Motors | Energy | Automation | Coatings

Load Cell Surface Winder

CFW-11

Application Manual

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ABOUT THE MANUAL

This manual provides the necessary description for the load cell surface winder 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 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
WSCAN	CANopen Network Configuration 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.

1 INTRODUCTION TO SURFACE WINDERS

The surface winder applications developed for the CFW-11 SoftPLC provide to the user system use and configuration flexibility. They use the tools already developed for the WLP programming software, together with configuration wizards and monitoring dialog boxes.

1.1 WINDING

Winding is a stage in the productive process where webs as paper, plastic, metals or fabric are converted. Sometimes the produced roll can be the final product, as, for instance, a roll of cassette ribbon or a toilet paper roll. But in most cases, the roll is part of an intermediate production process, as plastic packing for instance, where initially they are produced by the extruder, being printed by printing machines and at the end converted into the final product packing.

In order to accomplish this, it becomes necessary to have a driving system that is able to keep up with the several production stages. Therefore, we can apply in this case a frequency inverter controlling an induction motor. Where, according to the web characteristics, it will be winded in one of the following manners:

- **Center Winder**, where the roll with the web is driven directly at its shaft;
- **Surface Winder**, where the roll with the web is driven indirectly through friction rollers;
- **Center-Surface Winder**, where the roll with the web is driven directly at the shaft and also indirectly through friction rollers.

There are two ways for the frequency inverter control the traction force applied on the web to be wound:

- **Direct**, a load cell or a dancer gives the feedback of the tension applied to the web during the winding;
- **Indirect**, it uses the physical quantities measured by the inverter, torque and speed, as the feedback of the tension applied to the web during the winding.

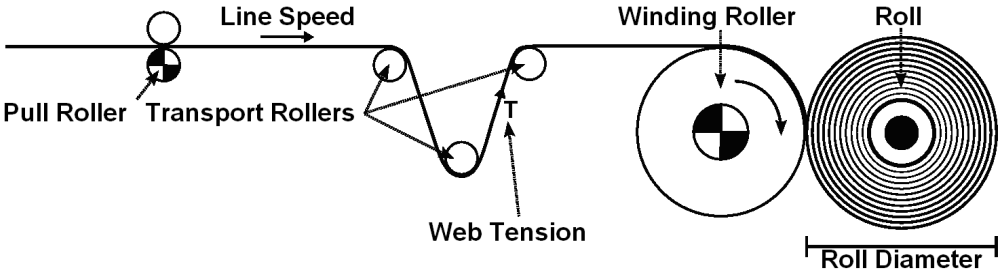
1.2 SURFACE WINDER CONCEPT

The characteristic of a surface winder is to present a load with a constant torque profile. The motor speed remains constant during the entire process in order to keep the roll surface speed also constant.

The winding is done by leaning the roll with the web against the winding roller driven by the motor. During the winding process either the winding roller driven by the motor or the roll must move while the diameter increases, but keeping in contact. The contact force (nip) between the roll and the winding roller is generally adjusted by means of a pneumatic or hydraulic system. The roll hardness in surface winders is controlled by the web tension as well as by the contact force (nip) from the roll against the winding roller.

1.3 TERMS USED IN SURFACE WINDERS

The figure below presents some terms used in surface winders.



1.3.1 Line Speed

The line speed corresponds to the operational speed of a coordinated process, where the speed of the web being processed can be expressed in meters per minute, feet per minute, yards per minute, meters per second, etc. Because in surface winders the web first goes through the pull roller and then it is winded, the line speed is used to synchronize the winder with the process and the web tension is obtained with the web tension control.

The formula below shows the relationship between the line or surface speed in m/min and the motor speed in rpm.

$$v = \frac{n \times \pi \times D}{i}$$

Where,

v = line or surface speed in m/min;
n = motor speed in rpm;
D = winding roller diameter;
i = reduction ratio (gearbox ratio) between the motor shaft and the driven shaft (winding roller).

1.3.2 Web Tension

Tension is the longitudinal traction force that is being applied to the web, i.e., how firmly the web is being pulled. The tension can be expressed in the following units: kN/m, kgf/m, lbs/ft, lbs/in, etc.

1.3.3 Pull Roller

It is a roller that is pressed against another roller, belt or conveyor belt in order to help transport and keep the web on the correct track. The pull roller may be sized to be the main web transport mean or it can be less powerful, just to help in the web transport.

1.3.4 Transport Roller

It is a roller that has the function of helping passing and moving the web through the machine. It may also be used as the installation point for the web traction force measurement sensor.

1.3.5 Taper

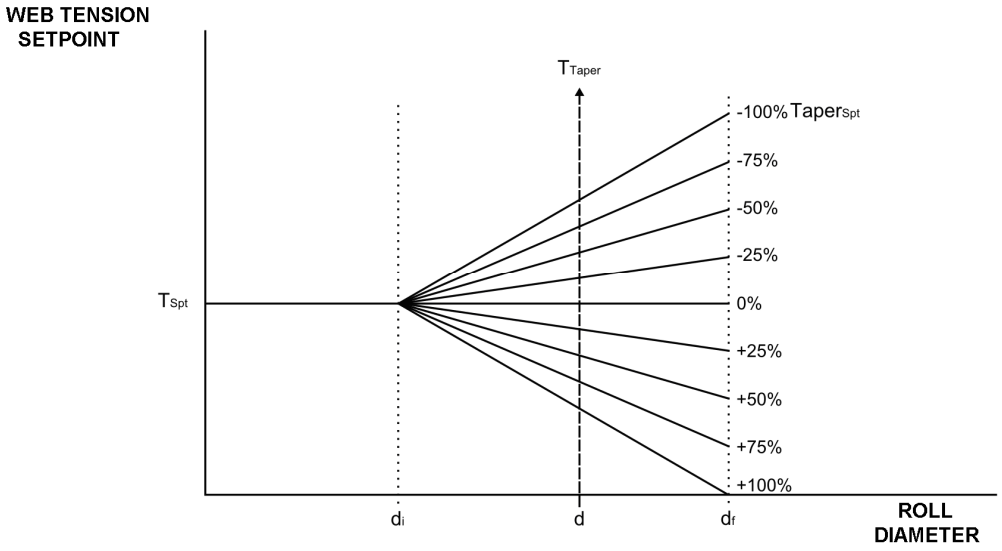
Taper is a function that has the purpose of reducing the tension on the web being wound as the diameter of the roll increases. The formula below shows the linear equation that governs the Taper function.

$$T_{Taper} = T_{Spt} \times \left[100\% - \left(Taper_{Spt} \times \frac{d - d_i}{d_f - d_i} \right) \right]$$

Where,

T_{Taper} = web tension setpoint after the Taper function is applied;
T_{Spt} = web tension setpoint adjusted via parameter or the AI3 input;
$Taper_{Spt}$ = taper function setpoint in %;
d = actual roll diameter in mm;
d_i = initial diameter for the Taper function, in mm;
d_f = final diameter for the Taper function, in mm.

The graph below shows, in a general manner, the behavior of web tension setpoint when the Taper function is enabled.



1.3.6 Inertia

Inertia is the physical quantity that expresses the tendency of a body to remain in rest or continue in motion unless disturbed by an external force. In order to move a brick with a specific mass, it must be pushed with some force. The brick could remain in movement forever, except by the friction that brakes and eventually stops it. The same inertia principle applies to rotating objects. A torque must be applied to cause a change in the angular velocity.

In order to accelerate or decelerate a motor and its load, the motor, the gearbox and other process related equipment must mechanically withstand the velocity change. If extra power is not supplied during the acceleration or deceleration, the system inertia will cause undesirable tension transients, broken web rupture or a slack winding.

1.3.7 Roll Diameter

Knowing the diameter of a roll while winding or unwinding a web makes it possible to perform compensations that are conditioned to the diameter, such as the Taper function for instance. The diameter can also be used to be shown to the operator or for some automatic machine logic. The diameter can be measured with an ultrasonic sensor or with a contact roller connected to an analog potentiometer. The diameter can also be estimated or calculated by multiplying the web thickness by the wound length. The formula below equates this relationship:

$$d = \sqrt{\frac{4 \times L \times t}{\pi} + d_o^2}$$

Where,

d = roll diameter in mm;
L = wound web length in mm;
t = wound web thickness in μm;
d_o = minimum diameter (core) of the roll in mm.

1.3.8 Dancer

It is an idler roller or wheel positioned between transport rollers, being mounted on a shaft counterbalanced by a pneumatic cylinder with air pressure adjustment. The dancer position is transmitted by a rotating potentiometer or a similar device. When the web traction force increases, the dancer is moved to a new position that is transmitted to the control, which must detect the change and correct its position by increasing or decreasing speed or torque.

1.3.9 Load Cell

Load cell or transducer for force measurement is an electro mechanic sensor united to a transport roller that signalizes the tension being applied on the web. Its operation is based on the variation of the ohmic resistance of a sensor called strain gauge, when submitted to a deformation. Load cells normally use four strain gauges connected according to a Wheatstone Bridge, and its unbalance, due to the due to the deformation of the strain gauges, is proportional to the force that causes it. It is through the measurement of the unbalance that the applied force value is obtained.

The strain gauges are glued on a metallic part (aluminum, steel or cupper-beryllium alloy) denominated body of the load cell and entirely solidary to its deformation. Therefore, the force acts on the load cell body and its deformation is transmitted to the strain gauges, which on their turn will measure its intensity. The form and the characteristics of the load cell body must obviously be the object of a meticulous care in its project as well as in its execution, aiming to assure that the proportionality relationship between the intensity of the acting force and the consequent deformation of the strain gauges be preserved in the initial weighing cycle as well as in the subsequent cycles, regardless of the environmental conditions.

Two load cells are normally used for the measurement, thus assuring that the force applied on the sensor roller be indicated in its totality, regardless of the point where the force is applied. Those two load cells are connected to a signal transducer that sends the measured value, in voltage or current, to the control equipment.

1.4 GENERAL CHARACTERISTICS OF THE SURFACE WINDER APPLICATIVE

The surface winder control developed for the CFW-11 with SoftPLC presents the following characteristics:

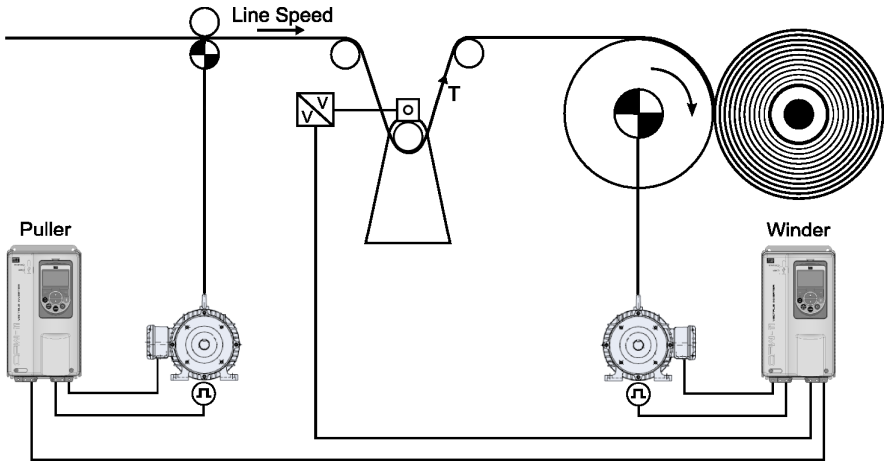
- Synchronism of the surface winder speed with the process line speed;
- Web tension control with feedback through dancer, load cell or motor torque;
- Web tension setpoint via parameter or analog input;
- Web roll diameter measurement (through an analog input) or estimation;
- Web tension control via a PID controller;
- Detection of the web presence through an external sensor or through an applicative logic;
- Configuration of command functions for exchanging the roll, external web presence sensor and error reset, to be executed via digital inputs;
- Taper function;
- Acceleration and deceleration ramps for the surface winder;
- Minimum and maximum speed limits for the surface winder;
- Gain, offset and filter adjustment for the control signals via analog inputs;
- Alarm indicating the winder web braking;
- Possibility of applicative implementation or modification by the user through the WLP software.

See below a comparison between the types of feedback for the web tension control.

Type	Advantages	Disadvantages
Dancer	■ It measures during the web transportation process the tension being applied on it; ■ It allows a good precision in the reading of the web tension; ■ It makes the detection of broken web easy; ■ It attenuates small speed oscillations.	■ Mechanic installation of the equipment; ■ External adjustments for operation; ■ Not measurable measured value; ■ It may transmit a delay in the web tension reading.
Load Cell	■ It measures during the web transportation process the tension being applied on it; ■ It allows an optimum precision in the reading of the web tension; ■ Measurable measure value (in kgf); ■ It makes the detection of broken web easy; ■ It detects small speed oscillations.	■ Mechanic installation of the equipment; ■ Calibration for the correct measurement of the equipment; ■ Equipment sensitive to stress.
Motor Torque	■ It does not need mechanic installation of equipment; ■ It does not require calibration end external settings.	■ The web tension is not measured, only an estimation of the motor force; ■ The detection of broken web is more difficult (unless there is an external sensor); ■ Not measurable measured value.

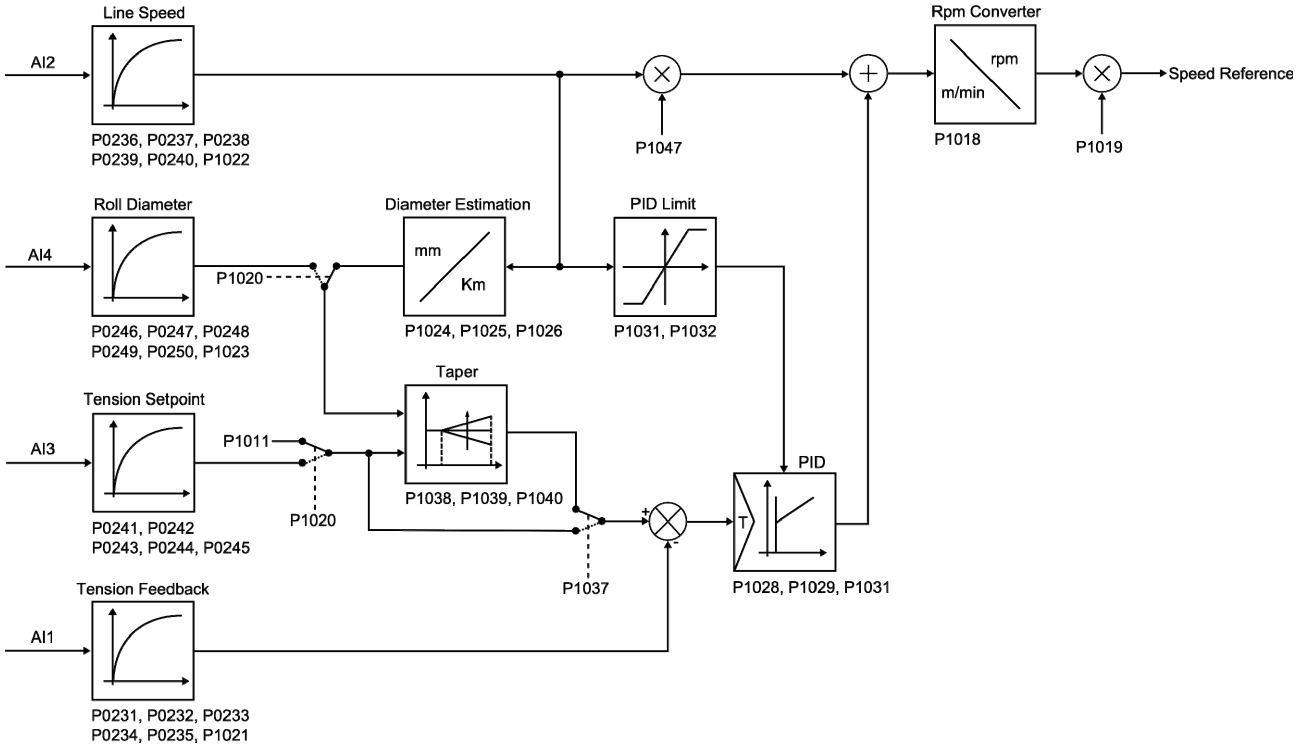
2 LOAD CELL SURFACE WINDER

In a surface winder, or by leaning, the roll is positioned leaning it against a roller with a constant diameter, and the control of the winding tension is done by the friction between both of them. The control strategy is based in the synchronism between the line speed and the winding roller driven by the inverter plus the web tension control done through a PID controller that increments or decrements the speed of the winding roller according to the load cell feedback.



2.1 CONTROL BLOCK DIAGRAM

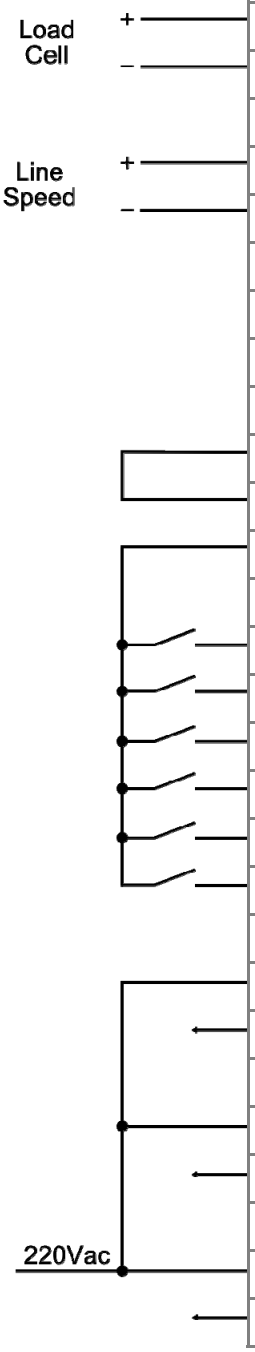
See below the control block diagram for a load cell surface winder.



NOTE!
Refer to chapter 5 for the parameter description.

2.2 CONTROL CONNECTIONS

The control connections (analog inputs/outputs, digital input/outputs) made at the CFW-11 control board CC11 terminal strip XC1 for a load cell surface winder in the default configuration, i.e., with the parameter P1020 set in 0 (tension feedback via AI1, line speed via AI2 and tension setpoint via parameter/EP), are presented below.



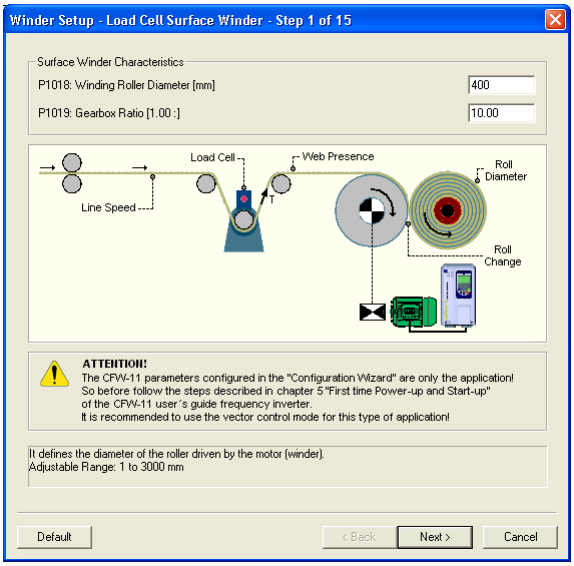
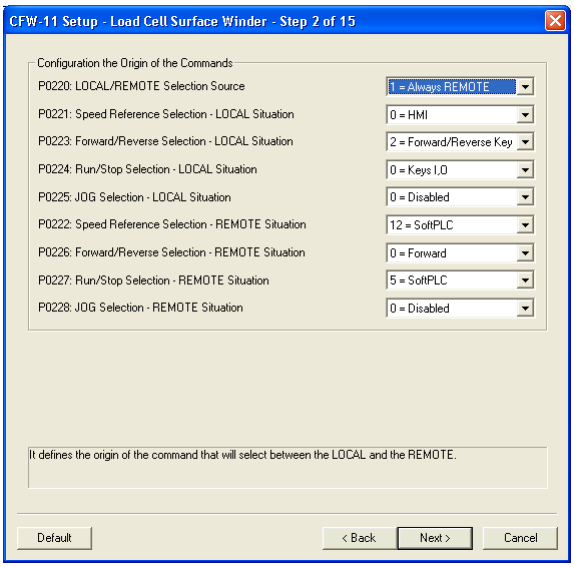
XC1 Terminal Strip		Default Function for Load Cell Surface Winder
1	REF+	Positive reference for potentiometer
2	AI1+	Analog input 1 (0-10 V): Web tension feedback
3	AI1-	
4	REF-	Negative reference for potentiometer
5	AI2+	Analog input 2 (0-10 V): Line speed
6	AI2-	
7	AO1	Analog output 1: Motor speed
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	24VDC	24 VDC power supply
14	COM	Common point of the digital inputs
15	DI1	Digital input 1: Enable winder
16	DI2	Digital input 2: No function
17	DI3	Digital input 3: Roll change
18	DI4	Digital input 4: Web presence
19	DI5	Digital input 5: Increase EP setpoint
20	DI6	Digital input 6: Decrease EP setpoint
21	NC1	Digital output #1 DO1 (RL1): Winder enabled
22	C1	
23	NO1	
24	NC2	Digital output #2 DO2 (RL2): No fault
25	C2	
26	NO2	
27	NC3	Digital output #3 DO3 (RL3): No function
28	C3	
29	NO3	

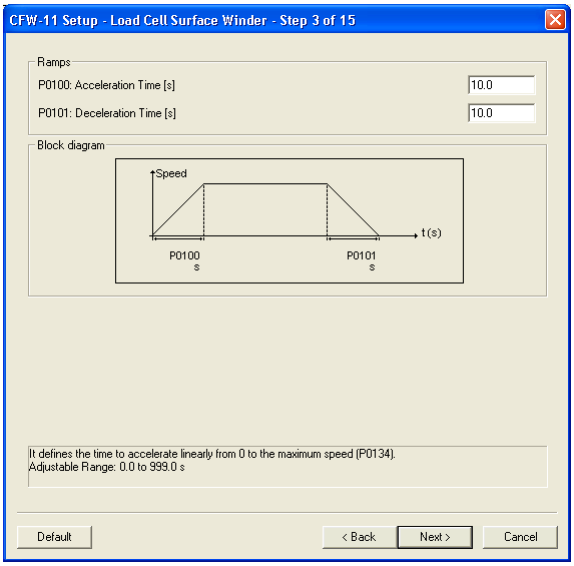
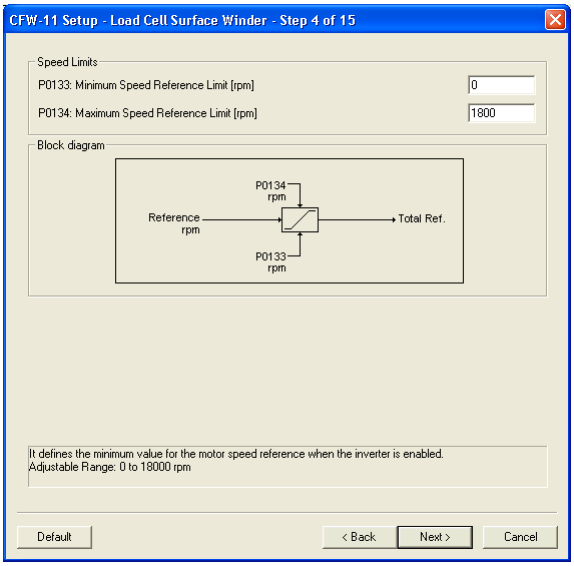
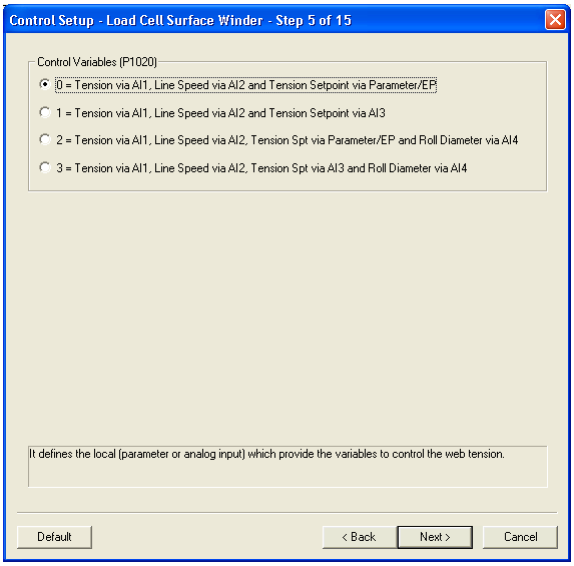
NOTE!
Refer to CFW-11 frequency inverter manual for further information on the connections.

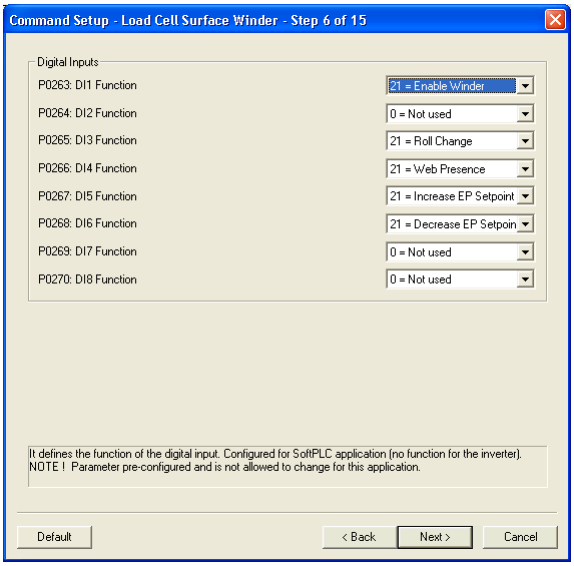
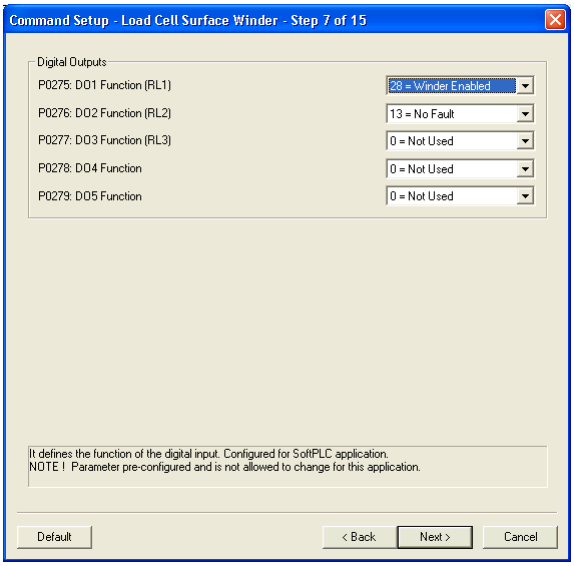
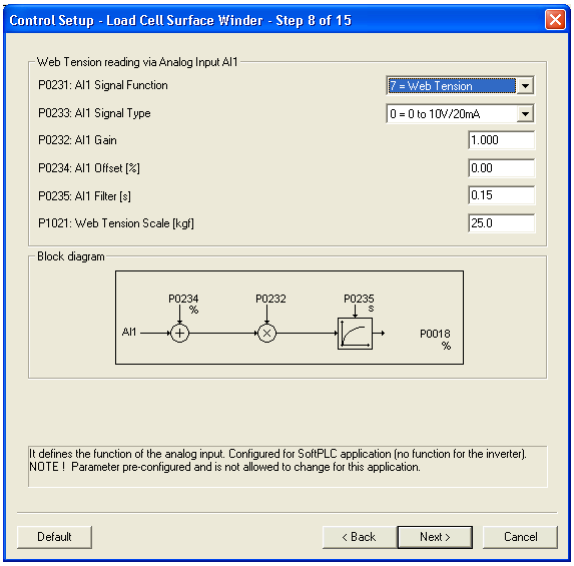
3 WLP APPLICATIVE CONFIGURATION

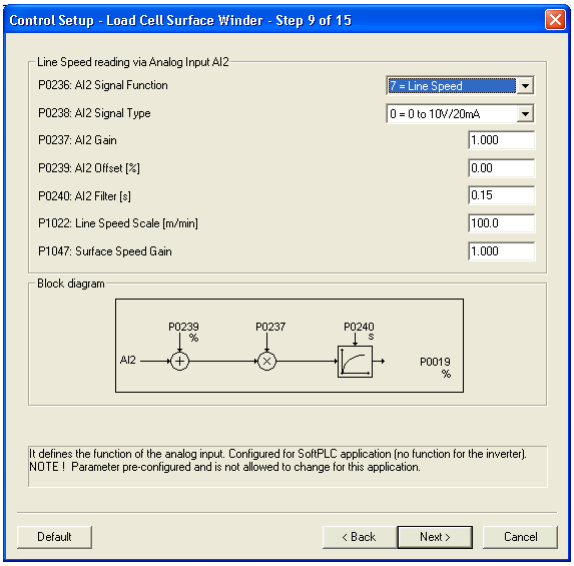
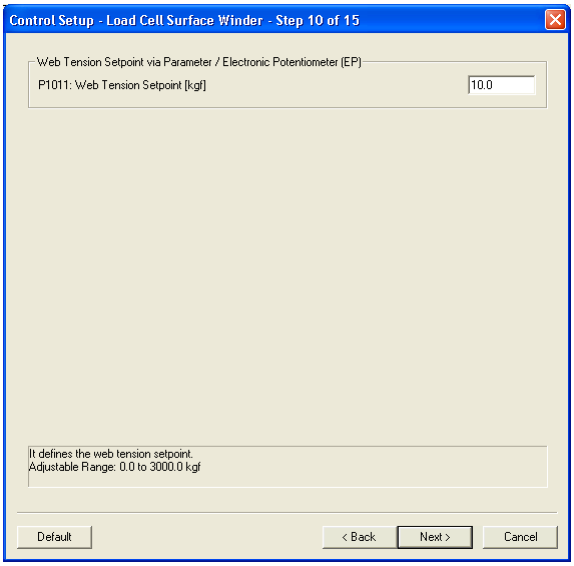
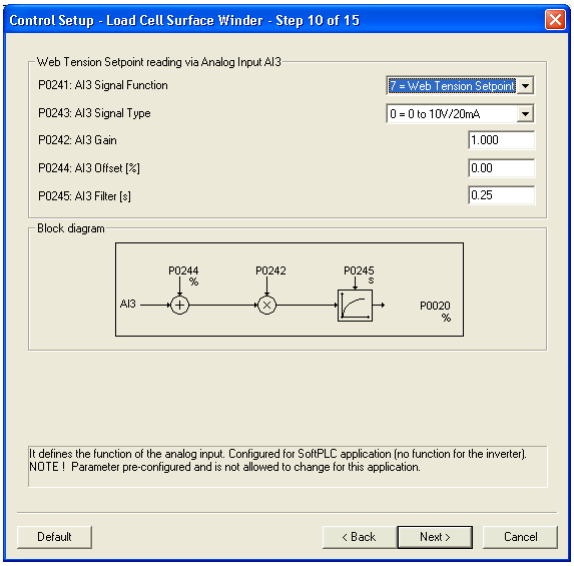
Through the WLP it is possible to create and configure the applicative for a load cell surface winder. Refer to help topics in the WLP programming software for further details on how to create an applicative. The configuration of the applicative is done with the load cell surface winder configuration wizard, which consists of an oriented step by step guide for the configuration of the parameters regarding the application.

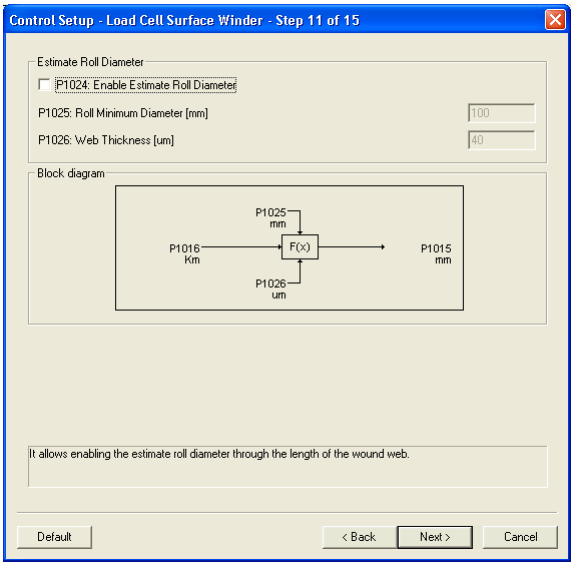
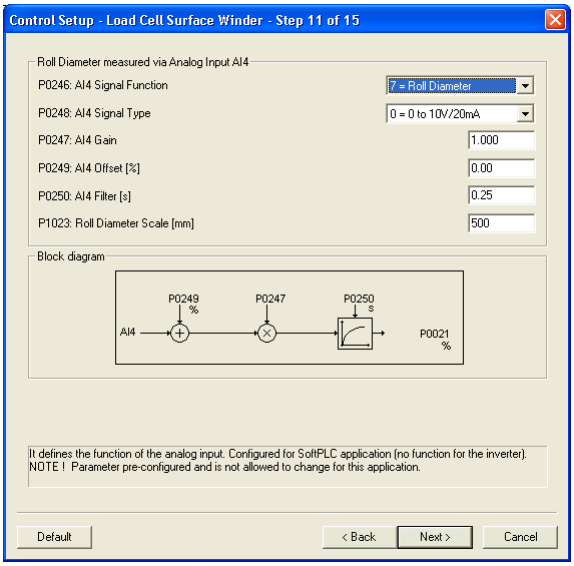
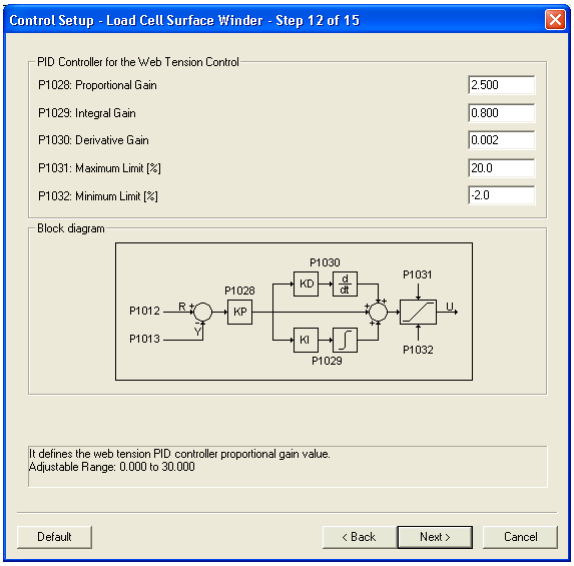
NOTE!
When powering up the inverter for the first time follow the steps described in the chapter 5 “First Time Power-up and Start-up” of the CFW-11 frequency inverter manual. It is recommended to use the sensorless vector control or the vector control with encoder for this kind of application!

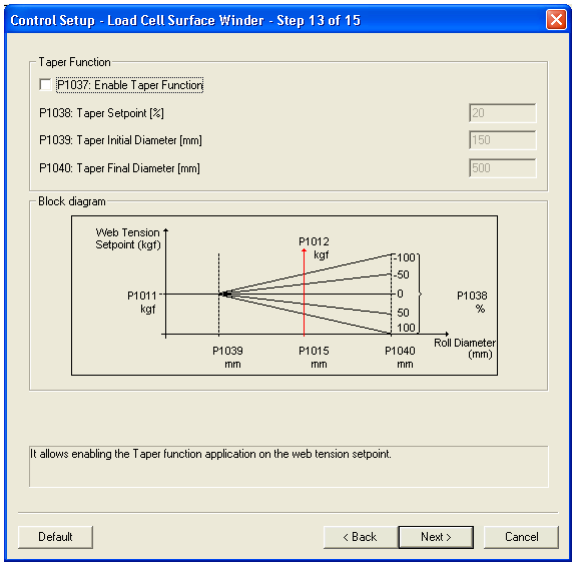
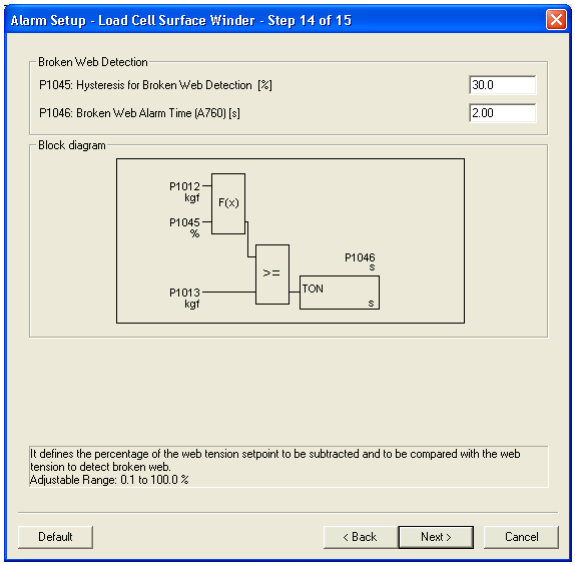
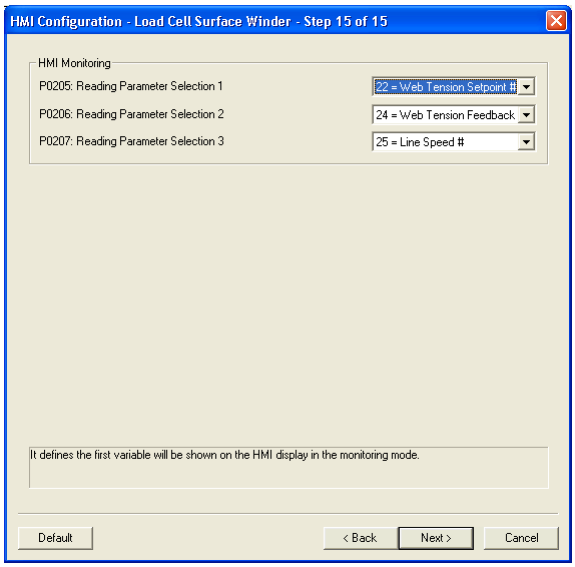
Step	Description	WLP Configuration Wizard
1	It presents the parameters for the configuration of the load cell surface winder characteristics: P1018: Winding Roller Diameter P1019: Gearbox Ratio	
2	It presents the parameters for the configuration of the CFW-11 source of commands: P0220: Local/Remote Selection Source P0221: Speed Reference Selection - Local Situation P0223: Forward/Reverse Selection - Local Situation P0224: Run/Stop Selection - Local Situation P0225: JOG Selection - Local Situation P0222: Speed Reference Selection - Remote Situation P0226: Forward/Reverse Selection - Remote Situation P0227: Run/Stop Selection - Remote Situation P0228: JOG Selection - Remote Situation	

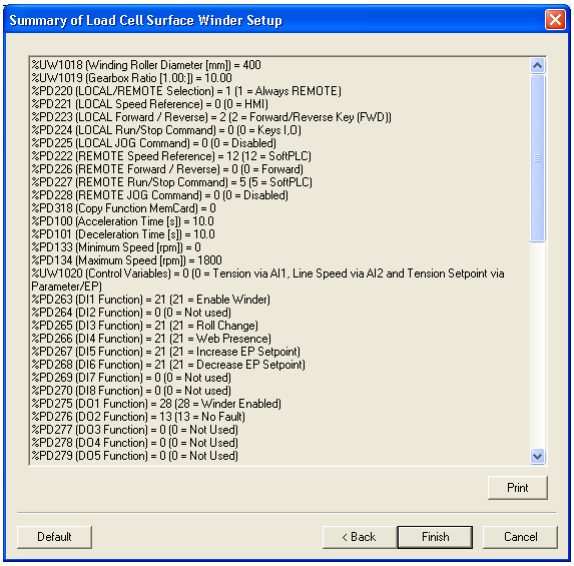
3	It presents the parameters for the configuration of the CFW-11 ramps: P0100: Acceleration Time P0101: Deceleration Time	
4	It presents the parameters for the configuration of the CFW-11 speed limits: P0133: Minimum Speed Reference Limit P0134: Maximum Speed Reference Limit	
5	It presents the parameter that defines the origin of the signals for the web tension control in the load cell surface winder: P1020: Control Variables	

6	It presents the parameters for the configuration of the command functions via the CFW-11 digital inputs: P0263: DI1 Function P0264: DI2 Function P0265: DI3 Function P0266: DI4 Function P0267: DI5 Function P0268: DI6 Function P0269: DI7 Function P0270: DI8 Function	
7	It presents the parameters for the configuration of the command functions via the CFW-11 digital outputs: P0275: DO1 Function (RL1) P0276: DO2 Function (RL2) P0277: DO3 Function (RL3) P0278: DO4 Function P0279: DO5 Function	
8	It presents the parameters for the configuration of the web tension reading via the analog input AI1: P0231: AI1 Signal Function P0233: AI1 Signal Type P0232: AI1 Gain P0234: AI1 Offset P0235: AI1 Filter P1021: Web Tension Scale	

9	It presents the parameters for the configuration of the line speed reading via the analog input AI2: P0236: AI2 Signal Function P0238: AI2 Signal Type P0237: AI2 Gain P0239: AI2 Offset P0240: AI2 Filter P1022: Line Speed Scale P1047: Surface Speed Gain	
10 - 0	It presents the parameter for the configuration of the web tension control setpoint via parameter/electronic potentiometer (EP): P1011: Web Tension Setpoint	
10 - 1	It presents the parameters for the configuration of the web tension control setpoint via analog input AI3: P0241: AI3 Signal Function P0243: AI3 Signal Type P0242: AI3 Gain P0244: AI3 Offset P0245: AI3 Filter	

11 - 0	It presents the parameters for the configuration of the estimate roll diameter: P1024: Enable Estimate Roll Diameter P1025: Roll Minimum Diameter P1026: Web Thickness	
11 - 1	It presents the parameters for the configuration of the roll diameter reading via the analog input AI4: P0246: AI4 Signal Function P0248: AI4 Signal Type P0247: AI4 Gain P0249: AI4 Offset P0250: AI4 Filter P1023: Roll Diameter Scale	
12	It presents the parameters for the configuration of the web tension PID controller: P1028: Proportional Gain P1029: Integral Gain P1030: Derivative Gain P1031: Maximum Limit P1032: Minimum Limit	

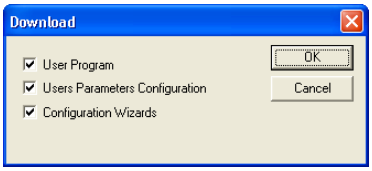
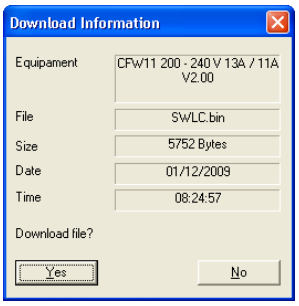
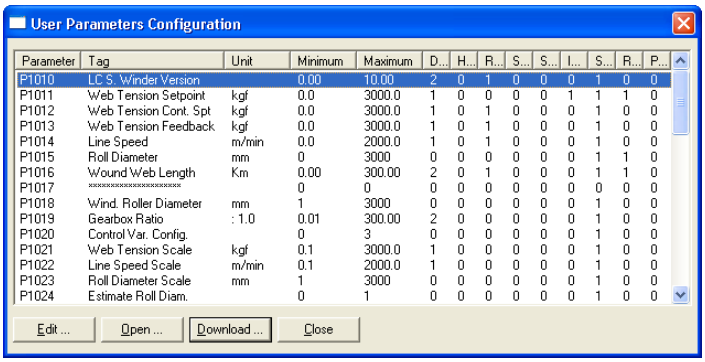
13	It presents the parameters for the configuration of the surface winder Taper function: P1037: Enable Taper Function P1038: Taper Setpoint P1039: Taper Initial Diameter P1040: Taper Final Diameter	
14	It presents the parameters for generating the broken web alarm: P1045: Hysteresis for Broken Web Detection P1046: Broken Web Alarm Time	
15	It presents the parameters that define which variables are showed on the HMI display in monitoring mode: P0205: Reading Parameter Selection 1 P0206: Reading Parameter Selection 2 P0207: Reading Parameter Selection 3	

	It presents a summary with all the parameters configured by the load cell surface winder setup wizard.	

4 WLP APPLICATIVE DOWNLOAD

After the conclusion of the load cell surface winder applicative configuration, it becomes necessary to download the applicative to the CFW-11 frequency inverter SoftPLC. Then, after finishing the configuration wizard, the download dialog box will be showed, as presented below.

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

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; ■ Configuration Wizards.	
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 hour; ■ Command to transfer or not 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 Load cell Surface Winder configuration wizard.	

5 PARAMETERS DESCRIPTION

The CFW-11 as well as the SoftPLC parameters for the load cell surface winder application will be presented next.

NOTE!
The adjustable range of the CFW-11 parameters has been customized for the surface winder application. Refer to CFW-11 programming manual for further details on the parameters.

Symbols for the Parameter Proprieties Description:

RO	Read-only parameter.
CFG	Parameter that can be changed only with a stopped motor.
Net	Parameter visible on the HMI if the inverter has the network interface installed – RS-232, RS-485, CAN, Anybus-CC, Profibus – or if the USB interface is connected.
Serial	Parameter visible on the HMI if the inverter has the RS-232 or RS-485 interface installed.
USB	Parameter visible on the HMI if the inverter USB interface is connected.

5.1 SURFACE WINDER CHARACTERISTICS

This parameter group allows the user to configure the winder mechanic characteristics that are necessary to control its speed.

P1018 – Winding Roller Diameter

Adjustable Range:	1 to 3000 mm	**Factory Setting:**	400 mm
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS └ 50 SoftPLC		

Description:
This parameter defines the diameter of the roller driven by the motor, i.e., the winding roller diameter.

P1019 – Gearbox Ratio

Adjustable Range:	0.01 to 300.00	**Factory Setting:**	10.00
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS └ 50 SoftPLC		

Description:
This parameter defines the ratio of the reduction, or the gearbox, existent between the shaft driven by the motor and the winding roller, always respecting the ratio of x to 1,00, i.e., for x revolutions of the shaft driven by the motor we have one revolution of the winding roller.

5.2 ORIGIN OF THE COMMANDS

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

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

REMOTE Situation:
It enables the load cell surface winder 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 CFW-11 programming manual for further information on the command origin parameters. Some parameter options have been removed from the configuration wizard.

5.3 RAMPS

This group of parameters allows the user to adjust the inverter ramps, so that the motor be accelerated or decelerated in a faster or in a slower manner.

P0100 – Acceleration Time

P0101 – Deceleration Time

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

5.4 SPEED LIMITS

This group of parameters allows the user to configure the motor speed limits.

P0133 – Minimum Speed Reference Limit

P0134 – Maximum Speed Reference Limit

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

5.5 CONTROL VARIABLES

P1020 – Control Variables

Adjustable **Factory Setting:** 0
Range: 0 = Tension via AI1, Line Speed via AI2 and Tension Setpoint via Parameter/EP
1 = Tension via AI1, Line Speed via AI2 and Tension Setpoint via AI3
2 = Tension via AI1, Line Speed via AI2, Tension Setpoint via Par./EP and Roll Diameter via AI4
3 = Tension via AI1, Line Speed via AI2, Tension Setpoint via AI3 and Roll Diameter via AI4
Proprieties:
Access groups via HMI: 01 PARAMETER GROUPS
∟ 50 SoftPLC

Description:
This parameter defines the origin of the signals for the web tension control in the load cell surface winder.

P1020	Description
0	It defines that the web tension, which is the measured variable (feedback), will be read through the analog input AI1; the line speed will be read through the analog input AI2; the setpoint for the web tension control will be read through a parameter and changed via electronic potentiometer (EP); the roll diameter can be estimated if the parameter P1024 is enabled.
1	It defines that the web tension, which is the measured variable (feedback), will be read through the analog input AI1; the line speed will be read through the analog input AI2; the setpoint for the web tension control will be read through the analog input AI3; the roll diameter can be estimated if the parameter P1024 is enabled.
2	It defines that the web tension, which is the measured variable (feedback), will be read through the analog input AI1; the line speed will be read through the analog input AI2; the setpoint for the web tension control will be read through a parameter and changed via electronic potentiometer (EP); the roll diameter will be read through the analog input AI4.
3	It defines that the web tension, which is the measured variable (feedback), will be read through the analog input AI1; the line speed will be read through the analog input AI2; the setpoint for the web tension control will be read through the analog input AI3; the roll diameter will be read through the analog input AI4.

5.6 DIGITAL INPUTS

This parameter group allows the user to configure the command function of each digital input in the load cell surface winder applicative.

P0263 – DI1 Function

Adjustable 21 = Enable Winder (PLC use) **Factory Setting:** 21
Range:
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 enabling the surface winder for the operation.

With logic level “0”, the surface winder is disabled.

With logic level “1”, the surface winder is enabled to the operation for the control of the web tension.

P0264 – DI2 Function

Adjustable Range:	0 to 31	**Factory Setting:**	0
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 40 Digital Inputs or 07 I/O CONFIGURATION ∟ 40 Digital Inputs		

Description:
This parameter defines the digital input DI2 function. No specific function has been defined for this load cell surface winder application.

P0265 – DI3 Function

Adjustable Range:	0 = No Function 21 = Roll Change (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 to indicate the change of the roll that was being wound. It has a purpose in case that the roll diameter is being estimated (P1024 = 1). If it is programmed in “0 = No Function”, it will not be possible to reset the length of the wound web, so that the logic created to estimate the diameter cannot work properly.

With logic level “0”, it indicates that there is no roll change.

With logic level “1”, it indicates that the roll that was being wound has been changed. A reset command is executed on the accumulated length of the wound web (P1016), so that the roll diameter is reset to the minimum value (P1025).

P0266 – DI4 Function

Adjustable Range:	0 = No Function 21 = Web Presence (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 DI4 will be to indicate the presence of the web to be wound. If it is programmed in “0 = No Function”, the detection of the web presence in the winder will be done via a logic in the applicative.

With logic level “0”, it indicates that there is no web to be wound, then the alarm “A760: Broken Web”, which has the function to disable the wound web counting, is generated. Refer to section 5.14 for further details on the parameters of this alarm.

With logic level “1”, it indicates the presence of the web to be wound.

P0267 – DI5 Function

Adjustable Range:	0 to 31	**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 allows the programming of a command for increasing the surface winder tension setpoint via electronic potentiometer (EP) if programmed in “21 = Increase EP Setpoint”, and P1020 be programmed in 0 or 2. The value to be changed is stored in the parameter P1011.

With logic level “0”, it does not execute the command for increasing the tension setpoint via electronic potentiometer (EP).

With logic level “1”, it executes the command for increasing the tension setpoint via electronic potentiometer (EP).

P0268 – DI6 Function

Adjustable Range:	0 to 31	**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 allows the programming of a command for decreasing the surface winder tension setpoint via electronic potentiometer (EP) if programmed in “21 = Decrease EP Setpoint”, and P1020 be programmed in 0 or 2. The value to be changed is stored in the parameter P1011.

With logic level “0”, it does not execute the command for decreasing the tension setpoint via electronic potentiometer (EP).

With logic level “1”, it executes the command for decreasing the tension setpoint via electronic potentiometer (EP).

P0269 – DI7 Function

P0270 – DI8 Function

Adjustable Range:	0 to 31	**Factory Setting:**	0
Proprieties:			

Access groups via HMI: 01 PARAMETER GROUPS
└ 40 Digital Inputs
or
07 I/O CONFIGURATION
└ 40 Digital Inputs

Description:
These parameters define the function of the digital inputs DI7 and DI8. It is necessary to install the expansion board IOB-01 to get access to those digital inputs.

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

5.7 DIGITAL OUTPUTS

This parameter group allows the user to configure the command function of each digital output in the load cell surface winder applicative.

P0275 – DO1 Function (RL1)

Adjustable Range	28 = Winder Enabled (SoftPLC)	**Factory Setting:**	28
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 41 Digital Outputs or 07 I/O CONFIGURATION ∟ 41 Digital Outputs		

Description:
This parameter defines that the function of the digital output DO1 will be indicating that the load cell surface winder is enabled for the operation. According to the section 2.2, a NO contact of the DO1 relay must be used.

P0276 – DO2 Function (RL2)

P0277 – DO3 Function (RL3)

P0278 – DO4 Function

P0279 – DO5 Function

Adjustable Range:	0 to 42	**Factory Setting:**	P0276 = 13 P0277 = 0 P0278 = 0 P0279 = 0
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 41 Digital Outputs or 07 I/O CONFIGURATION ∟ 41 Digital Outputs		

Description:
These parameters define the function of the digital outputs DO2, DO3, DO4 and DO5. It is necessary to install the expansion board IOB-01 in order to get access to the digital outputs DO4 and DO5.

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

5.8 WEB TENSION

This parameter group allows the user to configure the measured variable (feedback) for the web tension control.

P0231 – AI1 Signal Function

Adjustable Range:	7 = Web Tension (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 AI1will be the reading of the web tension measured by a load cell, for the control of the web tension.

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. 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 further information on the analog input parameters. Some parameter options have been removed from the configuration wizard.

P1021 – Web Tension Scale

Adjustable Range:	0.1 to 3000.0 kgf	**Factory Setting:**	25.0 kgf
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter configures the full scale of the load cell that measures the web tension, installed at the CFW-11 analog input AI1, i.e., the maximum value measured by the load cell in kgf that corresponds to the maximum value measured by the analog input (10V or 20mA).

5.9 LINE SPEED

This parameter group allows the user to configure the line speed variable.

P0236 – AI2 Signal Function

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

Descrição:
This parameter defines that the function of the analog input AI2 will be the line speed reading.

P0238 – AI2 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. Adjust the CFW-11 control board DIP switch S1.3 according to the selected option.

P0237 – AI2 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 AI2, i.e., the value obtained at the input is multiplied by the gain, thus allowing adjustments in the measured variable.

P0239 – AI2 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.

P0240 – AI2 Filter

Adjustable Range:	0.00 to 16.00 s	**Factory Setting:**	0.15 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 AI2.

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

P1022 – Line Speed Scale

Adjustable Range:	0.1 to 2000.0 m/min	**Factory Setting:**	100.0 m/min
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter configures the full scale of the line speed obtained at the CFW-11 analog input AI2, i.e., the maximum line speed in m/min that corresponds to the maximum value measured by the analog input (10 V or 20 mA).

P1047 – Surface Speed Gain

Adjustable Range:	0.010 to 30.000	**Factory Setting:**	1.000
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter defines the value to be multiplied by the line speed in order to provide to the winding roller a surface speed higher or lower than the process line speed.

5.10 WEB TENSION SETPOINT

This parameter group allows the user to configure the setpoint for the web tension control.

NOTE!
The setpoint for the web tension control may be set via a parameter/EP or through the reading of the analog input AI3 (it is necessary to install the IOB-01 expansion boarder in order to get access to that analog input), as programmed in P1020.

P0241 – AI3 Signal Function

Adjustable Range:	7 = Web Tension Setpoint (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 AI3 will be the setpoint for the web tension control.

P0243 – AI3 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. Adjust the IOB-01 expansion board DIP switch S3.1 according to the selected option.

P0242 – AI3 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 AI3, i.e., the value obtained at the input is multiplied by the gain, thus allowing adjustments in the measured variable.

P0244 – AI3 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.

P0245 – AI3 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 AI3.

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

P1011 – Web Tension Setpoint

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

Description:
This parameter shows the web tension setpoint for the load cell surface winder. It has read-only or writing function according to the P1020 programming.

With P1020 equal to 0 or 2, it works as the parameter for writing the web tension setpoint and can be changed via electronic potentiometer (EP), via HMI, via serial or via net.

With P1020 equal to 1 or 3, it works as a read-only parameter for the web tension adjusted via the analog input AI3.

5.11 ROLL DIAMETER

This parameter group allows the user to configure the parameters for estimating (through the wound web) or measuring (through the analog input AI4) the roll diameter.

NOTE!
The roll diameter can be estimated via the length of the wound web, or it can be measured through the reading of the analog input AI4 (it is necessary to install the IOB-01 expansion boarder in order to get access to that analog input), according to the P1020 programming.

P0246 – AI4 Signal Function

Adjustable Range:	7 = Roll Diameter (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 AI4 will be to measure the diameter of the roll that is being wound.

P0248 – AI4 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. Adjust the IOB-01 expansion board DIP switch S3.2 according to the selected option.

P0247 – AI4 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 AI4, i.e., the value obtained at the input is multiplied by the gain, thus allowing adjustments in the measured variable.

P0249 – AI4 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.

P0250 – AI4 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 AI4.

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

P1023 – Roll Diameter Scale

Adjustable Range:	1 to 3000 mm	**Factory Setting:**	500 mm
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter configures the full scale of the roll diameter obtained at the CFW-11 analog input AI4, i.e., the maximum roll diameter in mm that corresponds to the maximum value measured by the analog input (10 V or 20 mA).

P1024 – Enable Estimate Roll Diameter

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

Description:
This parameter allows enabling the estimate roll diameter through the length of the wound web.

P1025 – Roll Minimum Diameter

Adjustable Range:	0 to 3000 mm	**Factory Setting:**	100 mm
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter defines the minimum diameter or the diameter of the roll core tube where the web is wound. It is the value used when a roll change condition is detected via the digital input DI3.

P1026 – Web Thickness

Adjustable Range:	1 to 30000 µm	**Factory Setting:**	40 µm
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter defines the thickness value of the web being wound.

5.12 PID CONTROLLER

This parameter group allows the user to adjust the gains and limits of the PID controller for the web tension control.

NOTE!
The PID controller of the standard load cell surface winder applicative is of the academic type. The change of the type will lead to alterations in the controller gain values that must be done by the user.

P1028 – Proportional Gain

Adjustable Range:	0.000 to 30.000	**Factory Setting:**	2.500
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter defines the web tension PID controller proportional gain value.

P1029 – Integral Gain

Adjustable Range:	0.000 to 30.000	**Factory Setting:**	0.800
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter defines the web tension PID controller integral gain value.

P1030 – Derivative Gain

Adjustable Range:	0.000 to 30.000	**Factory Setting:**	0.002
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter defines the web tension PID controller derivative gain value.

P1031 – Maximum Limit

Adjustable Range:	0.0 to +100.0 %	**Factory Setting:**	+20.0 %
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter defines the maximum limit value of the web tension PID controller action. This value is applied on the actual line speed.

P1032 – Minimum Limit

Adjustable Range:	-100.0 to 0.0 %	**Factory Setting:**	-2.0 %
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter defines the minimum limit value of the web tension PID controller action. This value is applied on the actual line speed.

NOTE!
The web tension PID controller has been configured to generate a correction in the speed (m/min) according to the block diagram presented in the section 2.1. The other PID block input arguments can only be changed by the ladder applicative developed with the WLP. Refer to help topics in the WLP programming software for further information on the PID block.

5.13 TAPER FUNCTION

This parameter group allows the user to adjust the operation conditions of the Taper function.

NOTE!
In order that the Taper function works properly, pay close attention to the roll diameter value, if it is estimated as well as if it is measured!

P1037 – Enable Taper Function

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

Description:
This parameter allows enabling the Taper function application on the setpoint of the tension applied on the web.

P1038 – Taper Function Setpoint

Adjustable Range:	-100 to +100 %	**Factory Setting:**	20 %
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter defines the setpoint value for the Taper function. It corresponds to the final value of the control setpoint when the roll diameter is equal or bigger than the final diameter (P1040).

NOTE!
Remember the Taper function concept. Therefore, a setpoint with positive value means decreasing the web tension as the roll diameter increases and negative setpoint means increasing it!

P1039 – Taper Function Initial Diameter

Adjustable Range:	1 to 3000 mm	**Factory Setting:**	150 mm
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter defines at what diameter the Taper function for the web tension setpoint will be initiated.

P1040 – Taper Function Final Diameter

Adjustable Range:	1 to 3000 mm	**Factory Setting:**	500 mm
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter defines the roll diameter to which the Taper function setpoint (P1038) applies; from this diameter onwards, the Taper function setpoint value for the control remains constant.

5.14 BROKEN WEB DETECTION

This parameter group allows the user to adjust the conditions to generate the broken web alarm in the load cell surface winder.

NOTE!
The broken web detection can be done via the digital input DI4 or through an applicative logic.

P1045 – Hysteresis for Broken Web Detection

Adjustable Range:	0.1 to 100.0 %	**Factory Setting:**	30.0 %
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter defines the percentage of the web tension setpoint to be subtracted from itself (P1012 x (100 % - P1045)) to be compared with the web tension feedback (P1013) in order to detect broken web.

NOTE!
This parameter has a purpose only if the digital input DI4 is not programmed for the web presence detection (P0266 = 21).

P1046 – Broken Web Alarm Time (A760)

Adjustable Range:	0.00 to 650.00 s	**Factory Setting:**	10.00 s
Proprieties:			
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC		

Description:
This parameter defines a time (delay) for the “Broken Web” condition, detected via the digital input DI4 or by the hysteresis (P1045), in order to generate the alarm message “A760: Broken Web”.

NOTE!
The value 0.00 in this parameter disables the alarm. The function of this alarm in the applicative is only to disable the measurement of the wound web and, consequently, to freeze the roll diameter estimation.

5.15 HMI MONITORING

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

P0205 – Reading Parameter Selection 1

P0206 – Reading Parameter Selection 2

P0207 – Reading Parameter Selection 3

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

5.16 COMMAND FOR DISABLING THE WEB TENSION CONTROL

This parameter group allows the user to disable the web tension control and define a surface speed for the winder operation. It has the purpose of helping the adjustment of the winding roller synchronism with the line speed.

P1048 – Web Tension Control Disabling

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

Description:
This parameter allows disabling the web tension control. With the control disabled, the winding roller follows the speed reference contained in the parameter P1049, i.e., the line speed and the PID controller (which is disabled) are not considered.

P1049 – Speed Reference when the Control is Disabled

Adjustable Range:	0.0 to 2000.0 m/min	**Factory Setting:** 0.0 m/min
Proprieties:		
Access groups via HMI:	01 PARAMETER GROUPS ∟ 50 SoftPLC	

Description:
This parameter defines the value of the speed reference in m/min for the winding roller when the web tension control is disabled via the parameter P1048.

5.17 READING PARAMETERS

P1010 – LC Surface Winder 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 load cell surface winder applicative software.

P1012 – Web Tension Control Setpoint

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

Description:
This parameter indicates the web tension that is being used by the PID controller. In case that the Taper function is enabled, it shows the setpoint value after its application, otherwise, it shows the same value contained in the parameter P1011.

P1013 – Web Tension Feedback

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

Description:
This parameter indicates the web tension feedback measured by the load cell and reading via analog input AI1.

P1014 – Line Speed

Adjustable Range:	0.0 to 2000.0 m/min	**Factory Setting:** -
Proprieties:	RO	
Access groups via HMI:	01 PARAMETER GROUPS	
	∟ 50 SoftPLC	

Description:
This parameter indicates the line speed read through the analog input AI2.

P1015 – Roll Diameter

Adjustable Range:	0 to 3000 mm	**Factory Setting:** -
Proprieties:		
Access groups via HMI:	01 PARAMETER GROUPS	
	∟ 50 SoftPLC	

Description:
This parameter shows the estimated or measured roll diameter value. It allows the input of a roll diameter value in case it is configured to estimate the roll diameter and the winding roller is disabled or with the broken web alarm (A760).

P1016 – Wound Web Length

Adjustable Range:	0.00 to 300.00 Km	**Factory Setting:** -
Proprieties:	RO	
Access groups via HMI:	01 PARAMETER GROUPS	
	∟ 50 SoftPLC	

Description:
This parameter shows the length of the web wound by the winder.

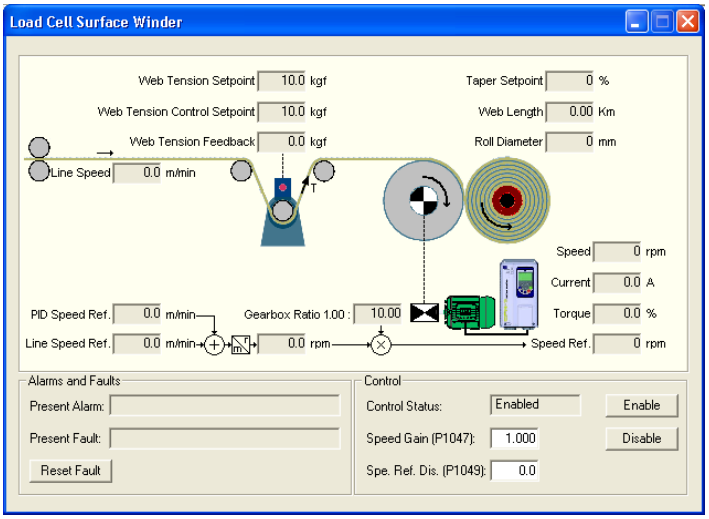
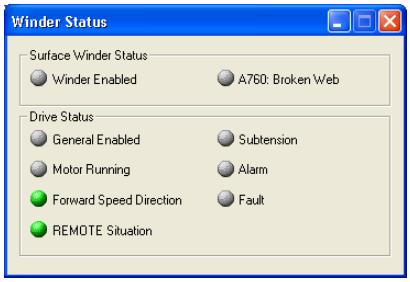
6 FAULT AND ALARM MESSAGES

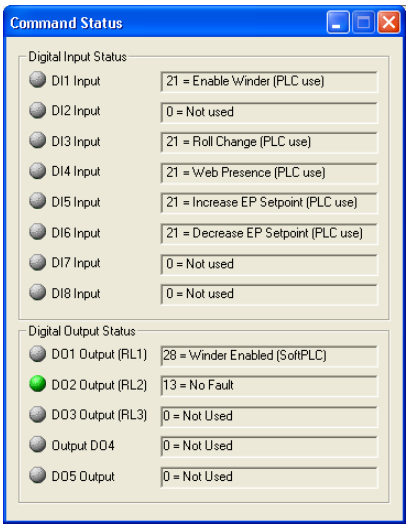
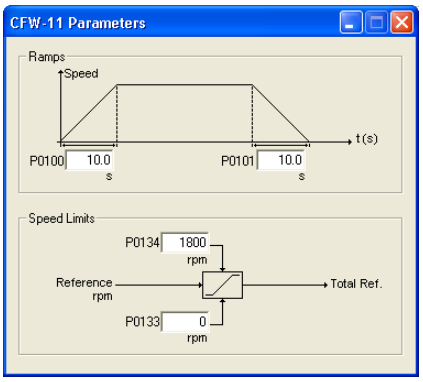
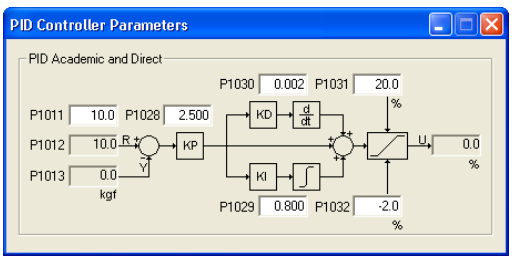
The load cell surface winder applicative generates the following fault and alarm messages:

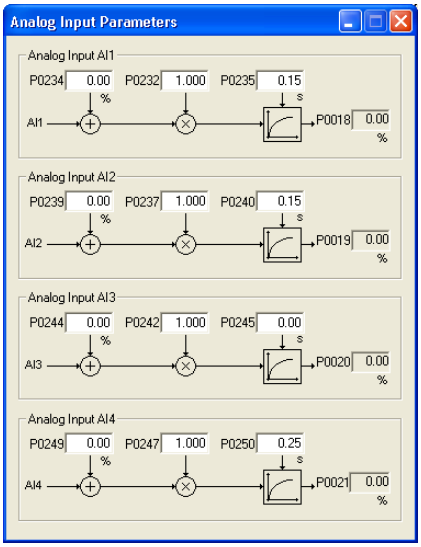
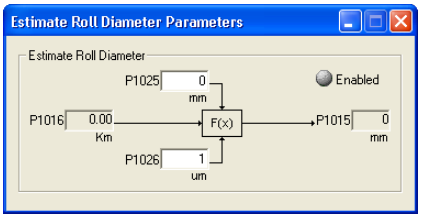
Fault / Alarm	Description	Probable Causes
A760: Broken Web	It indicates that there is no web being wound by the winding roller.	The digital input DI4 has detected the absence of web or the web tension feedback is lower than the setpoint for the broken web detection and the delay time (P1046) has elapsed.

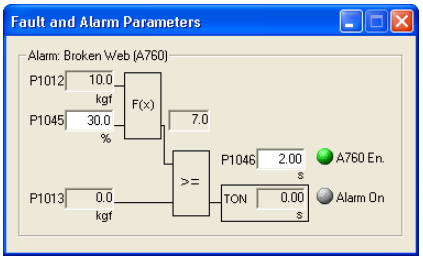
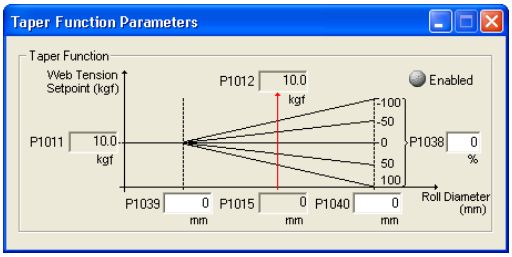
7 MONITORING DIALOGS

It is possible, through the WLP, to monitor and change the load cell surface winder applicative parameters.

Description	WLP Monitoring Dialog
Monitoring of the load cell surface winder operation. It makes possible the modification and visualization of the following variables: ■ Line Speed; ■ Adjusted Web Tension Setpoint, Web Tension Control Setpoint and Web Tension Feedback; ■ Taper Function Setpoint, Wound Web Length and Roll Diameter; ■ Block diagram of the speed control for the winding roller showing the PID controller speed reference, the line speed reference, the conversion of the m/min value into rpm, the gearbox ratio and the speed reference for the motor; ■ Frequency, current and torque of the winding roller motor, driven by the CFW-11 inverter; ■ Present fault and alarm; ■ System fault reset command; ■ Status of the web tension control; ■ Command for enable /disable web tension control; ■ P1047: Surface Speed Gain; ■ P1049: Speed Reference when the Control is Disabled.	
Monitoring of the winder status. It shows the following variables: ■ Winder enabled status and broken web alarm (A760) for the surface winder; ■ The status of general enabled, motor running, forward speed direction, remote situation, subtension, alarm and fault for the winding roller motor driven by the CFW-11.	

Monitoring of the commands carried out at the load cell surface winder. It shows the following variables: ■ Current status of the CFW-11 digital inputs; ■ Function of the digital inputs for the surface winder; ■ Current status of the CFW-11 digital outputs; ■ Function of the digital outputs for the surface winder.	
It shows the ramp and speed limit parameters of the CFW-11 inverter, configured for the load cell surface winder. It makes possible the modification of the following variables: ■ P0100: Acceleration Time; ■ P0101: Deceleration Time; ■ P0133: Minimum Speed Reference Limit; ■ P0134: Maximum Speed Reference Limit.	
It shows the web tension PID controller adjustment and operation parameters. It makes possible the modification and visualization of the following variables: ■ P1011: Web Tension Setpoint; ■ P1012: Web Tension Control Setpoint; ■ P1013: Web Tension Feedback; ■ P1028: Proportional Gain; ■ P1029: Integral Gain; ■ P1030: Derivative Gain; ■ P1031: Maximum Limit; ■ P1032: Minimum Limit; ■ PID controller output (U) (speed reference as % of the actual line speed).	

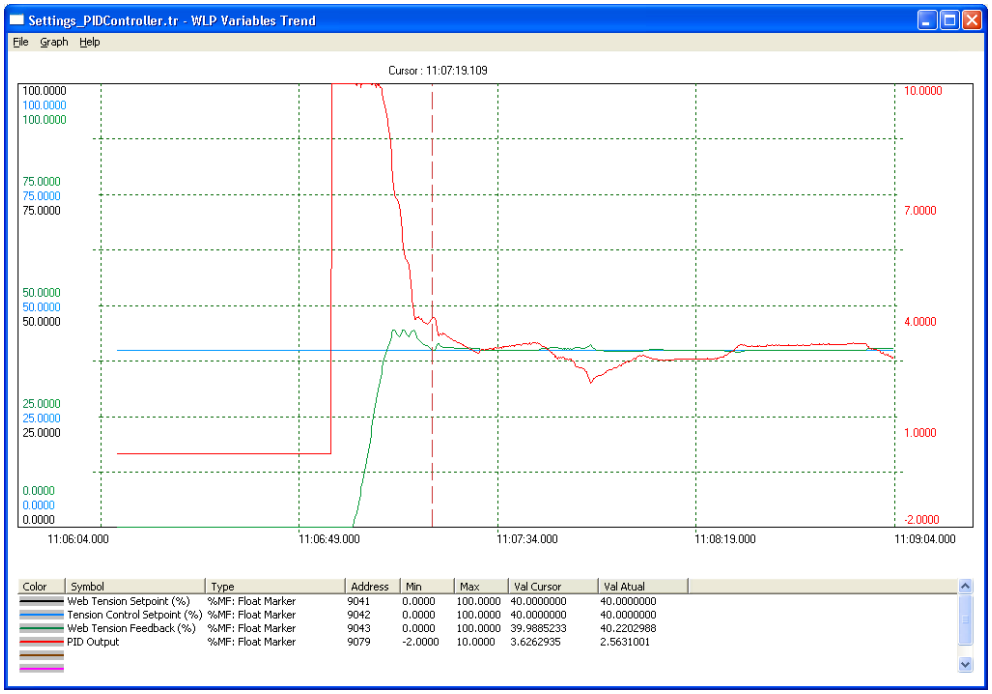
It shows the parameters for reading the load cell surface winder control signals via the CFW-11 analog inputs. It makes possible the modification and visualization of the following variables: ■ P0018: AI1 Value; ■ P0019: AI2 Value; ■ P0020: AI3 Value; ■ P0021: AI4 Value; ■ P0232: AI1 Gain; ■ P0234: AI1 Offset; ■ P0235: AI1 Filter; ■ P0237: AI2 Gain; ■ P0239: AI2 Offset; ■ P0240: AI2 Filter; ■ P0242: AI3 Gain; ■ P0244: AI3 Offset; ■ P0245: AI3 Filter; ■ P0247: AI4 Gain; ■ P0249: AI4 Offset; ■ P0250: AI4 Filter.	
It shows the operation parameters of the estimate roll diameter control logic. It makes possible the modification and visualization of the following variables: ■ P1015: Roll Diameter; ■ P1016: Wound Web Length; ■ P1025: Roll Minimum Diameter; ■ P1026: Web Thickness; ■ Indication of enabled estimate roll diameter.	

It shows the operation parameters of the control logic for generating faults and alarms. It makes possible the modification and visualization of the following variables: ■ P1012: Web Tension Control Setpoint; ■ P1013: Web Tension Feedback; ■ P1045: Hysteresis for Broken Web Detection; ■ P1046: Broken Web Alarm Time; ■ Value of the setpoint calculated to generate the alarm; ■ Value of the time elapsed to generate the alarm; ■ Indication of active alarm; ■ Indication of enabled alarm.	
It shows the operation parameters of the control logic for the Taper function applied to the web tension setpoint. It makes possible the modification and visualization of the following variables: ■ P1011: Web Tension Setpoint; ■ P1012: Web Tension Control Setpoint; ■ P1015: Roll Diameter; ■ P1038: Taper Function Setpoint; ■ P1039: Taper Function Initial Diameter; ■ P1040: Taper Function Final Diameter; ■ Indication of enabled Taper function.	

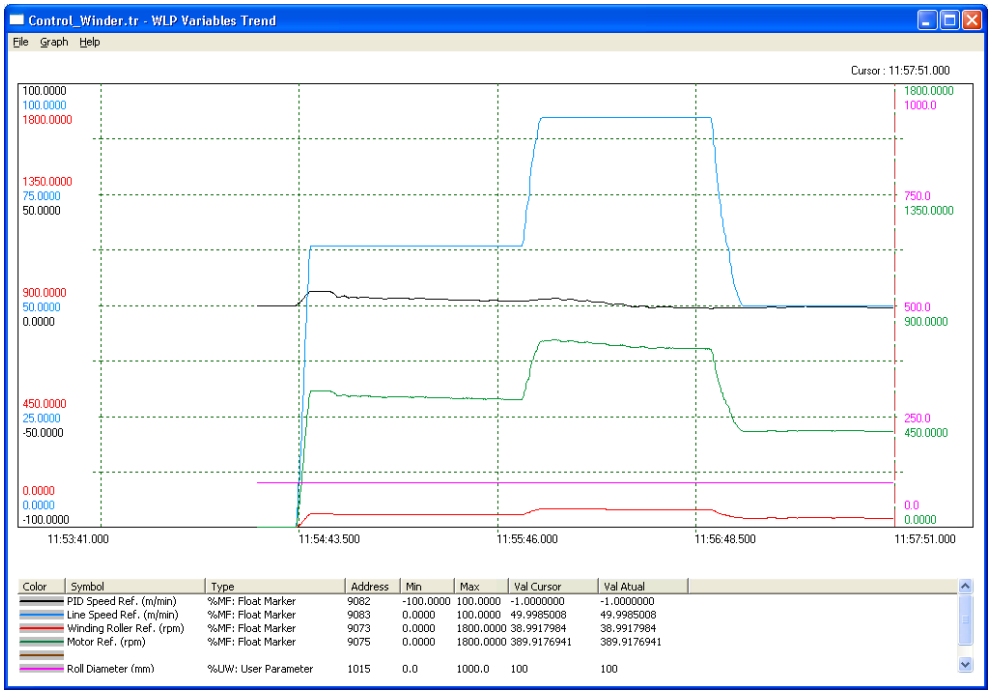
8 TREND VARIABLES DIALOGS

It is possible to monitor variables of the load cell surface winder applicative through the WLP.

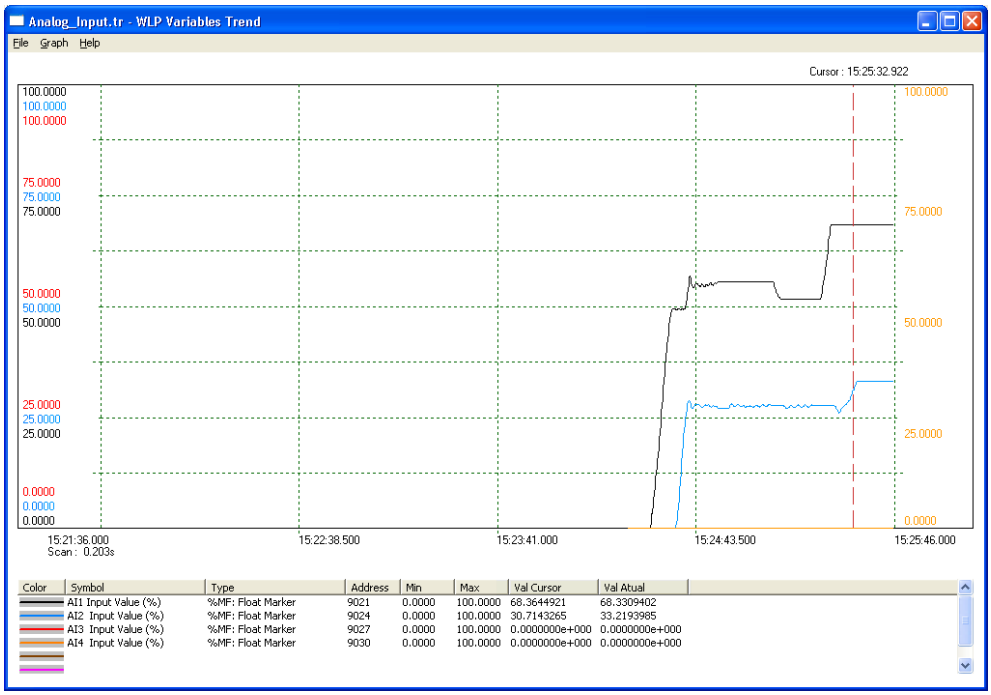
PID Controller Settings:
It makes possible the visualization of the values for the web tension PID controller settings values.



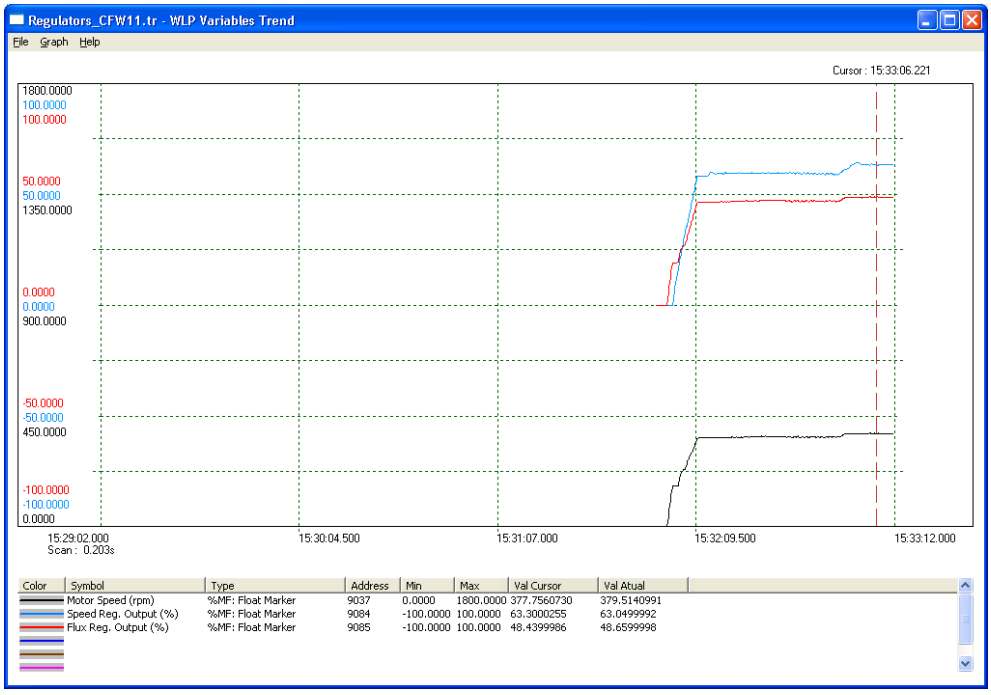
Winder Speed Control:
It makes possible the visualization of the values that generate the speed reference for the surface winder.



Analog Inputs:
It makes possible the visualization of the analog input values for an analysis of the response throughout the operation time.



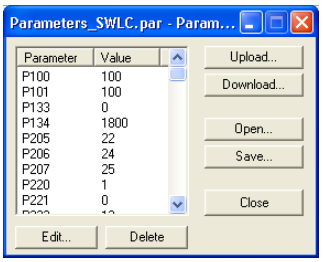
CFW-11 Regulators:
It makes possible the visualization of the motor speed value and the response of the speed regulator (Iq*) and the flux regulator (Id*) for an analysis of the CFW-11 inverter performance.



NOTE!
Refer to help topics in the WLP programming software for further information on the use of the variable trend dialogs.

9 PARAMETER VALUE DIALOGS

It is possible to save the parameters of the load cell surface winder applicative through the WLP.



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

10 GENERAL NOTES

Some points must be verified in order to assure a good performance of the considered winder. Some of these points are listed next.

Analog signals: The analog signals used in the applicative (web tension setpoint, process line speed, web tension external feedback and roll diameter measurement) are of extreme importance for the winder good operation. It is important to examine how and where the analog signal cable passes until reaching the CFW-11 frequency inverter, verifying the grounding and cabling quality. Therefore, it is important to analyze the oscillation level of the signal and how much this oscillation interferes with the winder control. In order to evaluate this oscillation, there is the trend of the “Analog Inputs” in the trend variable dialogs, which contains the application analog input readings. Another factor that must not be forgotten is the resolution of the analog inputs, being 12 bits for AI1 and AI3 and 11 bits + sign for AI2 and AI4 (the AI4 of the IOA-01 expansion board has a 14 bit resolution). Observe also the precision of the equipments that are sending these signals to the CFW-11.

Another important analysis variable is the value of the low-pass first-order filter time constant. Ideal values are around 100 ms to 300 ms, because they act as signal filters and do not transmit delays to the control.

Regarding the web tension external feedback signals, it is important to observe their correct operation and the positioning of their components, because if they were not correctly installed, they will transmit false signals and this will have a negative effect on the winder control.

When using load cells it is recommended that:

- The embracing angle be equal or bigger than 60 %;
- They are not mounted in a place where the web position varies, because this would be perceived by the load cells as a variation in the tension;
- Two load cells be used for the measurement, thus assuring that the force applied on the sensor roller be totally indicated, regardless of the point where the force is applied;
- The surfaces for mounting the load cells are flat and parallel;
- The value transmitted to the control never is the output with filter, because the signal transducers normally have two outputs, one with filter for display and another without filter to be used for the control.

CFW-11 Configuration: In order to get a good winder applicative performance, it is necessary first to evaluate the CFW-11 no load response, i.e., to observe its parameterization and the values estimated with the auto-tuning, if it operates in vector mode. It is also important to evaluate the chosen operation mode among the options “Scalar (V/Hz)”, “VVW”, “Sensorless Vector” and “Vector with Encoder”, because each operation mode has its own accuracy in speed as well as in torque. It is important to consider the motor overheating problem when operating at low speeds and beyond the nominal speed.

In order to evaluate the response in vector mode, in the trend variable dialogs, there is the “CFW-11 Regulators” trend that contains the motor speed reading in rpm, and the speed (Iq*) and flux (Id*) regulator outputs. Verify the response of these signals in several speeds and analyze them based on an acceptable average 2 % control oscillation. It is worthwhile to remind that in Sensorless Vector both Id* and Iq* act with similar amplitudes, whereas in the Vector with Encoder mode, only the Iq* acts and Id* remains more stable. If bigger oscillations are present, it becomes necessary to adjust the speed regulator (Iq*) and flux regulator (Id*) parameters, according to their response, always beginning with the one that oscillates more.

PID Controller: After the verification of the analog signals and the CFW-11 response in the winder control, it will be necessary to adjust the PID controller gains. This PID has the function of controlling the web tension, as has been seen previously in the description of each winder type. In the standard applicative, there are values that have been used in some applications. There are several factors, such as gearbox ratio, maximum line speed, winder inertia, type of wound web, among others, which influence the PID controller gain values. Due to this, there will be normally corrections in the values indicated in the standard applicative, where they must serve as starting values for the winder adjustment.

In order to monitor the PID control action, in the trend variable dialogs, there is the “PID Controller Settings” trend that contains the PID controller variable readings. In order to start the settings, the derivative gain must be set zero, so that it does not interfere in the process. Start increasing the proportional gain and monitoring the web tension feedback response, if it gets worse, reduce the gain and verify the improvement in the response. After finding the value where the response does not improve nor deteriorate any longer, proceed with the

integral gain in the same way as for the proportional. If after this there are still undesirable oscillations or a response delay during accelerations and decelerations, then adjust the default value for the derivative gain. For the derivative gain, proceed in the same way as for the other gains. After this, it may be necessary to redo some small adjustments in the gains.

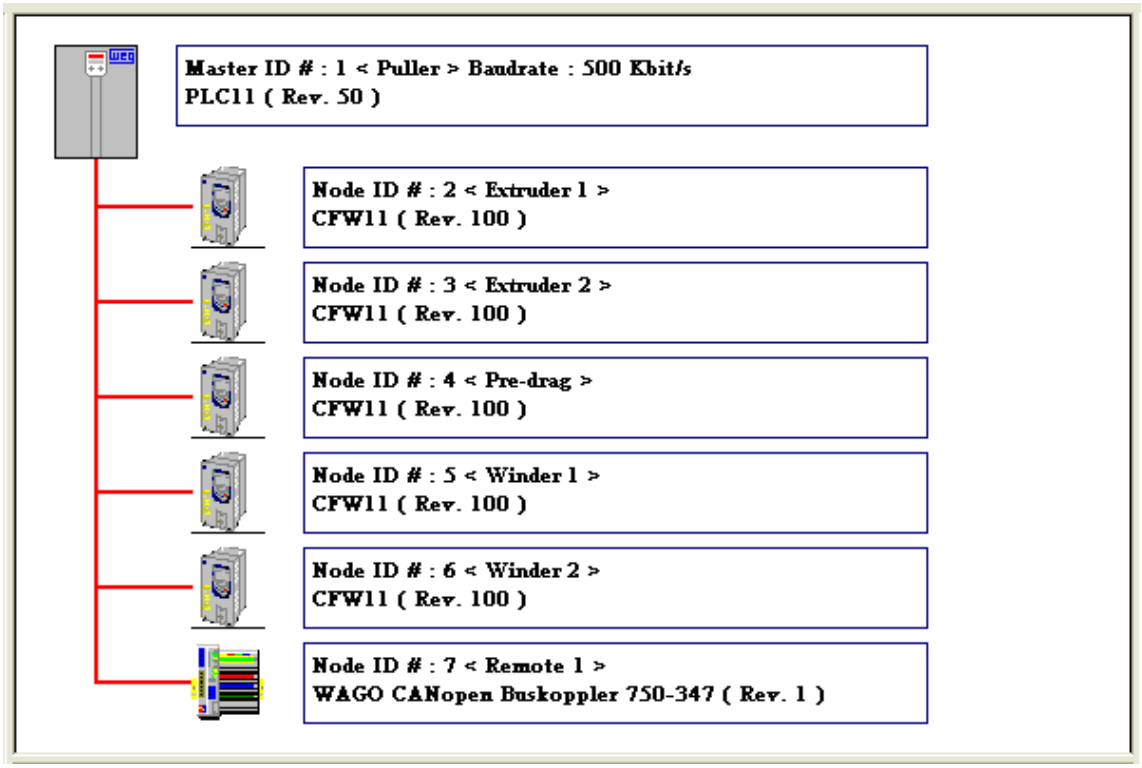
Another important factor for the PID adjustment is its sampling time. This value is introduced by the parameter directly in the PID block of the WLP applicative and it must always be longer than the program scan cycle that can be visualized in P1002.

CANopen Network: A surface winder is normally not alone in a machine or application. For instance, in a plastic web extruder we have the motors for the extruder screws, the pull roller, the pre drag and the surface winders.

In order to control the entire application process, we can use the CFW-11 frequency inverter optional board PLC-11, because it allows interconnecting all the drives through a CANopen communication network. This board will be assembled on one of the CFW-11 frequency inverters, thus enabling it to be the CANopen network master.

The WLP programming software allows the user to implement the control and interlocking logics necessary for the application control; and the WSCAN configuration and programming software makes the configuration and operation of the equipments in the CANopen network possible.

See below the CANopen network configuration executed via WSCAN with the inverters used in the application example mentioned above, where the PLC11 board was fitted on the pull roller. A remote unit for the acquisition of digital and analog points was also included.



NOTE!
Refer to help topics in the WLP and WSCAN programming software for further information.