User's guide

Guia del usuário

Manual do usuário

PLC²

Programmable Controller
PLC2 Board

Controlador Programable
Tarjeta PLC2

Controlador Programável
Cartão PLC2

WEG

MANUAL

PLC2 BOARD

PROGRAMMABLE IN LADDER LANGUAGE

BY WLP SOFTWARE

PLC2 Software: V1.5X

0899.5550 E/2

The table below describes all revisions made to this manual.

Revision	Description	Section
1	First Edition	-
2	General Revision	-

Quick Parameter Reference,
Fault Messages

CHAPTER 1
Safety Notices

CHAPTER 2
General Information

CHAPTER 3
Installation and Configuration

CHAPTER 4
Detailed Parameter Description

QUICK PARAMETER REFERENCE, FAULT MESSAGES

Software: V1.5X
Application:
Model:
Serial Number:
Responsible:
Date: /   /   .

I. Parameters
The parameters presented hereby represent the functions provided by the PLC2 board. Besides them, the PLC2 also makes available a general-purpose range of parameters from P800 to P899, which can be programmed by the user (refer to the WLP manual).

Parameter	Description [Type]	Adjustable Range	Factory Setting	Unit	Page
P750	PLC2 firmware version [Read]	Related to the purchased board	-	-	25
P751	Scan cycle in 100µs units [Read]	0 to 65535	-	x100µs	25
P752 (*)	Resets the retentive markers [Configuration]	0=No action 1=Reset register	0 = No action	-	25
P753 (*)	Loads factory settings, if =1234 [Configuration]	0 to 65535	0	-	25
P754	Position reference (rotations) [Read]	0 to 65535	-	rotations	25
P755	Position reference (fraction of rotation) [Read]	0 to 3599	-	degrees / 10	25
P756	Real position signal [Read]	0=Negative 1=Positive	-	-	25
P757	Real position (rotations) [Read]	0 to 65535	-	rotations	26
P758	Real position (fraction of rot.) [Read]	0 to 3599	-	degrees / 10	26
P759	Lag error [Read]	0 to 3599	-	degrees / 10	26
P760	Proportional position gain (Kp) [Configuration]	0 to 200	50	-	26
P761	Integral position gain (Ki) [Configuration]	0 to 200	0	-	26
P762	Max. lag error [Configuration]	0 to 65535	1800	degrees / 10	26
P763	Disable user program [Configuration]	0=Program enable 1=Program disable	0=Program enable	-	26
P764 (*)	PLC address at netwrok [Configuration]	1 to 247	1	-	26

(*) IMPORTANT: To enable the system to operate according the parameter seeting, the system must be reset after one or more parameters have been changed.

Parameter	Description [Type]	Adjustable Range	Factory Setting	Unit	Page
P765 (*)	Baud rate of RS232 [Configuration]	1=1200bps 2=2400bps 3=4800bps 4=9600bps 5=19200bps 6=38400bps	4=9600bps	bits/second	27
P766 (*)	PID sample time [Configuration]	1 to 10000	1	x1.2ms	27
P767 (*)	Synchronous motor speed [Configuration]	0 to 10000	1800	rpm	27
P768 (*)	Encoder 1 zero pulse (main) position [Configuration]	0 to 10000	1024	ppr = pulses per revolution	27
P769 (*)	Encoder 1 zero pulse (master) position [Configuration]	0 to 3599	0	degrees / 10	27
P770 (*)	CAN protocol [Configuration]	0=Disabled 1=CANopen 2=DeviceNet	0=Disabled	-	28
P771 (*)	CAN address [Configuration]	0 to 127	63	-	28
P772 (*)	CAN baud rate [Configuration]	0=1Mbit/s 1=Reserved 2=500 Kbit/s 3=250 Kbit/s 4=125 Kbit/s 5=100 Kbit/s 6=50 Kbit/s 7=20 Kbit/s 8=10 Kbit/s	0=1Mbit/s	Mbit/s or Kbit/s	28
P773	Bus off recovery [Configuration]	0=Manual 1=Automatic	0=Manual	-	29
P774	Action to be taken upon detection of a communication failure [Configuration]	0=Indicate the error 1=Cause a fatal error on the device	1=Cause a fatal error on the device.	-	29
P775	CAN status [Read]	0=Disable 1=Reserved 2=CAN enable 3=Warning 4=Error passive 5=Bus off 6=Not powered	-	-	29
P776	Counter of received telegrams [Read]	0 to 65535	-	-	30
P777	Counter of trasmitted telegrams [Read]	0 to 65535	-	-	30
P778	Counter of detected errors [Read]	0 to 65535	-	-	30

(*) IMPORTANT: To enable the system to operate according the parameter seeting, the system must be reset after one or more parameters have been changed.

Parameter	Description [Type]	Adjustable Range	Factory Setting	Unit	Page
P779	Configuration status CANopen [Read]	0=Slave 1=Master	-	-	30
P780	CANopen communication status [Read]	0=Disabled 1=Reserved 2=CANopen enabled 3=Node guarding enabled 4=Node guarding error	-	-	30
P781	CANopen node status [Read]	0=Not initialized 4=Stopped 5=Operational 127=Pre-operational	-	-	31
P782	DeviceNet network status [Read]	0=Not powered / Not on-line 1=On-line / Not connected 2=Link OK / On-line and Connected 3=Connection timeout 4=Critical link failure 5=Running auto-baud	-	-	31
P783	DeviceNet master status [Read]	0=Master running 1=Idle master	-	-	31
P784	Number of input words [Configuration]	1 to 10	1	-	31
P785	Number of output words [Configuration]	1 to 10	1	-	31
P786	Fieldbus board status [Read]	0=Disable 1=Inactive 2=Actine and Off-line 3=Active and On-line	-	-	32
P788	Operation mode for the Analog Output 1 [Configuration]	0=-10 to +10V (range from -32768 to +32767) 1=0 to 20mA (range from 0 to 32767) 2=0 to 20mA (range from 0 to 65535) 3=0 to 20mA (range from -32768 to +32767) 4=4 to 20mA (range from 0 to 32767) 5=4 to 20mA (range from 0 to 65535) 6=4 to 20mA (range from -32768 to +32767)	0	-	32

(*) IMPORTANT: To enable the system to operate according the parameter seeting, the system must be reset after one or more parameters have been changed.

Parameter	Description [Type]	Adjustable Range	Factory Setting	Unit	Page
P789	Operation mode for the analog output 2 [Configuration]	0= -10 to +10V (range from -32768 to +32767) 1=0 to 20mA (range from 0 to 32767) 2=0 to 20mA (range from 0 to 65535) 3=0 to 20mA (range from -32768 to +32767) 4=4 to 20mA (range from 0 to 32767) 5=4 to 20mA (range from 0 to 65535) 6=4 to 20mA (range from -32768 to +32767)	0	-	33
P790[(*)]	Encoder 2 pulse number (auxiliary) [Configuration]	0 to 10000	1024	ppr (pulses per revolution)	33
P791[(*)]	Enables the position feedback via encoder 2 (auxiliary) [Configuration]	0=Disable 1=Enable	0=Disable	-	33
P792[(*)]	Direction of encoder 2 signal (auxiliary) [Configuration]	0=A→B 1=B→A	1=B→A	-	33
P793 [(*)]	Select serial protocol [Configuration]	0=ModBus no parity 1=WegTP no parity 2=ModBus even parity 3=WegTP even parity 4=ModBus odd parity 5=ModBus odd parity	0	-	34
P794	Operation mode for the analog output [Configuration]	0= -10 to +10V (range from -32768 to +32767) 1=0 to 20mA (range from 0 to 32767) 2=0 to 20mA (range from 0 to 65535) 3=0 to 20mA (range from -32768 to +32767) 4=4 to 20mA (range from 0 to 32767) 5=4 to 20mA (range from 0 to 65535) 6=4 to 20mA (range from -32768 to +32767)	0	-	34

(*) IMPORTANT: To enable the system to operate according the parameter seeting, the system must be reset after one or more parameters have been changed.

II. Error Messages

Display	Description	Note
E50	Lag error	Fatal Error, it disables the converter. Refer to Parameter P762.
E51	Error during program saving	Reset the systems and try again.
E52	Two or more movements enabled simultaneously	Check the user program logic.
E53	Movement data are not valid	Perhaps some speed, acceleration value, etc. was reset to zero.
E54	Inverter disabled	Attempt to execute some movement with disabled inverter.
E55	Incompatible program or out of memory limits	Check program and install it again. This error also occurs when there is no program installed in the PLC (PLC powered-up first time).
E56	Wrong CRC	Transmit it again.
E57	Shaft has not been referenced to absolute movement	Before an absolut movement, you must set the machine movement to zero position.
E58	Master Reference Fault	Fatal Error: after enabled initial communication, between master and slave, by any cause has been disabled.
E59	Fieldbus off-line	Specific error of Fieldbus communication. For further information, please, refer to the Fieldbus Communication User's Guide included in the product CD.
E60	Board access / connection fault	Specific error of Fieldbus communication. For further information, please, refer to the Fieldbus Communication User's Guide included in the product CD.
E61	Bus off	*Bus off* has been detected on the CAN bus due to a high number of transfer erros. These erros may be caused due to bus problems or due to improper installation.
E63	Transceiver not powered	CANopen or DeviceNet communication error. For further information, please, refer to the CANopen or DeviceNet Communication User's Guide included in the product CD.
E65	Node Guarding Error	Specific error for the CANopen communication. For further information, please, refer to the CANopen communication user's guide provided with the product CD.
E66	Master in IDLE mode	Specific error for the DeviceNet communication. For further information, please, refer to the DeviceNet communication user's guide provided with the product CD.
E67	Timeout de conexões I/O	Specific error for the DeviceNet communication. For further information, please, refer to the DeviceNet communication user's guide provided with the product CD.

Note: the drive is disabled with fatal errors E50 and E58 and must be reset. It is possible to use the system bit register SX2 to reset a fatal error.

SAFETY NOTICES

This Manual contains all necessary information for the correct installation and operation of the PLC2 with the CFW-09 Variable Frequency Drive.

The PLC2 Manual has been written for qualified personnel with suitable training of technical qualifications to operate this type of equipment.

1.1 SAFETY NOTICES IN THE MANUAL

The following Safety Notices will be used in this Manual:

DANGER!
If the recommended Safety Instructions are not strictly observed, it can lead to serious or fatal injuries of personnel and/or equipment damage.

ATTENTION!
Failure to observe the recommended Safety Procedures can lead to material damage.

NOTE!
The content of this Manual supplies important information for the correct understanding of operation and proper performance of the equipment.

1.2 SAFETY NOTICES ON THE PRODUCT

The following symbols may be attached to the product, serving as Safety Notice:

High Voltages.

Components are sensitive to electrostatic discharge. Do not touch them.

Mandatory connection to ground protection (PE).

Shield connection to ground.

1.3   PRELIMINARY
        RECOMMENDATIONS

DANGER!
Only qualified personnel should plan or implement the installation, start-up, operation and maintenance of the CFW-09 and associated equipment.
The personnel must follow all safety instructions included in this Manual and/or defined by the local regulations.
Failure to comply with these instructions may result in personnel injury and/or equipment damage.

NOTE!
In this Manual, qualified personnel are defined as people that are trained to:
1. Install, ground, power up and operate the CFW-09, as well as the PLC2 board, according to this Manual and the local safety procedures;
2. Use the safety equipment according to the local regulations;
3. Give first aid.

DANGER!
Always disconnect the supply voltage before touching any electrical component inside the inverter.
Many components are charged with high voltages, even after the incoming AC power supply has been disconnected or switched OFF. Wait at least 10 minutes for the total discharge of the power capacitors.
Always connect the frame of the equipment to the ground (PE) at the suitable connection point.

ATTENTION!
All electronic boards have components that are sensitive to electrostatic discharges. Never touch any of the electrical components or connectors without following proper grounding procedures.
If necessary to do so, touch the properly grounded metallic frame or use a suitable ground strap.

NOTE!
Read this entire Manual carefully and completely before installing or operating PLC2 board with the CFW-09.

ATTENTION!
For correct use of PLC2 board it is necessary to know how to use the WLP software. Read the enclosed WLP software user's guide completely before using the PLC2 board on the drive.

GENERAL INFORMATION

This chapter defines the contents and purpose of this manual.

2.1   ABOUT THIS MANUAL

This manual provides instructions for installation and use of the PLC2 board.

Chapter 1 - Safety Notices;
Chapter 2 - General Information;
Chapter 3 - Installation and Configuration;
Chapter 4 - Detailed Parameter Description.

This Manual provides information required for the correct use of the PLC2. As the PLC2 is very flexible, it allows many different operation modes as described in this manual. As the PLC2 can be applied in several ways, it is impossible to describe here all application possibilities of this board. WEG does not assume any responsibility when the PLC2 is not used according to this manual.

No part of this Manual may be reproduced in any form, without written consent of WEG.

The communication user's guide for the PLC2 board presented in table 2.1 complements this user's guide. These user's guides are available in PDF format on the product CD and also at WEG website.
The compatibility of these user's guides and the product is directly related to the product software version. Hence, pay attention to the communication user's guide identification (E/1, E/2, ...) when downloading it from the WEG website.

PLC2 V1.5X User's Guide	Revision
ModBus User's Guide	E/1
WegTP User's Guide	P/1
CANopen Slave User's Guide	E/2
DeviceNet Slave User's Guide	P/3
WLP User's Guide	E/2
WSCAN User's Guide	E/2

Table 2.1 - Communication user´s guide for the PLC2 board

2.2   ABOUT THE PLC2 BOARD

The PLC2 board adds important CLP (Programmable Logical Controller) functions to the CFW-09, enabling the execution of complex linkage program by using the digital board inputs and outputs as well as the digital and analog inputs and outputs of the own inverter which can be accessed by the user´s program.

Among the several available functions we can mention simple contacts and coils up to functions that uses floating point, such as sum, subtraction, multiplication, division, trigonometry, square root functions, etc.

Other important functions are the PID blocks, high-pass and low-pass filters, saturation, comparison. All these functions operate with floating point.

Besides the functions mentioned above, the PLC2 provides blocks for motor speed and motor position control, that is a trapezoidal-profile positioning and a S-profile positioning, speed reference generation with trapezoidal acceleration ramp, etc. (Note: when positioning functions used, the coupling of an encoder on motor shaft is required).

All functions can interact with the user through the 100 programmable parameters that can be acessed directly through the inverter HMI. The texts and user units of the programmable parameters can be customized by the WLP.

ATTENTION!
- The **CFW-09** inverter software version should be the version **V2.64** or later.
-It is possible to use the set speed block with the V/Hz control mode (scalar) for CFW-09 drives with software version V3.70 or later.

2.3 GENERAL CHARACTERISTICS OF THE PLC2

2.3.1 Hardware

The PLC2 board has the following hardware characteristics:

- ☑ 9 isolated digital inputs, bi-directional, 24Vdc;
- ☑ 1 motor PTC input;
- ☑ 3 digital relay output 250V x 3A;
- ☑ 3 digital optocoupled outputs, bi-directional, 24Vdc x 500mA;
- ☑ 1 differential analog input (-10 to +10)Vdc or (-20 to +20)mA, 14 Bits;
- ☑ 2 analog outputs (-10 to +10)Vdc or (0 to +20)mA, 12bits;
- ☑ 2 isolated encoder input, with external supply of 5Vdc or 18Vdc to 24Vdc;
- ☑ 1 serial communication interface -- RS-232C (standard Protocol: MODBUS-RTU);
- ☑ All sizes compatible with CFW-09;

☑ It permits the use of digital and analog inputs/ouputs of the CFW-09, comprising 15 digital inputs, 9 digital outputs, 3 analog inputs and 4 analog outputs, accessed by the ladder;

☑ CANopen Master/Slave and DeviceNet Slave communication;

☑ Option for Profibus DP Slave communication;

☑ Option for DeviceNet communication.

2.3.2   Software

The software for the PLC2 board has the following characteristics:

☑ The Parameter Range comprises the parameter from 750 to 899, totaling 150 parameters. The 50 first parameters are predefined by the system or are reserved parameters. The other 100 remaining parameters are for general use, i. e., they may be programmed by the user and can be used for the most different functions, as contactors, timers, speed, acceleration and position references, etc.;

☑ Volatile (zero-initialized) and retentive BIT, WORD and FLOAT registers;

☑ The programming of the PLC2 board is performed via WLP Software using the Ladder Logic Language, with specific blocks for positioning and CLP functions;

☑ Memory capacity for the user program: 64kB (65536 bytes);

☑ On-line monitoring.

ATTENTION!
The PLC2 version 1.5X is compatible only with the WLP software version 6.20 or higher.

INSTALLATION AND CONFIGURATION

This chapter is intended to describe the installation and configuration procedures for the PLC2 board.

⚠️ **ATTENTION!**
Follow the instructions included in this user's guide to guarantee the correct installation and operation of the PLC2 board and the CFW-09 drive.

3.1 INSTALLING THE PLC BOARD ON THE DRIVE

The PLC2 board is directly installed on the CFW-09 control board (CC9 control board), as presented in figures 3.1 and 3.2.
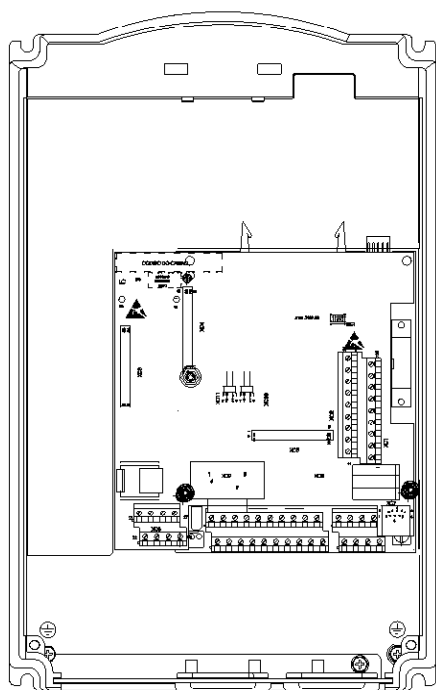
Sizes 1 and 2
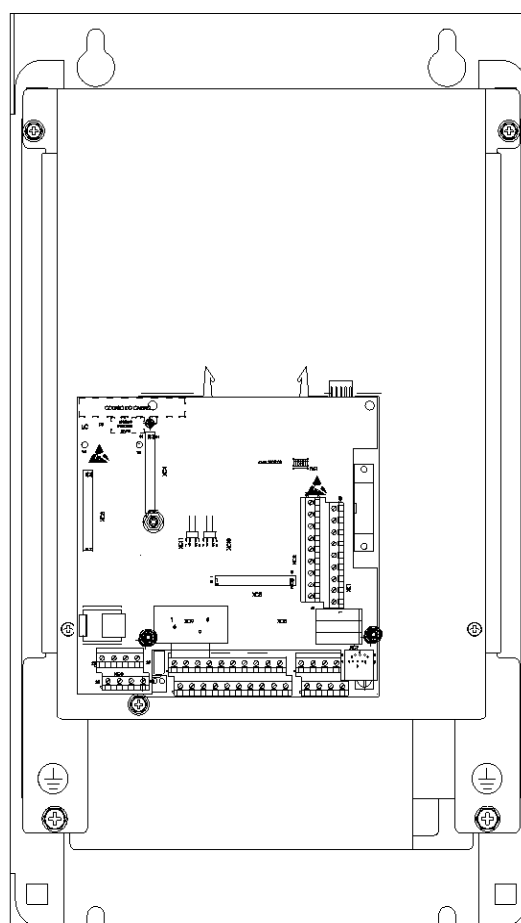
Sizes 3 to 10

Figure 3.1 – *Location of the PLC2 board installation on the CFW-09 drive*
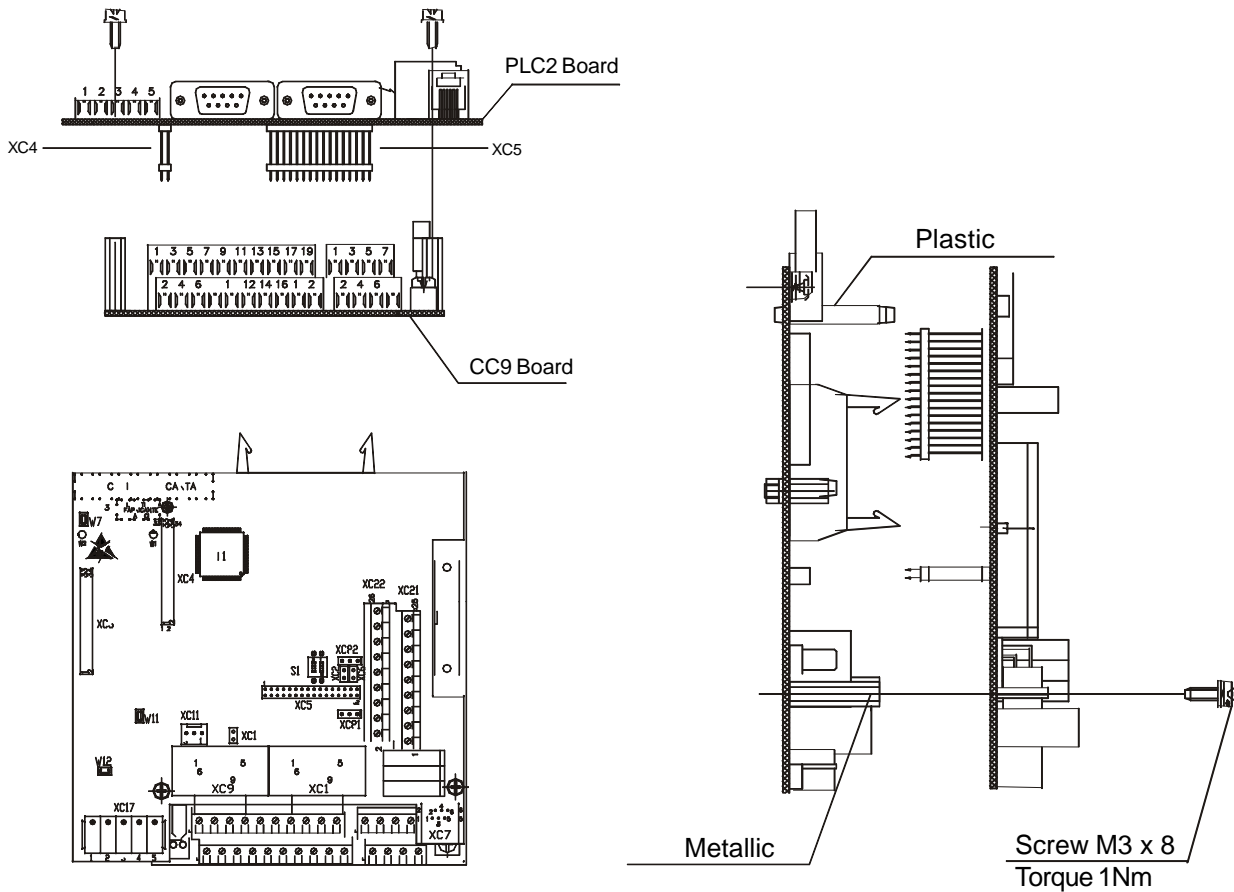
Figure 3.2 - *Seating the PLC2 on the CC9 control board*

Follow the steps bellow for the proper installation of the board:

Step 1 - Make sure the equipment is disconnected from the power supply and remove the frontal cover of the CFW-09.

Step 2 - When using size 1 drives, remove the plastic side cover.

Step 3 - Configure the jumpers of the board according to tables 3.1, 3.2 and 3.3 of the CONFIGURING THE JUMPERS section.

Step 4 - Replace the metal and plastic spacers installed on the CC9 control board by the spacers provided with the PLC2 kit.

Step 5 - Seat the PLC board on the CC9 control board aligning the terminals of the XC4 and XC5 connectors (on the PLC board) with the terminals of the female XC140 and XC3 connectors (on the CC9 control board).

Step 6 - Check if all terminals of the XC4 and XC5 connectors are aligned.

Step 7 - Press the center and the left up corner of the board until it is completely seated on the spacers.

Step 8 - Insert and tighten the screws to firmly secure the board to the 2 metal spacers.

Step 9 - When using the PTC input of the PLC2 board, plug the cable connected to connector XC11 of the PLC2 board into connector XC11 of the drive control board (CC9).

3.2   CONFIGURING THE
       JUMPERS

Some functions and characteristics of the PLC board operation
are defined by the setting of the jumpers on the board (see
figure 3.3). The following tables describe the possible
configurations for the jumpers and their functions.

XC1 Jumper: Selection of Encoder Power Supply Voltage

XC1 Status	Encoder Power Supply
Open	(8 to 24)Vdc
Close	5Vdc

Table 3.1 - XC1 jumper

ATTENTION!
If XC1 is closed, do not supply the encoders with voltage
higher than 5Vdc. Higher voltages will damage the circuitry.

XC2 and XC6 Jumpers: Firmware Download

XC2 and XC6 Status	Operation
Open	Normal operation
Close	Firmware download

Table 3.2 - XC2 and XC6 jumpers

XC81 and XC82 Jumpers: Analog Outputs AO1 and AO2 Operation Mode

XC81 and XC82 position	Analog output operation mode
1 and 2	Voltage (-10 to +10)Vdc
2 and 3	Current (0 to 20)mA

Table 3.3 – XC81 and XC82 jumpers

3.3   CONNECTORS
       DESCRIPTION

Figure 3.3 shows the connectors and jumpers available on
the PLC2 board.
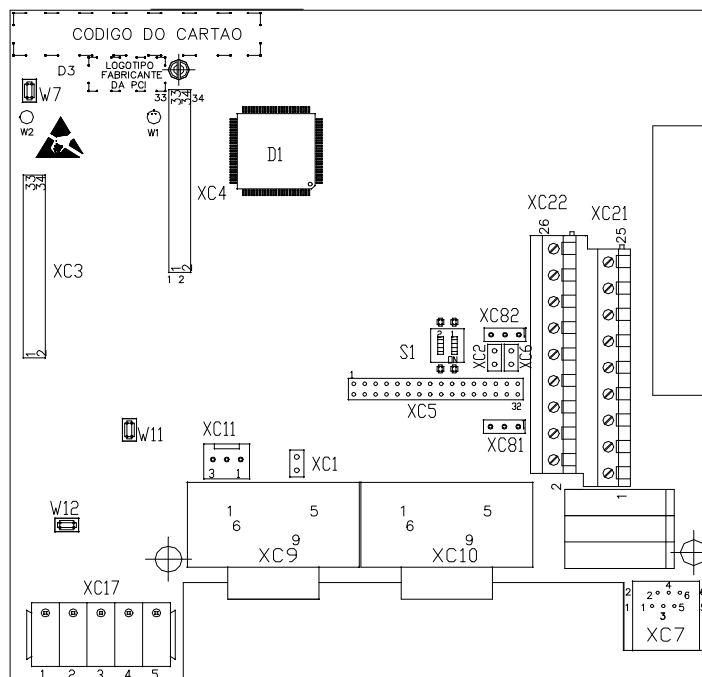
Figure 3.3 - Detailed view of the connectors and jumpers of the PLC2 board

The connectors and their terminals function are described below.

XC21 Connector: Relay Outputs and Digital Inputs

XC21 Connector			Function	Specification
1	C	DO1	Digital relay outputs	Contact capacity:
2	NO			
3	C	DO2		3A
4	NO			250Vac
5	C	DO3		
6	NO			
7	COM DO		Reference for digital outputs DO4, DO5, and DO6	-
8	DO4		Bidirectional Opto-isolated Digital Outputs	Maximum Voltage: 48Vdc
9	DO5			
10	DO6			Current capacity: 500mA
11	COM DI		Reference for digital inputs DI1 to DI9	-
12	DI9		Bidirectional Isolated Digital Inputs	Input Voltage: (15 to 30Vdc)
13	DI8			
14	DI7			Input Current: 11mA@24Vdc
15	DI6			

Figure 3.4 - Description of XC21 connector

ATTENTION!
(*) External Power Supplies.

XC22 Connector: 24Vdc Transistor Outputs and Digital Inputs

XC22 Connector			Function	Specifications
16	PTC1		Motor thermistor input	Attention: 3,9k
				Release: 1,6k
17	PTC2		PTC	Minimum resistance: 100Ω
18	GND ENC		Reference for the power supply of the encoder input	-
19	+ ENC		Encoder input power supply	Controlled 5Vdc or (8 to 24)Vdc Current consumption: 50mA + encoders current (*).
20	-	AO2	Analog output 2	(-10 to +10)Vdc or (0 to 20)mA
21	+			12 bits
22	-	AO1	Analog output 1	(-10 to +10)Vdc or (0 to 20)mA
23	+			12 bits
24	-	AI1	Differential Analog Input 1	(-10 to +10)Vdc or (-20 to +20)mA
25	+			14 bits (**)
26	DI1		Bidirectional, Isolated Digital Inputs	Input voltage: (15 to 30)Vdc
27	DI2			
28	DI3			Input current: 11mA@24Vdc
29	DI4			
30	DI5			

Figure 3.5 - Description of XC22 connector

ATTENTION!
(*) External Power Supply.
(**) For current switch S1 to ON.

Figure 3.6 shows the PTC connection to terminals 16 and 17 of XC22 connector, its operation under a motor temperature raise condition, and its return to the regular operation.
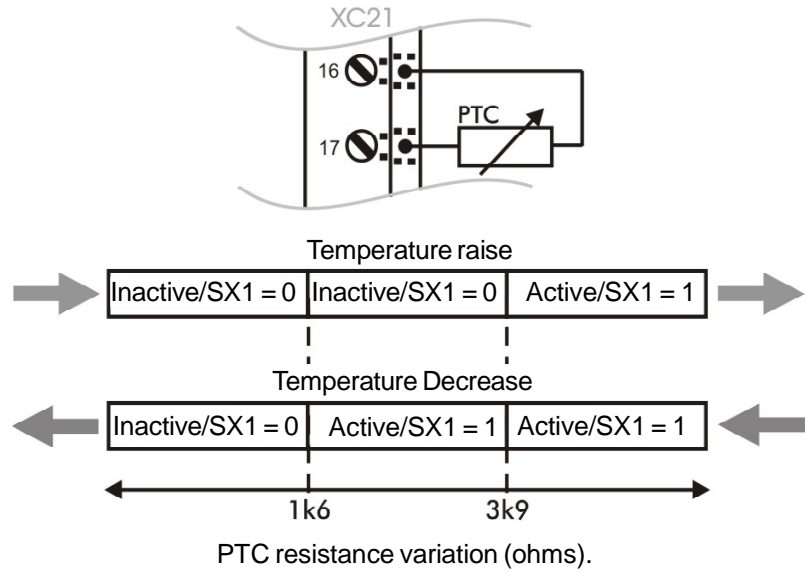
Figure 3.6 - *Using PTC*

XC3 Connector: Profibus of the HMS Board

For the connection of the Anybus-S board, which enables the PLC to communicate in a Profibus DP or DeviceNet network.

XC7 Connector: RS-232C

XC7 Connector		Function	Specification
1	5Vdc	5Vdc supply	Current capacity: 50mA
2	RTS	Request to send	-
3	GND	Reference	-
4	RX	Receives	-
5	GND	Reference	-
6	TX	Transmits	-

Table 3.4 - *Description of XC7 connector*

XC11 connector: PTC Circuit power supply

When the PTC sensor is used, the appropriated cable must be connected from PLC2 board XC11 connector to the XC11 from the control board (CC9).

XC17 Connector: CAN Network

XC17 Connector		Function	Specifications
1	V-	Reference (GND) for the CANopen power supply	-
2	CANL	CANL	-
3	SHEILD	Shield	-
4	CANH	CNAH	-
5	V+	CANopen power supply	(11 to 25)Vdc 50mA@24Vdc

Table 3.5 - *Description of XC17 connector*

ATTENTION!
Both ends of the CAN network bus shall be terminated with a 120Ω resistor. The resistor should be connected between terminals CANL and CANH.

XC9 Connector: Incremental Encoder 1 (Main)

Applications that require more speed or positioning accuracy, a speed feedback of the motor shaft by means of incremental encoder is required. The inverter connection is realized through the XC9 (DB9) connector of the PLC2 board. This input has no encoder fault detection

The used encoder should have following features:
☑ Supply voltage: 15 Vdc, with current consumption lower than 200 mA;
☑ 2 quadrature channels (90⁰) + zero pulse with
☑ supplementary outputs (differential): Signals A, $\overline{A}$, B, $\overline{B}$, Z and $\overline{Z}$;
☑ "Linedriver" type or "Push-Pull" circuit;
☑ Electronic circuit isolated against encoder frame;
☑ Number of pulses recommended per revolution: 1024 ppr.

Follow the instructions below when mounting the encoder on the motor:

☑ Couple the encoder onto the motor shaft directly (by using a flexible coupling, but without torsional flexibility);
☑ Both motor shaft and metallic encoder frame must be isolated electrically against motor (min. spacing: 3 mm);
☑ Use flexible couplings of high quality to prevent mechanical oscillation or "backlash".

For electrical connection use shielded cable and lay it separately (spacing >25cm) from the other wirings (power, control cables, etc). If possible, install it inside a metallic conduit.
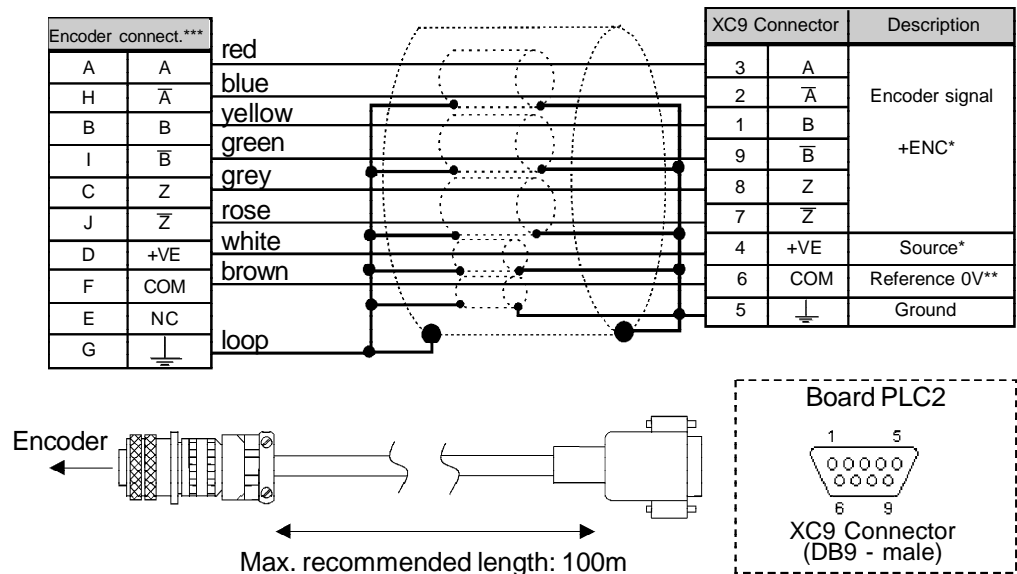
Encoder connect.***				XC9 Connector		Description
A	A	red		3	A	Encoder signal +ENC*
H	$\overline{A}$	blue		2	$\overline{A}$	
B	B	yellow		1	B	
I	$\overline{B}$	green		9	$\overline{B}$	
C	Z	grey		8	Z	
J	$\overline{Z}$	rose		7	$\overline{Z}$	
D	+VE	white		4	+VE	Source*
F	COM	brown		6	COM	Reference 0V**
E	NC			5	⏚	Ground
G	⏚	loop				

Encoder — Max. recommended length: 100m

Board PLC2
XC9 Connector (DB9 - male)

* Power supply connected to XC22: 18 and 19.
** Referenced to ground via 1μF in parallel with 1kΩ.
*** Valid pin location for encoder HS35B-Dynapar. When other encoder models are used, check the correct connection to meet the required sequence.

***Figure 3.7** - Encoder 1 connection*

XC10 Connector: Incremental Encoder 2 (Auxiliary)
The connection of the auxiliary encoder 2 is made through the XC10 connector (DB9) of the PLC2 board.
This input can be used in applications where it is necessary to use an external encoder to perform positioning functions.
However, this input shall not be used for motor speed feedback. Motor speed feedback is made through XC9 connector of the main encoder 1. This input has not encoder fault detection.

The used encoder should have following features:
- ☑ Supply voltage: 15 Vdc, with current consumption lower than 200mA;
- ☑ 2 quadrature channels (90º) + zero pulse with supplementary outputs (differential): Signals A, $\overline{A}$, B, $\overline{B}$, Z and $\overline{Z}$;
- ☑ "Linedriver" type or "Push-Pull" (level 15VDC) circuit;
- ☑ Electronic circuit isolated against encoder frame;
- ☑ Number of pulses recommended per revolution: 1024 ppr.

Use shielded cable for the electrical connection and run it away (at least 25cm) from the other wiring (power, control cables, etc.). If possible, run the cables inside a metal conduit.

Set P791 to 1 in order to use this input as a position feedback.
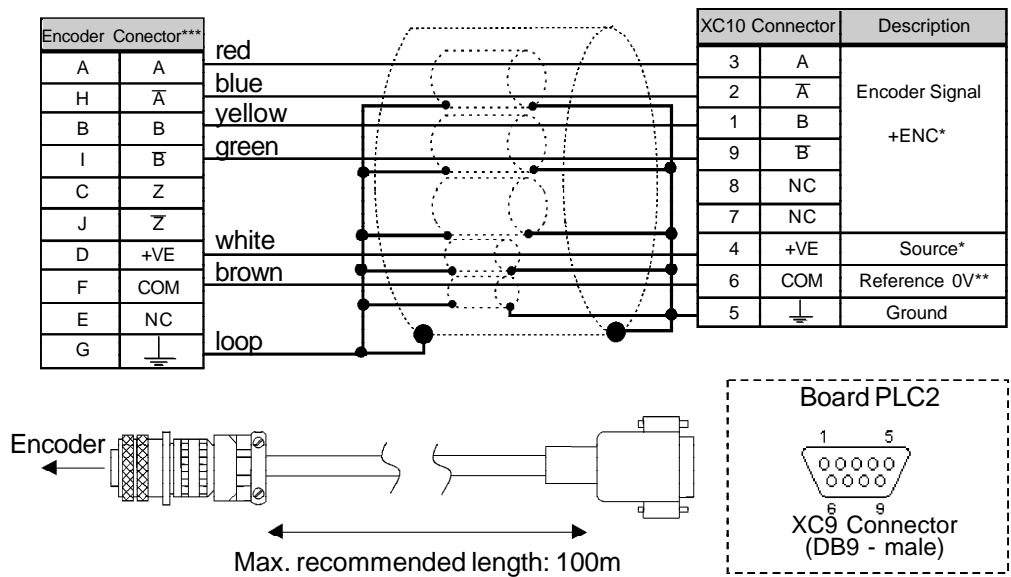
Encoder Conector***				XC10 Connector		Description
A	A	red		3	A	
H	$\overline{A}$	blue		2	$\overline{A}$	Encoder Signal
B	B	yellow		1	B	+ENC*
I	$\overline{B}$	green		9	$\overline{B}$	
C	Z			8	NC	
J	$\overline{Z}$			7	NC	
D	+VE	white		4	+VE	Source*
F	COM	brown		6	COM	Reference 0V**
E	NC			5	⏚	Ground
G	⏚	loop				

Max. recommended length: 100m

Board PLC2
XC9 Connector (DB9 - male)

* Power supply connected to XC22: 18 and 19.
** Referenced to ground via 1μF in parallel with 1kΩ.
*** Valid pin location for encoder HS35B-Dynapar. When other encoder models are used, check the correct connection to meet the required sequence.

***Figure 3.8** – Encoder 2 connection*

NOTE!
The maximum permitted frequency for the main/auxiliary encoder is 100 kHz.

3.4   CONFIGURING THE CFW-09 TO OPERATE WITH PLC2 BOARD

In order to enable the CFW-09 to be controlled by the PLC2 board it is necessary to perform the following configurations, depending on the desired functions:

☑ **Control Type (P202):**
For the blocks that generate speed reference, you can use the converter in 'Sensorless' (**P202=3**) mode. Please consider that in this operation mode there is no high precision at low speed. In addition, the position gain Kp (P760) should be reset to zero to prevent instability when the motor is disabled.
For the position blocks, the inverter must be operated in vector mode with encoder (**P202 = 4**).

Important Notes:
☑ Always when possible, use the vector mode with encoder;
☑ The scalar mode operation (V/Hz) should be avoided if the PLC will generate speed reference and the CFW-09 firmware version is earlier than V3.70.
☑ Check the correct setting of the P161 and P162 parameters that are the proportional speed gain and the integral speed gain, respectively. The correct setting of these parameters are very important for a good inverter performance.

☑ **Local / Remote Selection (P220):**

When the PLC is used as movement generator, this option must be set to 'Always Local' (**P220=0**).

☑ **Local Reference Selection (P221):**

When the PLC is used as movement generator, this option must be set to 'PLC' (**P221=11**), i. e., the speed reference will be given by the PLC board.

☑ **Local Run/Stop Selection (P224)**

To enable the PLC to control the converter through the run/stop options and also enable the PLC to disable the drive, this option must be set to 'PLC' (**P224=4**).

☑ **AO1 Output Function (P251):**

To enable the PLC to control the analog inverter output 1 (AO1), set **P251=12**. Note that P252 is the gain of the analog output 1.

☑ **AO2 Output Function (P253):**

To enable the PLC to control the analog inverter output 2 (AO2), set **P253=12**. Note that P254 is the gain of the analog output 2.

☑ **Digital Inputs DI101 to DI106, P263 to P268:**

There is no need of special CFW-09 programming to access the drive's digital inputs through the PLC board.
In the PLC board programming, the digital inputs of the drive (DI1 to DI6) are named DI101 to DI106, respectively.

☑ **Digital Relay Outputs DO101 to DO103, P277, P279 and P280:**

These Parameters correspond to the RL1 to RL3 drive outputs. To enable the PLC to control these outputs, you must set these parameters to the function 'PLC', i. e. **P277=27**, **P279=27** and **P280=27**.

DETAILED PARAMETER DESCRIPTION

This chapter describes in details all the PLC programming and read parameters. Besides these parameters, the CFW-09 parameters must also be configured in accordance with the application (refer to the CFW-09 User's Guide for its parameter description).

Parameter	Range [Factory Setting] Unit	Description / Note
P750 Firmware version PLC2 [Read parameter]	- [-] -	☑ It shows the firmware version of the PLC board. Example: version 1.00. At the parameter you can read 100.
P751 Scan cycle of the user program [Read parameter]	0 to 65535 [-] x100 µs	☑ It shows the duration of the user program cycle. Each unit corresponds to 100µs. To obtain the value of the scan cycle, divide the value of P751 by 10. Exemple: when 79 is read, this means that the program scan cycle is 79 ÷ 10 = 7,9ms.
P752 (*) Resets the retentive markers [Configuration parameter]	0 or 1 [0] -	☑ It reset the retentive markers, both bit type and word type. Set the parameter to 1 (one) and restart the system. The value of this parameter returns to 0 (zero) automatically.
P753 (*) Loads factory settings, if =1234 [Configuration parameter]	0 to 65535 [0] -	☑ It loads the factory setting to the system parameters (750 to P799). Set this parameter to 1234 and reset the system.
P754 Position reference (rotations) [Read parameter]	0 to 65535 [-] rotations	☑ It shows the position reference in rotations. The position reference starts at zero and after the movement has been concluded, it returns to zero.
P755 Position reference (fraction of rotation) [Read parameter]	0 to 3599 [-] degrees/10	☑ It shows the fraction of the revolution of the reference position in tenth of degree. The position reference starts at zero and after the movement has been concluded, it returns to zero.
P756 Real position signal [Read parameter]	0 or 1 [-] -	☑ Signal of the real position shown at Parameters P757 and P758. 0 = negative 1 = positive

(*) IMPORTANT: To enable the system to operate according the parameter seeting, the system must be reset after one or more parameters have been changed.

Parameter	Range [Factory Setting] Unit	Description / Note
P757 Real position (rotations) [Read parameter]	0 to 65535 [-] rotations	☑ It shows the real position in rotations.
P758 Real position (fraction of rotation) [Read parameter]	0 to 3599 [-] degrees/10	☑ It shows the fraction of revolution of the real position in tenth of degree.
P759 Lag error [Read parameter]	0 to 3599 [-] degrees/10	☑ Shows lag error in degrees/10.
P760 Proportional position gain (Kp) [Configuration parameter]	0 to 200 [50] -	☑ Increase this gain to speed up the answer to a position error and decrease this gain when system vibrates or becomes unstable.
P761 Integral position gain (Ki) [Configuration parameter]	0 to 200 [0] -	☑ It has the function to reset eventual position errors. In general, this gain is zero and may cause a position overshoot, i.e. to go beyoud the desired position and return.
P762 Max. lag error [Configuration parameter]	0 to 65535 [1800] degrees/10	☑ This is the max. permitted positioning error, i. e., the max. permitted difference between reference position and the real position, in degrees. The parameter and the lag values are divided by 10. For instance 10 at P762 means that the max. following error is 1 degree. When P762=0 (default setting), the lag error will not be checked.
P763 Disables user program if=1 [Configuration parameter]	0 or 1 [0] -	☑ When this Parameter is set to 1, it disables the user program. This setting should be used in any abnormal condition only, where the program is causing some error type, for instance, when it prevents the communication with the serial interface. In this case, disable the program and install the new corrected version and then enable it again.
P764 (*) PLC address at network [Configuration parameter]	1 to 247 [1] -	☑ When, for instance, the MODBUS network connection is used through serial interface RS-485 (inverter RS-232 / RS-485), this parameter defines the address at the network board.

(*) IMPORTANT: To enable the system to operate according the parameter seeting, the system must be reset after one or more parameters have been changed.

Parameter	Range [Factory Setting] Unit	Description / Note
P765 (*) Baud rate of RS-232 [Configuration parameter]	1 to 6 [4 (= 9600bps)] -	☑ Sets the baud rate of the serial interface. The permitted settings are: <table><tr><td>P765</td><td>Baud-Rate (bps)</td></tr><tr><td>1</td><td>1200</td></tr><tr><td>2</td><td>2400</td></tr><tr><td>3</td><td>4800</td></tr><tr><td>4</td><td>9600</td></tr><tr><td>5</td><td>19200</td></tr><tr><td>6</td><td>38400</td></tr></table> ***Table 4.1 -** Baud rate of RS-232*
P766 (*) PID sample time [Configuration parameter]	1 to 10000 [1] x 1.2 ms	☑ Defines the sampling time for the PID blocks in intervals of 1,2ms. Example: P766=10 means that the PID "sampling time" will be 12ms.
P767 (*) Synchronous motor speed [Configuration parameter]	0 to 10000 [1800] rpm	☑ Set this parameter to the driven motor synchronous speed. In order to calculate the motor synchronous speed use the following equation: $$n_s = \frac{120 \times f}{2p}$$ Where: ns= Synchronous speed f= Motor frequency p= Number of pole pairs of the motor ☑ For instance, a IV pole motor / 50Hz has a synchronous speed of 1500rpm.
P768 (*) Encoder 1 pulse number (main) [Configuration parameter]	0 to 10000 [1024] ppr	☑ It shows the number of pulses per encoder revolution.
P769 (*) Encoder 1 zero pulse position (main) [Configuration parameter]	0 to 3599 [0] degrees/10	☑ The input value should be in tenth of degree. This value can be used to search for the machine zero and so set the zero position.

(*) IMPORTANT: To enable the system to operate according the parameter seeting, the system must be reset after one or more parameters have been changed.

Parameter	Range [Factory Setting] Unit	Description / Note
P770 (*) CAN protocol [Configuration parameter]	0 to 2 [0] -	☑ The setting of this parameter allows selecting the communication protocol that will be used for the CAN interface available at the PLC2 board.

P770	Description	Note
0	Disable	CANopen and DeviceNet protocols are disabled. Setting P770 to '0' enables the speed synchronism via CAN, which is programmed via WLP software (FOLLOW and MSCANWEG function blocks).
1	CANopen	Setting P770 to '1' makes the PLC2 board operate as master or slave on the CANopen network. Additional information about how using the PLC2 board with this protocol can be found on the CANopen communication user's guide provided with the product CD.
2	DeviceNet	Setting P770 to '2' makes the PLC2 board operate as a slave on the DeviceNet network. Additional information about how using the PLC2 board with this protocol can be found on the DeviceNet communication user's guide provided with the product CD.

Table 4.2 - CAN interface available at the PLC2 board

NOTE!
Change of parameter P770 is executed when the device is reset or at next power up.

Parameter	Range [Factory Setting] Unit	Description / Note
P771 (*) CAN address [Configuration parameter]	0 to 127 [63] -	☑ P771 sets the address of the PLC2 board in the CAN network. The range of valid addresses is dependent on the selected protocol: CANopen: valid addresses from 1 to 127. DeviceNet: valid addresses from 0 to 63. ☑ It is not necessary to define the device address when the synchronism function via CAN is used.

NOTE!
Change of parameter P771 (CAN address) is executed when the device is reset or at next power up.

Parameter	Range [Factory Setting] Unit	Description / Note
P772 (*) CAN baud rate [Configuration parameter]	0 to 8 [0] bits/second	☑ Adjust CAN baud rate. Accept Values:

P772	Description	Maximum Cable Length
0	1 Mbit/s	25 m
1	Reservado	-
2	500 Kbit/s	100 m
3	250 Kbit/s	250 m
4	125 Kbit/s	500 m
5	100 Kbit/s	600 m
6	50 Kbit/s	1000 m
7	20 Kbit/s	1000 m
8	10 Kbit/s	1000 m

Table 4.3 - CAN baud rate

(*) IMPORTANT: To enable the system to operate according the parameter seeting, the system must be reset after one or more parameters have been changed.

Parameter	Range [Factory Setting] Unit	Description / Note
		☑ The DeviceNet protocol only supports three baud rates: 500 kbps, 250 kbps and 125 kbps. If any other option is chosen the auto-baud is selected. ☞ **NOTE!** Change of baud rate is valid only after the device is reset or at next power up.
P773 Bus off recovery [Configuration parameter]	0 or 1 [0] -	☑ This parameter allows the PLC2 action selection when a *bus off* error occurs. The permitted values are: | P773	Description	Note
0	Manual	After the *bus off* error has been detected, the device displays E61, the CAN communication will be disabled and the device must be reset manually to return to network operation.
1	Automatic	The communication will be restart automatically after *bus off* error has been detected. | ***Table 4.4 -*** *Permitted values when a bus off error occurs*
P774 Action to be taken upon detection of a communication failure [Configuration parameter]	0 or 1 [1] -	☑ Setting of this parameter selects the action to be taken by the PLC2 board upon detection of a communication failure on the CAN interface: | P774	Description	Note
0	Indicate the error	Setting P774 to '0' displays the error code on the HMI upon detection of communication failure.
1	Cause a fatal error on the device	Setting P774 to '1', besides displaying the error code on the HMI, disables the device upon detection of communication failure. Device needs to be reset in order to operate again. | ***Table 4.5 -*** *Action a communication failure* ☑ Communication errors may be different according to the protocol used. Please, refer to the communication guide specific for the protocol in use.
P775 CAN status [Read parameter]	0 to 6 [-] -	☑ Inform CAN status: 	P775	CAN Status
---	---
0	Disabled
1	Reserved
2	CAN enabled
3	Warning (some telegrams with error)	 ***Table 4.6 -*** *CAN status*

Parameter	Range [Factory Setting] Unit	Description / Note

		P775	**CAN Status**
		4	Error Passive (Much telegrams with error or is the only network device with enabled CAN transmitting telegrams).
		5	Bus Off (number of detected errors exceeded the internal device limit and the communication has been disabled)
		6	Bus not powered

Table 4.6 (cont.) - CAN status

Parameter	Range [Factory Setting] Unit	Description / Note
P776 Counter of received telegrams [Read parameter]	0 to 65535 [-] -	☑ Cyclic counter is incremented at each CAN telegram received with success. Counting is restart each time the counter reaches to upper limit.
P777 Counter of transmitted telegrams [Read parameter]	0 to 65535 [-] -	☑ Cyclic counter is incremented at each CAN telegram received with success. Counting is restart each time the counter reaches to upper limit.
P778 Counter of detected errors [Read parameter]	0 to 65535 [-] -	☑ Cyclic counter is incremented each time an error is detected (*bus off*). Counting is restart each time the counter reaches to upper limit.
P779 Configuration status CANopen [Read parameter]	0 to 65535 [-] -	☑ Shows the CANopen configuration Status. 0 = slave 1 = master
P780 Status CANopen communication status [Read parameter]	0 to 4 [-] -	☑ Indicates the status of the CANopen communication, informing if the protocol was correctly initialized and the state of the slave node guarding service.

P780	Description	Note
0	Disabled	The CANopen protocol was not set in parameter P700 and it is disabled.
1	Reserved	-
2	CANopen enabled	The CANopen protocol was correctly started.
3	Node Guarding enabled	Node guarding service was started by the master and it is properly working.
4	Node Guarding error	Timeout for the node guard service. This event results in a PLC board error (E65).

Table 4.7 - Status of the CAN communication

☑ Refer to CANopen communication user's guide to obtain detailed description about the protocol.
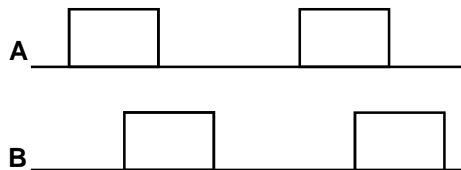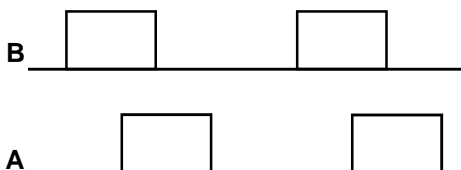
Parameter	Range [Factory Setting] Unit	Description / Note
P781 CANopen node status [Read parameter]	0 to 127 [-] -	☑ Each device in the CANopen network has an associated status. The current status of the PLC2 board is displayed in this parameter.

P781	Description	Note
0	Not initialized	The CANopen protocol was not set in parameter P700 and it is disabled.
4	Stopped	Data transfer between master and slave is not possible in this state
5	Operational	All communication services are available in this state.
127	Pre-operational	Only some CANopen communication services are available in this state.

Table 4.8 - Status of the CANopen node

☑ Refer to CANopen communication user's guide to obtain detailed description about the protocol.

Parameter	Range [Factory Setting] Unit	Description / Note
P782 DeviceNet network status [Read parameter]	0 to 5 [-] -	

P782	Description
0	Not Powered / Not On-line
1	On-line / Not Connected
2	Link Ok / On-line and Connected
3	Connection Timeout
4	Critical Link Failure
5	Running Auto-baud

Table 4.9 - DeviceNet network status

☑ A detailed description of these items can be found on the DeviceNet user's guide for this product.

Parameter	Range [Factory Setting] Unit	Description / Note
P783 DeviceNet master status [Read parameter]	0 or 1 [-] -	

P783	Description
0	Master in run mode
1	Master in Idle mode

Table 4.10 - Status of the DeviceNet master

☑ For a detailed description of these items, please, refer to the DeviceNet programming user's guide specific for this product.

Parameter	Range [Factory Setting] Unit	Description / Note
P784 Number of input words [Configuration parameter]	0 to 10 [1] -	☑ The setting of this parameter defines the number of reading words exchanged with the master of the DeviceNet network.
P785 Number of output words [Configuration parameter]	0 to 10 [1] -	☑ The setting of this parameter defines the number of writing words exchanged with the master of the DeviceNet network.

Parameter	Range [Factory Setting] Unit	Description / Note
P786 Fieldbus board status [Read parameter]	0 to 3 [-] -	☑ Indicates the status of the optional communication board. See below the status values and their description:

P786	Description	Note
0	Disabled: Indicates that the board was not enabled	The board is enabled through the WLP software, by using the tool for fieldbus board configuration.
1	Inactive board: Indicates that the board was programmed, however, the PLC2 board could not access the fieldbus board	This situation mainly happens during board initialization, (it can also happen during its operation), due to installation and bad connection problems. When the board is inactive, the drive shows an E60 error on the keypad, and it is only possible to enable the board again by resetting the drive.
2	Active and off-line board: indicates a communication error between the board and the network master	This error causes the interruption of master-slave communication and may happen due to several reasons (master configuration problems, incorrect installation of communication cables, noise during data transmission, etc.). When the fieldbus board is off-line, the drive shows an E59 error on the keypad.
3	Active and on-line board: indicates that the master-slave communication was successfully established	-

Table 4.11 - Status of the fieldbus board

Parameter	Range [Factory Setting] Unit	Description / Note
P788 Operation mode for the analog output 1 [Configuration parameter]	0 to 6 [-] -	

P788	Description
0	-10 to +10V (range from -32768 to +32767)
1	0 to 20mA (range from 0 to 32767)
2	0 to 20mA (range from 0 to 65535)
3	0 to 20mA (range from -32768 to +32767)
4	4 to 20mA (range from 0 to 32767)
5	4 to 20mA (range from 0 to 65535)
6	4 to 20mA (range from -32768 to +32767)

Table 4.12 - Operation mode for the analog output 1

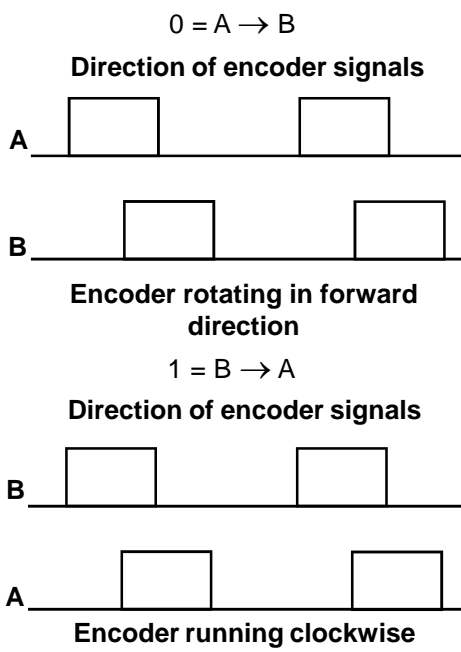| Parameter	Range [Factory Setting] Unit	Description / Note
P789 Operation mode for the analog output 2 [Configuration parameter]	0 to 6 [-] -	<table><tr><th>P789</th><th>Description</th></tr><tr><td>0</td><td>-10 to +10V (range from -32768 to +32767)</td></tr><tr><td>1</td><td>0 to 20mA (range from 0 to 32767)</td></tr><tr><td>2</td><td>0 to 20mA (range from 0 to 65535)</td></tr><tr><td>3</td><td>0 to 20mA (range from -32768 to +32767)</td></tr><tr><td>4</td><td>4 to 20mA (range from 0 to 32767)</td></tr><tr><td>5</td><td>4 to 20mA (range from 0 to 65535)</td></tr><tr><td>6</td><td>4 to 20mA (range from -32768 to +32767)</td></tr></table> *Table 4.13 -* Operation mode for the analog output 2
P790(*) Encoder 2 pulse number (auxiliary) [Configuration parameter]	0 to 10000 [1024] ppr	☑ This parameter represents the number of pulses per revolution of encoder 2 (auxiliary).
P791(*) Enables the position feedback via encoder 2 (auxiliary) [Configuration parameter]	0 or 1 [0] -	☑ Enables the position feedback via encoder 2 (auxiliary). <table><tr><th>P791</th><th>Description</th><th>Specification</th></tr><tr><td>0</td><td>Disabled</td><td>Encoder 1 (main encoder) is responsible for the position feedback.</td></tr><tr><td>1</td><td>Enabled</td><td>Encoder 2 (auxiliary encoder) is responsible for the position feedback.</td></tr></table> *Table 4.14* – Encoder 2
P792(*) Direction of encoder 2 signal (auxiliary) [Configuration parameter]	0 or 1 [1] -	☑ Defines the direction of the encoder signal: 0 = A → B **Direction of encoder signals** **Encoder rotating in forward direction** 1 = B → A **Direction of encoder signals** **Encoder running clockwise** *Figure 4.1 -* Direction of the encoder

(*) IMPORTANT: To enable the system to operate according the parameter seeting, the system must be reset after one or more parameters have been changed.

Parameter	Range [Factory Setting] Unit	Description / Note
P793 (*) Select serial protocol [Configuration parameter]	0 to 5 [-] -	☑ This parameter configures the serial communication: protocol, parity, and number of stop-bits, respectively.

P793	Description
0	Modbus, no parity and 2 stop-bits.
1	WegTP, no parity and 2 stop-bits.
2	ModBus, even parity and 1 stop-bit.
3	WegTP, even parity and 1 stop-bit.
4	ModBus, odd parity and 1 stop-bit.
5	WegTP, odd parity and 1 stop-bit.

Table 4.15 - Select serial protocol

Parameter	Range [Factory Setting] Unit	Description / Note
P794 Operation mode for the analog input 1 [Configuration parameter]	0 to 6 [-] -	

P794	Description
0	-10 to +10V / -20 to +20mA (range from -32768 to +32767)
1	0 to 20mA (range from 0 to 32767)
2	0 to 20mA (range from 0 to 65535)
3	0 to 20mA (range from -32768 to +32767)
4	4 to 20mA (range from 0 to 32767)
5	4 to 20mA (range from 0 to 65535)
6	4 to 20mA (range from -32768 to +32767)

Table 4.16 - Operation mode for the analog input

(*) IMPORTANT: To enable the system to operate according the parameter seeting, the system must be reset after one or more parameters have been changed.