Crane Horizontal Motion

CFW-11

Application Manual

Language: English
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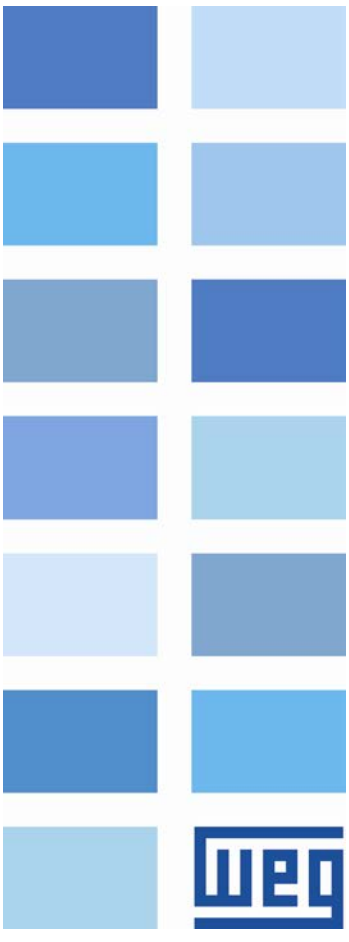

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CONTENTS

ABOUT THE MANUAL

This manual provides the necessary description for the crane horizontal motion application configuration developed of the CFW-11 frequency inverter SoftPLC function. This manual must be used together with the CFW-11 user manual, the SoftPLC function manual and the WLP software manual.

ABBREVIATIONS AND DEFINITIONS

PLC	Programmable Logic Controller
CRC	Cycling Redundancy Check
RAM	Random Access Memory
WLP	Ladder Language Programming Software
USB	Universal Serial Bus

NUMERICAL REPRESENTATION

Decimal numbers are represented by means of digits without suffix. Hexadecimal numbers are represented with the letter ‘h’ after the number.

QUICK PARAMETER REFERENCE, FAULTS AND ALARMS

Parameter	Description	Adjustable Range	Factory Setting	User Setting	Properties	Groups	Page
P1010	Crane Horizontal Motion Version	0.00 to 10.00			ro	50	50
P1011	Last Alarm	0 to 999			ro	50	50
P1012	Last Alarm Date	01.01 to 31.12			ro	50	50
P1013	Last Alarm Time	00.00 to 23.59			ro	50	51
P1014	Second Alarm	0 to 999			ro	50	50
P1015	Second Alarm Date	01.01 to 31.12			ro	50	50
P1016	Second Alarm Time	00.00 to 23.59			ro	50	51
P1017	Third Alarm	0 to 999			ro	50	50
P1018	Third Alarm Date	01.01 to 31.12			ro	50	50
P1019	Third Alarm Time	00.00 to 23.59			ro	50	51
P1020	Crane Horizontal Motion Status Word 1	Bit 0 = General Enabled Bit 1 = Running (RUN) Bit 2 = Rotation Direction Bit 3 = LOC / REM Bit 4 = Fault Condition Bit 5 = Undervoltage Bit 6 = Alarm Condition Bit 7 = Load Forward Command Bit 8 = Load Reverse Command Bit 9 = Brake Release Command Bit 10 to 15 = Reserved			ro	50	51
P1021	Crane Horizontal Motion Status Word 2	Bit 0 = Lightweight Operation Bit 1 = Coast to Stop Bit 2 = Fast Stop Bit 3 = Emergency Stop Bit 4 = Stop by Simultaneous Commands Bit 5 = Forward Slowdown Bit 6 = Reverse Slowdown Bit 7 = Stop Forward Bit 8 = Stop Reverse Bit 9 = Momentary Overload Alarm Bit 10 = Reserved Bit 11 = Reserved Bit 12 = Inverter in Torque Limit Bit 13 = Improper Operation Bit 14 = Reserved Bit 15 = Reserved			ro	50	52
P1022	Communication Network Control Word	Bit 0 = Load Forward Bit 1 = Load Reverse Bit 2 to 15 = Reserved	0		rw	50	29
P1023	Speed Reference Control Configuration	0 = Speed Reference via Electronic Potentiometer (EP) 1 = One Speed Reference via Digital Input DI4 2 = Two Speed References via Digital Input DI4 3 = Three Speed References via Digital Input DI4 and DI5 4 = Four Speed References via Digital Input DI4 and DI5 5 = Five Speed References via Digital Input DI4, DI5 and DI6 6 = Speed Reference via Analog Input AI1 (Step Less) 7 = Speed Reference via Communication Networks	2		cfg	50	25
P1024	Enable use of a Filter in the Forward and Reverse Commands	0 = Off 1 = On	0			50	22

Parameter	Description	Adjustable Range	Factory Setting	User Setting	Properties	Groups	Page
P1025	Limit Switches Configuration	0 = Without Limit Switches 1 = Forward Slowdown via DI7 and Reverse Slowdown via DI8 2 = Forward Slowdown via DI7 and Stop Forward via DI8 3 = Reverse Slowdown via DI7 and Stop Reverse via DI8 4 = Forward Slowdown via DI9 and Forward Slowdown via DI10 5 = Forward Slowdown via DI9 and Stop Forward via DI11 6 = Forward Slowdown via DI10 and Stop Reverse DI12 7 = Forward Slowdown via DI9, Forward Slowdown via DI10, Stop Forward via DI11 and Stop Reverse via DI12	0		cfg	50	29
P1026	Motor Rotation Direction Inversion	0 = Off 1 = On	0		cfg	50	22
P1027	Motor Demagnetization Time	0 to 65000 s	600 s			50	23
P1028	Speed Hysteresis for Inverter in Torque Limit Detection	0.0 to 50.0 %	7.5 %			50	48
P1029	Inverter in Torque Limit Fault (F775) Delay Time	0.00 to 650.00 s	0.75 s			50	48
P1030	Speed Reference via Communication Networks	0.0 to 1020.0 Hz	0.0 Hz			50	26
P1031	Speed Reference 1	0.0 to 1020.0 Hz	6.0 Hz			50	26
P1032	Speed Reference 2	0.0 to 1020.0 Hz	60.0 Hz			50	27
P1033	Speed Reference 3	0.0 to 1020.0 Hz	0.0 Hz			50	27
P1034	Speed Reference 4	0.0 to 1020.0 Hz	0.0 Hz			50	28
P1035	Speed Reference 5	0.0 to 1020.0 Hz	0.0 Hz			50	28
P1036	Dwell Time at Speed Reference 1	0.00 to 650.00 s	0.50 s			50	28
P1038	Current Threshold for Lightweight Detection	0.0 to 3000.0 A	10.0 A			50	37
P1039	Speed Threshold for Lightweight Detection Enabling	0.0 to 1020.0 Hz	0.0 Hz			50	38
P1041	Brake Release Frequency Threshold	0.0 to 1020.0 Hz	4.0 Hz			50	40
P1043	Brake Release Current Threshold	0.0 to 3000.0 A	0.0 A			50	40
P1045	Brake Release Torque Threshold	0.0 to 350.0 %	0.0 %			50	40
P1046	Brake Response Time to Release	0.00 to 650.00 s	0.10 s			50	41
P1047	Inhibition of the Brake Closing during a Forward/Reverse Command Transition	0 = Off 1 = On	0			50	41
P1048	Brake Closing Frequency Threshold	0.5 to 1020.0 Hz	2.5 Hz			50	41
P1049	Delay Time for Brake Closing	0.00 to 650.00 s	0.00 s			50	41
P1050	Time to Enable a new Command to Brake Release	0.10 to 650.00 s	0.20 s			50	42
P1052	Momentary Overload Current Threshold	0.0 to 3000.0 A	40.0 A			50	45
P1053	Momentary Overload Detection Delay Time	0.00 to 650.00 s	1.00 s			50	45
P1054	Momentary Overload Alarm (A770) Delay Time	0.00 to 650.00 s	1.00 s			50	46
P1058	Number of Consecutive Alarms for Improper Fault (F777)	0 to 10	3			50	48
P1059	Period of Time for Improper Fault (F777)	0 to 65000 s	120 s			50	49

FAULTS AND ALARMS

Fault/Alarm	Description	Possible causes
A750: Lightweight Operation	The Crane Horizontal Motion application is operating in the lightweight mode.	The motor speed is greater than P1039 and the motor current is less than P1038 when a load forward or reverse command is being executed.
A752: Coast to Stop	The general enable signal has been removed, releasing the motor to cast down.	Digital input DI3 with logical level “0”
A754: Fast Stop	The fast stop command has been activated.	Digital input DI3 with logical level “0”
A756: Emergency Stop	The emergency stop command has been activated.	Digital input DI3 with logical level “0”
A758: Stop by Simultaneous Commands	The application has been stopped because of the simultaneous activation of the hoisting and the lowering commands.	Digital inputs DI1 and DI2 with logical level “1”
A760: Forward Slowdown Limit Switch	The forward slowdown limit switch has been actuated.	The digital input DI5 or DI9 is with logical level “0”. The digital input for that function is defined by the parameter P1025.
A762: Reverse Slowdown Limit Switch	The reverse slowdown limit switch has been actuated.	The digital input DI5 or DI6 or DI10 is with logical level “0”. The digital input for that function is defined by the parameter P1025.
A764: Stop Forward Limit Switch	The stop forward limit switch has been actuated.	The digital input DI6 or DI11 is with logical level “0”. The digital input for that function is defined by the parameter P1025.
A766: Stop Reverse Limit Switch	The stop reverse limit switch has been actuated.	The digital input DI6 or DI12 is with logical level “0”. The digital input for that function is defined by the parameter P1025.
A770: Momentary Overload	An attempt a load heavier than the maximum operational capacity of the application has been detected	The motor current during the forward or reverse stage is greater than or equal to the value adjusted in P1052.
F775: Inverter in Torque Limit	The frequency inverter reached the adjusted torque limit because of excessive load or demanded force.	The difference between the actual speed and the speed reference is greater than or equal to the hysteresis value adjusted in P1028.
F777: Improper Operation	Several consecutive alarm messages occurred during a certain period, disabling the frequency inverter.	The number of consecutive alarms generated during a certain period is greater than or equal to the value adjusted in P1058.

1 INTRODUCTION TO THE CRANE

The applicatives for crane developed for the CFW-11 SoftPLC function provides flexibility to the user in the system use and in its configuration. It uses the tools already developed for the WLP programming software, together with configuration wizards and monitoring dialog boxes.

1.1 CRANE HORIZONTAL MOTION

The crane horizontal motion (or load translation) consists in moving the load in the horizontal direction by executing commands to forward and reverse the load. The long travel, the cross travel, and the boom rotation, among others, are horizontal motions.

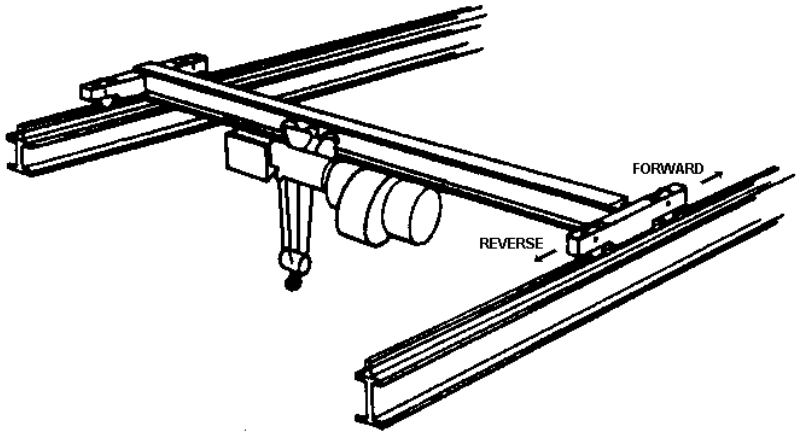


Figure 1.1 – Crane horizontal motion

1.2 CRANE VERTICAL MOTION

The crane vertical motion consists in moving the load vertically by executing commands to move it up and down. The load hoisting and its lowering are the vertical motions.

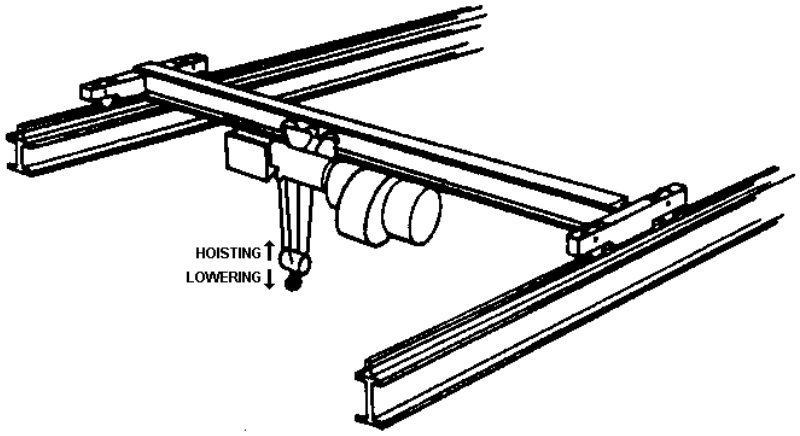


Figure 1.2 – Crane vertical motion

1.3 FREQUENCY INVERTER USE ADVANTAGES

We are able to evaluate the advantages of the variable frequency inverter use for crane horizontal motion or for crane vertical motion, under the following aspects:

■ Elimination of the electrical line disturbances: with the use of the inverter, by maintaining the motor flux constant (varying both frequency and voltage), it is possible to have the motor rated torque in the entire speed range. Therefore, with the inverter it becomes possible to start high torque loads with currents that are close to motor rated current thus eliminating the high direct on line motor starting currents (up to 7 x In). The frequency inverter eliminates those effects that cause voltage sags, the need of over sizing the switchgear, cables and transformers, avoiding nuisance trips, etc.;

■ Elimination of the mechanical stress: frequency inverters allow the programming of soft acceleration and deceleration ramps, still giving out high torque, eliminating mechanical stress while starting, during speed changes (if compared to the commutations of slip ring motor resistances), and while stopping, since the mechanical brake does not longer engage for regular stopping (braking becomes electrical), being used only for parking and emergencies. In this way downtime due to maintenance, adjustment of brake shoes, due to broken coupling, bearings or gearboxes, is drastically reduced. Easier load positioning and better precision are also achieved. All the settings are programmable and can be easily changed according to the application requirements (acceleration and deceleration ramps, speeds, etc.);

■ Energy savings: there is a reduction in the energy consumption because the motor power (kW) is determinated by the driven load and by the operation speed, consuming only what the process requires, eliminating energy wastes (low efficiency, energy and heat dissipation at slip ring motor drive systems), etc. In production overhead cranes with high duty cycles, the use of active front end frequency inverters (regenerative) becomes feasible, making it possible, besides the above mentioned energy savings for the return to the line of the energy regenerated by lowering and braking the load (when the motor is being driven and operates as a generator);

■ System automation: the frequency inverter makes the system automation possible by allowing the control through communication networks. By exchanging information with a higher hierarchy system (PLC, supervisory), it allows better process management through monitoring, report emission, etc. It also makes the adaptation to a remote radio control, with pushbuttons or joystick, easier;

■ Standardization: it makes the use of standard induction motors possible, facilitating the plant motor standardization, for maintenance and spares availability;

■ Comfort: the reduction of mechanical noises and vibrations improve operator and area personnel comfort, safety and productivity.

1.4 PRECAUTIONS IN THE FREQUENCY INVERTER SELECTION

For the great majority of loads (pumps, fans, compressors, etc.) the frequency inverter selection is made through the electric motor rated current, using an inverter with equal or slightly higher rated current (for environmental conditions: temperature up to 50 °C and altitude up to 1000 m).

This selection also considers 150 % overload during 60 s every 10 minutes for heavy duty (HD) loads, or 110 % overload during 60 seconds every 10 minutes for normal duty (ND) loads.

For crane applications, where there is need of starting heavy loads with relatively short acceleration times, it is certain that the inverter has to operate with overload to overcome the inertia during acceleration or deceleration, and normally the duty cycle is higher than the supported by the regular overload capability of frequency inverters. Therefore, in most of cases, it is necessary to take into account the worst-case duty cycle for a 10-minute operation period, calculating the rms current value for that period.

The chosen inverter will be for a current equal or higher than the calculated rms value. It must also be observed whether any overload current in the evaluated cycle is higher than 1.5 times the rated inverter current, where the inverter must be oversized in order to fulfill this requirement.

It is worthwhile to emphasize those environmental conditions such as altitude and temperature may require an over sizing of the frequency inverter:

- **Temperature:** 0 to 50°C, or up to 60°C with 2% / inverter current derating per °C above 50°C;

- **Altitude:** 0 to 1000 m, or up to 4000 m with 1% inverter current derating every 100 m above 1000 m.

1.5 FREQUENCY INVERTER AND BRAKING RESISTOR SELECTION CRITERIA

Some criteria have been established for the selection of the frequency inverter and the braking resistor in a crane application, according to the type of motion to be executed:

1.5.1 Horizontal Motion

The inverter must be selected according to its rated normal duty current (I_{ND}):

$$I_{ND} = I_N$$

Being:

I_{ND} = Frequency inverter rated normal duty current;
I_N = Motor rated current.

The braking resistor must be selected according to the equation:

$$P_R = 0.40 \times P_M \text{ with \%ED = 50.0\%}$$

Being:

P_R = Braking resistor power (kW);
P_M = Motor rated power (kW);
%ED = Braking duty cycle.

NOTE!
Refer to the CFW-11 user's guide, table 3.3, to verify the ohmic value of the braking resistor to be used according to the frequency inverter model.

1.5.2 Vertical Motion

The inverter must be selected according to its heavy duty rated current (I_{HD}):

- For light duty operation in non-aggressive environment:

$$I_{HD} = 1.15 \times I_N$$

- For heavy duty operation in aggressive environment:

$$I_{HD} = 1.30 \times I_N$$

Being:

I_{HD} = Frequency inverter rated heavy duty current;
I_N = Motor rated current.

NOTE!
In case of doubt about the duty cycle and the operation environment, use the biggest factor (1.30) to select the frequency inverter.

The braking resistor must be selected according to the equation:

$$P_R = 0.70 \times P_M \text{ with \%ED = 100.0\%}$$

Being:

P_R = Braking resistor power (kW);
P_M = Motor rated power (kW);
%ED = Braking duty cycle.

NOTE!
Refer to the CFW-11 user's guide, table 3.3, to verify the ohmic value of the braking resistor to be used according to the frequency inverter model.

1.5.3 General Notes

■ The braking resistor selection can be optimized if the customer provides the power calculated for the load hoisting or for its horizontal motion. E.g., supposing that the power calculated for the hoisting of an overhead crane is 62 kW, the used motor would be a 75 kW (commercial value). In this case, the braking resistor can be obtained from the calculated power, in other words, 0.7 x 62 = 43.4 kW. The same procedure can be adopted for the horizontal motion;

■ The installation condition, vibration, protection degree and painting, must be observed for the braking resistor specification;

■ For the replacement of slip ring motors by standard motors, use a minimum factor of 1.2. The inverter selection criteria remain the same, adopting the current of the new motor. Another criterion that can be adopted is to use a motor whose frame is the same of the slip ring motor, provided that the ratio between the power of the new motor and the old one is close to 1.2. The slip ring motors used in cranes usually have bigger frame sizes than the same power range standard motors. The main advantage of adopting this criterion is the easy mechanical adaptation of the new motor.

2 CRANE HORIZONTAL MOTION

The crane horizontal motion consists in moving a load horizontally, executing commands for load forward and load reverse together with the mechanical brake control, which must assure that the load remains in the intended position when no load forward or load reverse commands exist.

The crane horizontal motion control developed for the CFW-11 SoftPLC presents the following characteristics:

- Speed reference selection through electronic potentiometer (EP), logical combination of digital inputs (maximum of 5 references), analog input (step less) or communication networks;
- Commands for load forward and load reverse through digital inputs or through communication networks;
- Option of inverting the motor rotation direction adopted as standard for load forward and load reverse;
- Linear or “S” curve acceleration and deceleration ramps for crane horizontal motion;
- Option of stopping command via digital input, which can be for coast to stop, fast stop or emergency stop with deceleration ramp;
- Minimum and maximum speed limits for crane horizontal motion;
- Gain, offset and filter settings for control speed signal through analog input;
- Mechanical brake release logic controlled by motor frequency and/or motor current and/or motor torque;
- Adjust of the brake response time to release avoids the increase of the motor frequency;
- Mechanical brake closing logic controlled only by motor frequency (total speed reference in Hz);
- Possibility of brake closing delay time;
- Adjust of the time to enable a new command to brake release after the command to brake closing preventing a new command to be generated without the brake being mechanically closed;
- Possibility of brake inhibition during the transition from load forward to load reverse and vice-versa;
- Digital inputs programmed for limit switches (over travel limits) functions to reduce the speed (slowdown) while load forward, to reduce the speed (slowdown) while load reverse, to stop load forward and to stop load reverse;
- Lightweight detection while load forward or load reverse;
- Momentary overload detection while load forward or load reverse, with subsequent alarm;
- Inverter in torque limitation detection while load forward or load reverse, with subsequent fault;
- Fault trip by improper use of the crane horizontal motion;
- Fault trip due to motor current unbalance;
- Crane horizontal motion alarm (the last three) and fault (the last ten) history;
- Possibility of applicative implementation or modification by the user through the WLP software.

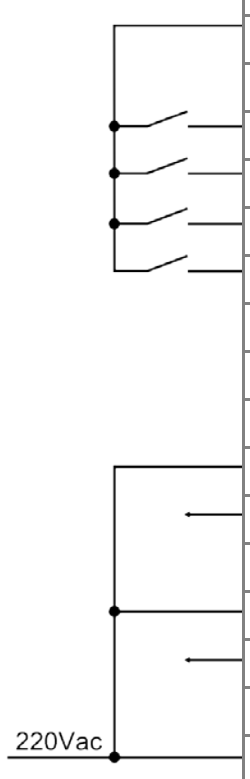
2.1 CONTROL CONNECTIONS

The selection of the speed reference defines four different control connection types, because it can be through electronic potentiometer (EP), logical combination of digital inputs (maximum of 5 references), analog input (step less) or communication networks. The control connections (analog inputs/outputs and digital inputs/outputs) are made at the CFW-11 electronic control board CC11 terminal strip XC1.

NOTE!
Refer to the CFW-11 frequency inverter manual for more information on the connections.

2.1.1 Speed Reference via Electronic Potentiometer (EP)

The control connections (analog inputs/outputs and digital inputs/outputs) wired at the CFW-11 electronic control board CC11 terminal strip XC1, when the speed reference is through electronic potentiometer (EP), are presented next.



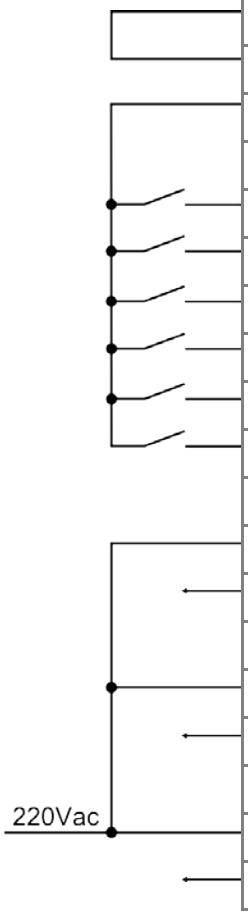
XC1 Terminal Strip		Default Function for Speed Reference via Electronic Potentiometer (EP)
1	REF+	Positive reference for potentiometer
2	AI1+	Analog input # 1 (0 - 10 V): No function
3	AI1-	
4	REF-	Negative reference for potentiometer
5	AI2+	Analog input # 2 (0 - 10 V): No function
6	AI2-	
7	AO1	Analog output # 1: Motor speed
8	AGND	
9	AO2	Analog output # 2: Motor current
10	AGND	
11	DGND	Reference (0 V) for the 24 Vdc power supply
12	COM	Common point of the digital inputs
13	24VCC	24 Vdc power supply
14	COM	Common point of the digital inputs
15	DI1	Digital input # 1: Load forward command
16	DI2	Digital input # 2: Load reverse command
17	DI3	Digital input # 3: Emergency stop
18	DI4	Digital input # 4: Acceleration (it increases the speed)
19	DI5	Digital input # 5: No function
20	DI6	Digital input # 6: No function
21	NC1	Digital output #1 DO1 (RL1): No fault
22	C1	
23	NO1	
24	NC2	Digital output #2 DO2 (RL2): Run
25	C2	
26	NO2	
27	NC3	Digital output #3 DO3 (RL3): Brake release
28	C3	
29	NO3	

Figure 2.1 – Signals at the XC1 terminal strip for crane horizontal motion with speed reference via electronic potentiometer

NOTE!
It is necessary to install the IOC-01 or IOC-02 accessory module in case the DI9, DI10, DI11 and DI12 digital inputs and/or the DO6 and DO7 digital outputs use is required. Refer to the CFW-11 frequency inverter manual for more information on accessory modules.

2.1.2 Speed Reference via Digital Inputs

The control connections (analog inputs/outputs and digital inputs/outputs) wired at the CFW-11 electronic control board CC11 terminal strip XC1, when the speed reference is through the logical combination of digital inputs for 5 references, are presented next.



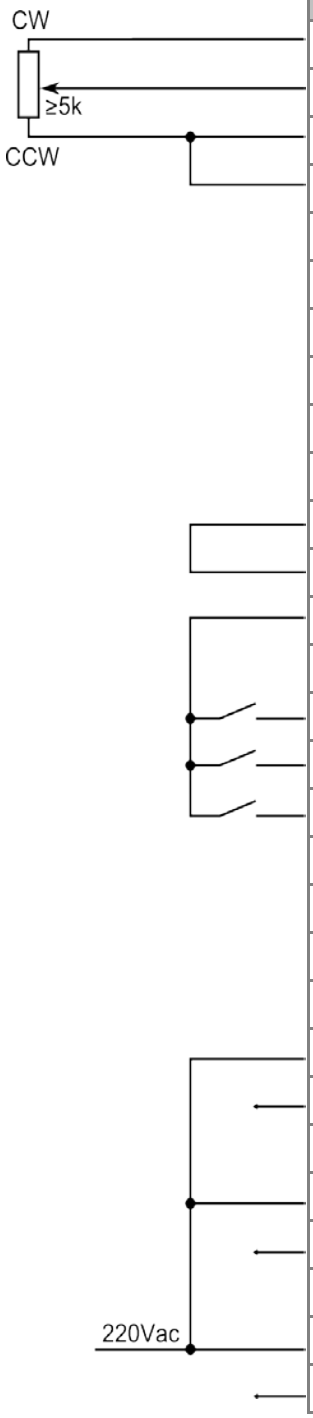
XC1 Terminal Strip		Default Function for Speed Reference via Digital Inputs
1	REF+	Positive reference for potentiometer
2	AI1+	Analog input # 1 (0 - 10 V): No function
3	AI1-	
4	REF-	Negative reference for potentiometer
5	AI2+	Analog input # 2 (0 - 10 V): No function
6	AI2-	
7	AO1	Analog output # 1: Motor speed
8	AGND	
9	AO2	Analog output # 2: Motor current
10	AGND	
11	DGND	Reference (0 V) for the 24 Vdc power supply
12	COM	Common point of the digital inputs
13	24VCC	24 Vdc power supply
14	COM	Common point of the digital inputs
15	DI1	Digital input # 1: Load forward command
16	DI2	Digital input # 2: Load reverse command
17	DI3	Digital input # 3: Emergency stop
18	DI4	Digital input # 4: 1st DI for speed reference
19	DI5	Digital input # 5: 2nd DI for speed reference
20	DI6	Digital input # 6: 3rd DI for speed reference
21	NC1	Digital output #1 DO1 (RL1): No fault
22	C1	
23	NO1	
24	NC2	Digital output #2 DO2 (RL2): Run
25	C2	
26	NO2	
27	NC3	Digital output #3 DO3 (RL3): Brake release
28	C3	
29	NO3	

Figure 2.2 – Signals at the XC1 terminal strip for crane horizontal motion with speed reference via the logical combination of digital inputs

NOTE!
It is necessary to install the IOC-01 or IOC-02 accessory module in case the DI9, DI10, DI11 and DI12 digital inputs and/or the DO6 and DO7 digital outputs use is required. Refer to the CFW-11 frequency inverter manual for more information on accessory modules.

2.1.3 Speed Reference via Analog Input AI1

The control connections (analog inputs/outputs and digital inputs/outputs) wired at the CFW-11 electronic control board CC11 terminal strip XC1, when the speed reference is through the analog input AI1, are presented next.



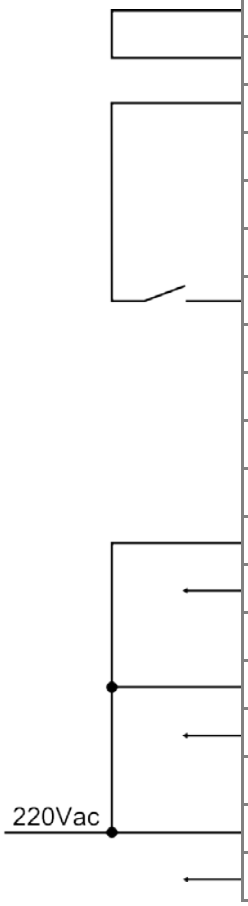
XC1 Terminal Strip		Default Function for Speed Reference via Analog Input AI1
1	REF+	Positive reference for potentiometer
2	AI1+	Analog input # 1 (0 - 10 V): Speed reference
3	AI1-	
4	REF-	Negative reference for potentiometer
5	AI2+	Analog input # 2 (0 - 10 V): No function
6	AI2-	
7	AO1	Analog output # 1: Motor speed
8	AGND	
9	AO2	Analog output # 2: Motor current
10	AGND	
11	DGND	Reference (0 V) for the 24 Vdc power supply
12	COM	Common point of the digital inputs
13	24VCC	24 Vdc power supply
14	COM	Common point of the digital inputs
15	DI1	Digital input # 1: Load forward command
16	DI2	Digital input # 2: Load reverse command
17	DI3	Digital input # 3: Emergency stop
18	DI4	Digital input # 4: No function
19	DI5	Digital input # 5: No function
20	DI6	Digital input # 6: No function
21	NC1	Digital output #1 DO1 (RL1): No fault
22	C1	
23	NO1	
24	NC2	Digital output #2 DO2 (RL2): Run
25	C2	
26	NO2	
27	NC3	Digital output #3 DO3 (RL3): Brake release
28	C3	
29	NO3	

Figure 2.3 – Signals at the XC1 terminal strip for crane horizontal motion with speed reference via the analog input AI1

NOTE!
It is necessary to install the IOC-01 or IOC-02 accessory module in case the DI9, DI10, DI11 and DI12 digital inputs and/or the DO6 and DO7 digital outputs use is required. Refer to the CFW-11 frequency inverter manual for more information on accessory modules.

2.1.4 Speed Reference via Communication Networks

The control connections (analog inputs/outputs and digital inputs/outputs) wired at the CFW-11 electronic control board CC11 terminal strip XC1, when the speed reference is through communication networks, are presented next.



XC1 Terminal Strip		Default Function for Speed Reference via Communication Networks
1	REF+	Positive reference for potentiometer
2	AI1+	Analog input # 1 (0 - 10 V): No function
3	AI1-	
4	REF-	Negative reference for potentiometer
5	AI2+	Analog input # 2 (0 - 10 V): No function
6	AI2-	
7	AO1	Analog output # 1: Motor speed
8	AGND	
9	AO2	Analog output # 2: Motor current
10	AGND	
11	DGND	Reference (0 V) for the 24 Vdc power supply
12	COM	Common point of the digital inputs
13	24VCC	24 Vdc power supply
14	COM	Common point of the digital inputs
15	DI1	Digital input # 1: No function
16	DI2	Digital input # 2: No function
17	DI3	Digital input # 3: Emergency stop
18	DI4	Digital input # 4: No function
19	DI5	Digital input # 5: No function
20	DI6	Digital input # 6: No function
21	NC1	Digital output #1 DO1 (RL1): No fault
22	C1	
23	NO1	
24	NC2	Digital output #2 DO2 (RL2): Run
25	C2	
26	NO2	
27	NC3	Digital output #3 DO3 (RL3): Brake release
28	C3	
29	NO3	

Figure 2.4 – Signals at the XC1 terminal strip for crane horizontal motion with speed reference via communication networks

NOTE!
It is necessary to install the IOC-01 or IOC-02 accessory module in case the DI9, DI10, DI11 and DI12 digital inputs and/or the DO6 and DO7 digital outputs use is required. Refer to the CFW-11 frequency inverter manual for more information on accessory modules.

2.2 BRAKE SYSTEM

The brake is the element of the crane responsible for hold the load when the motor is not running. Therefore it is very important that it be configured to operate in the safest way possible.

The electromagnet coil is powered by direct current (DC) which can be supplied by a DC voltage source or bridge rectifier which converts AC to DC current. The bridge rectifier consists of diodes and varistors that filter undesirable voltage spikes and enable fast current shutdown.

NOTE!
It is recommended always power the brake by direct current (DC) as it provides greater speed and reliable brake operation.

2.2.1 Connection Diagram

NOTE!
The following connection diagrams shown are valid for WEG brake motors. The same must be suitable for other types of brake or brake motor.

2.2.1.1 AC Power Supply

Usually brake motors admit two braking systems: normal and fast.

■ Normal Braking: the interruption of DC power to brake closing is done by removal of the AC power supply to terminals 1 and 2.

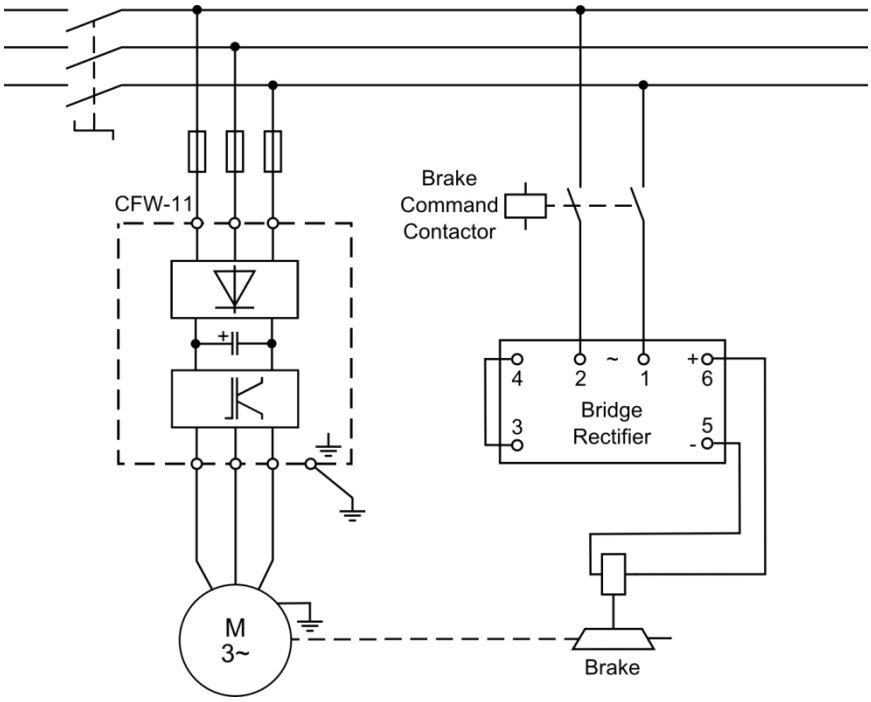


Figure 2.5 – Connection diagram of the bridge rectifier for normal braking

■ **Fast Braking:** the interruption of DC power to brake closing is done directly in the direct current source to terminals 3 and 04 keeping the terminals 1 and 2 on AC power supply.

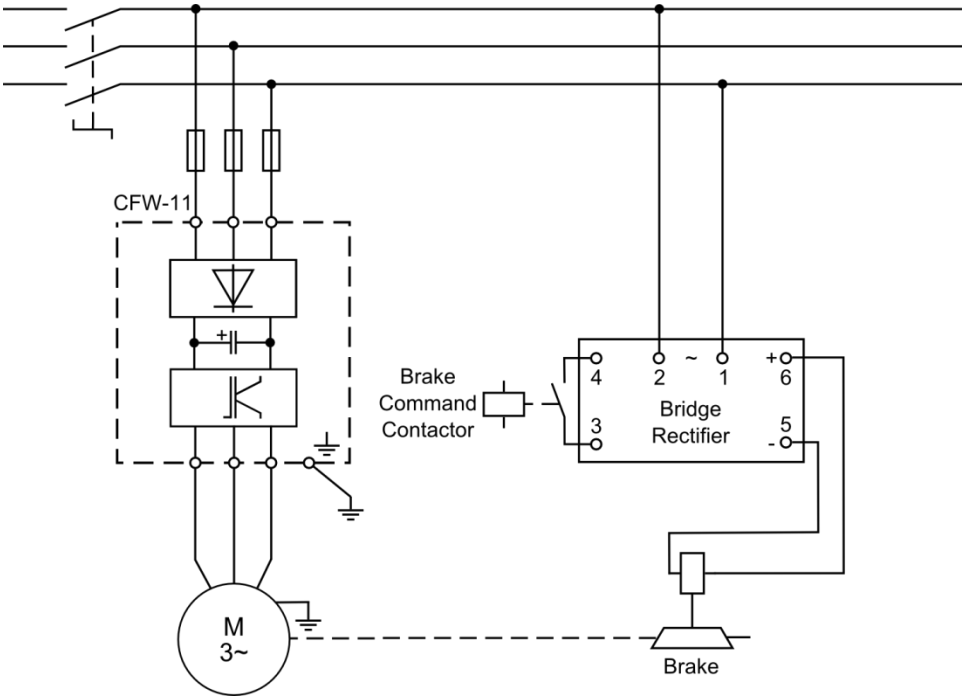


Figure 2.6 – Connection diagram of the bridge rectifier for fast braking

2.2.1.2 DC Power Supply

The connection must be made directly on the brake terminals as the voltage on the brake power nameplate.

3 PARAMETERS DESCRIPTION

Next, the parameters of the crane horizontal motion application, for both the CFW-11 frequency inverter and the SoftPLC, will be presented.

NOTE!
The adjustable range of the CFW-11 parameters has been customized for the crane horizontal motion application. Refer to the CFW-11 programming manual for more details on the parameters.

Symbols for the parameter properties:

RO Read-only parameter
RW Read and write parameter
CFG Configuration parameter, value can be programmed only with motor stopped
Vector Available when a vector control mode is chosen

3.1 ORIGIN OF THE COMMANDS

This parameter group allows the user to configure the origin of the CFW-11 frequency inverter commands. For this application, the inverter control in LOCAL situation is done via HMI and in REMOTE situation via SoftPLC function.

LOCAL Situation:
It allows the user to command the motor of crane driven by the CFW-11 inverter disregarding the control logics.

REMOTE Situation:
It enables the crane horizontal motion control logics, according to the programming performed by the user.

P0220 – LOCAL/REMOTE Selection Source

P0221 – Speed Reference Selection - LOCAL Situation

P0222 – Speed Reference Selection - REMOTE Situation

P0223 – Forward Reverse Selection - LOCAL Situation

P0226 – Forward Reverse Selection - REMOTE Situation

P0224 – Run/Stop Selection - LOCAL Situation

P0227 – Run/Stop Selection - REMOTE Situation

P0225 – JOG Selection - LOCAL Situation

P0228 – JOG Selection - REMOTE Situation

NOTE!
Refer to the CFW-11 programming manual for more information on the command origin parameters. Some parameter options have been removed from the configuration wizard.

3.1.1 Configuration of the Commands

This parameter group allows the user to configure some particularities of the CFW-11 frequency inverter commands, necessary for the crane horizontal motion applicative.

P0229 – Stop Mode Selection

Adjustable Range:	0 = Ramp to Stop 1 = Coast to Stop 2 = Fast Stop 3 = Ramp to Stop with Iq* reset 4 = Fast Stop with Iq* reset	**Factory Setting:** 0
Proprieties:		
Access groups via HMI:	01 PARAMETER GROUPS ∟ 20 Ramps	

Description:
This parameter defines the motor stop mode when the inverter receives the “Stop” command.

NOTE!
Options 3 and 4 operate only in vector mode with encoder. The difference in behavior, compared to the options 0 and 2, is in the torque current reference (Iq*) reset. This reset occurs during the inverter state transition from Run to Ready, after executing a “Stop” command. The purpose of the options 3 and 4 is to avoid that a high current reference value is stored in the speed regulator when, for instance, using a mechanical brake to stop the motor shaft before its speed is null.

NOTE!
Refer to the CFW-11 programming manual for more information on the stop mode.

P1024 – Enable use of a Filter in the Forward and Reverse Commands

Adjustable Range:	0 = Off 1 = On	**Factory Setting:** 0
Proprieties:		
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC	

Description:
This parameter enables the use of a time of 100 ms as a filter to accept the load forward and load reverse commands via the digital inputs DI1 and DI2 to prevent too fast or false commands are accepted by the crane horizontal motion.

With the option "0" (Off), there is no filter on the digital inputs DI1 and DI2.

With the option "1" (On), the filter 100 ms is applied to the digital inputs DI1 and DI2 in changing the logic state "0" to "1". The change from "1" to "0" there is no filter.

P1026 – Motor Rotation Direction Inversion

Adjustable Range:	0 = On 1 = Off	**Factory Setting:** 0
Proprieties:	CFG	
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC	

Description:
This parameter inverts the motor rotation direction that is normally adopted for the load forward and reverse commands.

With the option "0" (Disabled), the load forward command occurs with forward rotation direction and the load reverse command with reverse rotation direction.

With the option "1" (Enabled), the load forward command occurs with reverse rotation direction and the load reverse command with forward rotation direction.

P1027 – Motor Demagnetization Time

Adjustable Range:	0 to 65000 s	**Factory Setting:**	600 s
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter defines the period without load forward or reverse commands that has to elapse before the inverter general enable command is removed, thus demagnetizing the motor. This measure prevents the motor from remaining energized during a period while the crane horizontal motion is not being used.

NOTE!
Keeping the motor magnetized in the absence of forward or reverse commands allows a faster motor response when those commands are issued, expediting its operation.

3.2 RAMPS

This parameter group allows the user to configure the inverter ramps, so that the motor is accelerated or decelerated in a faster or in a slower manner.

P0100 – Acceleration Time

Adjustable Range:	0.0 to 999.9 s	**Factory Setting:**	3.0 s
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 20 Ramps		

Description:
This parameter defines the time to accelerate lineally from 0 to the maximum speed (defined in P0134).

P0101 – Deceleration Time

Adjustable Range:	0.0 to 999.9 s	**Factory Setting:**	2.0 s
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 20 Ramps		

Description:
This parameter defines the time to decelerate linearly from the maximum speed (defined at P0134) to zero, except in case of an emergency stop command execution.

P0103 – Emergency Stop Time (2nd Ramp Deceleration)

Adjustable Range:	0.0 to 999.9 s	**Factory Setting:**	0.3 s
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 20 Ramps		

Description:
This parameter defines the time to decelerate linearly from the maximum speed (defined at P0134) to zero, when an emergency stop command via the digital input DI3, the limit switch "Stop Forward" or the limit switch “Stop Reverse”, is executed.

P0104 – S Ramp

Adjustable Range:	0 = Off (linear) 1 = 50% 2 = 100%	**Factory Setting:** 0
Proprieties:		
Access groups via HMI:	01 PARAMETER GROUPS ∟ 20 Ramps	

Description:
This parameter allows that the acceleration and deceleration ramps have a nonlinear profile, similar to an "S" shape curve.

The "S" ramp reduces mechanical shocks during accelerations and decelerations.

P0105 – 1st/2nd Ramp Selection

Adjustable Range:	6 = SoftPLC	**Factory Setting:** 6
Proprieties:		
Access groups via HMI:	01 PARAMETER GROUPS ∟ 20 Ramps	

Description:
This parameter defines the source of the command that will select between the 1st and the 2nd ramp, which is only SoftPLC for the crane horizontal motion applicative.

NOTE!
Refer to the CFW-11 programming manual for more information on the ramp parameters.

3.3 SPEED LIMITS

This parameter group allows the user to configure the motor speed limits.

P0133 – Minimum Speed Reference Limit

Adjustable Range:	0 to 18000 rpm	**Factory Setting:** 150 rpm (5.0 Hz)
Proprieties:		
Access groups via HMI:	01 PARAMETER GROUPS ∟ 22 Speed Limits	

Description:
This parameter defines the minimum motor speed reference value when the inverter is enabled. It is the value used when the limit switch "Forward Slowdown" or limit switch "Reverse Slowdown" is activated.

P0134 – Maximum Speed Reference Limit

Adjustable Range:	0 to 18000 rpm	**Factory Setting:** 1800 rpm
Proprieties:		
Access groups via HMI:	01 PARAMETER GROUPS ∟ 22 Speed Limits	

Description:
This parameter defines the maximum motor speed reference value when the inverter is enabled. It is the value used when the hoist is operating in the "Lightweight" mode.

NOTE!
Refer to the CFW-11 programming manual for more information on the speed limit parameters.

3.4 DYNAMIC BRAKING

This parameter group allows the user to configure the braking resistor to be used for dynamic braking.

P0154 – Dynamic Braking Resistor

P0155 – Dynamic Braking Resistor Power

NOTE!
Refer to the CFW-11 programming manual for more information on the dynamic braking parameters.

3.5 SPEED REFERENCES

This parameter group allows the user to configure the speed reference control for the crane horizontal motion applicative.

P1023 – Speed Reference Control Configuration

Adjustable Range:	0 = Speed Reference via Electronic Potentiometer (EP) 1 = One Speed Reference via Digital Input DI4 2 = Two Speed References via Digital Input DI4 3 = Three Speed References via Digital Input DI4 and DI5 4 = Four Speed References via Digital Input DI4 and DI5 5 = Five Speed References via Digital Input DI4, DI5 and DI6 6 = Speed Reference via Analog Input AI1 7 = Speed Reference via Communication Networks	**Factory Setting:** 2
Proprieties:	CFG	
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC	

Description:
This parameter defines how the control of the speed reference for the crane horizontal motion applicative will be done.

Table 3.1 – Speed reference control configuration

P1023	Description
0	It defines that the speed reference will be controlled via the electronic potentiometer (EP) logic developed for the load forward, load reverse and load acceleration (increases the speed reference) commands.
1	It defines that there will be one speed reference controlled through the logic combination of the load forward, load reverse and 1st digital input for speed reference (DI4) commands.
2	It defines that there will be two speed references controlled through the logic combination of the load forward, load reverse and 1st digital input for speed reference (DI4) commands.
3	It defines that there will be three speed references controlled through the logic combination of the load forward, load reverse, 1st digital input for speed reference (DI4) and 2nd digital input for speed reference (DI5) commands.
4	It defines that there will be four speed references controlled through the logic combination of the load forward, load reverse, 1st digital input for speed reference (DI4) and 2nd digital input for speed reference (DI5) commands.
5	It defines that there will be five speed references controlled through the logic combination of the load forward, load reverse, 1st digital input for speed reference (DI4), 2nd digital input for speed reference (DI5) and 3rd digital input for speed reference (DI6) commands.
6	It defines that the speed reference will be controlled via the value read by the analog input AI1, combined with the load forward and load reverse commands.
7	It defines that the speed reference will be written via a communication network and that the load forward and load reverse commands will be given through the network control word (P1022).

When the speed reference is selected through the logic combination of the DI4, DI5 and DI6 digital inputs, the following truth table must be applied to obtain the speed reference.

Table 3.2 – Speed reference truth table with the logical combination of DI4, DI5 and DI6 digital inputs

	P1031 - Speed reference 1	P1032 - Speed reference 2	P1033 - Speed reference 3	P1034 - Speed reference 4	P1035 - Speed reference 5
Digital input DI4	0	1	0	1	0
Digital input DI5	0	0	1	1	0
Digital input DI6	0	0	0	0	1

P1030 – Speed Reference via Communication Networks

Adjustable Range:	0.0 to 1020.0 Hz	**Factory Setting:**	P1023 = 0: 0.0 Hz P1023 = 1: 0.0 Hz P1023 = 2: 0.0 Hz P1023 = 3: 0.0 Hz P1023 = 4: 0.0 Hz P1023 = 5: 0.0 Hz P1023 = 6: 0.0 Hz P1023 = 7: 6.0 Hz
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter has different functions according to the speed reference control configuration:

■ P1023 = 0, 1, 2, 3, 4, 5 or 6, the parameter does not have a specific function for the crane horizontal motion applicative.

■ P1023 = 7, it defines the speed reference value via communication networks for the crane horizontal motion applicative.

P1031 – Speed Reference 1

Adjustable Range:	0.0 to 1020.0 Hz	**Factory Setting:**	P1023 = 0: 6.0 Hz P1023 = 1: 60.0 Hz P1023 = 2: 6.0 Hz P1023 = 3: 6.0 Hz P1023 = 4: 6.0 Hz P1023 = 5: 6.0 Hz P1023 = 6: 6.0 Hz P1023 = 7: 0.0 Hz
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter has different functions according to the speed reference control configuration:

■ P1023 = 0, it defines the minimum speed reference value for the crane horizontal motion applicative. In other words, it is the initial speed reference value when the load forward or reverse command is executed. This value can be subsequently incremented through the “acceleration” command via the digital input DI4.

■ P1023 = 1, 2, 3, 4 or 5, it defines the value of the 1st speed reference for the crane horizontal motion applicative.

■ P1023 = 6, it defines the minimum speed reference value for the crane horizontal motion applicative. In other words, it is the initial speed reference value when the value read at the analog input is 0 V, 0 mA or 4 mA.

■ P1023 = 7, the parameter does not have a specific function for the crane horizontal motion applicative.

P1032 – Speed Reference 2

Adjustable Range:	0.0 to 1020.0 Hz	**Factory Setting:**	P1023 = 0: 60.0 Hz P1023 = 1: 0.0 Hz P1023 = 2: 60.0 Hz P1023 = 3: 30.0 Hz P1023 = 4: 20.0 Hz P1023 = 5: 15.0 Hz P1023 = 6: 60.0 Hz P1023 = 7: 0.0 Hz
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter has different functions according to the speed reference control configuration:

■ P1023 = 0, it defines the maximum speed reference value for the crane horizontal motion applicative. In other words, this is the maximum value that the “acceleration” command via digital input DI4 can provide.

■ P1023 = 1 or 7, the parameter does not have a specific function for the crane horizontal motion applicative.

■ P1023 = 2, 3, 4 or 5, it defines the value of the 2nd speed reference for the crane horizontal motion applicative.

■ P1023 = 6, it defines the maximum speed reference value for the crane horizontal motion applicative. In other words, it is the maximum speed reference value when the value read at the analog input is 10 V or 20 mA.

P1033 – Speed Reference 3

Adjustable Range:	0.0 to 1020.0 Hz	**Factory Setting:**	P1023 = 0: 0.0 Hz P1023 = 1: 0.0 Hz P1023 = 2: 0.0 Hz P1023 = 3: 60.0 Hz P1023 = 4: 40.0 Hz P1023 = 5: 30.0 Hz P1023 = 6: 0.0 Hz P1023 = 7: 0.0 Hz
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter has different functions according to the speed reference control configuration:

■ P1023 = 0, 1, 2, 6 or 7, the parameter does not have a specific function for the crane horizontal motion applicative.

■ P1023 = 3, 4 or 5, it defines the value of the 3rd speed reference for the crane horizontal motion applicative.

P1034 – Speed Reference 4

Adjustable Range:	0.0 to 1020.0 Hz	**Factory Setting:**	P1023 = 0: 0.0 Hz P1023 = 1: 0.0 Hz P1023 = 2: 0.0 Hz P1023 = 3: 0.0 Hz P1023 = 4: 60.0 Hz P1023 = 5: 45.0 Hz P1023 = 6: 0.0 Hz P1023 = 7: 0.0 Hz
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter has different functions according to the speed reference control configuration:

■ P1023 = 0, 1, 2, 3, 6 or 7, the parameter does not have a specific function for the crane horizontal motion applicative.

■ P1023 = 4 or 5, it defines the value of the 4th speed reference for the crane horizontal motion applicative.

P1035 – Speed Reference 5

Adjustable Range:	0.0 to 1020.0 Hz	**Factory Setting:**	P1023 = 0: 0.0 Hz P1023 = 1: 0.0 Hz P1023 = 2: 0.0 Hz P1023 = 3: 0.0 Hz P1023 = 4: 0.0 Hz P1023 = 5: 60.0 Hz P1023 = 6: 0.0 Hz P1023 = 7: 0.0 Hz
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter has different functions according to the speed reference control configuration:

■ P1023 = 0, 1, 2, 3, 4, 6 or 7, the parameter does not have a specific function for the crane horizontal motion applicative.

■ P1023 = 5, it defines the value of the 5th speed reference for the crane horizontal motion applicative.

P1036 – Dwell Time at Speed Reference 1

Adjustable Range:	0.00 a 650.00 s	**Factory Setting:**	0.50 s
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter defines the crane dwell time with the speed reference 1 after the brake release. I.e., maintains the speed reference 1 for a while even if another speed has been selected by the user.

3.6 CONTROL WORD

P1022 – Communication Network Control Word

Adjustable Range:	0000h to FFFFh	**Factory Setting:**	0000h
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter defines the control word for the crane horizontal motion applicative when the speed reference control via communication networks has been selected (P1023 = 7).

Each bit of this word represents a command that can be executed via communication networks.

Table 3.3 – Description of the communication network control word

Bits	15 to 2	1	0
Function	Reserved	Load Reverse	Load Forward

Bits	Values
Bit 0 Load Forward	0: It removes the load forward command. 1: It executes the load forward command.
Bit 1 Load Reverse	0: It removes the load reverse command. 1: It executes the load reverse command.
Bits 2 to 15	Reserved

3.7 CONFIGURATION OF THE LIMIT SWITCHES

P1025 – Limit Switches Configuration

Adjustable Range:	0 = Without Limit Switches 1 = Forward Slowdown via DI5 and Reverse Slowdown via DI6 2 = Forward Slowdown via DI5 and Stop Forward via DI6 3 = Reverse Slowdown via DI5 and Stop Reverse via DI6 4 = Forward Slowdown via DI9 and Reverse Slowdown via DI10 5 = Forward Slowdown via DI9 and Stop Forward via DI11 6 = Reverse Slowdown via DI10 and Stop Reverse via DI12 7 = Forward Slowdown via DI9, Reverse Slowdown via DI10, Stop Forward via DI11 and stop Reverse via DI12	**Factory Setting:**	0
Proprieties:	CFG		
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter configures the manner an interlocking function of the crane horizontal motion applicative will be associated to a digital input. This interlocking is no more than limit switches installed in the forward and reverse travel course, which indicate operation conditions when activated.

■ Forward Slowdown (speed reduction): With an active forward command and activated sensor (logical level "0"), It decelerates the motor down to the minimum speed defined at P0133 respecting the ramp defined at P0101.

■ Reverse Slowdown (speed reduction): With an active reverse command and activated sensor (logical level “0”), It decelerates the motor down to the minimum speed defined at P0133 respecting the ramp defined at P0101.

■ Stop Forward: With an active forward command and activated sensor (logical level “0”), it causes an normal stop respecting the ramp defined at P0101.

■ Stop Reverse: With an active reverse command and activated sensor (logical level “0”), it causes an normal stop respecting the ramp defined at P0101.

NOTE!
Refer to the section 3.8 for more information on the functions of the digital inputs, bearing in mind that the parameters P1023 and P1025 operate together in the execution of the commands for the crane horizontal motion applicative.

3.8 DIGITAL INPUTS

This parameter group allows the user to configure the command function of each digital input in the crane horizontal motion applicative.

P0263 – DI1 Function

Adjustable Range:	0 to 31 / 21 = Load Forward (PLC Use)	**Factory Setting:**	P1023 ≠ 7: 21 P1023 = 7: 0
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 40 Digital Inputs	or	07 I/O CONFIGURATION ∟ 40 Digital Inputs

Description:
This parameter defines that the function of the digital input DI1 will be the load forward command, which enables the motor to run in the forward rotation direction (or the reverse direction if P1026 is enabled (1)), except when P1023 = 7.

With logical level “0”, the crane horizontal motion is disabled (except if there is a command for reverse the load).

With logical level “1”, the crane horizontal motion is enabled for forward the load.

NOTE!
When the speed reference control is programmed for communication networks (P1023 = 7), then the digital input DI1 does not have a specific function for the crane horizontal motion applicative.

P0264 – DI2 Function

Adjustable Range:	0 to 31 / 21 = Load Reverse (PLC Use)	**Factory Setting:**	P1023 ≠ 7: 21 P1023 = 7: 0
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 40 Digital Inputs	or	07 I/O CONFIGURATION ∟ 40 Digital Inputs

Description:
This parameter defines that the function of the digital input DI2 will be the load reverse command, which enables the motor to run in the reverse rotation direction (or the forward direction if P1026 is enabled (1)), except when P1023 = 7.

With logical level “0”, the crane horizontal motion is disabled (except if there is a command for forward the load).

With logical level “1”, the crane horizontal motion is enabled for reverse the load.

NOTE!
When the speed reference control is programmed for communication networks (P1023 = 7), then the digital input DI2 does not have a specific function for the crane horizontal motion applicative

P0265 – DI3 Function

Adjustable Range:	0 to 31 / 0 = Not Used 2 = Coast to Stop 3 = Fast Stop 21 = Emergency Stop (PLC Use)	**Factory Setting:**	21
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 40 Digital Inputs	or	07 I/O CONFIGURATION ∟ 40 Digital Inputs

Description:
This parameter defines that the function of the digital input DI3 will be stopping the operation of the crane horizontal motion.

■ Not Used: It defines that no operation stopping command for the crane horizontal motion will be executed.

■ Coast to Stop (General Enable): It defines that the crane horizontal motion operation stopping will be by motor coasting (the motor is demagnetized).

With logical level “0”, it executes the stopping command by coasting, not exercising any control to decelerate the crane horizontal motion motor, so that the motor coasts to stop and remains demagnetized. The alarm “A752, Coast to Stop” is generated until the digital input DI3 is activated with level "1".

With logical level “1”, it indicates that the crane horizontal motion is enabled, so that a command for load forward or load reverse can be executed.

■ Fast stop: It defines that the stopping operation will be carried out with a null deceleration ramp, so that the motor is decelerated down to zero rpm in the shortest possible time.

With logical level “0”, it executes the fast stop command with null deceleration ramp, so that the crane horizontal motion motor stops in the shortest possible time. The alarm “A754: Fast Stop” is generated until the digital input DI3 is activated with level "1".

With logical level “1”, it indicates that the crane horizontal motion is enabled, so that a command for load forward or load reverse can be executed.

■ Emergency Stop: It defines that the stopping operation will occur according to the deceleration ramp that has been programmed in P0103.

With logical level “0”, it executes the emergency stop command by decelerating the crane horizontal motion motor according to the deceleration ramp that has been programmed in P0103. The alarm “A756: Emergency Stop” is generated until the digital input DI3 is activated with level "1".

With logical level “1”, it indicates that the crane horizontal motion is enabled, so that a command for load forward or load reverse can be executed.

NOTE!
This command overrides the load forward or load reverse command, stopping the crane horizontal motion and preventing the execution of a new command.

P0266 – DI4 Function

Adjustable Range:	0 to 31 / 21 = Acceleration (PLC Use)	**Factory Setting:**	P1023 = 0: 21
	21 = 1st Speed Reference Digital Input (PLC Use)		P1023 = 1: 21
	21 = 1st Speed Reference Digital Input (PLC Use)		P1023 = 2: 21
	21 = 1st Speed Reference Digital Input (PLC Use)		P1023 = 3: 21
	21 = 1st Speed Reference Digital Input (PLC Use)		P1023 = 4: 21
	21 = 1st Speed Reference Digital Input (PLC Use)		P1023 = 5: 21
	0 = No Function		P1023 = 6: 0
	0 = No Function		P1023 = 7: 0
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 40 Digital Inputs	or	07 I/O CONFIGURATION ∟ 40 Digital Inputs

Description:
This parameter has different functions according to the speed reference control configuration:

■ P1023 = 0 defines that the function of the digital input DI4 will be to execute the command to accelerate (increase) the speed reference for the crane horizontal motion. It operates together with the load forward or load reverse command.

With logical level “0”, it freezes the current speed reference value for the crane horizontal motion, in case the load forward (DI1) or load reverse (DI12) command is still active.

With logical level “1”, it accelerates (increases) the speed reference for the crane horizontal motion according to the acceleration ramp defined in P0100, up to the maximum value defined in P1032.

When a load forward or a load reverse command is executed, the motor is accelerated to the value programmed in P1031. Then, if an acceleration command is given, the motor is accelerated from the P1031 value up to the maximum programmed in P1032. If the acceleration command is removed before reaching that maximum speed, then the actual speed value is kept (frozen) as the crane horizontal motion speed reference. When the load forward or load reverse command is removed, then the motor decelerates to 0 rpm.

■ P1023 = 1, 2, 3, 4 or 5: These options define that the function of the DI4 is to be the 1st digital input for the selection of the crane horizontal motion speed reference via the logical combination of digital inputs, as described in the section 3. 3.

■ P1023 = 6 or 7: These options define that the digital input DI4 has no specific function for the crane horizontal motion.

P0267 – DI5 Function

Adjustable Range:	0 to 31 / 21 = Fwd / Rev Slowdown LS (PLC Use)	**Factory Setting:**	P1023 = 0: 0
	21 = Forward / Reverse Slowdown Limit Switch (PLC Use)		P1023 = 1: 0
	21 = Forward / Reverse Slowdown Limit Switch (PLC Use)		P1023 = 2: 0
	21 = 2nd Speed Reference Digital Input (PLC Use)		P1023 = 3: 21
	21 = 2nd Speed Reference Digital Input (PLC Use)		P1023 = 4: 21
	21 = 2nd Speed Reference Digital Input (PLC Use)		P1023 = 5: 21
	21 = Forward / Reverse Slowdown Limit Switch (PLC Use)		P1023 = 6: 0
	21 = Forward / Reverse Slowdown Limit Switch (PLC Use)		P1023 = 7: 0
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 40 Digital Inputs	or	07 I/O CONFIGURATION ∟ 40 Digital Inputs

Description:
This parameter has different functions according to the speed reference control configuration:

■ P1023 = 0, 1, 2, 6 or 7 and P1025 = 0, 4, 5, 6 or 7: These options define that the digital input DI5 has no specific function for the crane horizontal motion.

■ P1023 = 0, 1, 2, 6 or 7 and P1025 = 1 or 2: These options define that the function of the DI5 is “Forward Slowdown Limit Switch”.

With logical level “0” (sensor actuated) and with a load forward command present, it decelerates the motor down to the minimum speed defined in P0133.

With logical level “1” (sensor not actuated), it allows commands for load forward or load reverse.

■ P1023 = 0, 1, 2, 6 or 7 and P1025 = 3: These options define that the function of the DI5 is “Reverse Slowdown Limit Switch”.

With logical level “0” (sensor actuated) and with a load reverse command present, it decelerates the motor down to the minimum speed defined in P0133.

With logical level “1” (sensor not actuated), it allows commands for load forward or reverse.

■ P1023 = 3, 4 or 5: These options define that the function of the DI5 is to be the 2nd digital input for the selection of the crane horizontal motion speed reference via the logical combination of digital inputs, as described in the section 3. 3.

P0268 – DI6 Function

Adjustable Range:	0 to 31 / 21 = Rev Slowdown / Stop Fwd / Stop Rev	**Factory Setting:**	P1023 = 0: 0
	21 = Reverse Slowdown / Stop Fwd / Stop Rev LS (PLC Use)		P1023 = 1: 0
	21 = Reverse Slowdown / Stop Fwd / Stop Rev LS (PLC Use)		P1023 = 2: 0
	0 = No Function		P1023 = 3: 0
	0 = No Function		P1023 = 4: 0
	21 = 3rd Speed Reference Digital Input (PLC Use)		P1023 = 5: 21
	21 = Reverse Slowdown / Stop Fwd / Stop Rev LS (PLC Use)		P1023 = 6: 0
	21 = Reverse Slowdown / Stop Fwd / Stop Rev LS (PLC Use)		P1023 = 7: 0
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS └ 40 Digital Inputs	or	07 I/O CONFIGURATION └ 40 Digital Inputs

Description:
This parameter has different functions according to the speed reference control configuration:

■ P1023 = 0, 1, 2, 6 or 7 and P1025 = 0, 4, 5, 6 or 7: These options define that the digital input DI6 has no specific function for the crane horizontal motion.

■ P1023 = 0, 1, 2, 6 or 7 and P1025 = 1: These options define that the function of the DI6 is “Reverse Slowdown Limit Switch”.

With logical level “0” (sensor actuated) and with a reverse command present, it decelerates the motor down to the minimum speed defined in P0133.

With logical level “1” (sensor not actuated), it allows commands for load forward or load reverse.

■ P1023 = 0, 1, 2, 6 or 7 and P1025 = 2: These options define that the function of the DI6 is “Stop Forward Limit Switch”.

With logical level “0” (sensor actuated) and with a forward command present, it performs an emergency stop respecting the ramp defined in P0103.

With logical level “1” (sensor not actuated), it allows commands for load forward or reverse.

■ P1023 = 0, 1, 2, 6 or 7 and P1025 = 3: These options define that the function of the DI6 is “Stop Reverse Limit Switch”.

With logical level “0” (sensor actuated) and with a reverse command present, it performs an emergency stop respecting the ramp defined in P0103.

With logical level “1” (sensor not actuated), it allows commands for load forward or reverse.

■ P1023 = 3 or 4: These options define that the digital input DI6 has no specific function for the crane horizontal motion.

■ P1023 = 5: These options define that the function of the DI6 is to be the 3rd digital input for the selection of the crane horizontal motion speed reference via the logical combination of digital inputs, as described in the section 3. 3.

NOTE!
Refer to the CFW-11 programming manual for more information on the digital input parameters. Some parameter options have been removed from the configuration wizard.

DI9 Function

Description:
It is an IOC-01 or IOC-02 accessory module digital input with exclusive SoftPLC function use, not presenting a parameter for configuring its function.

■ P1025 = 0, 1, 2, 3 or 6: These options define that the digital input DI9 has no specific function for the crane horizontal motion.

■ P1025 = 4, 5, or 7: This option defines that the function of the DI9 is “Forward Slowdown Limit Switch”.

With logical level “0” (sensor actuated) and with a load forward command present, it decelerates the motor down to the minimum speed defined in P0133.

With logical level “1” (sensor not actuated), it allows commands for load forward or load reverse.

DI10 Function

Description:
It is an IOC-01 or IOC-02 accessory module digital input with exclusive SoftPLC function use, not presenting a parameter for configuring its function.

■ P1025 = 0, 1, 2, 3 or 5: These options define that the digital input DI9 has no specific function for the crane horizontal motion.

■ P1025 = 4, 6, or 7: This option defines that the function of the DI9 is “Reverse Slowdown Limit Switch”.

With logical level “0” (sensor actuated) and with a load reverse command present, it decelerates the motor down to the minimum speed defined in P0133.

With logical level “1” (sensor not actuated), it allows commands for load forward or load reverse.

DI11 Function

Description:
It is an IOC-01 or IOC-02 accessory module digital input with exclusive SoftPLC function use, not presenting a parameter for configuring its function.

■ P1025 = 0, 1, 2, 3, 4 or 6: These options define that the digital input DI11 has no specific function for the crane horizontal motion.

■ P1025 = 5 or 7: This option defines that the function of the DI11 is “Stop Forward Limit Switch”.

With logical level “0” (sensor actuated) and with a forward command present, it performs an emergency stop respecting the ramp defined in P0103.

With logical level “1” (sensor not actuated), it allows commands for load forward or load reverse.

DI12 Function

Description:
It is an IOC-01 or IOC-02 accessory module digital input with exclusive SoftPLC function use, not presenting a parameter for configuring its function.

■ P1025 = 0, 1, 2, 3, 4 or 5: These options define that the digital input DI12 has no specific function for the crane horizontal motion.

■ P1025 = 6 or 7: This option defines that the function of the DI12 is “Stop Reverse Limit Switch”.

With logical level “0” (sensor actuated) and with a reverse command present, it performs an emergency stop respecting the ramp defined in P0103.

With logical level “1” (sensor not actuated), it allows commands for load forward or load reverse.

NOTE!
Refer to the IOC-01 or IOC-02 accessory module installation, configuration and operation guide for more information on the DI9, DI10, DI11 and DI12 digital inputs.

3.9 DIGITAL OUTPUTS

This parameter group allows the user to configure the command function of each digital output in the crane horizontal motion applicative.

P0275 – DO1 Function (RL1)

P0276 – DO2 Function (RL2)

P0277 – DO3 Function (RL3)

Adjustable Range:	0 to 36 / 28 = Brake Release (SoftPLC)	**Factory Setting:**	P0275 = 13 P0276 = 11 P0277 = 28
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 41 Digital Outputs	or	07 I/O CONFIGURATION ∟ 41 Digital Outputs

Description:
These parameters define the functions of the DO1, DO2 and DO3 digital outputs. If the option “28 = Brake Release (SoftPLC)” has been selected, the output assumes the function of commanding the crane horizontal motion brake. As presented in the section 2.1, the NO relay contact of DO1, DO2 and DO3 digital outputs must be used.

NOTE!
Refer to the section 3.12 in this application manual for more information on the brake control logic.

NOTE!
Refer to the CFW-11 programming manual for more information on the digital output parameters. Some parameter options have been removed from the configuration wizard.

DO6 Function

Description:
It is an IOC-01 or IOC-02 accessory module digital output with exclusive SoftPLC function use, not presenting a parameter for its configuration. It has the function of indicating the alarm “A770: Momentary Overload”.

NOTE!
Refer to the section 3.13 in this application manual for more information on the momentary overload detection logic.

DO7 Function

Description:
It is an IOC-01 or IOC-02 accessory module digital output with exclusive SoftPLC function use, not presenting a parameter for its configuration. It has the function of indicating the fault “F775: Inverter in Torque Limit”.

NOTE!
Refer to the section 3.14 in this application manual for more information on the inverter torque limit detection logic.

NOTE!
Refer to the IOC-01 or IOC-02 accessory module installation, configuration and operation guide for more information on the DO6 and DO7 digital outputs.

3.10 ANALOG INPUT

This parameter group allows the user to configure the analog input AI1 for the speed reference control of the crane horizontal motion.

NOTA!
It is configured only when the parameter P1023 (speed reference control configuration) is programmed with the option 6.

P0231 – AI1 Signal Function

Adjustable Range:	7 = Speed Reference (PLC Use)			**Factory Setting:**	7
Proprieties:					
Access groups via HMI:	01 PARAMETER GROUPS ∟ 38 Analog Inputs	or	07 I/O CONFIGURATION ∟ 38 Analog Inputs		

Description:
This parameter defines that the function of the analog input AI1 will be the crane horizontal motion speed reference.

P0233 – AI1 Signal Type

Adjustable Range:	0 = 0 to 10 V / 20 mA 1 = 4 to 20 mA			**Factory Setting:**	0
Proprieties:					
Access groups via HMI:	01 PARAMETER GROUPS ∟ 38 Analog Inputs	or	07 I/O CONFIGURATION ∟ 38 Analog Inputs		

Description:
This parameter configures the type of signal (voltage or current) that will be read by the analog input AI1. Adjust the CFW-11 control board DIP switch S1.4 according to the selected option.

P0232 – AI1 Gain

Adjustable Range:	0.000 to 9.999		**Factory Setting:**	1.000
Proprieties:				
Access groups via HMI:	01 PARAMETER GROUPS ∟ 38 Analog Inputs	or	07 I/O CONFIGURATION ∟ 38 Analog Inputs	

Description:
This parameter applies a gain to the value read at the analog input AI1, i.e., the value obtained at the input is multiplied by the gain, thus allowing adjustments in the measured variable.

P0234 – AI1 Offset

Adjustable Range:	-100.00 % to +100.00 %		**Factory Setting:**	0.00 %
Proprieties:				
Access groups via HMI:	01 PARAMETER GROUPS ∟ 38 Analog Inputs	or	07 I/O CONFIGURATION ∟ 38 Analog Inputs	

Description:
This parameter adds to the measured quantity a value, in percentage, in order to adjust the read variable.

P0235 – AI1 Filter

Adjustable Range:	0.00 to 16.00 s		**Factory Setting:**	0.25 s
Proprieties:				
Access groups via HMI:	01 PARAMETER GROUPS ∟ 38 Analog Inputs	or	07 I/O CONFIGURATION ∟ 38 Analog Inputs	

Description:
This parameter configures the 1st order filter time constant that will be applied to the analog input AI1.

NOTE!
Refer to the CFW-11 programming manual for more information on the analog input parameters. Some parameter options have been removed from the configuration wizard.

3.11 LIGHTWEIGHT MODE

This parameter group allows the user to adjust the lightweight mode operation conditions.

Lightweight is an operation status of the crane horizontal motion in which the motor current is monitored after a certain speed, in order to determine whether it is at a low value, which would indicate lightweight. This allows an increase to the control speed reference, therefore expediting the operation of the crane horizontal motion.

NOTE!
While in lightweight operation mode, the motor speed reference will be the maximum value programmed in parameter P0134.

P1038 – Current Threshold for Lightweight Detection

Adjustable Range:	0.0 to 3000.0 A		**Factory Setting:**	10.0 A
Proprieties:				
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC			

Description:
This parameter configures the motor current threshold for lightweight detection. In other words, when the actual motor current is below the adjusted value, this indicates that it is with lightweight.

P1039 – Speed Threshold for Lightweight Detection Enabling

Adjustable Range:	0.0 to 1020.0 Hz	**Factory Setting:**	0.0 Hz
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter configures the speed threshold for lightweight detection. In other words, when the actual motor speed is higher than or equal to the adjusted value, it enables the lightweight detection through the motor current monitoring.

NOTE!
Setting this parameter in 0.0 disables the lightweight detection.

The lightweight detection operation diagram, considering that the crane horizontal motion has been configured for two speed references obtained from the digital input logic, is presented next. The brake control logic has not been considered.

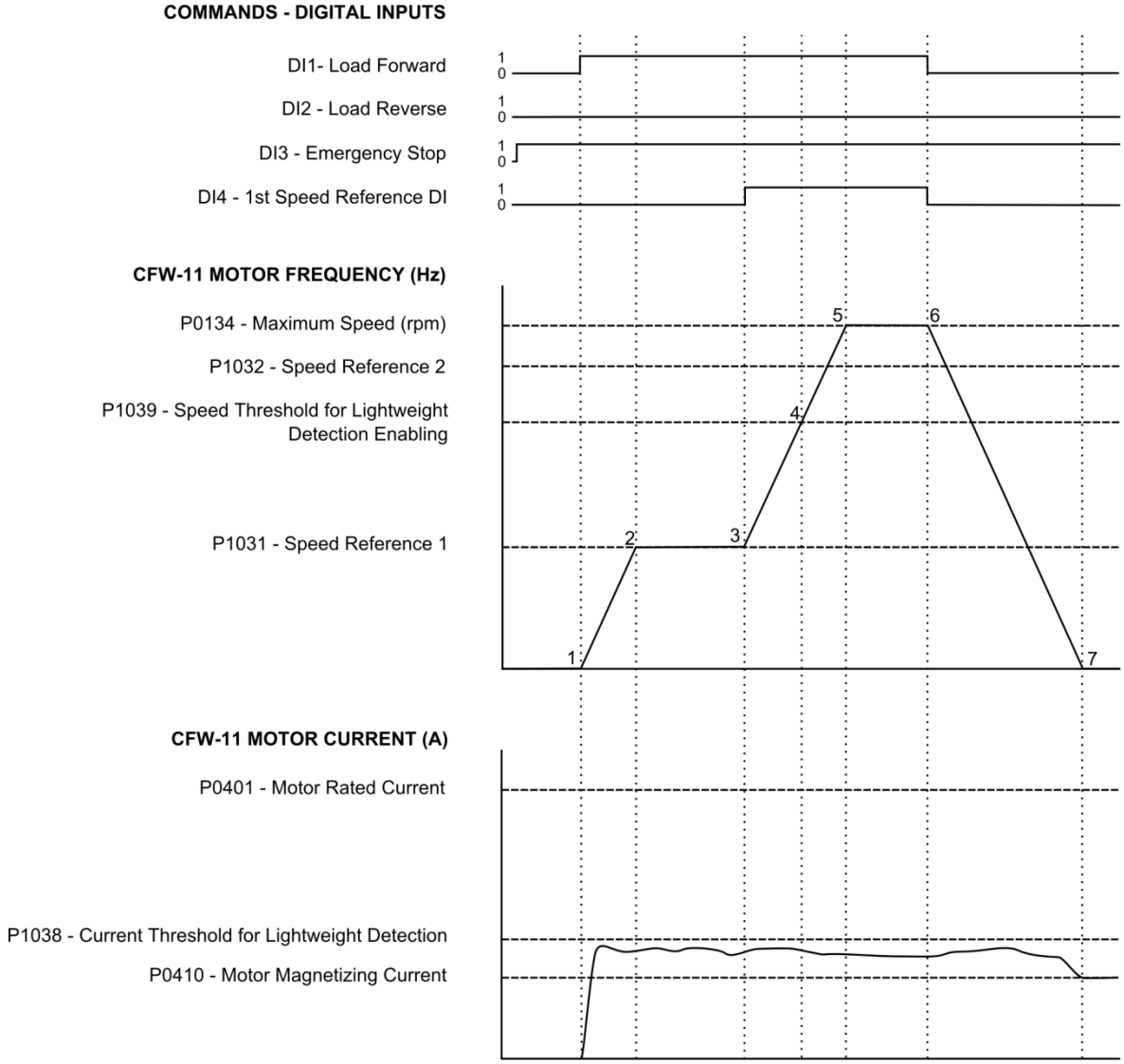


Figure 3.1 – Lightweight detection operation mode

Description of the identified moments:

1 – The load forward command is given through the digital input DI1. The motor becomes magnetized, and voltage and frequency are applied to it

2 – The motor is accelerated to the speed reference 1 value set in P1031.

3 – The speed reference 2, programmed in P1032, is selected through the digital input DI4 and the load is then accelerated to that speed. Note that the motor current remains below the lightweight threshold set in P1038.

4 – At that moment, the motor frequency crosses the speed threshold for lightweight detection adjusted in P1039 and because the motor current remains below the current threshold set in P1038, lightweight, generating the alarm A750, is detected. The motor is then accelerated up to the maximum speed adjusted in P0134.

5 – The motor reaches the programmed maximum speed.

6 – The load forward command is removed from the digital input DI1 (and consequential removal of the selection done via the digital input DI4). The motor deceleration begins.

7 – The motor reaches 0 rpm and remains magnetized (If within the period programmed in P1027 a new load forward or reverse command does not occur, the motor will be demagnetized).

3.12 BRAKE CONTROL

P1041 – Brake Release Frequency Threshold

Adjustable Range:	0.0 to 500.0 Hz	**Factory Setting:**	4.0 Hz
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter define the motor frequency threshold to release the brake. In other words, if the total speed reference (as motor frequency) after the ramp is higher than or equal to the adjusted value, then the brake release command is permitted. It is also necessary that the other conditions be satisfied for effectively commanding the brake release.

NOTE!
Setting this parameter in 0.0 disables the motor frequency verification for the brake control.

P1043 – Brake Release Current Threshold

Adjustable Range:	0.0 to 3000.0 A	**Factory Setting:**	0.0 A
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter define the motor current threshold to release the brake. In other words, if the actual motor current is higher than or equal to the adjusted value, then the brake release command is permitted. It is also necessary that the other conditions be satisfied for effectively commanding the brake release.

NOTE!
Setting this parameter in 0.0 disables the motor current verification for the brake control.

P1045 – Brake Release Torque Threshold

Adjustable Range:	0.0 to 350.0 %	**Factory Setting:**	0.0 %
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter define the motor torque threshold to release the brake. In other words, if the actual motor torque is higher than or equal to the adjusted value, then the brake release command is permitted. It is also necessary that the other conditions be satisfied for effectively commanding the brake release.

NOTE!
Setting this parameter in 0.0 disables the motor torque verification for the brake control.

P1046 – Brake Response Time to Release

Adjustable Range:	0.00 to 650.00 s	**Factory Setting:**	0.10 s
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter defines the brake response time to release, or how long the brake takes to release after receiving the command from the digital output of the CFW-11, and thus be mechanically released.

NOTE!
In time for the brake release, the speed reference is kept in the brake release frequency threshold if it is enabled (P1041 ≠ 0). This avoids the increase of the motor frequency with the brake closing can thus minimize motor current spikes.

P1047 – Inhibition of the Brake Closing during a Forward/Reverse Command Transition

Adjustable Range:	0 = Disabled 1 = Enabled	**Factory Setting:**	0
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter inhibits the brake closing during the transition from load forward to load reverse and vice versa.

P1048 – Brake Closing Frequency Threshold

Adjustable Range:	0.5 to 1020.0 Hz	**Factory Setting:**	2.5 Hz
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter defines the motor frequency threshold to close the brake. In other words, if the total speed reference after the ramp is less than or equal to that threshold, a command for brake closing is issued.

P1049 – Delay Time for Brake Closing

Adjustable Range:	0.00 to 650.00 s	**Factory Setting:**	0.00 s
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter defines a delay after the frequency threshold condition to close the brake is fulfilled, before effectively issuing the brake closing command.

NOTE!
The delay time to close the brake does not apply in the event of a fault, coast to stop, fast stop or emergency stop.

P1050 – Time to Enable a new Command to Brake Release

Adjustable Range:	0.10 to 650.00 s	**Factory Setting:**	0.20 s
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter defines a time after the command to brake closing has been executed via the digital output of the CFW-11, so that a new command to load forward or load reverse is accepted and thus the brake can be released again thus preventing a new command to be generated without the brake being closed mechanically.

NOTE!
The value of the set time should be sufficient to ensure that a new command to load forward or load reverse performs with the brake closed, but that does not generate a very large delay in the crane operation.

NOTE!
Refer to the section 2.2 in this application manual for more information on the connection diagram and brake power supply.

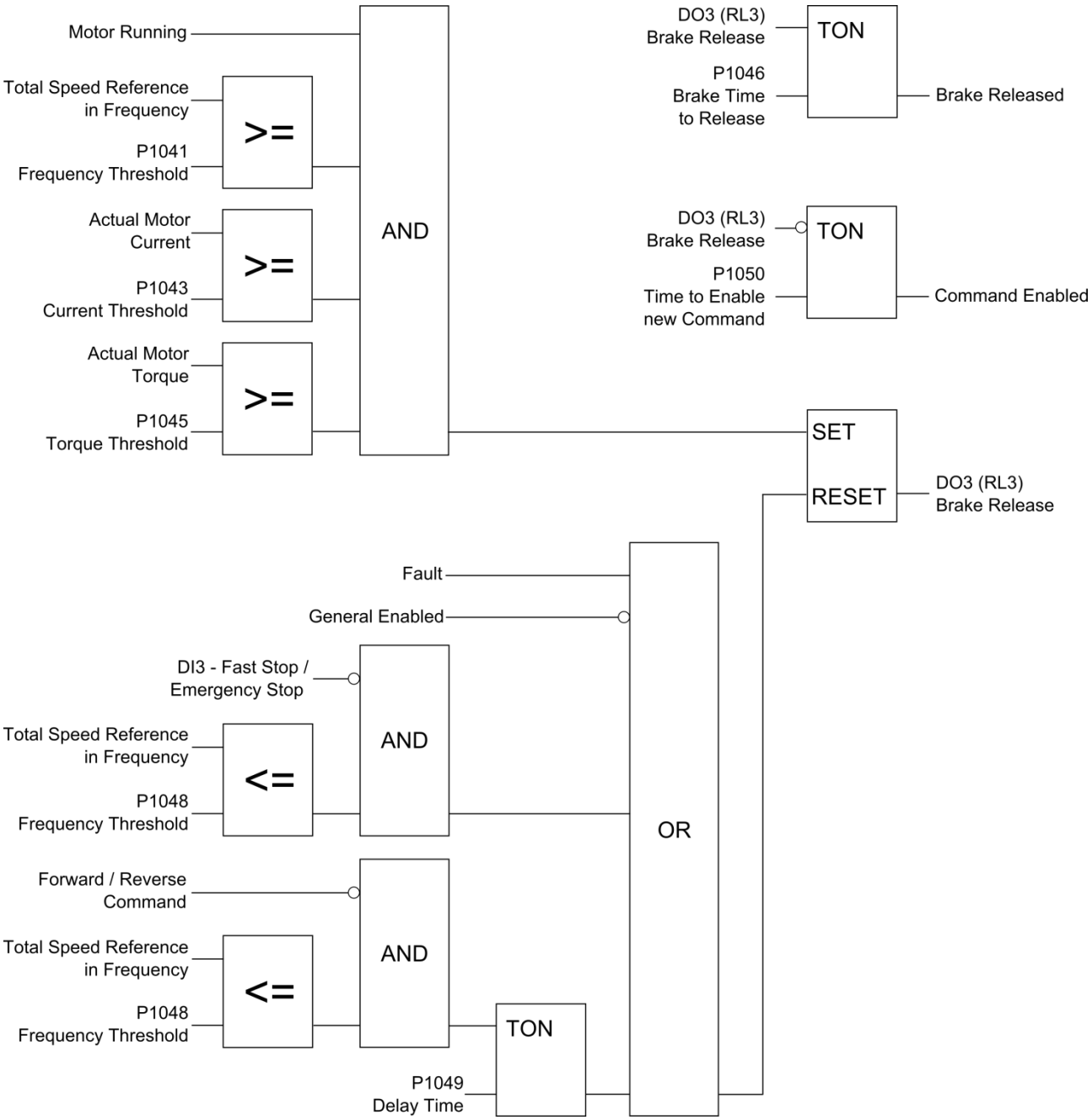


Figure 3.2 – Logic block diagram for the mechanical brake control through the digital output DO3

The brake control operation diagram considering that the crane horizontal motion has been configured for two speed references obtained from the digital input logic, and that the evaluations of motor frequency and motor current for the control of the mechanical brake are enabled, is presented next.

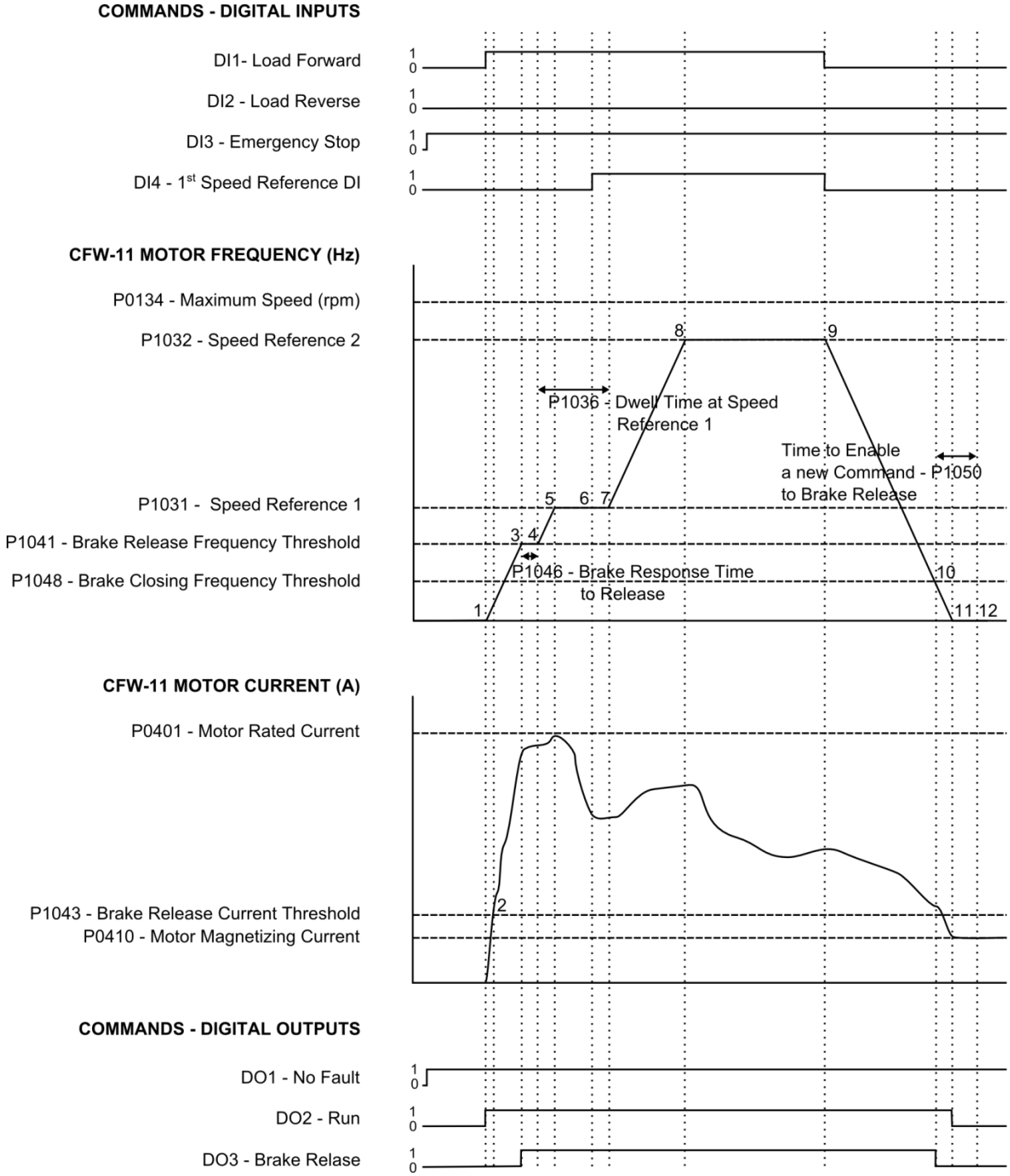


Figure 3.3 – Brake control operation

Description of the identified moments:

1 – The load forward command is given through the digital input DI1. The motor becomes magnetized, and voltage and frequency are applied to it. The brake remains closed.

2 – The motor current reaches the P1043 threshold, the brake, however, remains closed because the motor frequency is below the frequency threshold adjusted in P1041.

3 – The motor current remains greater than or equal to the P1043 threshold, and since the motor frequency reaches the P1041 threshold, the command to release the mechanical brake through the digital output DO3 is executed

4 – With the brake released, the load forward remains with the speed reference 1 adjusted in P1031.

5 – The speed reference 2, programmed in P1032, is selected through the digital input DI4. The load is then accelerated to that speed reference 2 selected through the digital input DI4. Note that the motor current increases, but momentary overload is not detected while forward the load.

6 – The motor reaches the speed reference 2 and keeps forward the load at that speed.

7 –The motor deceleration begins. The brake remains release.

8 – The motor frequency becomes less than or equal to the threshold adjusted in P1048, and the command to close the mechanical brake is executed through the removal of the digital output DO3 command.

9 – The motor is decelerated down to 0 rpm and remains magnetized (If within the period programmed in P1027 a new forward or reverse command does not occur, the motor will be demagnetized). The load remains stopped, being held by the mechanical brake.

3.13 MOMENTARY OVERLOAD

This parameter group allows the user to adjust the conditions for the crane horizontal motion momentary overload detection at the load forward or load reverse stage.

Momentary Overload is an abnormal condition detected during the crane horizontal motion operation where, during the command to load forward or load reverse, it appears that a further effort to get the load moving and this can be caused by some object that is in route or a misalignment of the mechanical equipment.

P1052 – Momentary Overload Current Threshold

Adjustable Range:	0.0 to 3000.0 A	**Factory Setting:**	50.0 A
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter defines the momentary overload current threshold when, during the command to load forward or load reverse, the momentary overload condition can be detected. In other words, if the actual motor current is greater than or equal to the adjusted threshold, then the momentary overload condition will be detected at the load forward or load reverse.

NOTE!
With the momentary overload detection, only is generate an alarm message “A770: Momentary Overload”.

NOTE!
Setting this parameter in 0.0 disables the alarm.

P1053 – Momentary Overload Detection Delay Time

Adjustable Range:	0.00 to 650.00 s	**Factory Setting:**	1.00 s
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter defines a delay time after the load forward or load reverse command has been given, before initiating the momentary overload monitoring according to the current threshold defined in P1050.

P1054 – Momentary Overload Alarm (A770) Delay Time

Adjustable Range:	0.00 to 650.00 s	**Factory Setting:**	1.00 s
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter defines a delay time after the motor current becomes greater than or equal to the threshold defined in P1052, during a load forward or load reverse command, before the alarm "A770: Momentary Overload", is generated.

The momentary overload detection operation diagram, considering that the crane horizontal motion has been configured for two speed references obtained from the digital input logic, is presented next. Only the frequency has been considered in the brake control logic.

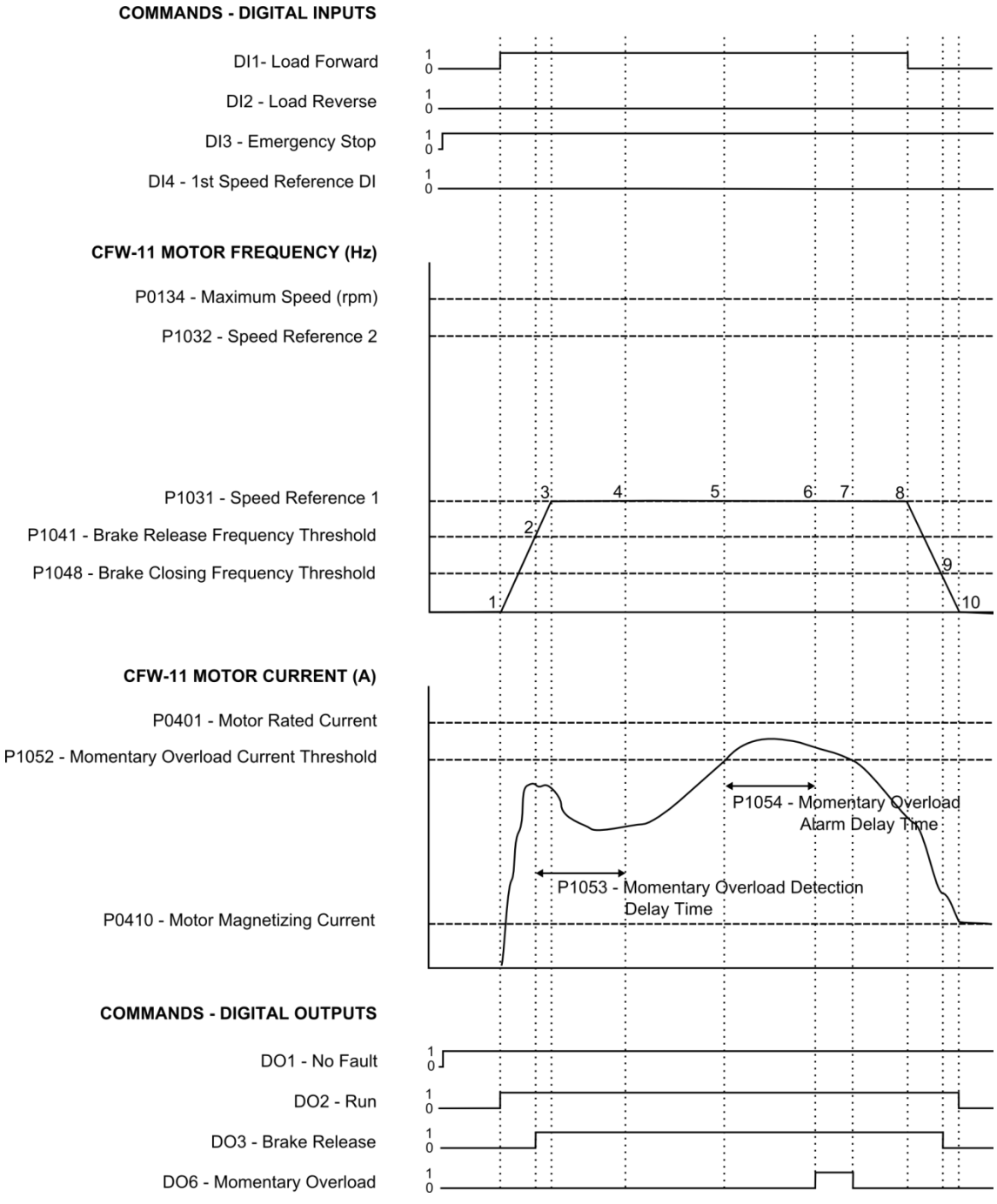


Figure 3.4 – Momentary overload detection operation

Description of the identified moments:

1 – The load forward command is given through the digital input DI1. The motor becomes magnetized, and voltage and frequency are applied to it. The brake remains closed.

2 – The motor frequency reaches the threshold adjusted in P1041 and the command to release the mechanical brake through the digital output DO3 is executed. Momentary overload detection delay time, programmed in P1053, starts elapsing because the load forward and brake release commands are presented.

3 – With the brake release, the load forward with the speed reference 1 adjusted in P1031 begins.

4 – The overweight detection delay time has elapsed.

5 – The motor current is greater than the overweight threshold programmed in P1050, the momentary overload alarm delay timer begins counting the time programmed in P1052.

6 – The overweight alarm delay time has elapsed and the alarm "A770: Momentary Overload", is generated. The digital output DO6 is activated indicating the momentary overload condition. The crane continues to operate normally.

7 – The value of motor current is less than the value adjusted to momentary overload current threshold in P1050 and the momentary overload alarm condition is normalized. The digital output DO6 is deactivated indicating no more alarm. The crane continues to operate normally

8 – The load forward command is removed from the digital input DI1. The motor deceleration begins. The brake remains release.

9 – The motor frequency becomes less than or equal to the threshold adjusted in P1048, and the command to close the mechanical brake is executed through the removal of the digital output DO3 command.

10 – The motor is decelerated down to 0 rpm and remains magnetized (If within the period programmed in P1027 a new load forward or load reverse command does not occur, the motor will be demagnetized). The load remains stopped, being held by the mechanical brake.

3.14 INVERTER IN TORQUE LIMIT DETECTION

This parameter group allows the user to adjust the conditions for the crane horizontal motion torque limit detection during the load forward or reverse stages.

Inverter in Torque Limit is an abnormal condition detected in the crane horizontal motion operation, when the CFW-11 frequency inverter is not able to execute the motion in the desired manner (with controlled speed), i.e., operating in a torque limit condition.

NOTE!
The inverter in torque limit detection is based on the CFW-11 frequency inverter speed control, after the command to release the brake, i.e., the torque limit detection is not performed with the brake closed. It is necessary to use sensorless vector or vector with encoder control mode for inverter in torque limit detection.

P0169 – Maximum Positive Torque Current

P0170 – Maximum Negative Torque Current

Adjustable Range:	0.0 to 350.0 %	**Factory Setting:**	130.0 %
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 29 Vector Control ∟ 95 Torque Current Limit		

Description:
These parameters limit the motor current component that produces positive (P0169) or the negative (P0170) torque. The adjustment is expressed as a percentage of the rated motor torque current.

P1028 – Speed Hysteresis for Inverter in Torque Limit Detection

Adjustable Range:	0.0 to 50.0 %	**Factory Setting:**	7.5 %
Proprieties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines the percentage of the motor synchronous speed that will be the hysteresis used to detect inverter torque limits during the execution of load hoisting/forward or lowering/reverse commands in the crane horizontal motion application. In other words, if the motor speed is less than (hoisting/forward) or greater than (lowering/reverse) the hysteresis value when compared to the speed reference, then the inverter torque limit condition is detected.

NOTE!
A setting of "0.0 %" disables the fault.

P1029 – Inverter in Torque Limit Fault (F775) Delay Time

Adjustable Range:	0.00 to 650.00 s	**Factory Setting:**	0.75 s
Proprieties:			
Access groups via HMI:	SPLC		

Description:
This parameter defines a delay time after the inverter in torque limit condition has been detected, before the fault "F775: Inverter in Torque Limit", is generated.

3.15 IMPROPER OPERATION

This parameter group allows to the user to adjust the conditions to supervise the use of the crane horizontal motion verifying whether it is being operated properly.

P1058 – Number of Consecutive Alarms for Improper Operation Fault (F777)

Adjustable Range:	0 to 10	**Factory Setting:**	3
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter defines the number of consecutive alarms during the period programmed in P1059 to generate the fault "F777: Improper Operation". The practical result of this fault is not allowing the user to continue the crane horizontal motion operation in case of consecutive alarm messages.

NOTE!
The alarms A750, A760, A762, A764 and A766 are not computed in the consecutive alarm counter, because they just indicate an operation status of the crane horizontal motion.

NOTE!
Setting this parameter in 0 disables the fault.

P1059 – Period of Time for Improper Operation Fault (F777)

Adjustable Range:	0 to 65000 s	**Factory Setting:**	120 s
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter defines the period of time during which the number of consecutive alarms programmed in P1058 must occur, in order to generate the fault “F777: Improper Operation”.

3.16 MOTOR UMBALANCED CURRENT

P0342 – Motor Unbalanced Current Detection

Adjustable Range:	0 = Off 1 = On	**Factory Setting:**	0
Proprieties:	CFG		
Access groups via HMI:	01 PARAMETER GROUPS ∟ 45 Protections		

Description:
This parameter enables the motor unbalanced current detection, which will be responsible for the F076 fault generation. This function will be enabled to trip when the conditions below were fulfilled simultaneously for longer than 2 seconds:

1. P0342 = On;
2. Enabled inverter;
3. Speed reference higher than 3 %;
4. |Iu - Iv| or |Iu - Iw| or |Iv - Iw|> 0.125 x P0401.

NOTE!
Refer to the CFW-11 programming manual for more information on the protection parameters.

3.17 HMI MONITORING

This parameter group allows the user to configure which parameters will be shown on the HMI display in the monitoring mode.

P0205 – Reading Parameter Selection 1

P0206 – Reading Parameter Selection 2

P0207 – Reading Parameter Selection 3

NOTE!
Refer to the CFW-11 programming manual for more information on the HMI parameters. Some parameter options have been removed from the configuration wizard.

3.18 READ-ONLY PARAMETERS

P1010 – Crane Horizontal Motion Version

Adjustable Range:	0.00 to 10.00	**Factory Setting:**	-
Proprieties:	RO		
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter indicates the version of the applicative developed for the crane horizontal motion.

3.18.1 Alarm History

This parameter group allows to the user to visualize the last three alarms that have occurred in the inverter, together with their time and date information.

P1011 – Last Alarm

P1014 – Second Alarm

P1017 – Third Alarm

Adjustable Range:	0 to 999	**Factory Setting:**	-
Proprieties:	RO		
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
These parameters indicate the last three alarm codes.

The recording systematic is the following:
Axxx → P1011 → P1014 → P1017

P1012 – Last Alarm Date

P1015 – Second Alarm Date

P1018 – Third Alarm Date

Adjustable Range:	01.01 to 31.12	**Factory Setting:**	-
Proprieties:	RO		
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
These parameters indicate the occurrence date (day and month) of the last to the third alarm in the DD.MM format.

P1013 – Last Alarm Time

P1016 – Second Alarm Time

P1019 – Third Alarm Time

Adjustable Range:	00.00 to 23.59	**Factory Setting:**	-
Proprieties:	RO		
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
These parameters indicate the occurrence time (hour and minute) of the last to the third alarm in the HH.MM format.

3.18.2 Status Word

This parameter group allows the user to visualize the status of the crane horizontal motion.

P1020 – Crane Horizontal Motion Status Word 1

Adjustable Range:	0000h to FFFFh	**Factory Setting:**	-
Proprieties:	RO		
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter allows the status monitoring of the CFW-11 frequency inverter and of the crane horizontal motion commands. Each bit represents a specific status.

Table 3.4 – Status word 1 description

Bits	15 to 10	9	8	7	6	5	4	3	2	1	0
Function	Reserved	Brake Release Command	Load Reverse Command	Load Forward Command	Alarm Condition	Undervoltage	Fault Condition	LOC / REM	Rotation Direction	Running	General Enabled

Bits	Values
Bit 0 General Enabled	0: The inverter is general disabled. 1: The inverter is general enabled and ready to run the motor.
Bit 1 Running	0: Stopped motor 1: The inverter is driving the motor at the set point speed, or executing either the acceleration or the deceleration ramp.
Bit 2 Rotation Direction	0: Motor in reverse speed direction 1: Motor in forward speed direction
Bit 3 LOC / REM	0: Inverter in local mode 1: Inverter in remote mode
Bit 4 Fault Condition	0: The inverter is not in a fault condition. 1: The inverter has detected a fault. Note: The fault number can be read by means of the parameter P0049 – Present Fault.
Bit 5 Undervoltage	0: No undervoltage 1: Undervoltage
Bit 6 Alarm Condition	0: The inverter is not in alarm condition. 1: The inverter is in alarm condition. Note: The alarm number can be read by means of the parameter P0048 – Present Alarm.
Bit 7 Load Forward Command	0: No load forward command 1: It indicates that a load forward command is being executed.

Bit 8 Load Reverse Command	0: No load reverse command 1: It indicates that a load reverse command is being executed.
Bit 9 Brake Release Command	0: It indicates that a brake closing command is being executed. 1: It indicates that a brake release command is being executed.
Bits 10 to 15	Reserved.

P1021 – Crane Horizontal Motion Status Word 2

Adjustable Range: 0000h to FFFFh **Factory Setting:** -

Proprieties: RO

Access groups via HMI: 01 PARAMETER GROUPS
∟ 50 SoftPLC

Description:
This parameter allows the monitoring of the present alarm and fault condition in the crane horizontal motion application. Each bit represents one specific status.

Table 3.5 – Status word 2 description

Bits	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Function	Reserved	Reserved	Improper Operation (F777)	Inverter Torque Limit (F775)	Reserved	Reserved	Momentary Overload (A770)	Stop Reverse (A766)	Stop Forward (A764)	Reverse Slowdown (A762)	Forward Slowdown (A760)	Stop by Simultaneous Commands (A758)	Emergency Stop (A756)	Fast Stop (A754)	Coast to Stop (A752)	Lightweight Operation (A750)

Bits	Values
Bit 0 Lightweight Operation	0: No alarm indication 1: It indicates that the crane horizontal motion is in the lightweight operation mode (A750).
Bit 1 Coast to Stop	0: No alarm indication 1: The general enable signal has been removed from the DI3 causing the motor to cast down (A752).
Bit 2 Fast Stop	0: No alarm indication 1: It indicates that a fast stop via digital input DI3 has been executed (A754).
Bit 3 Emergency Stop	0: No alarm indication 1: It indicates that an emergency stop via digital input DI3 has been executed (A756).
Bit 4 Stop by Simultaneous Commands	0: No alarm indication 1: It indicates that a stop occurred because of simultaneous forward and reverse commands (A758).
Bit 5 Forward Slowdown	0: No alarm indication 1: It indicates that the forward slowdown limit switch has been actuated (A760).
Bit 6 Reverse Slowdown	0: No alarm indication 1: It indicates that the reverse slowdown limit switch has been actuated (A762).
Bit 7 Stop Forward	0: No alarm indication 1: It indicates that the stop forward limit switch has been actuated (A764).
Bit 7 Stop Reverse	0: No alarm indication 1: It indicates that the stop reverse limit switch has been actuated (A766).
Bit 9 Momentary Overload Alarm	0: No alarm indication 1: It indicates that the momentary overload condition has been detected during the forward or reverse stage (A770).
Bit 10	Reserved
Bit 11	Reserved
Bit 12 Inverter in Torque Limit	0: No fault indication 1: It indicates that the inverter in torque limit condition has been detected (F775).
Bit 13 Improper Operation	0: No fault indication 1: It indicates that the improper operation condition has been detected (F777).
Bit 14	Reserved
Bit 15	Reserved

4 CREATION AND DOWNLOAD THE APPLICATION

In order to configure the CFW-11 inverter for Crane Horizontal Motion application, it is necessary to create the ladder application on the WLP and then download it to the SoftPLC function of the CFW-11 inverter, as well as the parameter values configured on the configuration wizard.

The following steps show how to create and configure the Crane Horizontal Motion application in the WLP and how to transfer it to the CFW-11 inverter.

1st Step: Create a new project on the WLP based on the Crane Horizontal Motion ladder standard application. For this, select Tools, Application, CFW-11, Create and finally click in an application selected;

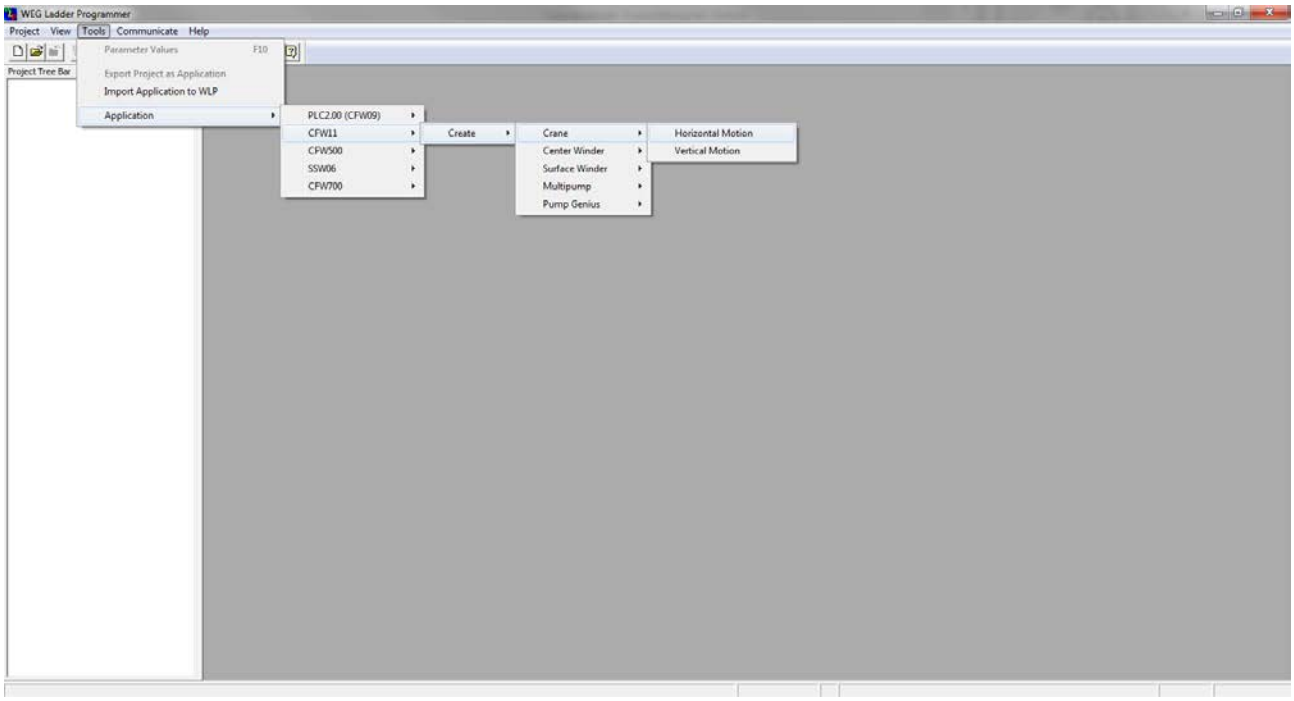


Figure 4.1 – Create the Crane Horizontal Motion application in the WLP

2nd Step: Name the new project created;

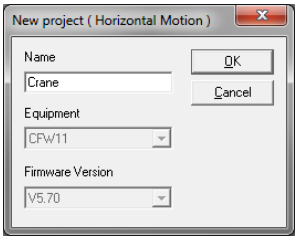


Figure 4.2 – Dialog to name the new project

3rd Step: Adjust the configuration of the WLP communication interface with the equipment, can be via USB or serial port (COM1..COM8). For this, select Communicate and then click Configuration (Shift + F8);

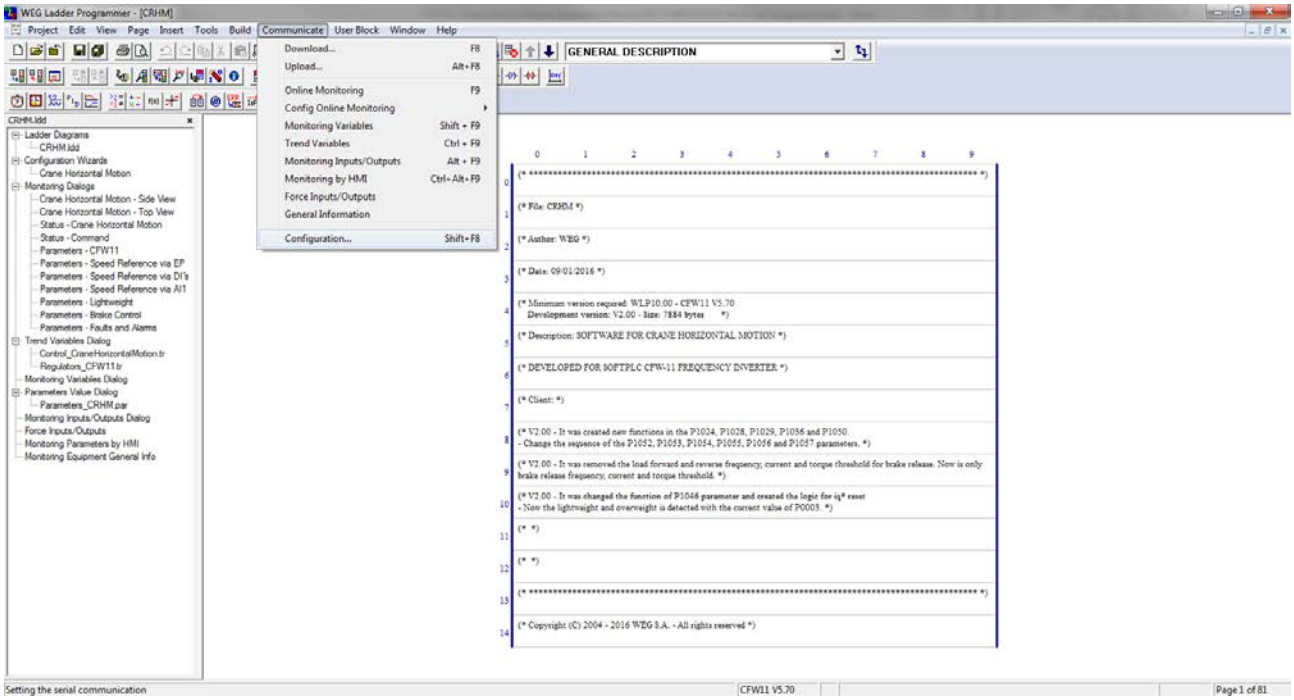


Figure 4.3 – Adjust the communication interface in the new project

4th Step: Download the ladder application and user's parameter. For this, select Communicate and then click Download (F8);

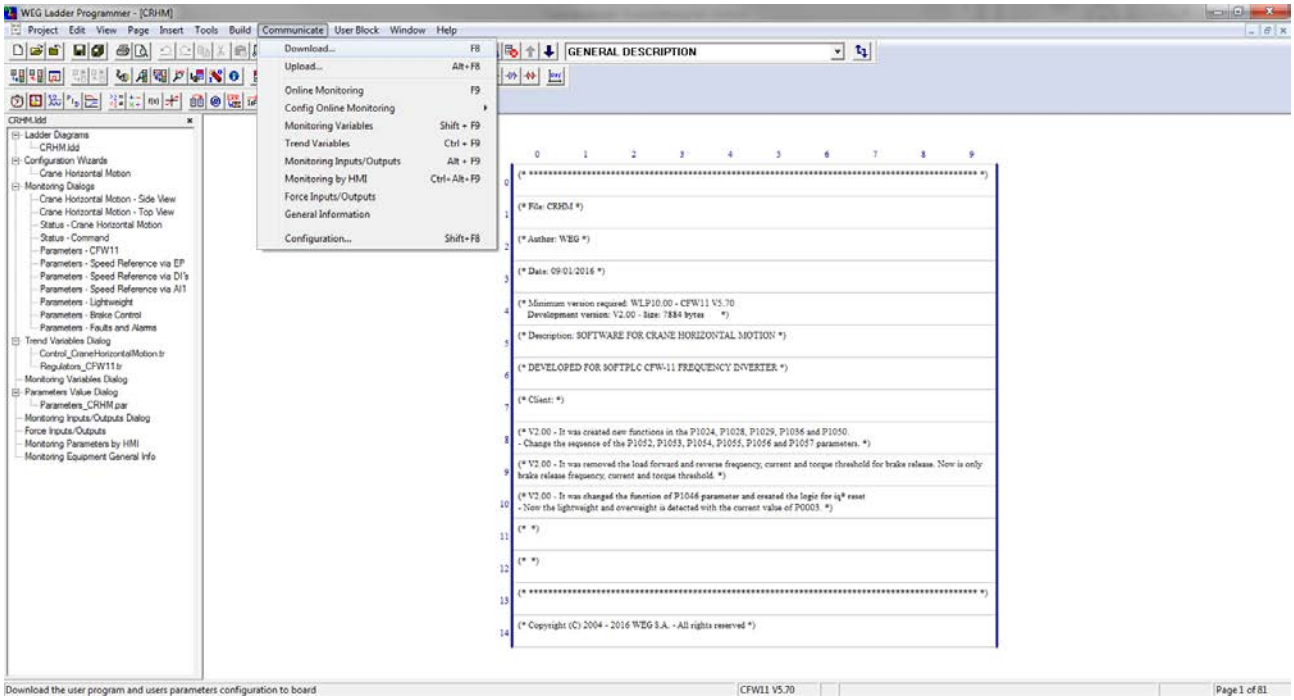


Figure 4.4 – Download the new project

5th Step: Select “User Program”, “Users Parameters Configuration” and Configuration Wizards in the download dialog. Then click “Ok” to start the transfer to the CFW-11 inverter;

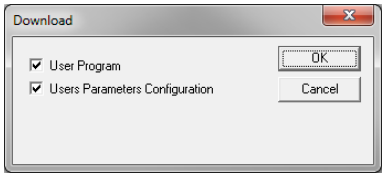


Figure 4.5 – Ladder application download dialog

6th Step: Download the ladder application to the CFW-11 inverter. For this, after the project is compiled and the CFW-11 inverter is identified, click "Yes" to start the download;

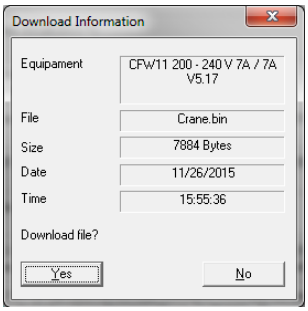


Figure 4.6 – User program download dialog

7th Step: Enable the execution of the SoftPLC user program after the download of the ladder application to the CFW-11 inverter. Click "Yes" to enable the execution of the SoftPLC user program;

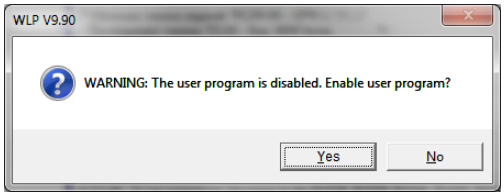


Figure 4.7 – Enabling dialog of the SoftPLC user’s program

8th Step: Download the user’s parameters configuration of the ladder application to the CFW-11 inverter. For this, click “Download” in the user parameters configuration dialog; and then, click "Yes" to start the download;

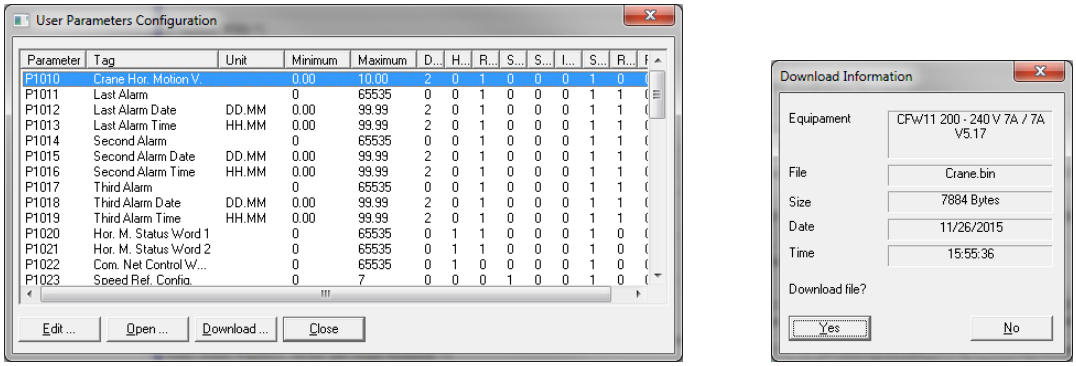


Figure 4.8 – User parameters download dialogs

9th Step: Start the configuration wizard setup for Crane Horizontal Motion application. For this, click the Configuration Wizard “Crane Horizontal Motion” in the project tree bar;

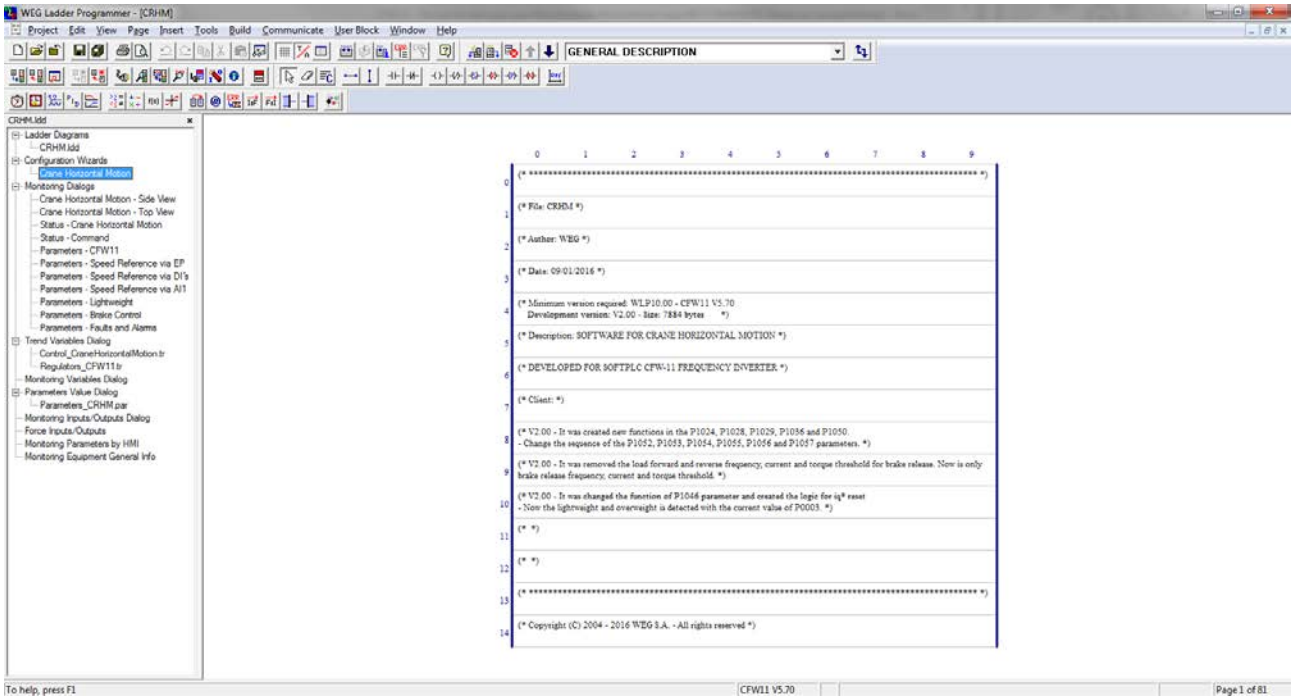


Figure 4.9 – Select the configuration wizard for Crane Horizontal Motion application

10th Step: Click "Finish" in the summary of Crane Horizontal Motion configuration;

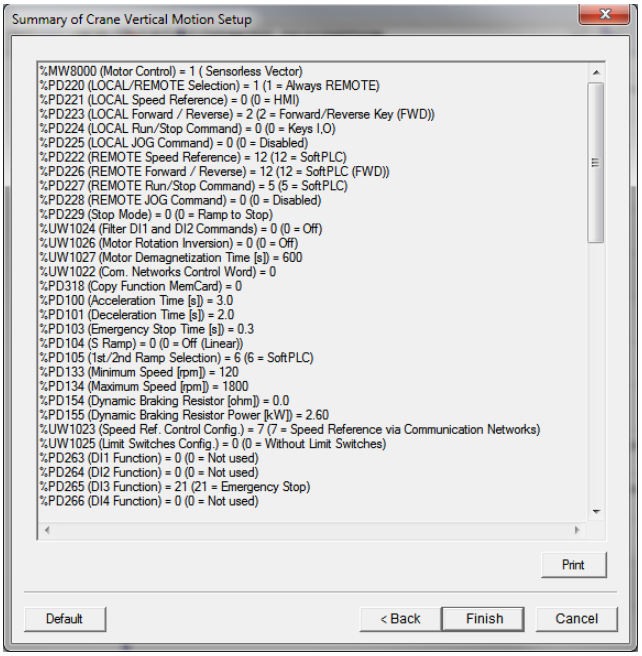


Figure 4.10 – Summary of Crane Horizontal Motion configuration

11th Step: Send the values of the parameters configured in the configuration wizard of Crane Horizontal Motion for the CFW-11 inverter. For this, click "Yes" to start sending the values.

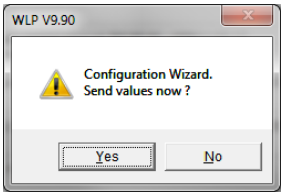


Figure 4.11 – Dialog for download the values of configuration wizard

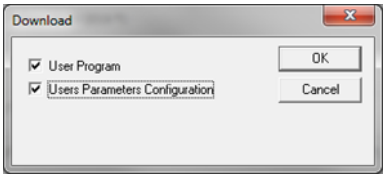
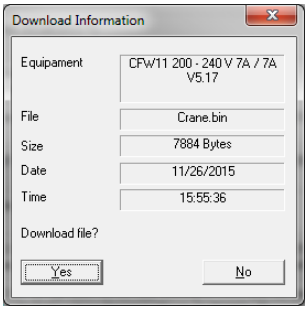
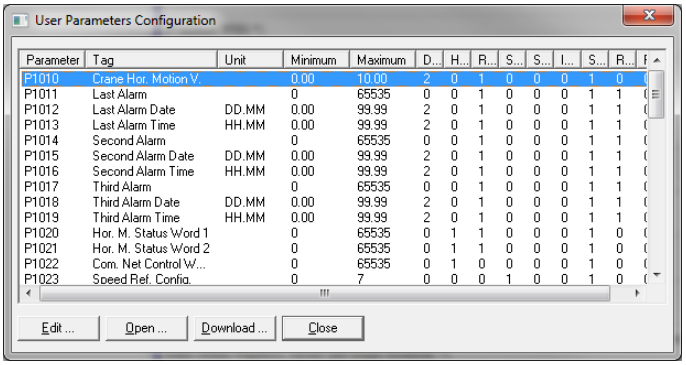
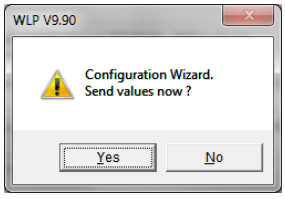
NOTE!
After performing these steps, the CFW-11 inverter is configured for Crane Horizontal Motion application.

5 DOWNLOAD DIALOG BOXES

Through the WLP it is possible to download the user´s ladder program, the configuration of user´s parameters and the values configured in the configuration wizard. Below is a presentation of the main download dialogs to the CFW-11 inverter.

NOTE!
Refer to the help topics in the WLP programming software for more details on the download.

Table 5.1 – Download dialog box for the Crane Horizontal Motion application

Description	WLP Download Dialog Box
Download dialog box of the applicative developed with the WLP containing the following options: ■ User Program; ■ Configuration of the User Parameters;	
User program download dialog box containing: ■ Characteristics of the connected equipment; ■ Name of the file to be downloaded; ■ Size of the applicative to be downloaded; ■ File compilation date; ■ File compilation time; ■ Confirmation command to transfer the compiled applicative.	
Configuration of the user parameters dialog box containing: ■ Parameter number; ■ Name given to the parameter by the user; ■ Unit given to the parameter by the user; ■ Minimum and maximum values; ■ Number of decimal positions; ■ Options for visualization in hexadecimal format, with sign, ignoring the password, visualization on the HMI, retentive and for change confirmation; ■ Commands for opening, editing, performing the download and for closing the dialog box of the user parameters.	
Dialog box for the download of the values configured with the crane horizontal motion configuration wizard.	

6 PROJECT TREE ON WLP

Using WLP programming software can implement or change ladder application of Crane Horizontal Motion Application, configure the parameters through the Configuration Wizards (2), monitor parameters and variables through the Monitoring Dialogs (3), monitor variables through Trend Variables Dialogs (4), and upload/download drive parameters CFW-11 through the parameter Values Dialogues (5). The figure 6.1 presents the project tree where the functions mentioned before.

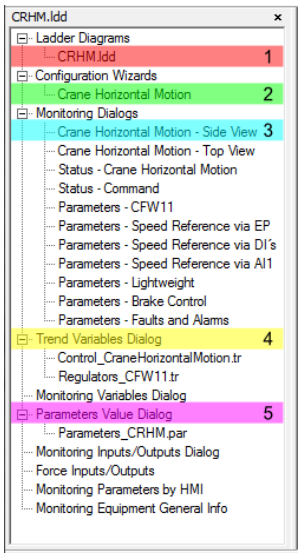


Figure 6.1 – Project Tree

6.1 LADDER DIAGRAMS

Using WLP (WEG Ladder Programmer) software is possible to open and to edit the programming done in ladder language. The figure 6.2 presents a page programmed in ladder.

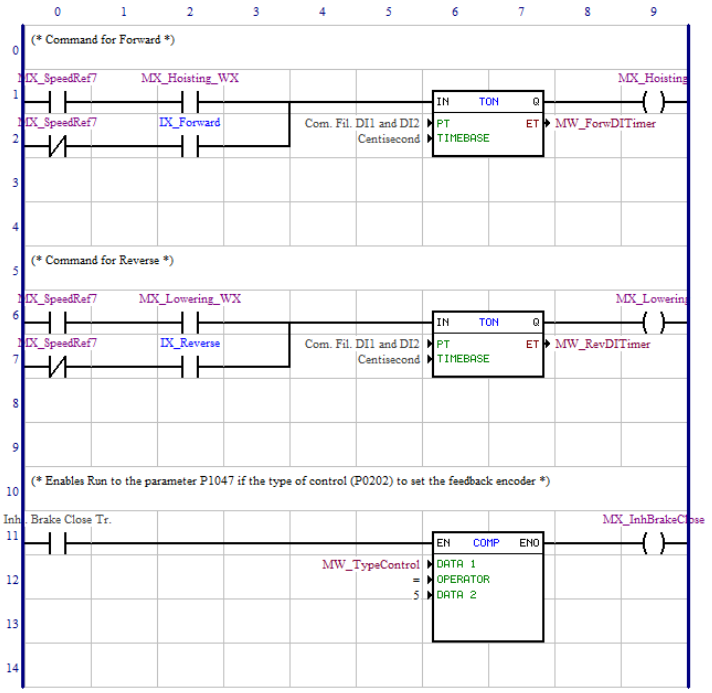


Figure 6.2 – Ladder Diagrams

6.2 APPLICATION CONFIGURATION WIZARD

The Crane Horizontal Motion application can be configured with the WLP (WEG Ladder Programmer) software using the configuration wizards, which consists of an oriented step by step guide for the configuration of the parameters regarding the application.

NOTE!
When powering up the inverter for the first time follow the steps described in the chapter 5 “First time Power-up and Start-up” of the CFW-11 user´s guide inverter. It is recommended to use the V/f control mode for this type of application!

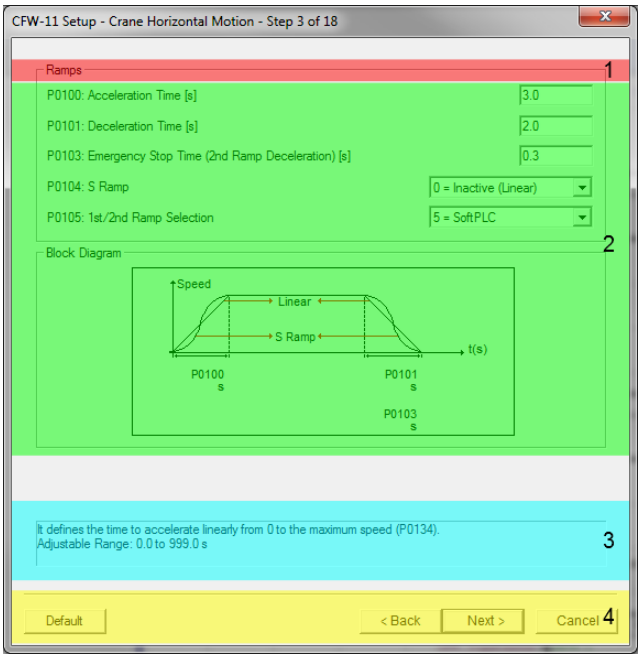


Figure 6.3 – Configuration wizard for Crane Horizontal Motion application

6.2.1 Tittle

The page title indicates that the feature is covered.

6.2.2 Input Value for Parameters

The input values for the parameters are spaces where are inserted values of drive parameters. Only after finishing the configuration wizard, the same will be sent to CFW-11 frequency inverter.

6.2.3 Info

The info is to explain previously which of the selected parameter functionality, adjustable range and relevant comments.

6.2.4 Browse Buttons

The configuration wizard has four kinds of browse buttons being:

- **Default:** loads the default values of each parameter on the page in use;
- **Back:** back to previous page;
- **Next:** advance to the next page;
- **Cancel:** close the configuration wizard without sending/save the values of the parameters edited.

6.3 MONITORING DIALOG BOXES

It is possible to monitor and change the parameters of the Crane Horizontal Motion application through the WLP.

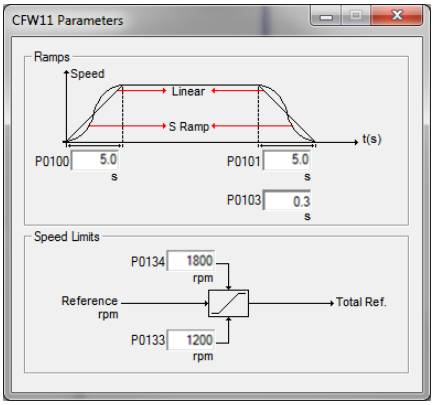


Figure 6.4 – Monitoring dialog of the Crane Horizontal Motion application

6.4 TREND VARIABLES DIALOG BOXES

It is possible to monitor variables of the Crane Horizontal Motion application through the WLP.

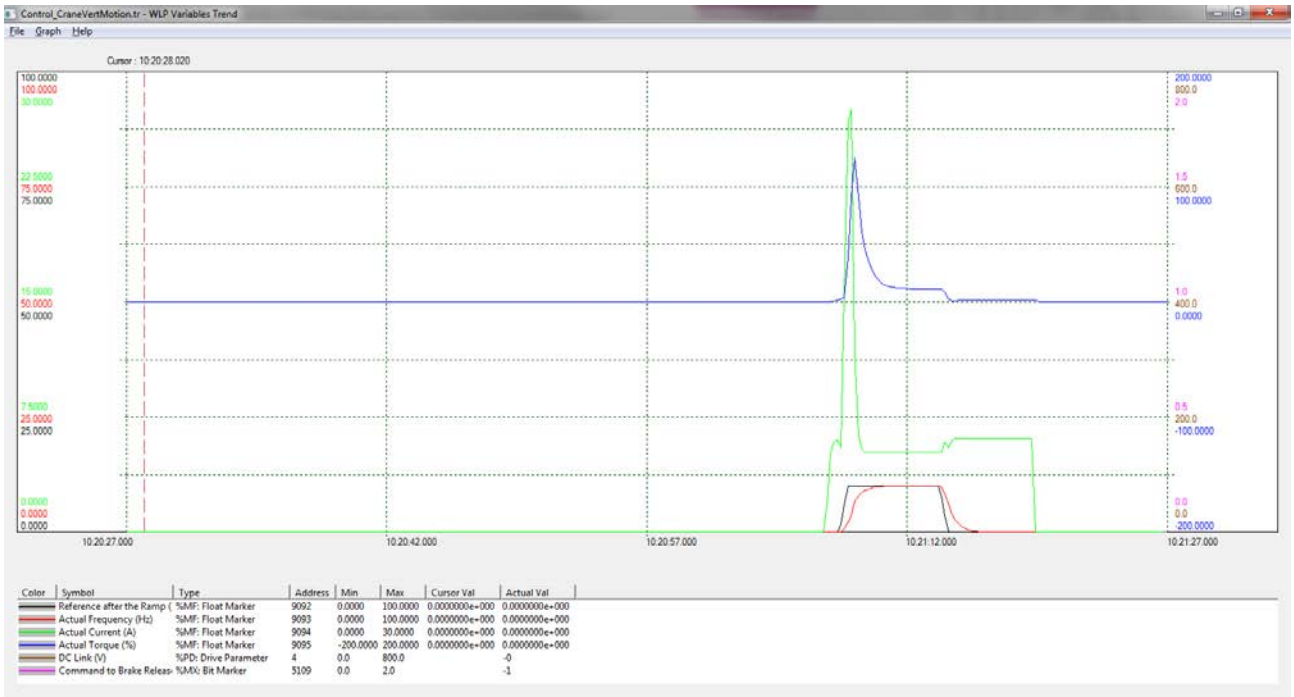


Figure 6.5 – Trend variable dialog

NOTE!
Refer to the WLP programming software help topics for more information on the use of the trend variables.

6.5 PARAMETER VALUE DIALOG

Through the WLP, it is possible to save the parameters of the Crane Horizontal Motion applicative.

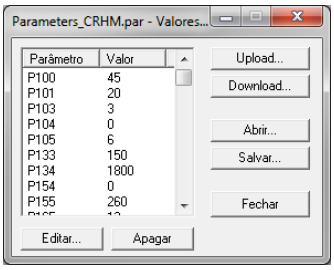


Figure 6.6 – Parameter value dialog

NOTE!
Refer to the WLP programming software help topics for more information on the use of the parameter value dialog box.