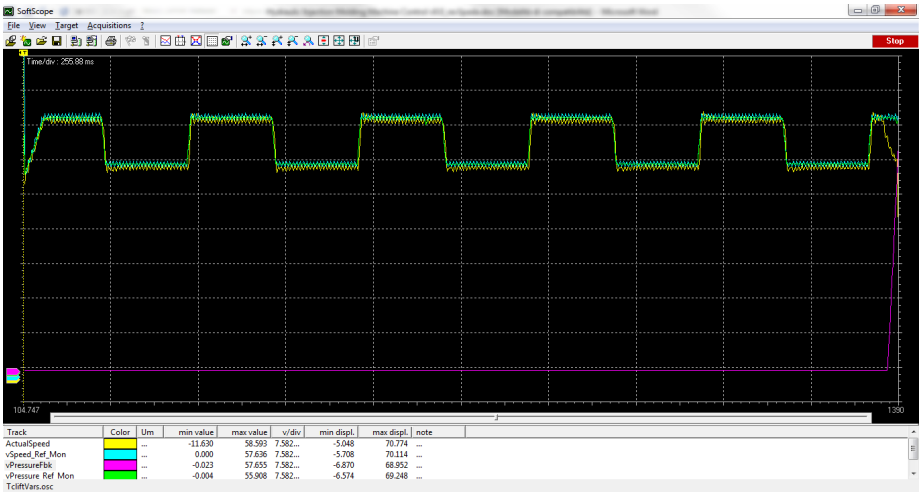


Figure : Example of Speed Tuning

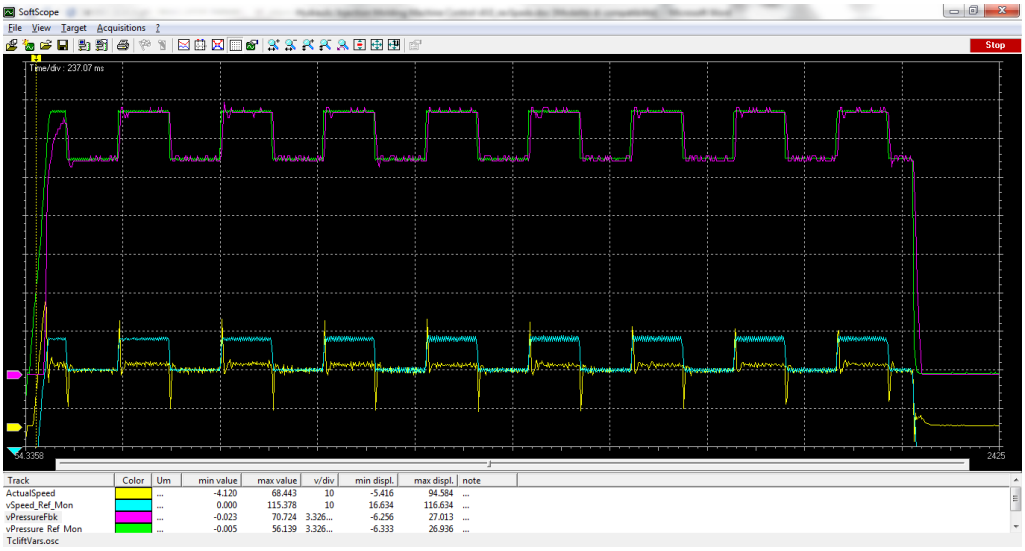


Figure : Example of Pressure Tuning

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