OWECON
Optimum Web Control

Closed Loop Web Tension Controller
OWC330

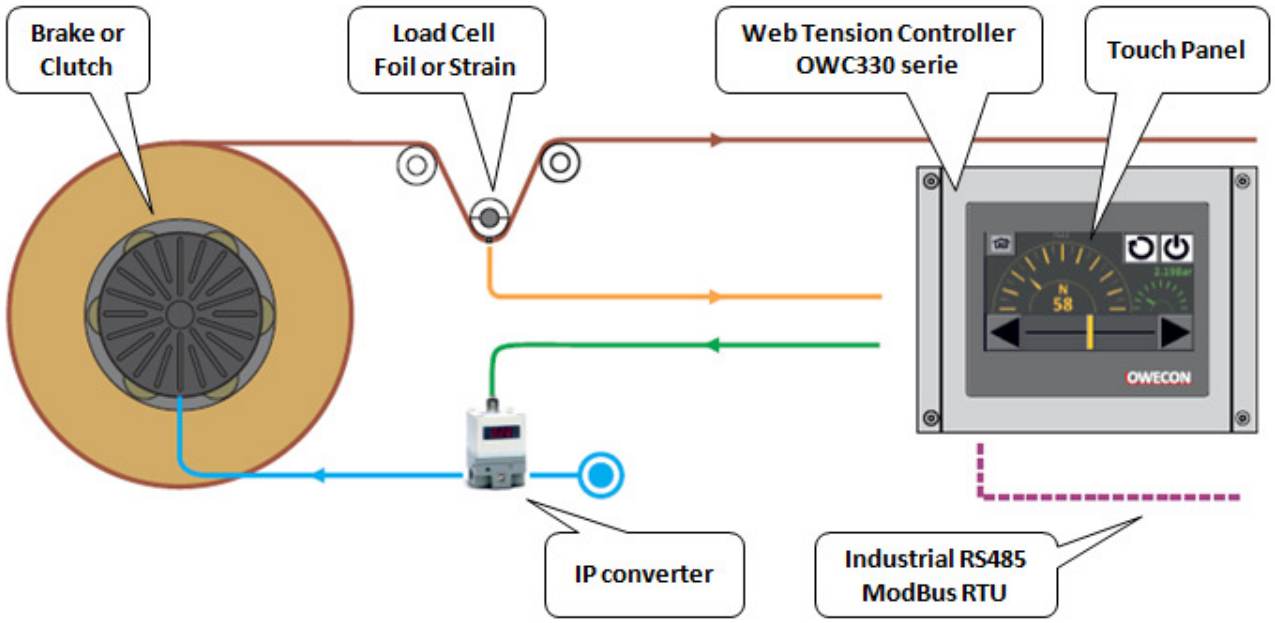
Technical Manual

CONTENTS

1 How does it work?

1.1 General deskription

OWC330 is a closed loop tension controller for use in various web unwind applications, it features optimum ease in installation, setup and use.
In the basic applications, measurement of the web tension is done by load cells. The signal is computed by the controller and forwarded via an interface to the actuating component, in most cases a pneumatic brake
A change (+ or -) in expected tension calculated by the controller results in a reactive signal (– or +) on the output - controlling the actuating component, and so the web Tension.



Working principle of the closed loop tension control method using the Owecon OWC330 controller, Load cell configuration

Terms and definitions:

Load cell function

Two load cells – or tension sensors – are used. The load cell signals are added together by an amplifier to indicate a total web tension expression. Each load cell has 2 strain gauges in series, 2 load cells form a resistor full-bridge, which is supplied with 5 VDC

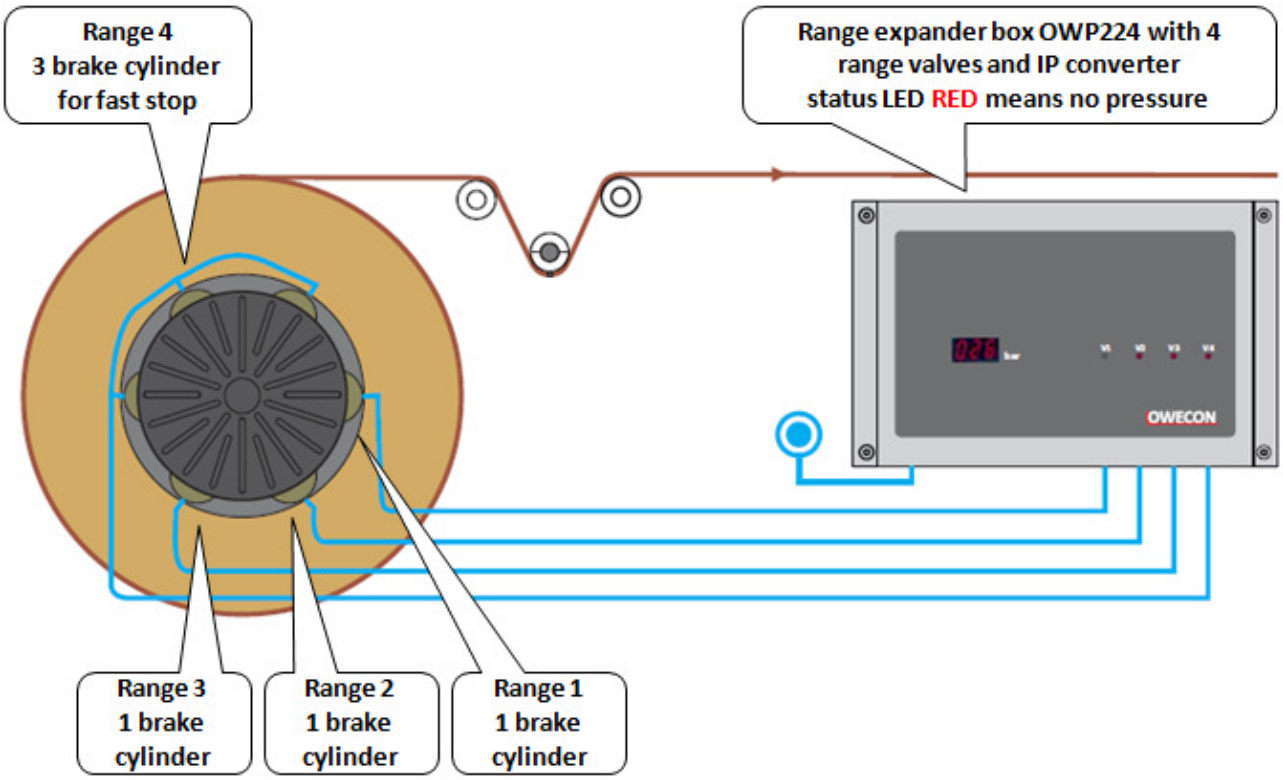
I/P converter function

The I/P converter converts the regulator output from the OWC330 controller into a proportional 0 to 6 Bar to control a pneumatic brake/clutch.

Brake

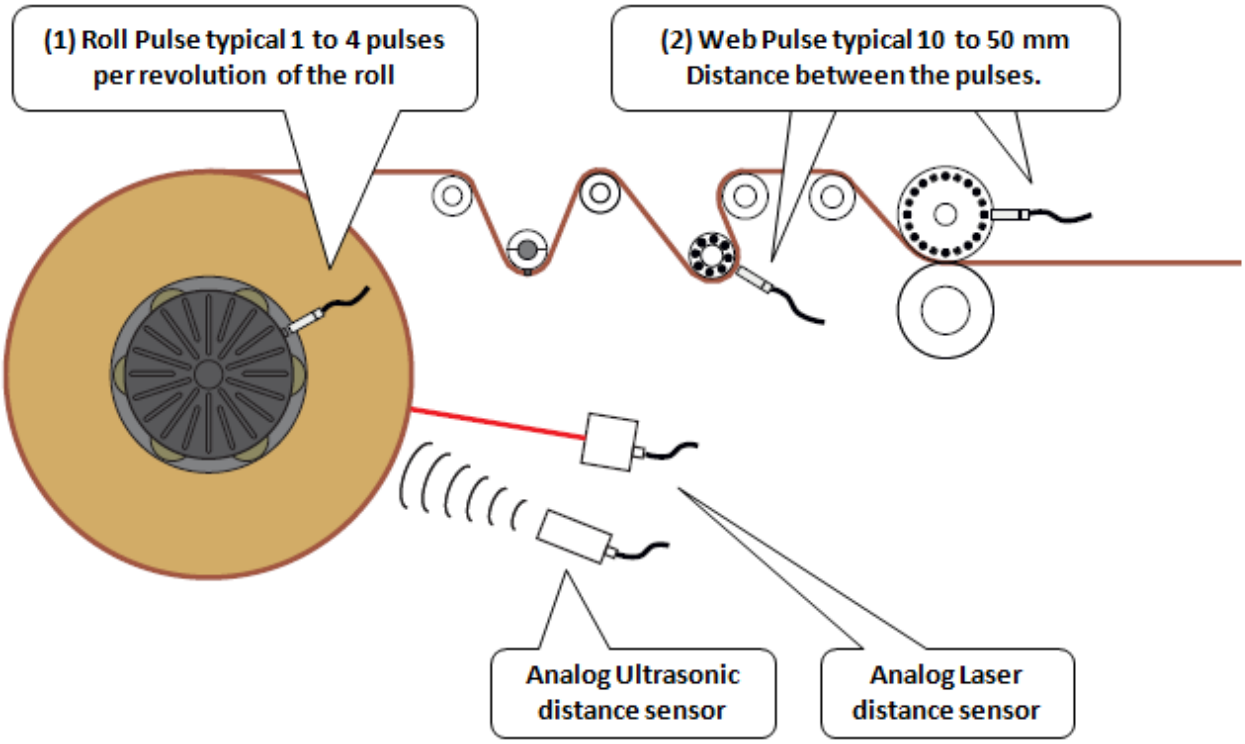
Pneumatic brakes are controlled by the air pressure from the I/P converter or pneumatic interface box / Range Expander circuit.

1.2 Range Expander *optional*



Pneumatic interface box containing both the I/P converter and a set of magnetic valves, enabling the OWC330 controller to switch the number of brake-modules used, as a function of the load on the brake, emergency stop etc.
The Range Expander enables the use of a larger brake, with extra torque resources, even when smaller torques / fine regulation is needed.

1.3 Diameter signal *optional*

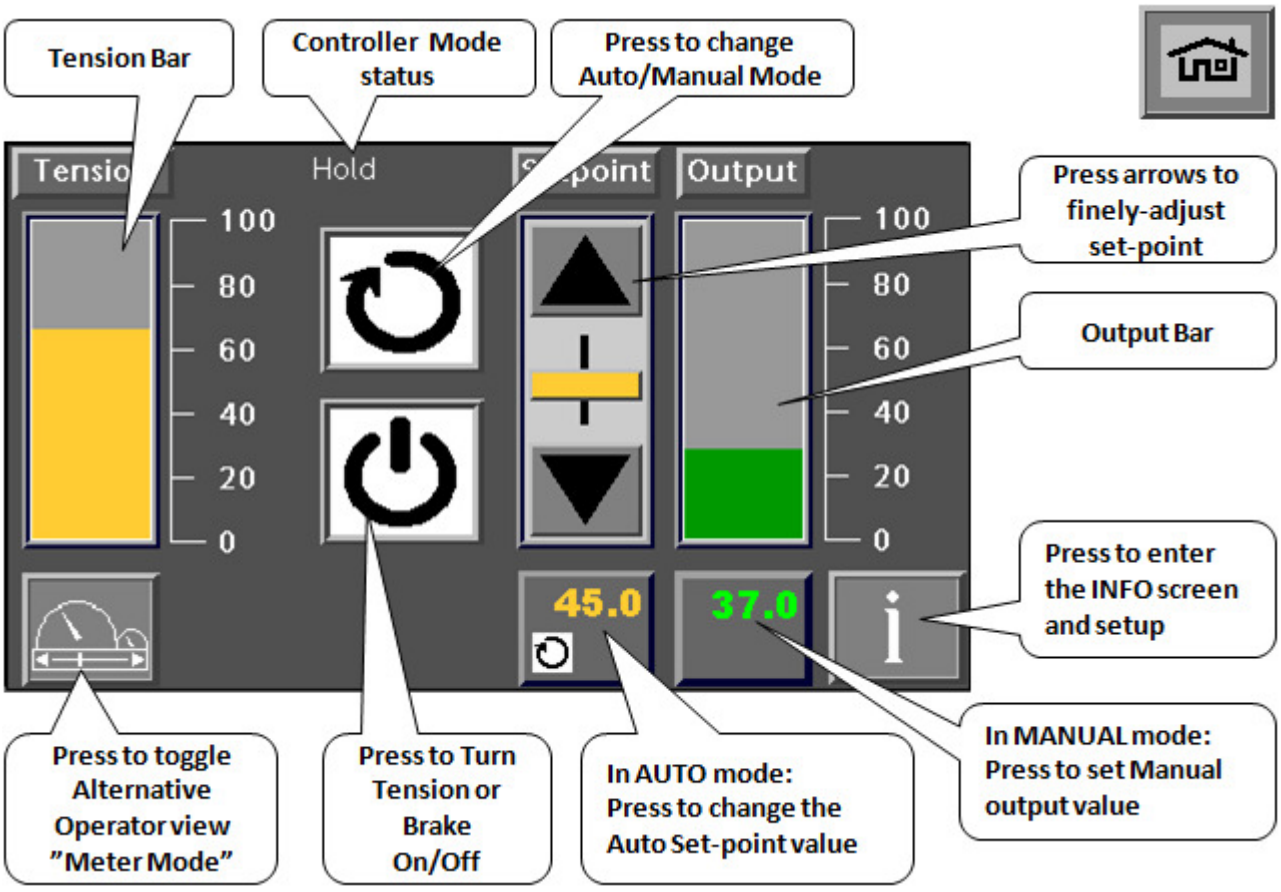


To optimize a system, a diameter signal is recommended. An expression for the actual roll diameter can be calculated from 2 proximity switches, counting pulses from the unwind roll/brake and an idler roller (at web speed). **The sensor is ideally mounted on any roller that represents line speed and does not slip relative to the web. Choose rollers such as positive grip idlers, driven shafts / nips.**

Alternatively, the diameter is read by an analogue sensor, ultrasonic or laser.

2 General operation

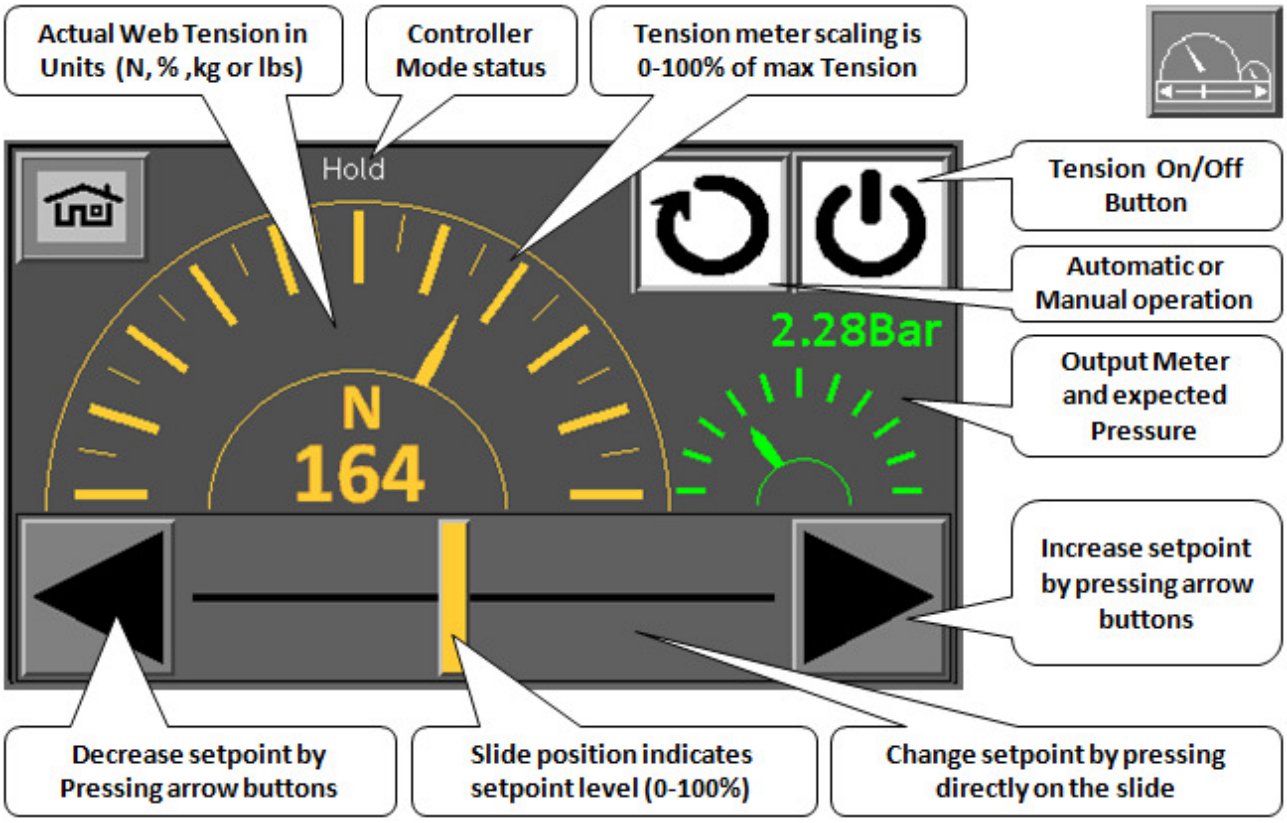
2.1 Operator Screen 1



Controller Status Mode:

- Hold
- Run Auto
- Run Man
- Tension Off
- Stop
- Manual
- Splice (optional)

2.2 Operator Screen 2 ”Meter Mode”



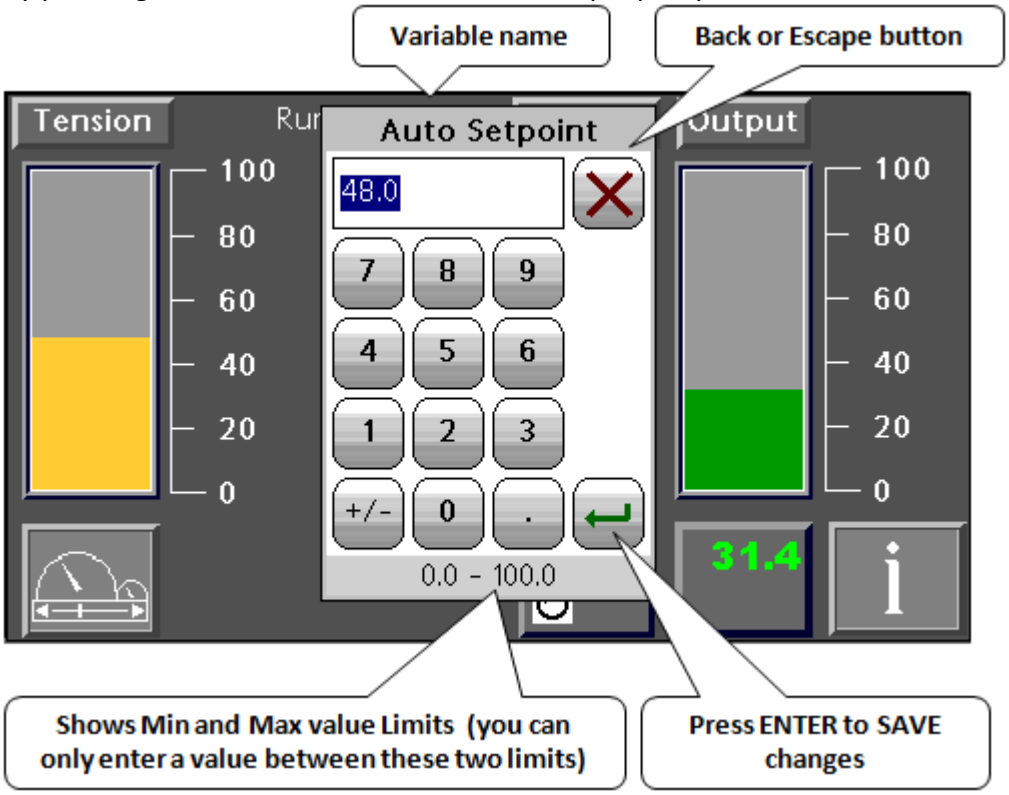
Press the OFF key  to change status to ON: 
This function is used to hold/release the roll.

Pressing the MANUAL key  changes the working mode to AUTO 
In AUTO MODE, the output will be controlled automatically, according to Auto Setpoint and the present input from the senor. The system works in closed loop mode.

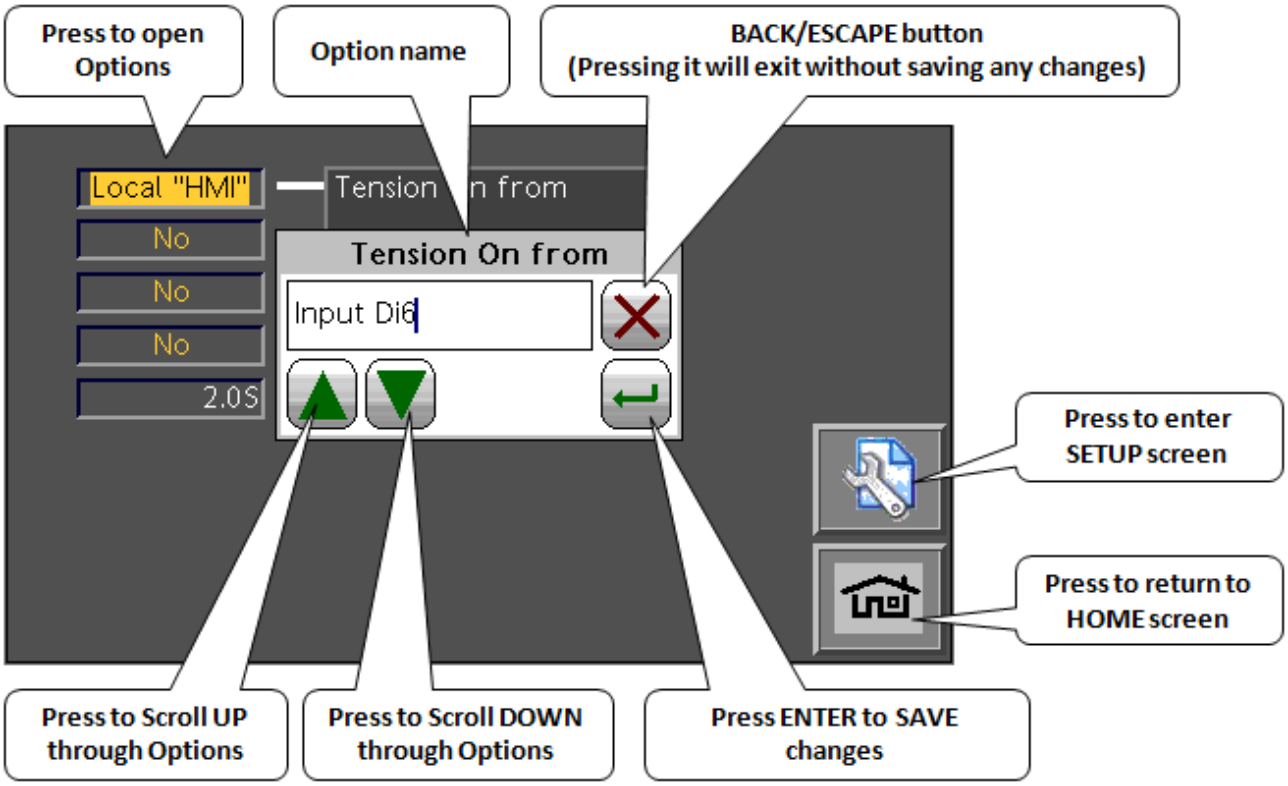
In MANUEL MODE , the output value stays constant, the system works in an open loop mode and requires adjustment from the operator.
Setpoints can be changed by pressing the numeric value or using the”up/down” arrows.

2.3 The Pop-Up Keyboards

By pressing the numeric value-button, the Pop-Up Keyboard is shown.



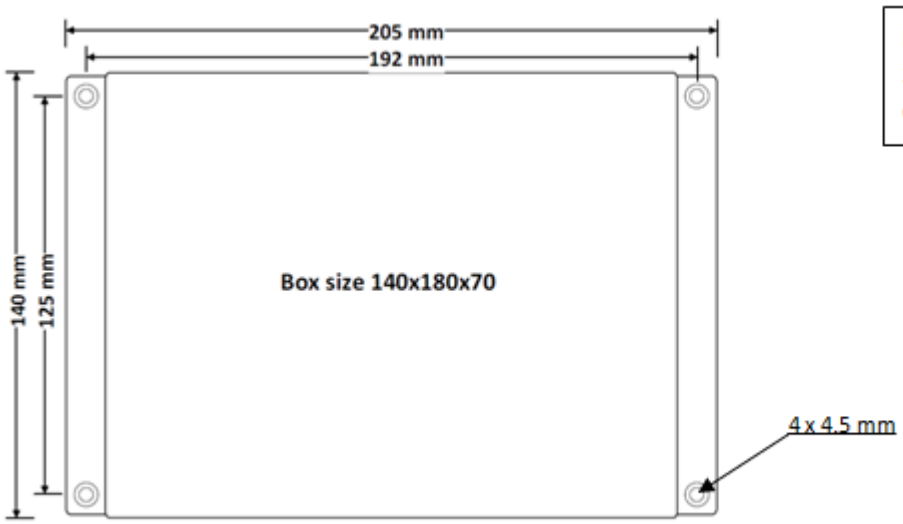
The Pop-Up Keyboard is a multi input tool, to use for all data value entries. Simply touch a datablock in the program for entry - and the keyboard pops up. Enter by touching the keys w. finger or pen.



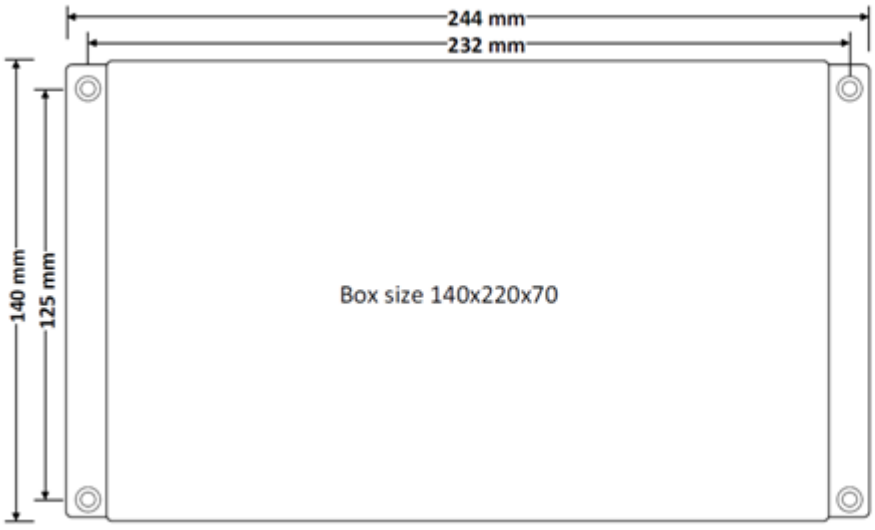
3 Installation

Installation is done by follow the chapters: 3.1 – 3.2 – 3.3 – 3.4.
This will get your system up running.

3.1 Mechanical Installation, mounting the boxes



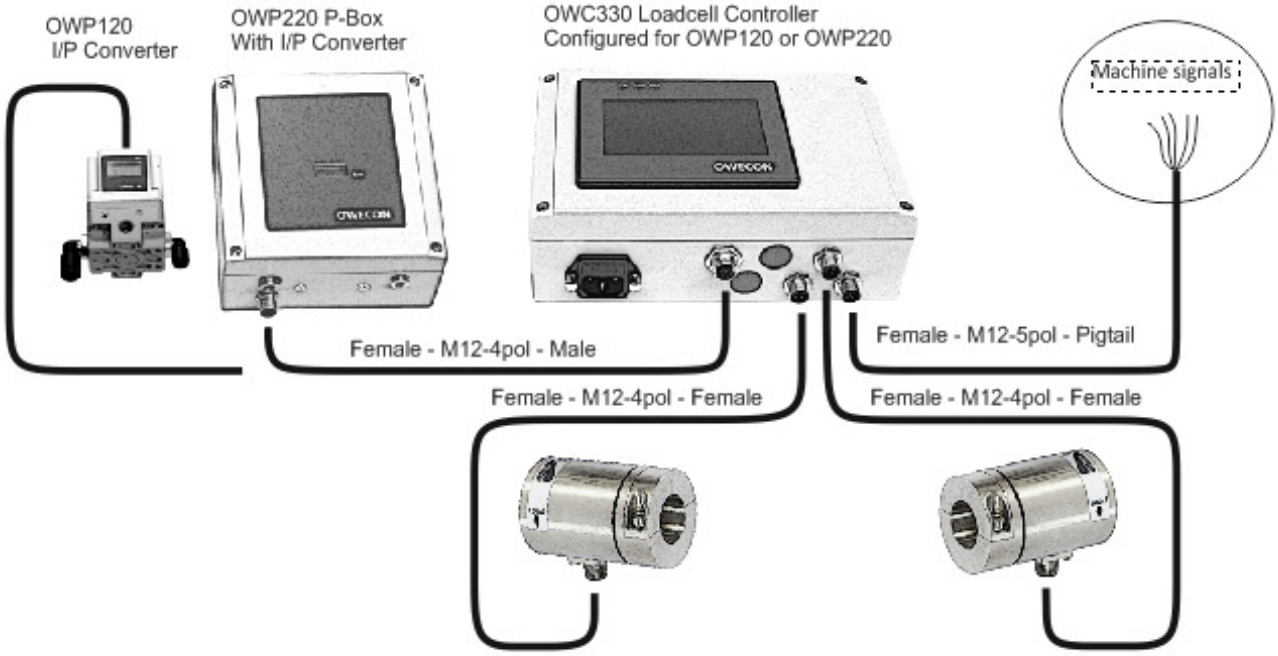
Box mount
24VDC supply version
OWC310, 320, 330

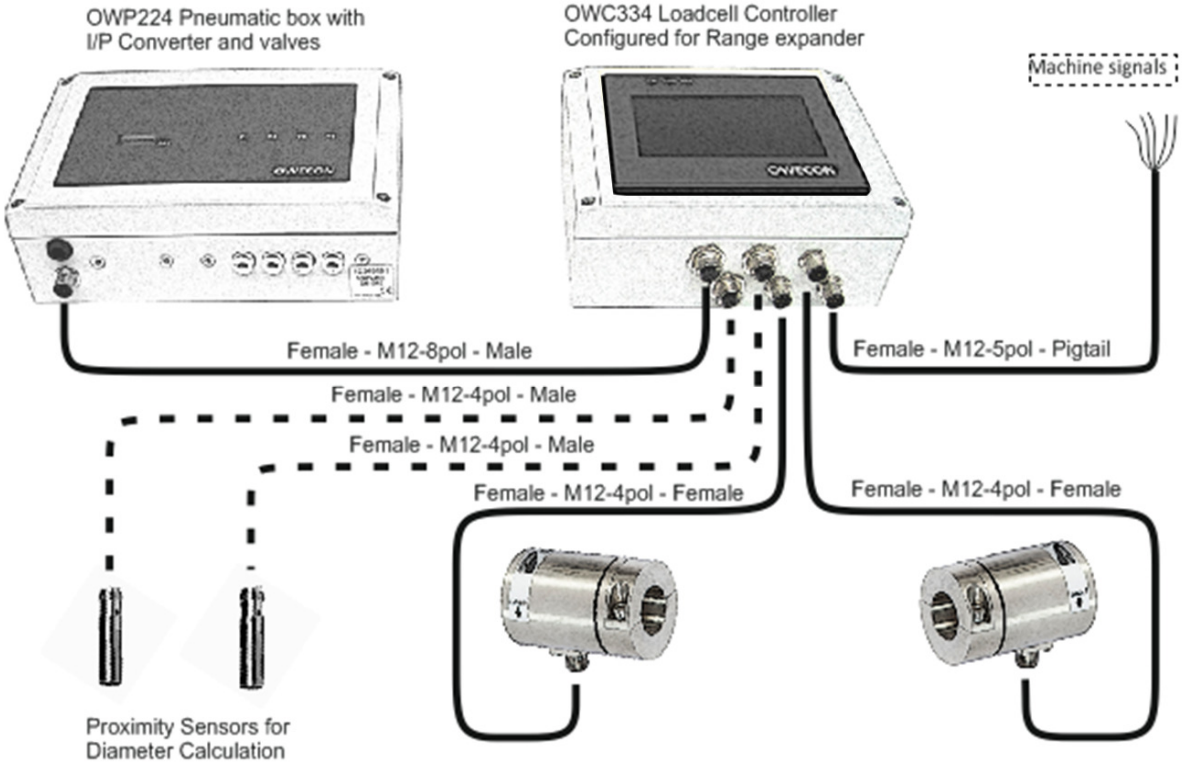


Box mount
110 / 240VAC Version
OWC310, 320, 330

3.2 Cable Connections

Connector to the controller whit the prepared cables as shown.

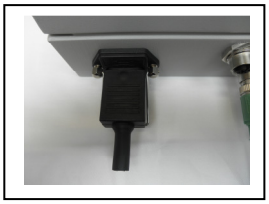




3.3 Electrical Installation

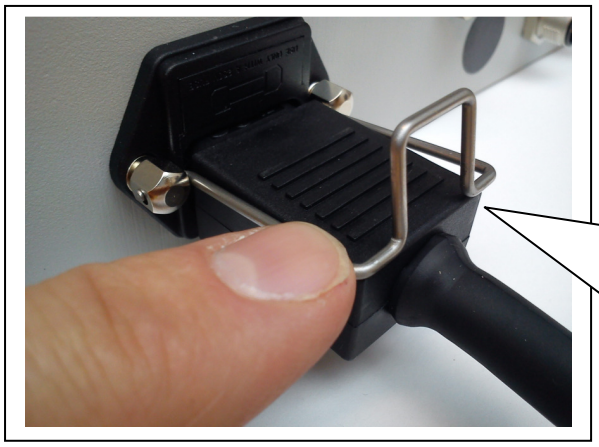
3.3.1 Warning and Safety

- Electrical installation must be done by authorized personnel. Wiring must meet all applicable codes and standards.
- Refer to the appropriate wiring and terminal descriptions for external connections.
- An external 1A fuse is integrated in the cabinet power connector.



- **Always double check the cable connections before applying Power to the system, damage caused by improper wiring is not covered by warranty**

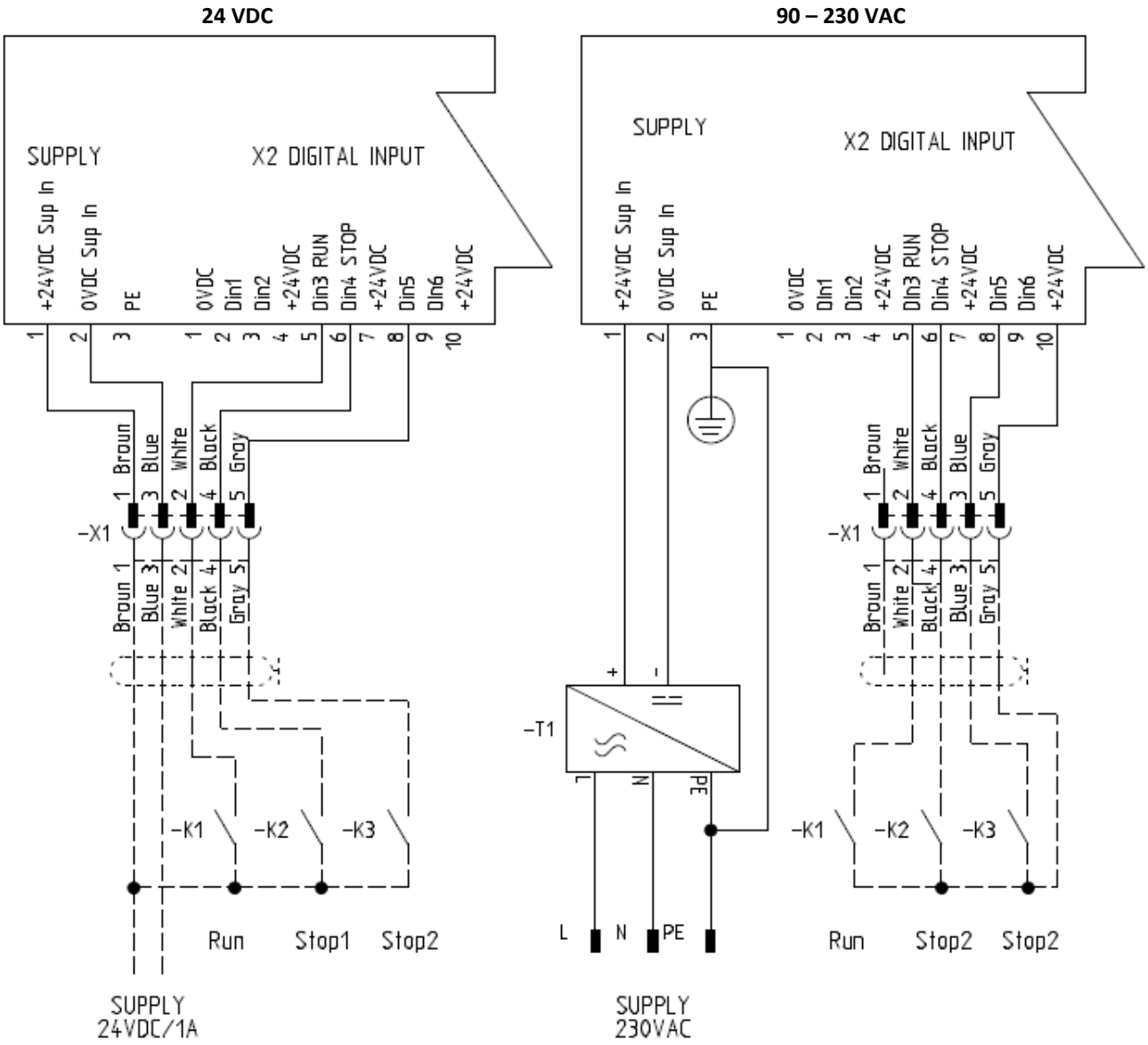
⚠ WARNING ⚠



After connecting the loadcells and I/P converter:

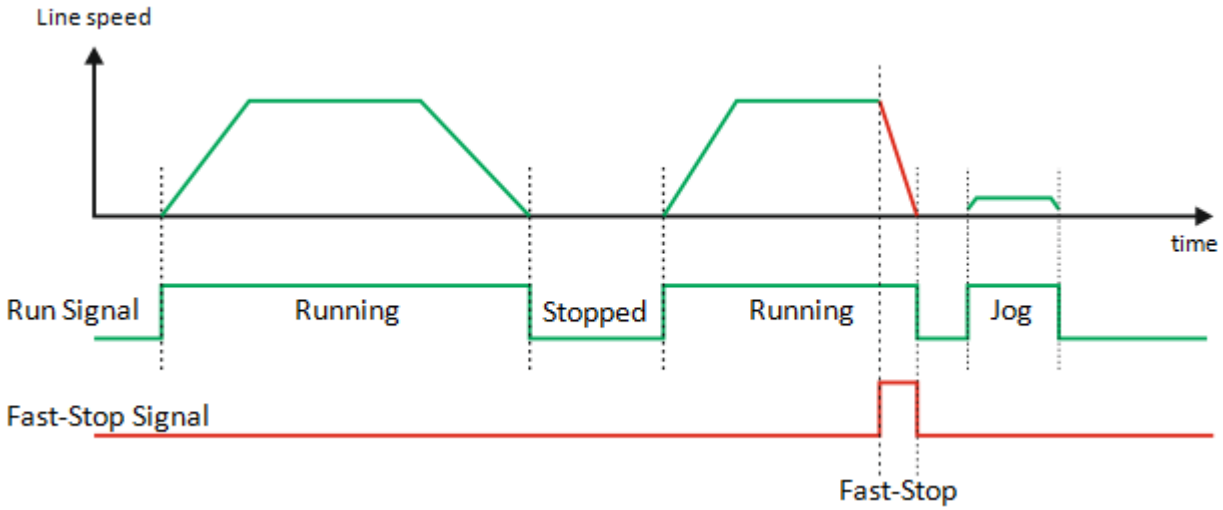
Connect the 90-230 VAC supply via the supplied power cable connector to the OWC300 controller box. Secure the power plug using the integrated safety spring

3.3.2 Machine Signals diagram



Digital inputs are active with a High 24VDC signal for PLC connections use PNP output and common ground 0VDC. Di 3-6 can be inverted under the Digital input menu under setup

3.3.3 Machine Signals Description



The **run** signal serves the following purposes:

1. At start of the machine, the controller goes into run mode Auto and regulates the brake torque to obtain correct tension
2. At machine still stand the controller goes in to hold mode, the brake torque stays at a constant level to insure an optimal web tension at restart of the machine.

Note: The run signal shall ideally always be activated when the web is moving, also when turning or inching the machine. The Run Signal applies on Digital input 3

The **Stop** signals should be applied if the tension drops during stopping of the machine
When the stop signal is applied the brake torque will increase directly to compensate for the inertia of the running roll during deceleration of the machine.

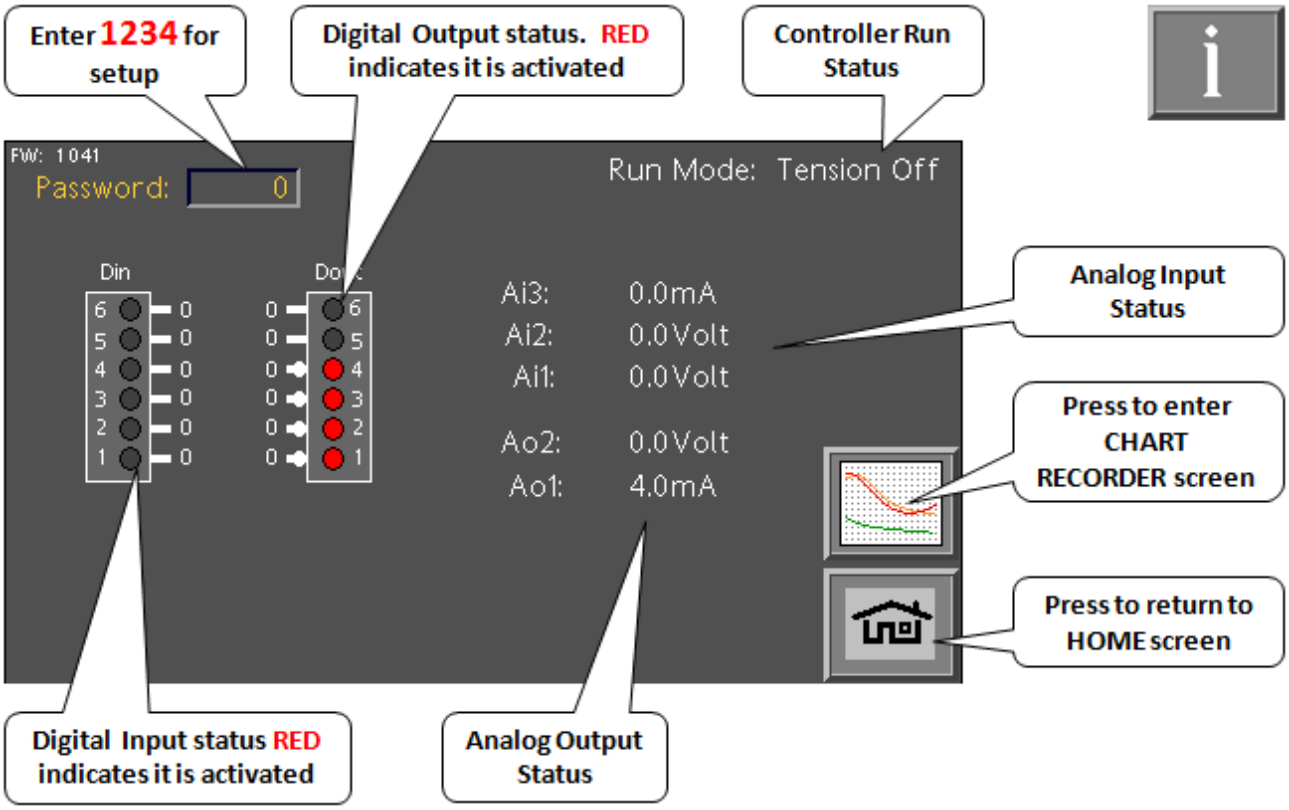
Note: Using the diameter calculation or measurement features, the controller calculates the mass of the roll allowing controlled fast stop of the machine with control of the web tension

4 Setup the controller Step by step

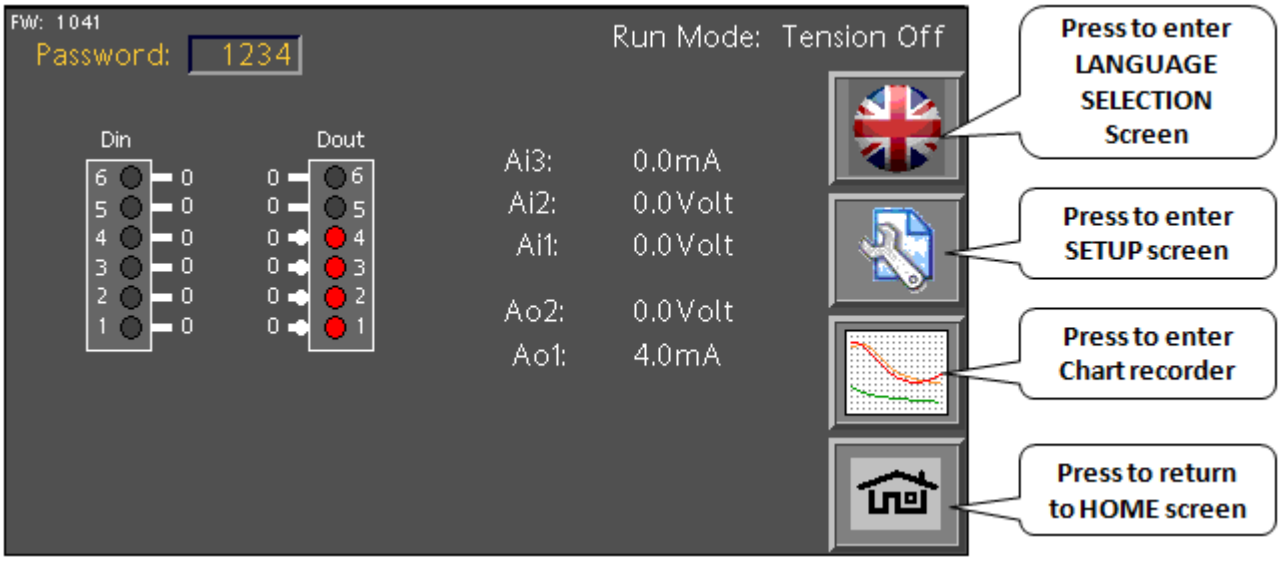
⚠ CAUTION ⚠

Moving parts
Make sure machine is Stopped

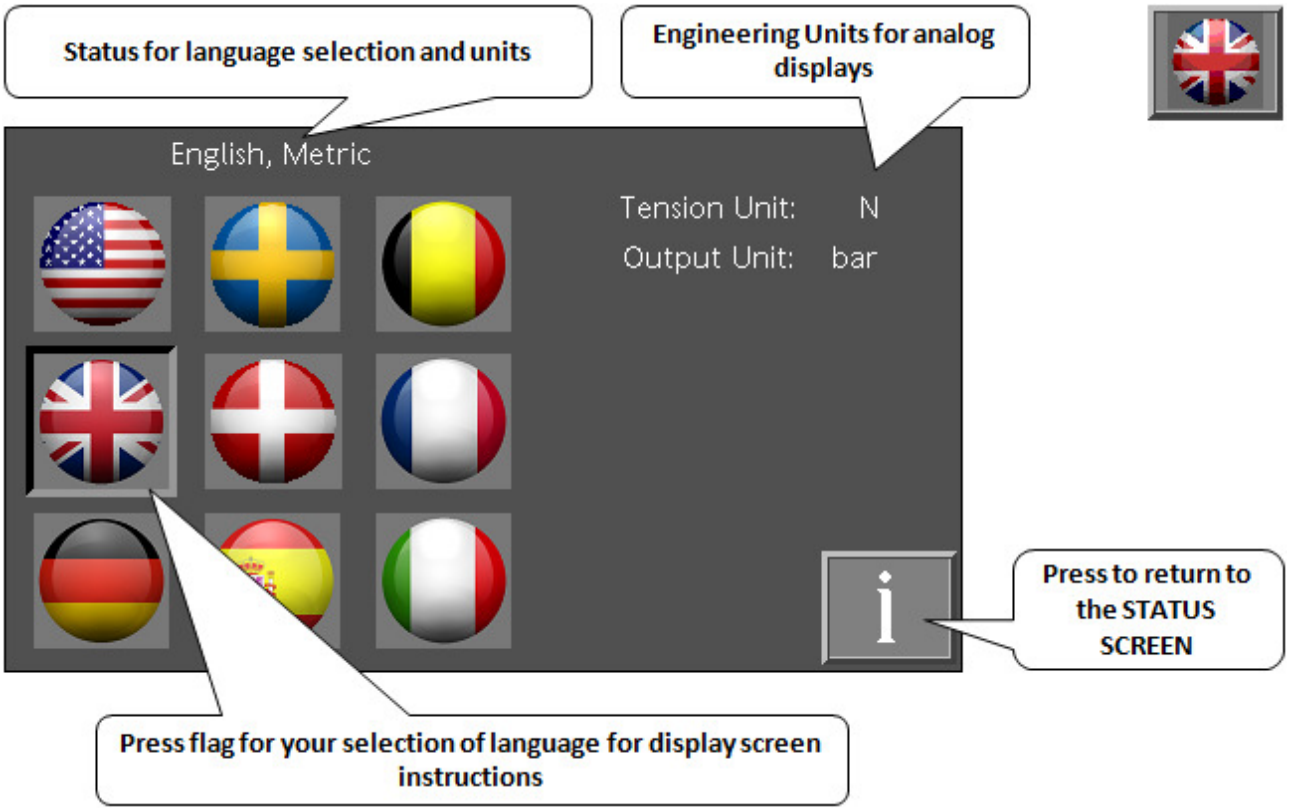
Press the STATUS Button  on the Operator screen to go to the Status Screen



4.1 Step 1…Status Screen

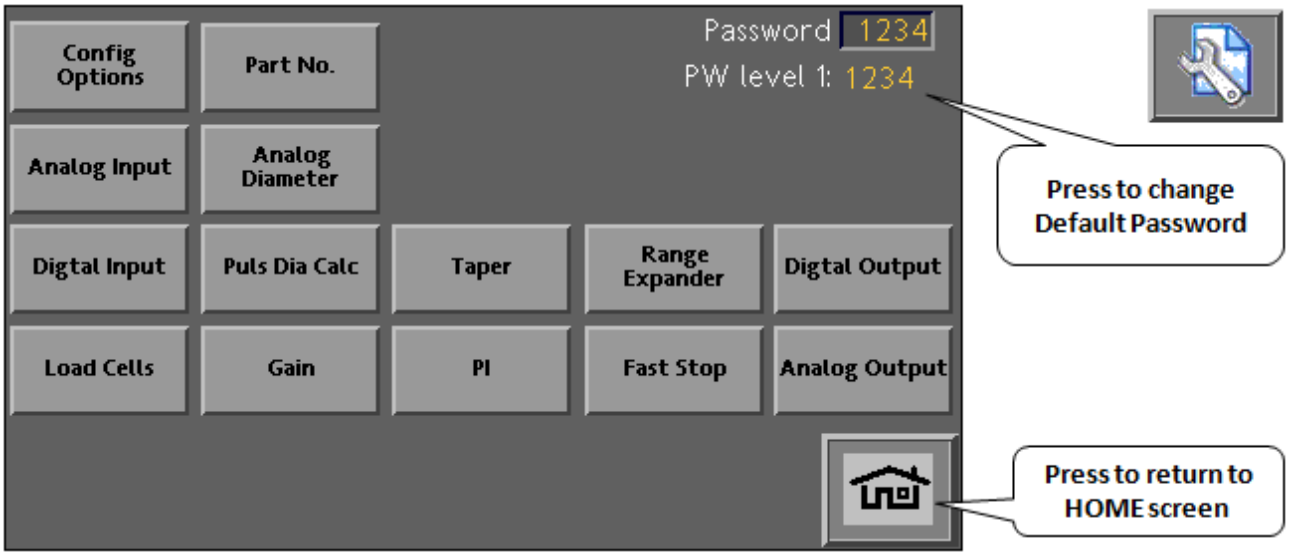


4.2 Step 2 Language Screen



From the Status screen: press  to get to the general Setup screen:

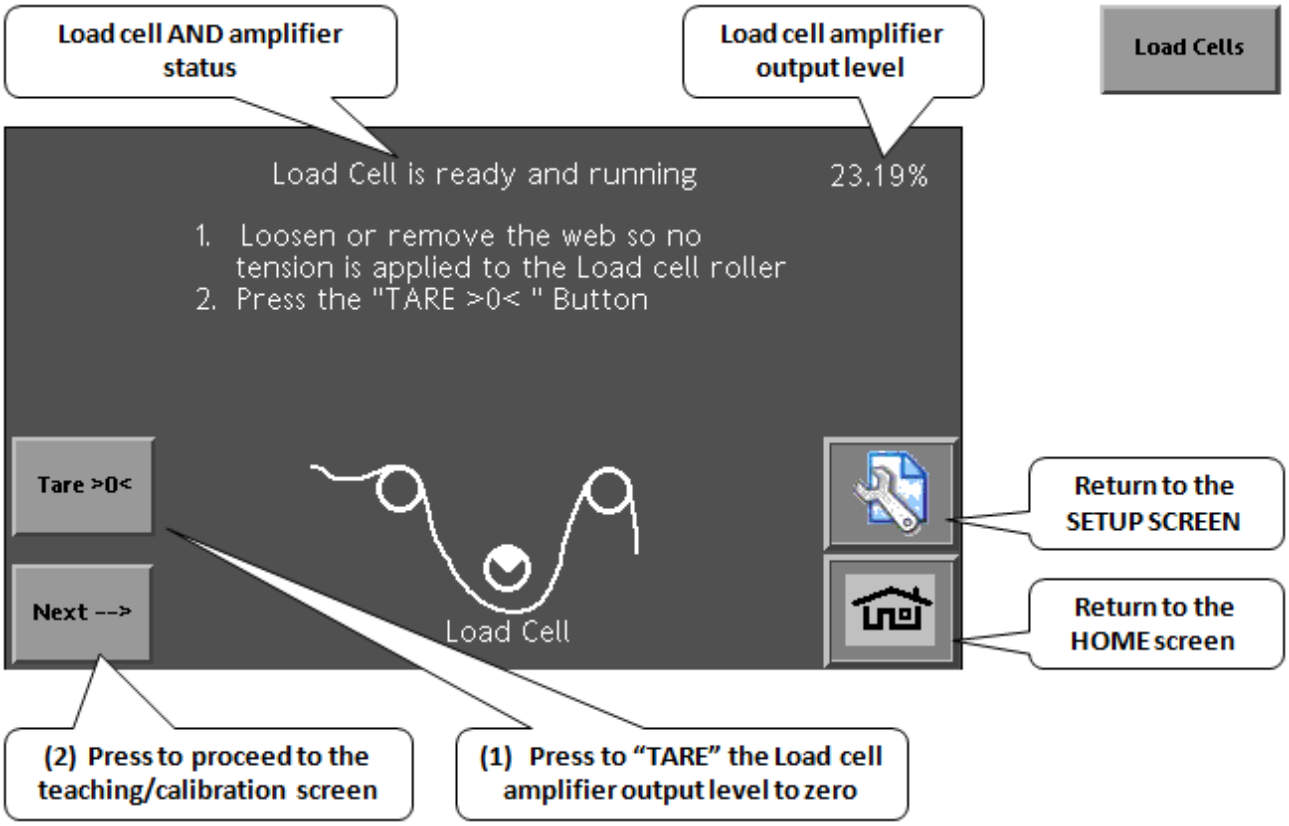
4.3 Setup Screen



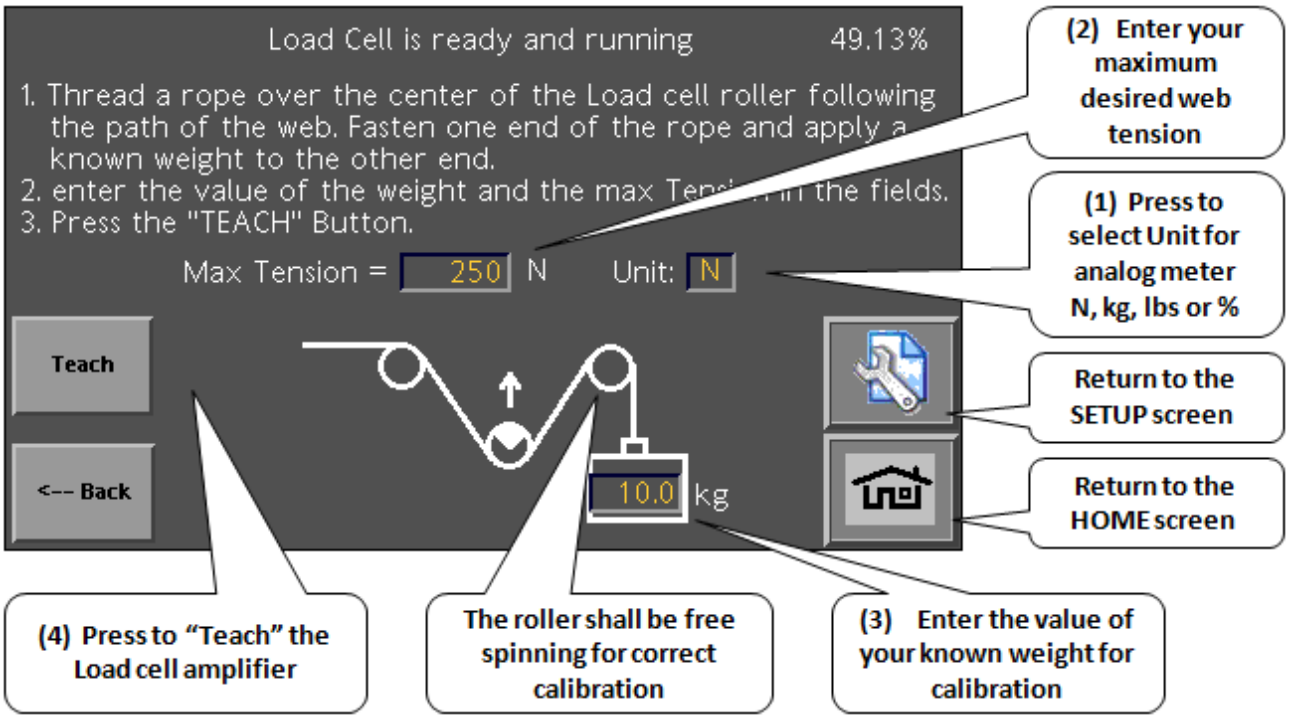
From here, you can, via the buttons, access the individual function blocks needed.'
The number of available blocks on the screen will depend of the configuration part number

4.4 Step 4 “TARE” Load Cells

The Screen instructions will be in the selected language

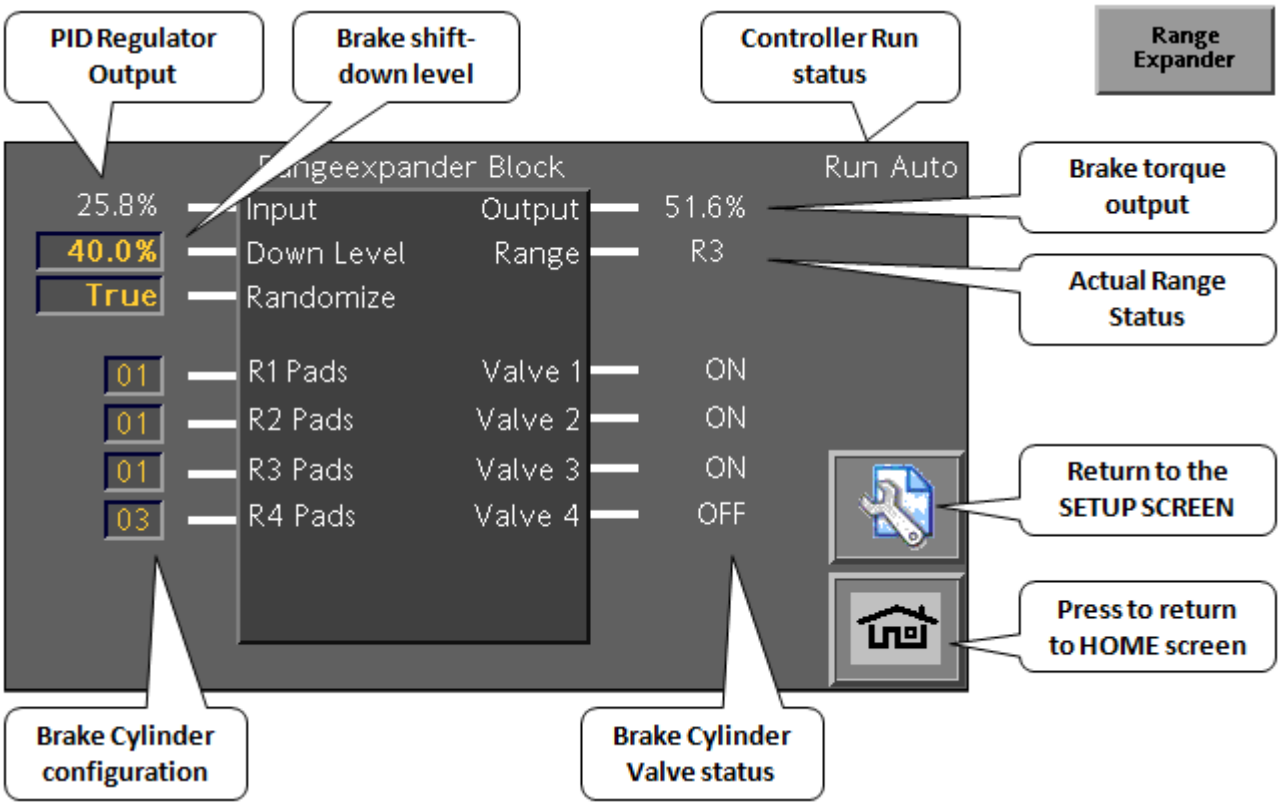


4.5 Step 5 “TEACH Load Cells



5 Optional Features

5.1 Rangeexpander

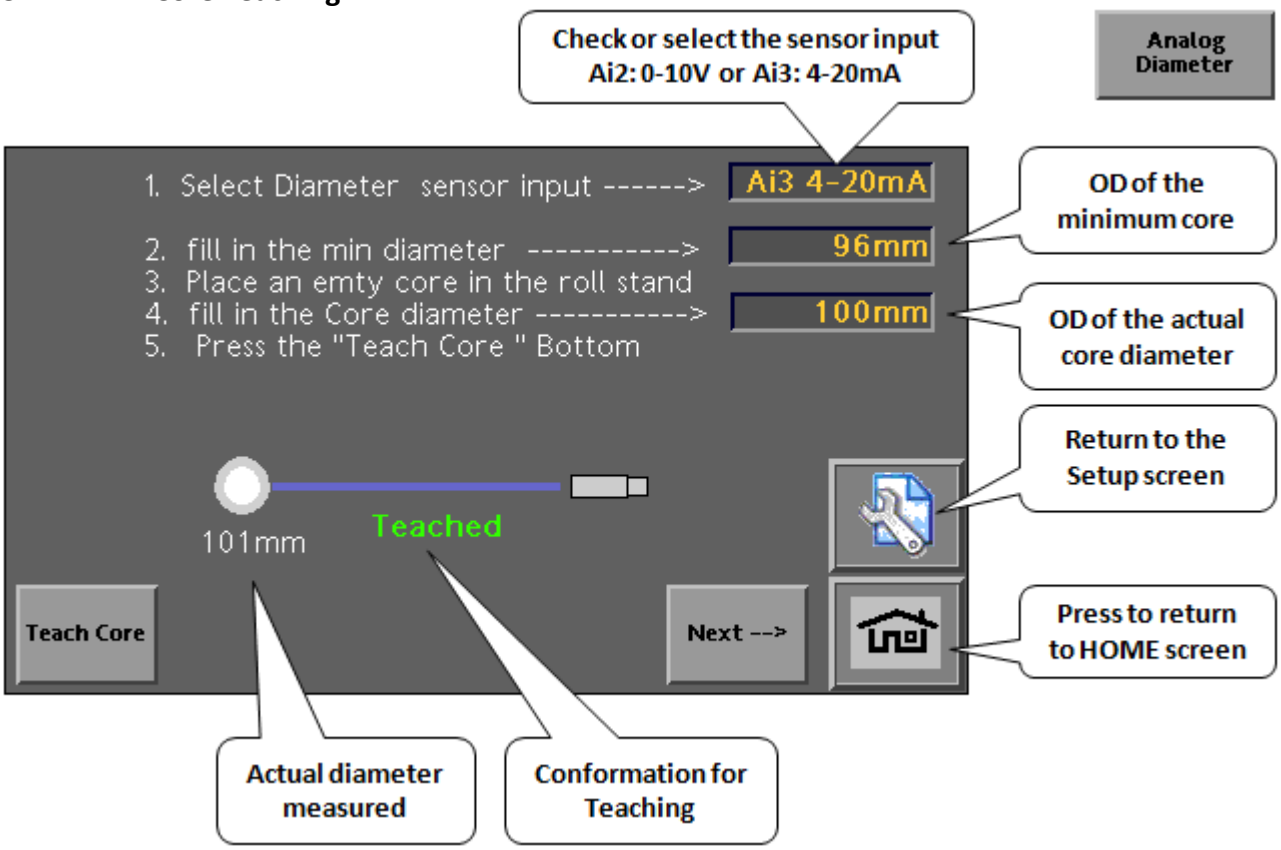


Parameter	Description	Value
Output	Output from Range Expander	0 – 100%
RE State	Actual Range status	R1 - R6
Valve 1-6	Actual valve status 1-6	False - True
Input	Input from PID controller	0 – 100%
Down Level	Threshold value for the new output	0 – 100% Default: 30%
Randomize	Function for even wear of friction pads	False – True Default: True
Pads R1 – R6	Number of friction pads per area (R1 – R6)	0 – 12 (Default: 1)

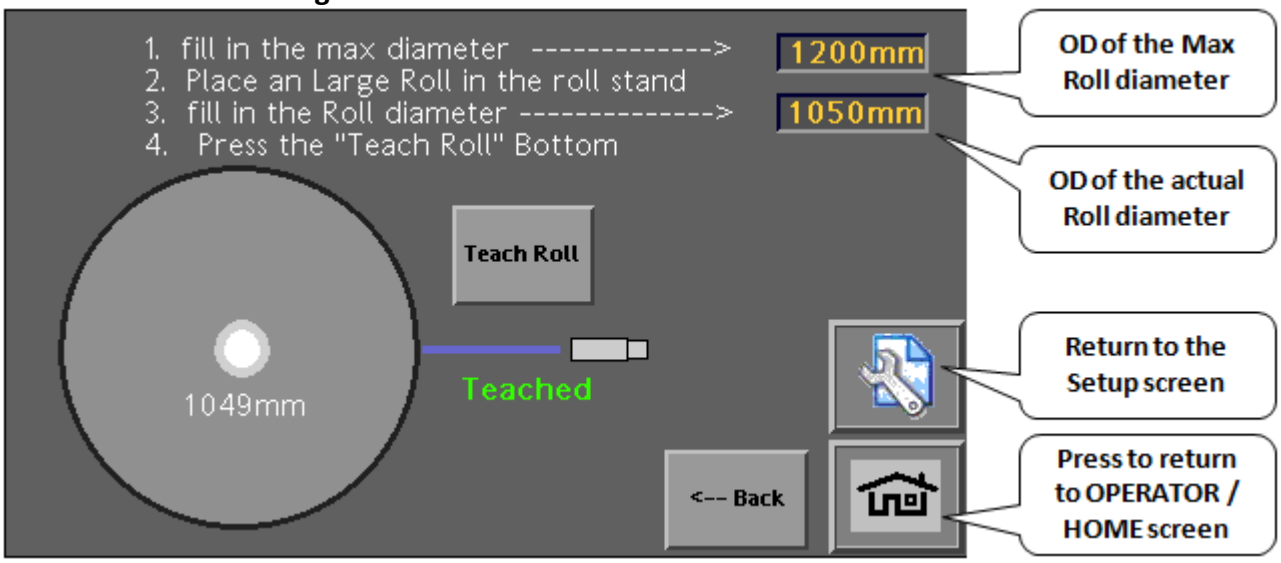
Note. The number of ranges is defined via the part number configuration

5.2 Analog Diameter measurement

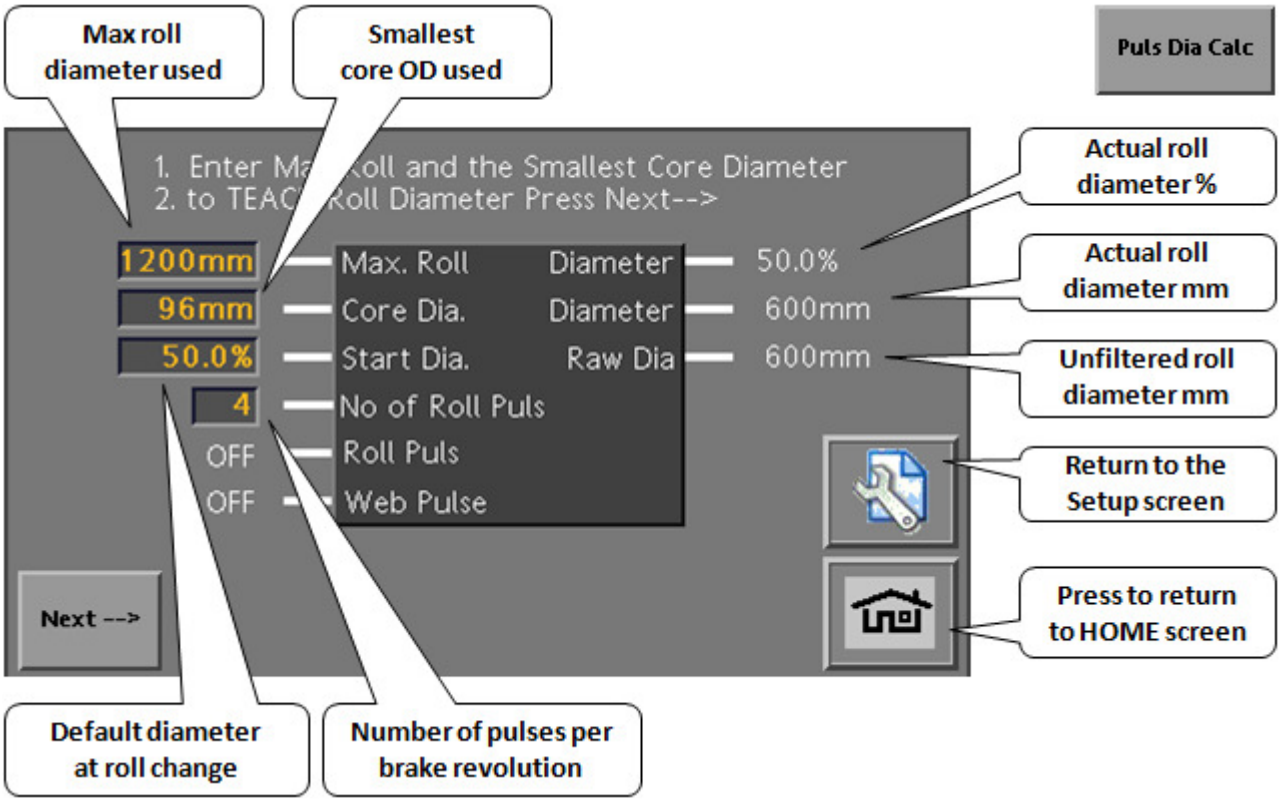
5.2.1 Core Teaching



5.2.2 Roll Teaching

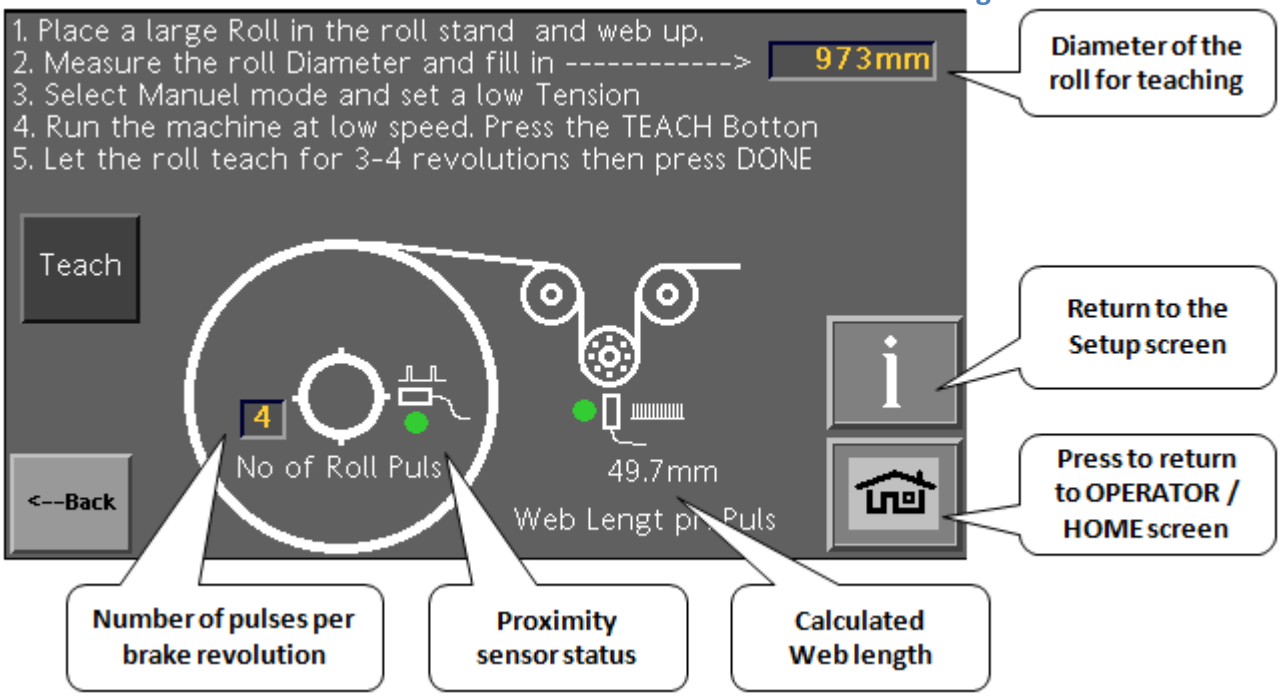


5.3 Pulse Diameter calculation



Parameter	Description	Value
Max. Roll	Entry field for max. roll diameter	0 – 3000 mm
Core Dia.	Entry field for core diameter	0 – 500 mm
Start Dia.	Start diameter for new roll	0.0 – 100.0 %
No of Roll Puls	Entry field for number of roll pulses of proximity switches	1 – 4

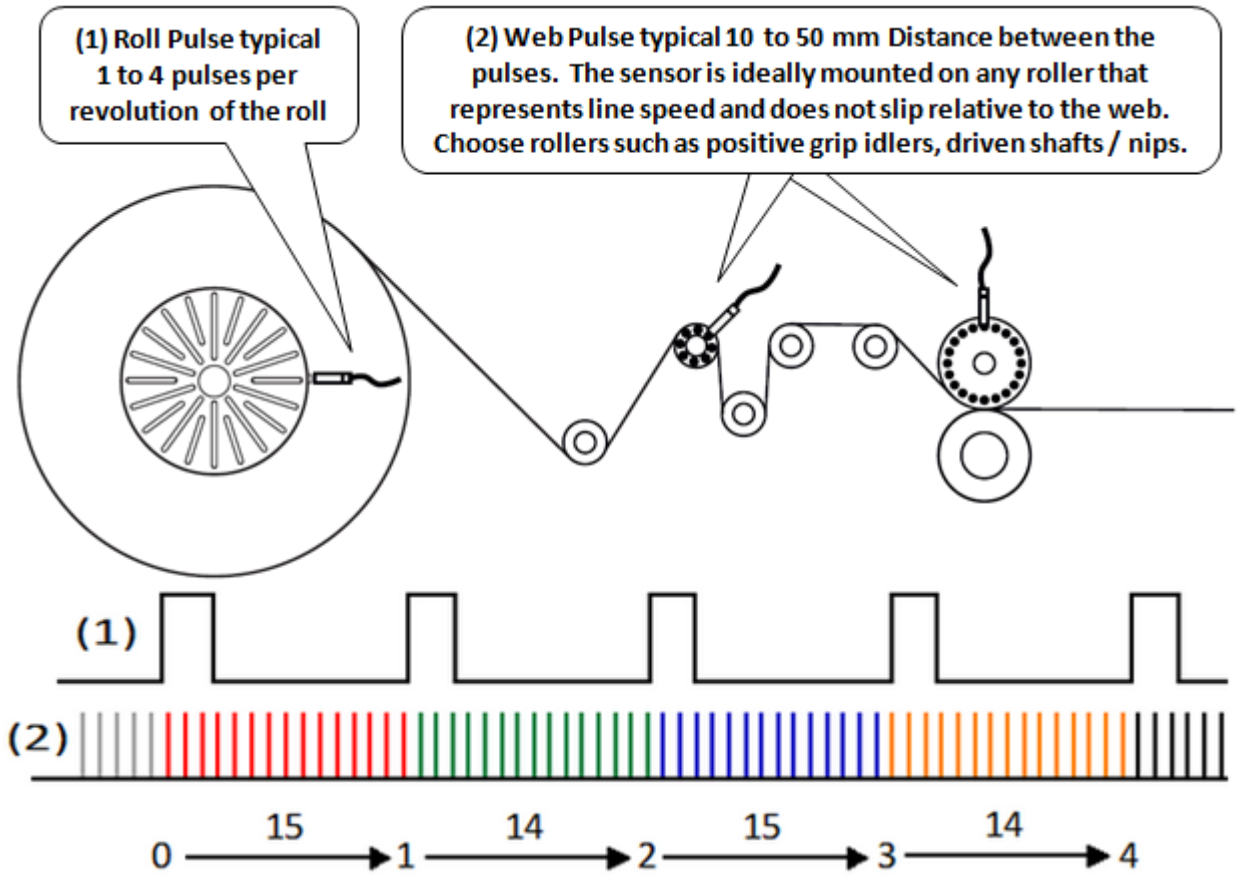
5.3.1 5.9.1 Teaching



5.3.2 Diameter calculation Description

Impulse-Diameter calculation through 2 proximity switches

The roll diameter is determined by 2 proximity switches, one of which captures the roll revolutions and the other the length of material passing through (material length impulse).



(1) The proximity switch captures 1 to 4 impulses per roll revolution.
(2) The proximity switch captures the length of material passing through per impulse.

The recommended length of material should be between 3 and 100 mm per impulse.

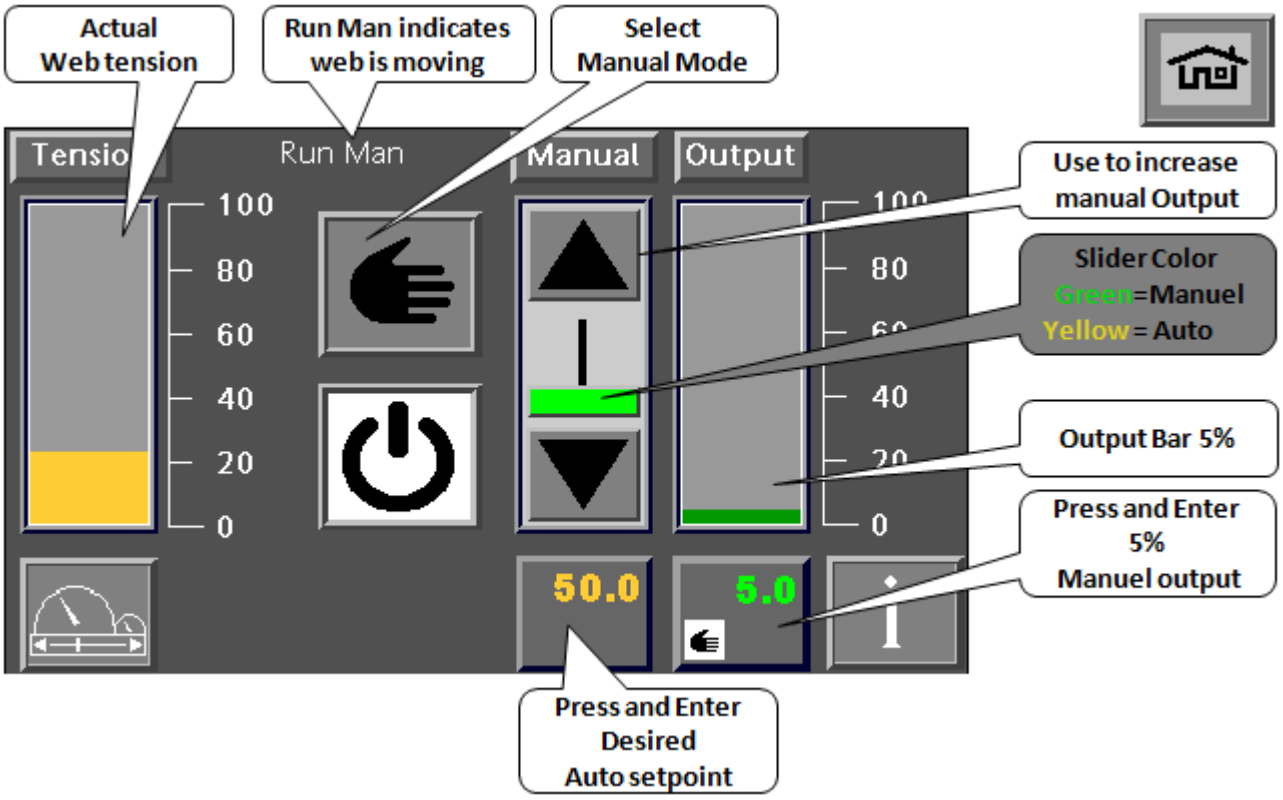
The diameter of the new roll is calculated as soon as the controller has received 2 impulses of the new roll.

Inductive sensor requirement depending on line speed

Housing	Range	Switching frequency	Design	Connection	Temperature range	Approval
M12 / L = 65 mm	3 mm	2000 Hz	M12	DC PNP (200mA)	-25...70 °C	cULus (CCC)
M12 / L = 65 mm	3 mm	4000 Hz	M12	DC PNP (200mA)	-25...70 °C	cULus (CCC)

Note: For machines faster than 600 meters/min (1800fpm), you must use a 4000 Hz sensor

5.4 Tuning



5.5 Small Roll:

1. Start with a Small roll in the machine. On the HOME screen, chose manual mode *the controller mode is **Manual*** and a 5% manual setting.
2. Run the machine at slow speed, observe that the controller mode changes to **Run Man** if the controller mode is still **Manual,** the controller is not receiving a run signal *Check wiring to the machine and make sure that the relay used for the machine Start/Stop signal is closing and opening when pressed or switched. If the switch is working but is inverted, then you will need to invert the start/stop signal (DI3) in the controller.*
3. While running the machine, adjust the Manual setpoint sliders to desired web tension
4. Enter the Auto setpoint to the desired web tension and change from  to 
5. Observe that the controller is regulating to the correct web tension. In MOST applications, *the default PI parameters in the controller will NOT need changed.*
6. Run the machine up to production speed and run the roll to the end and observe that the web tension is stable and constant within a few %. If the Tension is increasing towards the end of the roll, some additional tuning is required.

Note: the PI parameter that has the most effect on small rolls is **Min Gain**. Lower gain means it will be less responsive. Higher gain means it will be more responsive.

SEE ADDITIONAL PI TUNING SECTION FOR ASSISTANCE.

5.6 Large Roll:

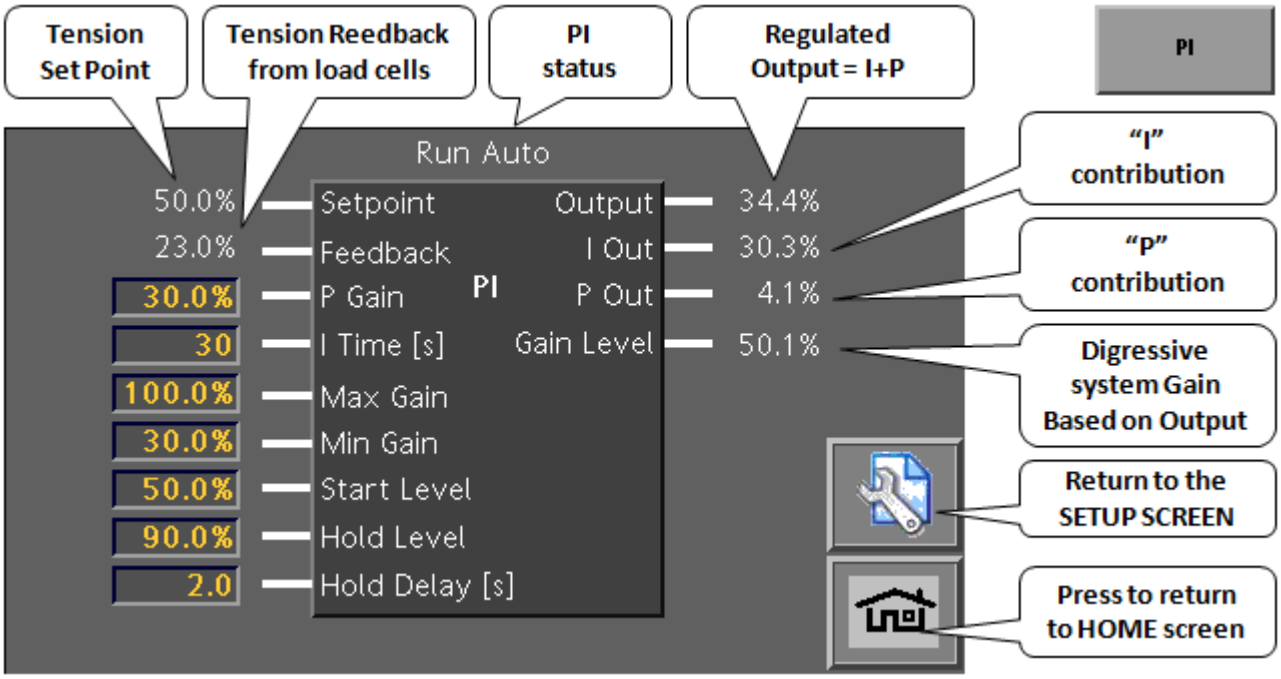
1. Keep the controller in Auto Mode  and change the roll to a large roll. Re-start the machine and turn the machine speed up and down and observe that the web tension and output is stable. *If the tension is jumping or erratic, it can be due to bad roll shape. To check to see if the roll quality is causing a problem with tension control, switch the controller from Auto*  *to Manual*  *and compare the tension variation in the 2 modes. If the tension is still erratic or jumpy, and the control output is stable (which in manual mode, the output is fixed) then the roll shape is probably causing a problem OR there is some other mechanical problem. These can sometimes be "Tuned Out" by turning the Max Gain down. Otherwise* some PI parameter tuning is required.
2. Perform Fast and auto stop of the Machine. If the web tension drops (i.e. becomes slack or drops to the floor) then consider setting up the Fast stop functions. SEE FAST STOP TUNING SECTION FOR ADDITIONAL ASSISTANCE.

Note: the PI parameter that has the most effect on large rolls is **Max Gain**. Lower gain means it will be less responsive. Higher gain means it will be more responsive.

SEE ADDITIONAL PI TUNING SECTION FOR ASSISTANCE

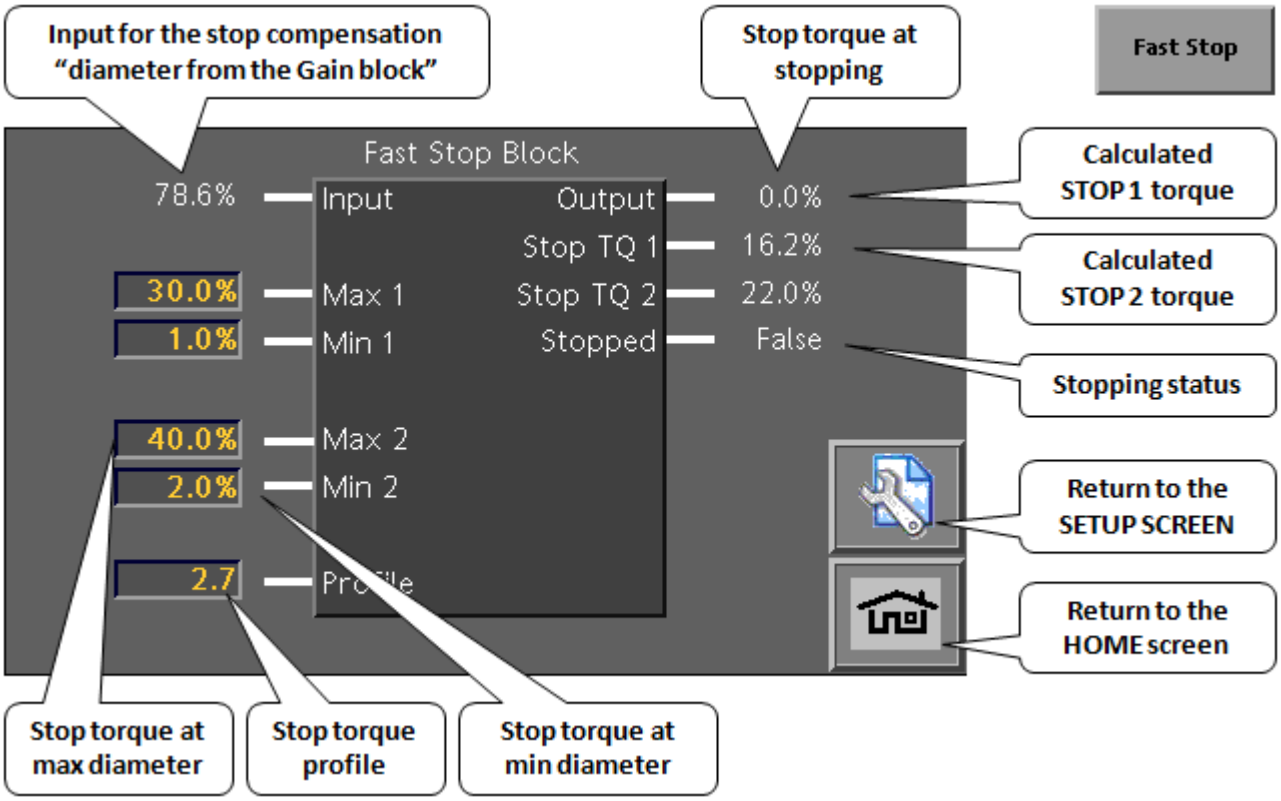
5.7 PI

The control algorithm uses a specially designed DYNAMIC GAIN FUNCTION that automatically takes roll size into consideration. The gain level automatically decreases or increases with roll size. The PI Regulator algorithm is specially designed for handling web tension in machines with booth small and large rolls due to the digressive internal gain control.



Parameter	Description	Value
P Gain	**Pout= Pgain x (Setpoint-Feedback) x Gain Level** Adjust **Pgain** at small roll if oscillation occurs	0– 300% Default: 20 %
I Time	Integration time "Ramp time" of the regulator. If the time is too small, the output will not stabilize at large rolls; the symptom is called "waving" and is similar to oscillating but more slowly.	0 – 200 s Default: 15s
Max. Gain	This controls how fast the controller reacts at at large output. It has the most effect on **LARGE ROLLS**.	0– 300 % Default: 100%
Min. Gain	This controls how quickly the control reacts at small output. It has the most best effect on **SMALL ROLLS**. If the controller is not reacting fast enough and tension is increasing as the roll gets smaller, Increase this value. If the controller is reacting too quickly and tension is oscillating as the roll becomes smaller, Decrease this value.	0– 100% Default: 30%
Start Level	Output=Start Level*Setpoint. This is the level that the controller will start with when you start a new roll and turn "Tension Off" to "Tension On"	0– 100% Default: 50%
Hold Level	This is the level that the controller will go to when the machine is stopped. It is a percentage of the most recent output when you stopped the machine	
Hold Delay	This is the amount of time, in seconds, that the controller will wait before it goes into HOLD mode. The timer is activated when the RUN signal is removed .	0-30sec Default: 2s

5.8 Fast Stops



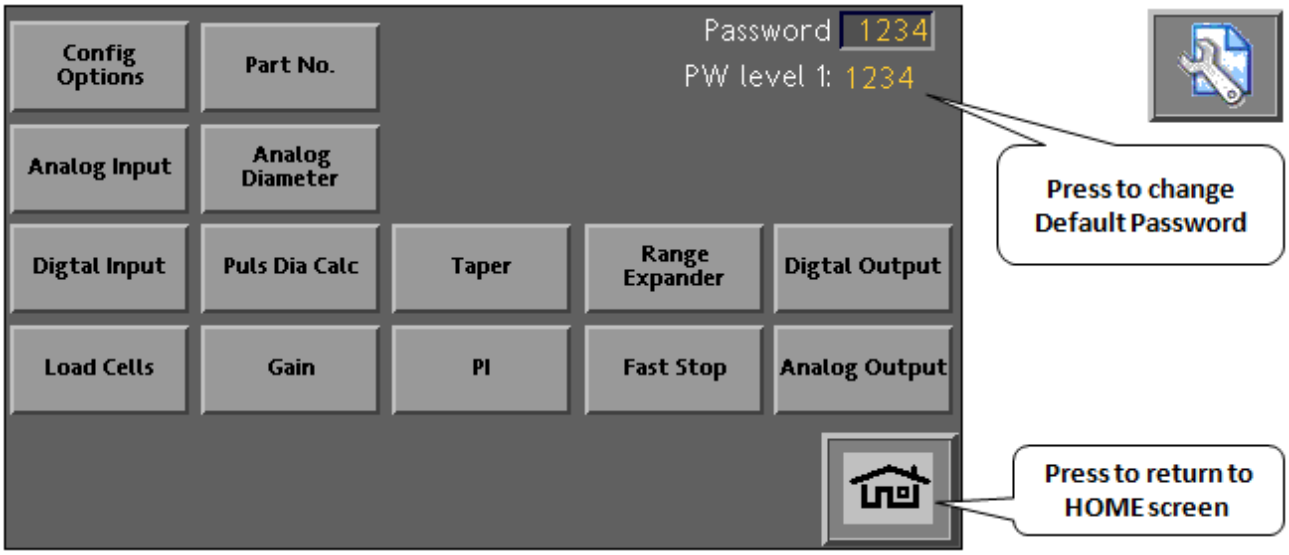
Parameter	Description	Value
Max. 1	Contribution at max. roll diameter for 'Stop 1 signal'	0.0 – 100.0 % Default: 40.0%
Min. 1	Contribution at min. roll diameter for 'Stop 1' signal'	0.0 – 100.0 % Default: 1.0%
Max. 2	Contribution at max. roll diameter for 'Stop 2' signal'	0.0 – 100.0 % Default: 80.0%
Min. 2	Contribution at min. roll diameter for 'Stop 2' signal'	0.0 – 100.0 % Default: 2.0%
Profile	Gain characteristic (max. To min. roll diameter)	– 3.0* Default: 2.7

* 1.0 = linear course of gain from max. to min. roll diameter
  3.0 = max. progression of gain (diameter ^{3} ≈ inertia)

6 Parameter Menu

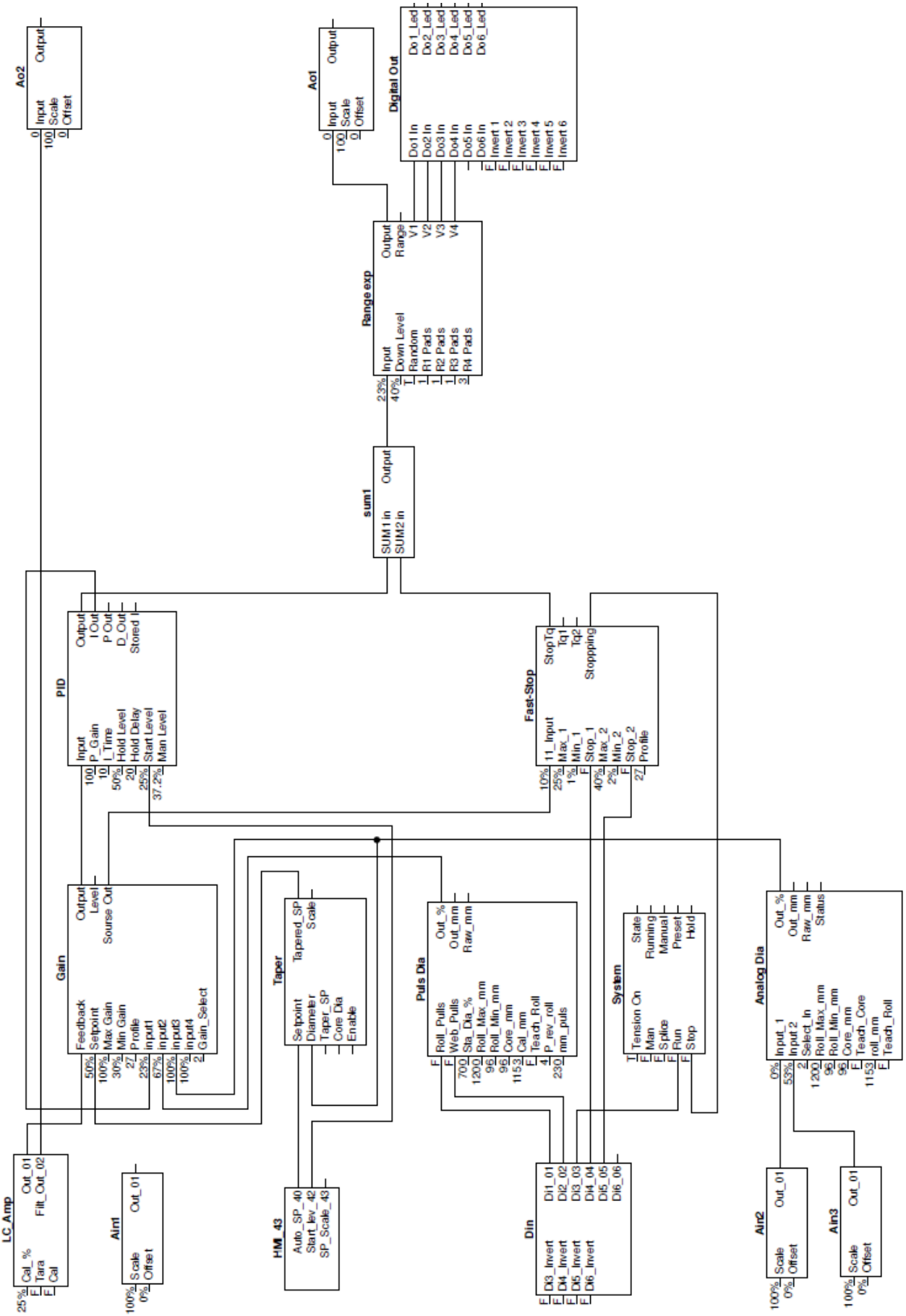
From the Status screen: press  to get to the general Setup screen:

6.1 Setup Screen

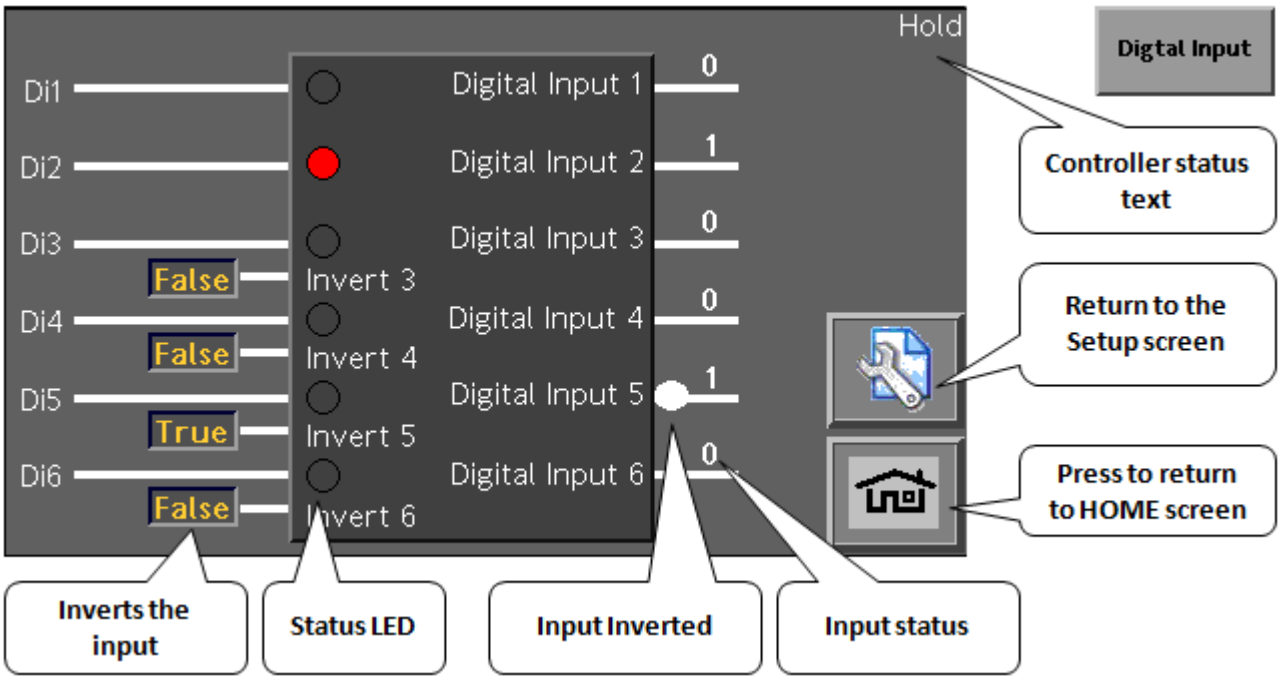


From here, you can, via the buttons, access the individual function blocks.
Note: The number of available blocks on the screen will depend of the controller configuration.

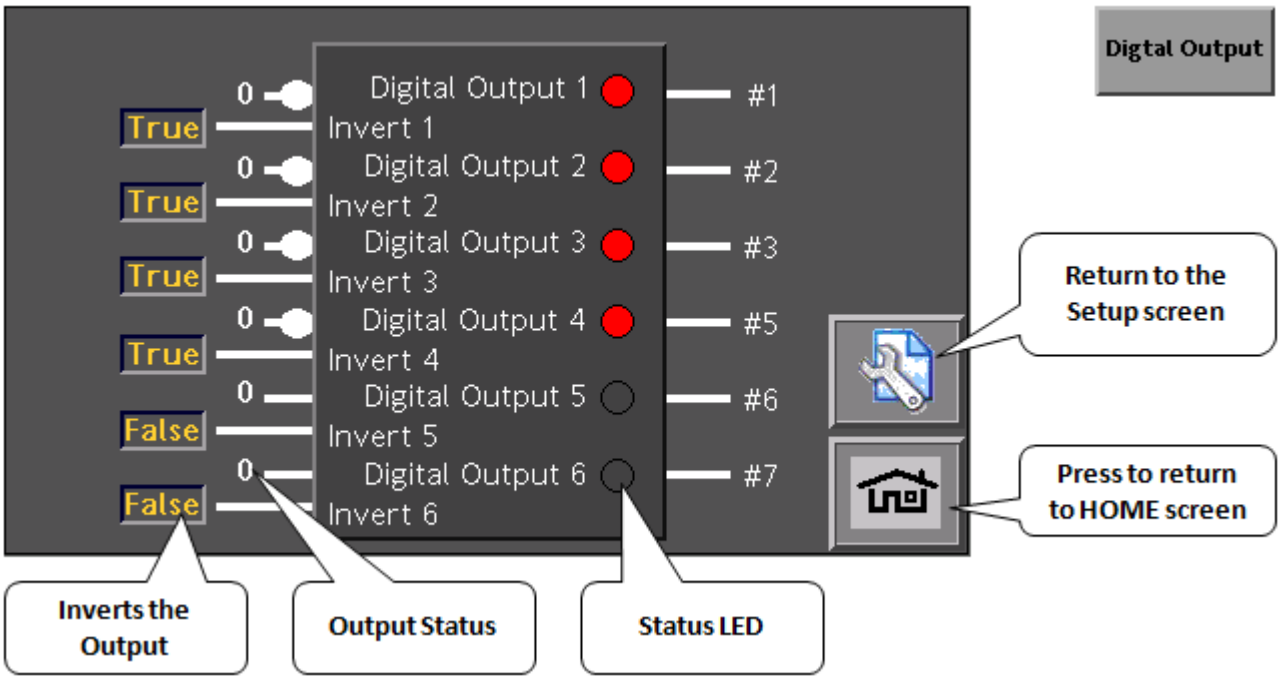
6.1.1 Block diagram



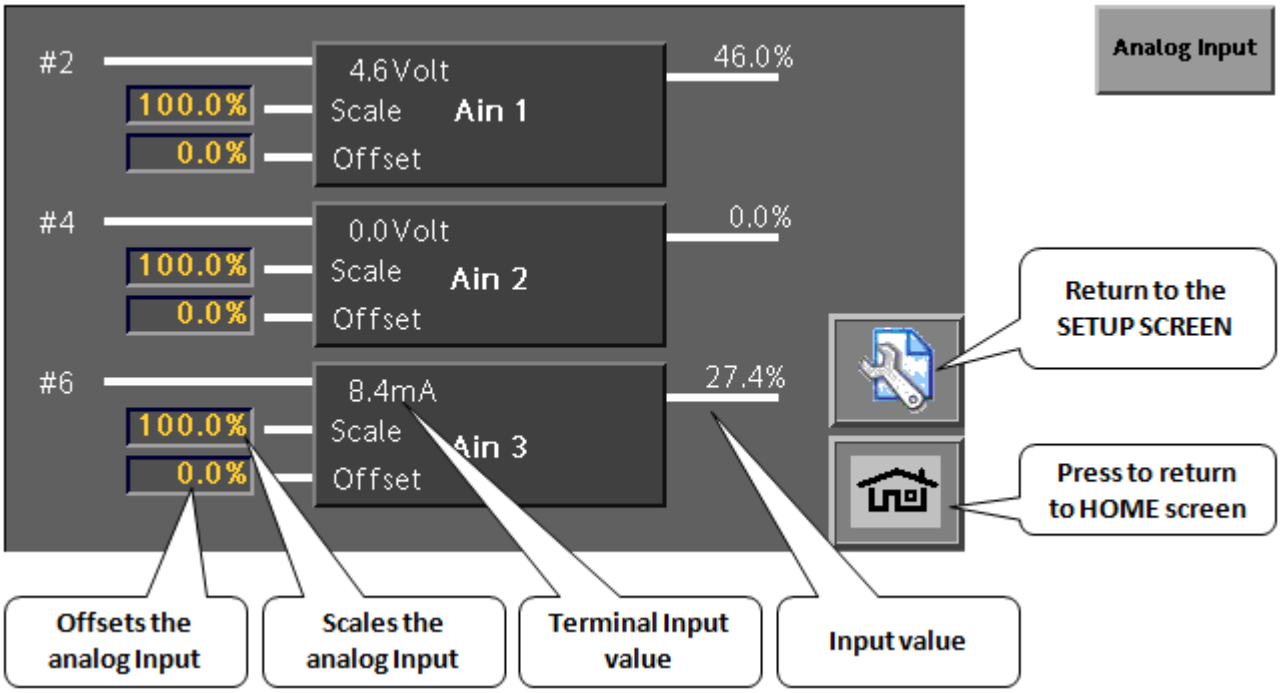
6.2 Digital Inputs



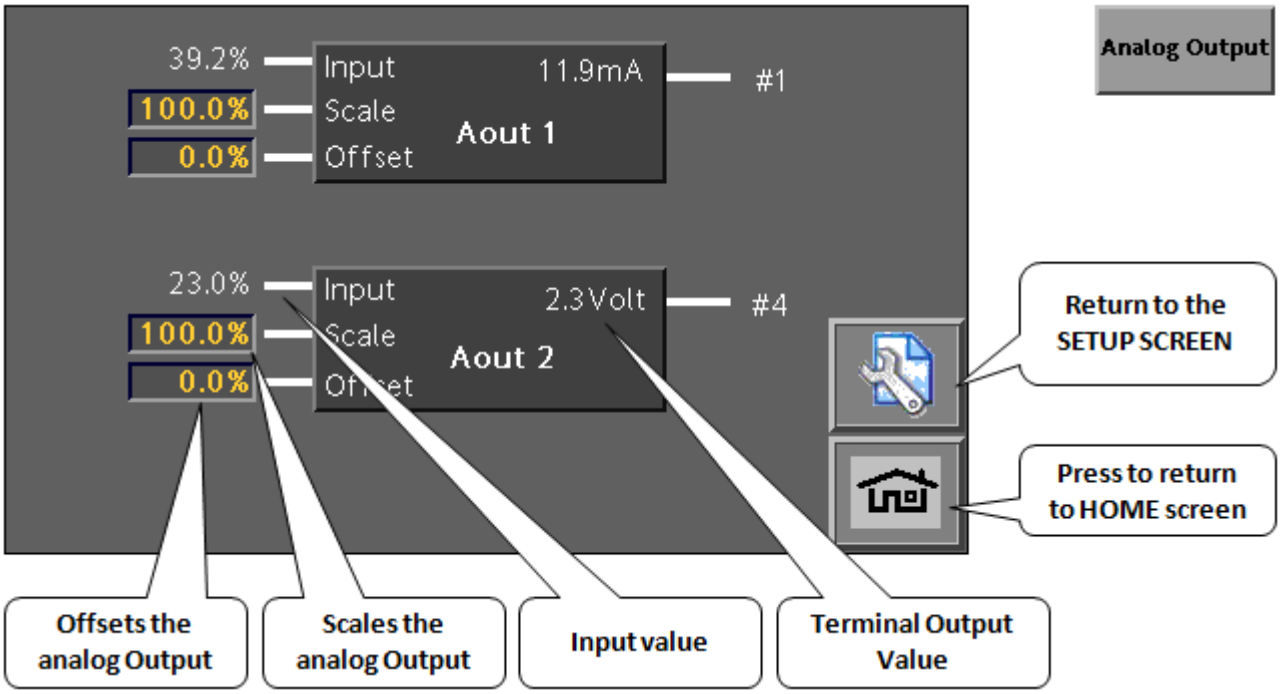
6.3 Digital Outputs



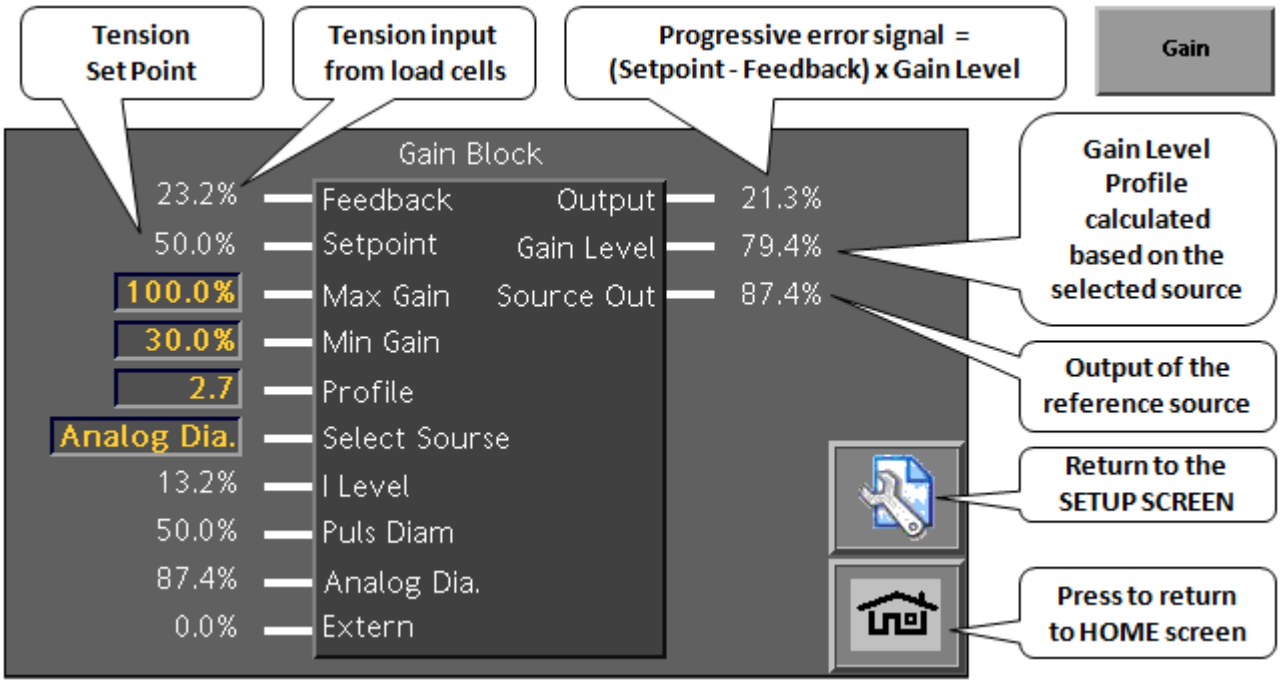
6.4 Analog Inputs



6.5 Analog outputs



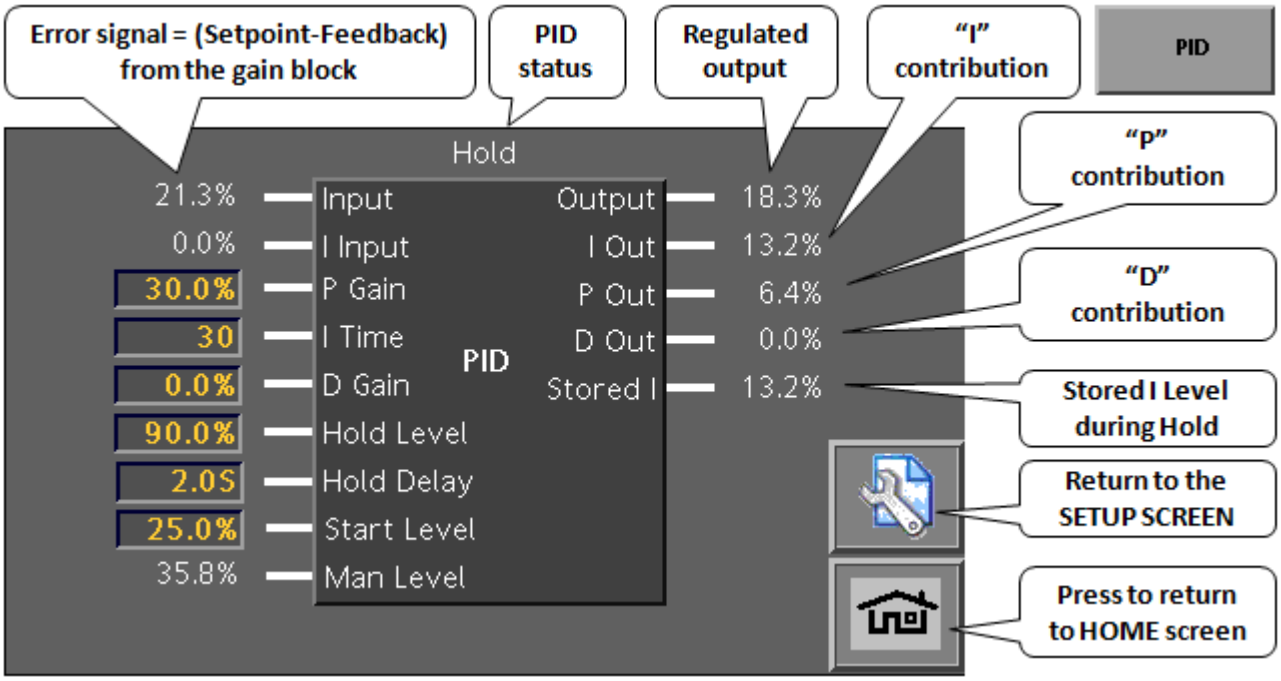
6.6 Gain setup screen



Parameter	Description	Value
Max. Gain	Gain value at max. roll diameter	– 300.0 % Default: 100.0 %
Min. Gain	Gain value at min. roll diameter	– 100.0 % Default: 30.0 %
Profile	Gain characteristic (max. To min. roll diameter)	– 3.0* Default: 1.0
Select Source	Select source of Error - Gain characteristic	1=I Level (Default) 2=Puls Dia. 3=Analog Dia. 4=Extern
I Level	Integrator level of PID controller	0.0 – 100.0 %
Puls Dia.	Calculated roll diameter through proximity switches	0.0 – 100.0 %
Analog Dia.	Measured roll diameter through Ultrasonic- / Laser-Sensor	0.0 – 100.0 %
Extern	Free input for an external source	0.0 – 100.0 %

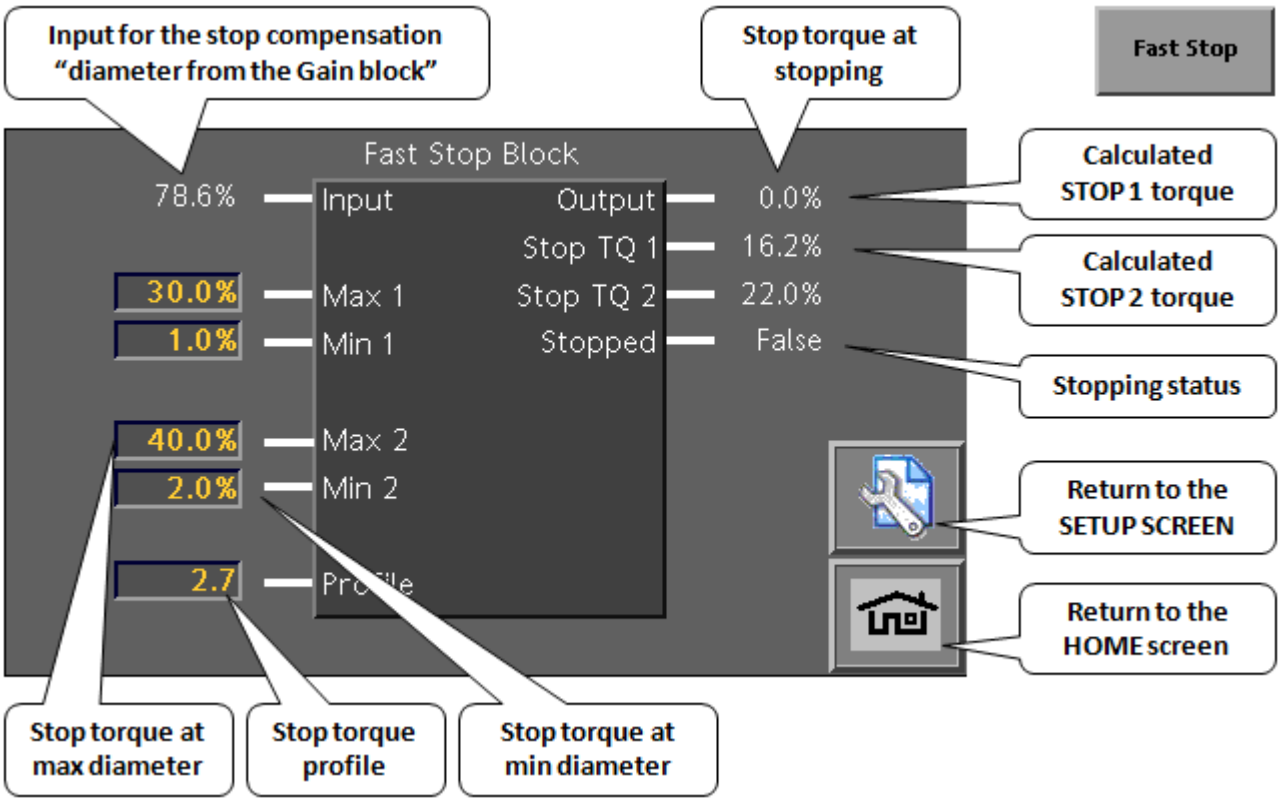
* 1.0 = linear course of gain from max. to min. roll diameter
  3.0 = max. progression of gain (diameter ^{3} ≈ inertia)

6.7 PID parameters setup



Parameter	Description	Value
P Gain	Gain value of P-share	0.0 – 300.0 % Default: 20 %
I Time	Re-adjustment time of I-share	0 – 200 s Default: 15 s
D Gain	Gain value of D-share	– 300.0 % Default: 0.0 %
Hold Level	Hold level of I-share (at maschine standstill)	– 300.0 % Default: 90.0 %
Hold Delay		
Start Level	Start level of I-share (after roll change)	– 100.0 % Default: 25.0 %
Man Level	Manual adjustment of I-share (P + D not activ)	0.0 – 100.0 %

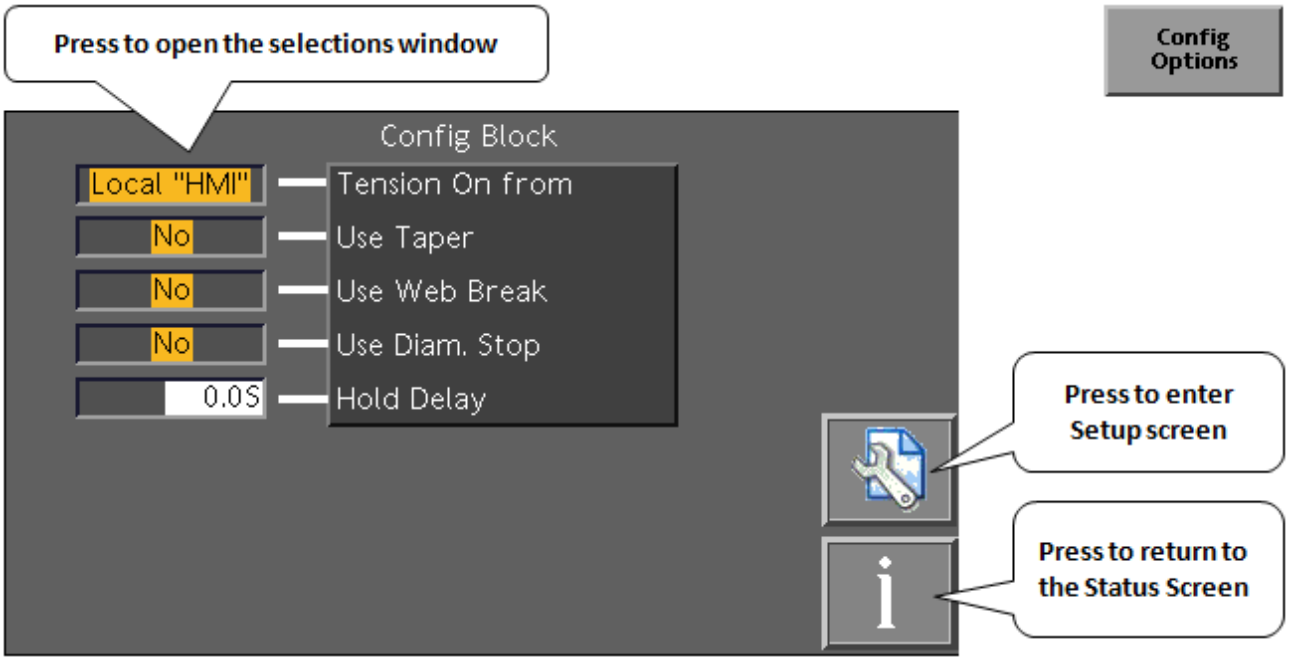
6.8 Fast Stops



Parameter	Description	Value
Max. 1	Contribution at max. roll diameter for 'Stop 1'	0.0 – 100.0 % Default: 40.0%
Min. 1	Contribution at min. roll diameter for 'Stop 1'	0.0 – 100.0 % Default: 1.0%
Stop 1	Activation of calculated contributory value for 'Stop 1'	False - True
Max. 2	Contribution at max. roll diameter for 'Stop 2'	0.0 – 100.0 % Default: 80.0%
Min. 2	Contribution at min. roll diameter for 'Stop 2'	0.0 – 100.0 % Default: 2.0%
Stop 2	Activation of calculated contributory value for 'Stop 2'	False - True
Profile	Gain characteristic (max. To min. roll diameter)	– 3.0* Default: 2.7

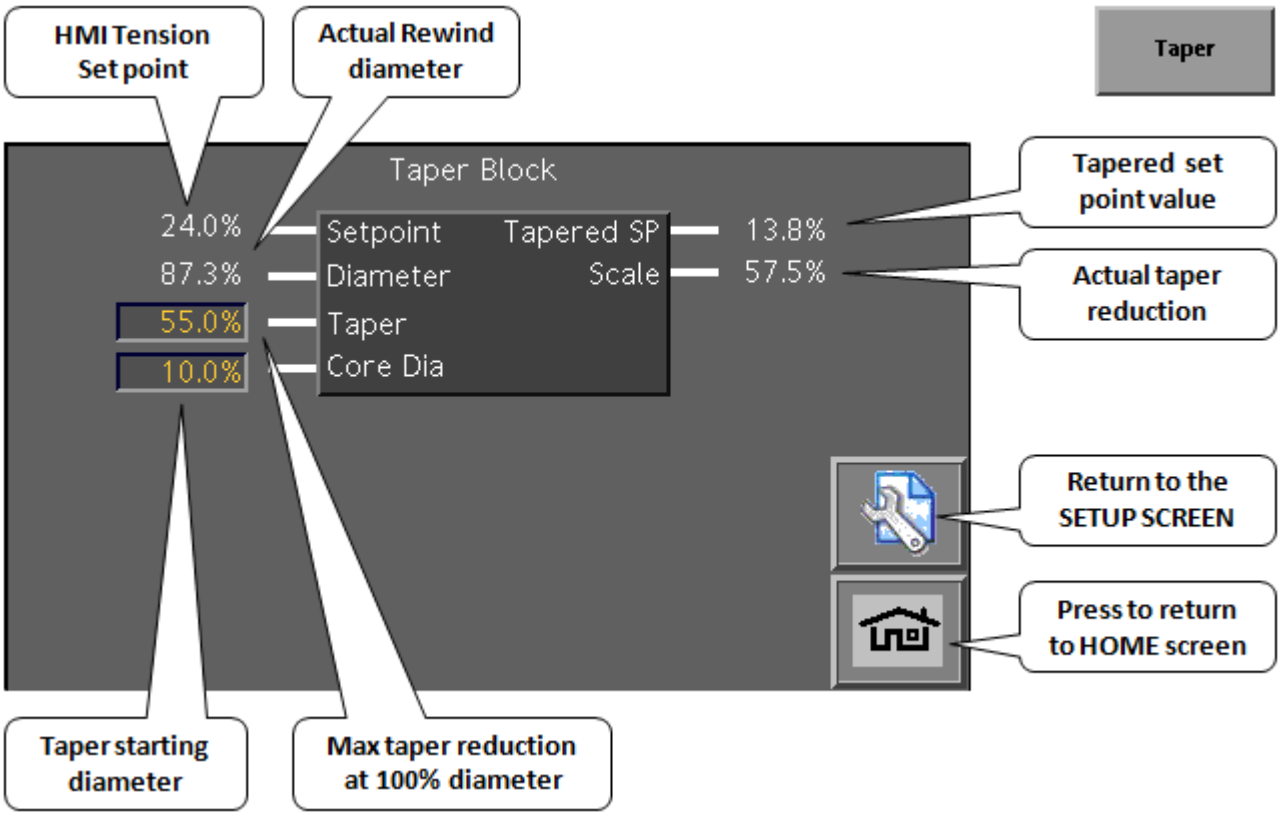
* 1.0 = linear course of gain from max. to min. roll diameter
  3.0 = max. progression of gain (diameter ^{3} ≈ inertia)

6.9 Config Screen “optional functions”



Tension On From: selection HMI or Digital input 6

6.10 Taper tension



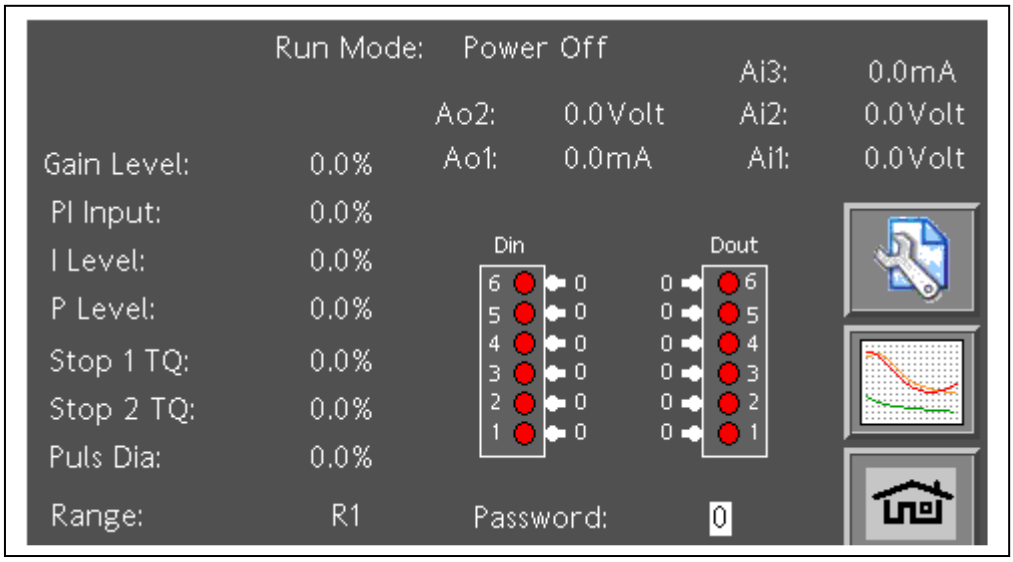
Parameter	Description	Value
Output	Output from Range Expander	0.0 – 100.0 %
RE State	Actual Range status	R1 - R6
Valve 1-6	Actual valve status 1-6	False - True
Input	Input from PID controller	0.0 – 100.0 %
Down Level	Threshold value for shift down of Range Expander	0.0 – 100.0 % Default: 30.0%
Randomize	Function for even wear of friction pads	False – True Default: True
Pads R1 – R6	Number of friction pads per area (R1 – R6)	0 – 12 (Default: 1)

Note. The number of ranges is defined via the part number configuration

7 Status Screen and Chart recorder

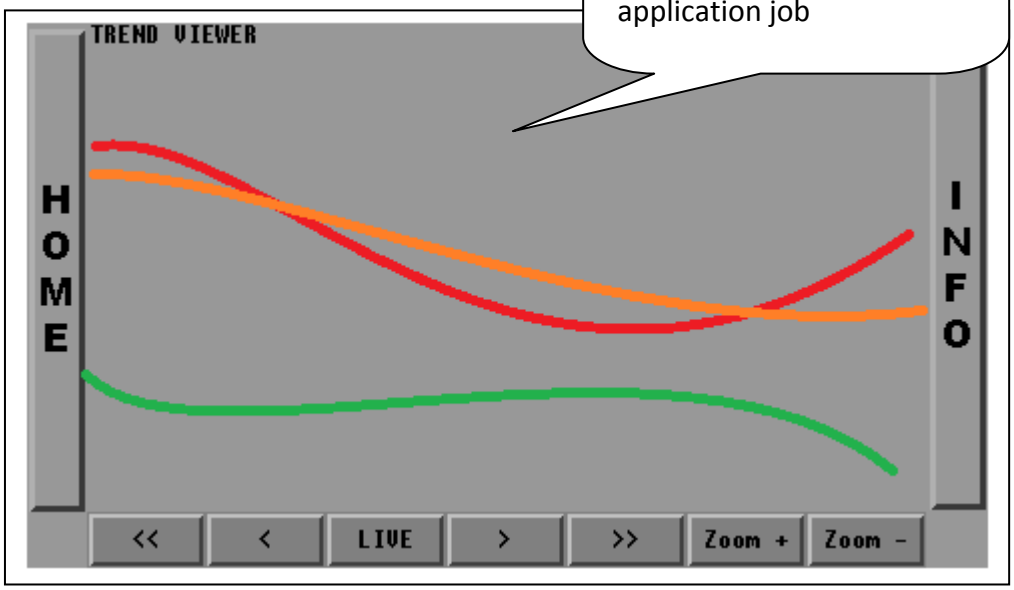
If the system experiences a power-down situation, the controller status i.e. setpoints and mode are stored. *At power on, the controller returns to the stored status.*

Use the Status page, press :



Use the built in Chart Viewer for analysis of the present running application .

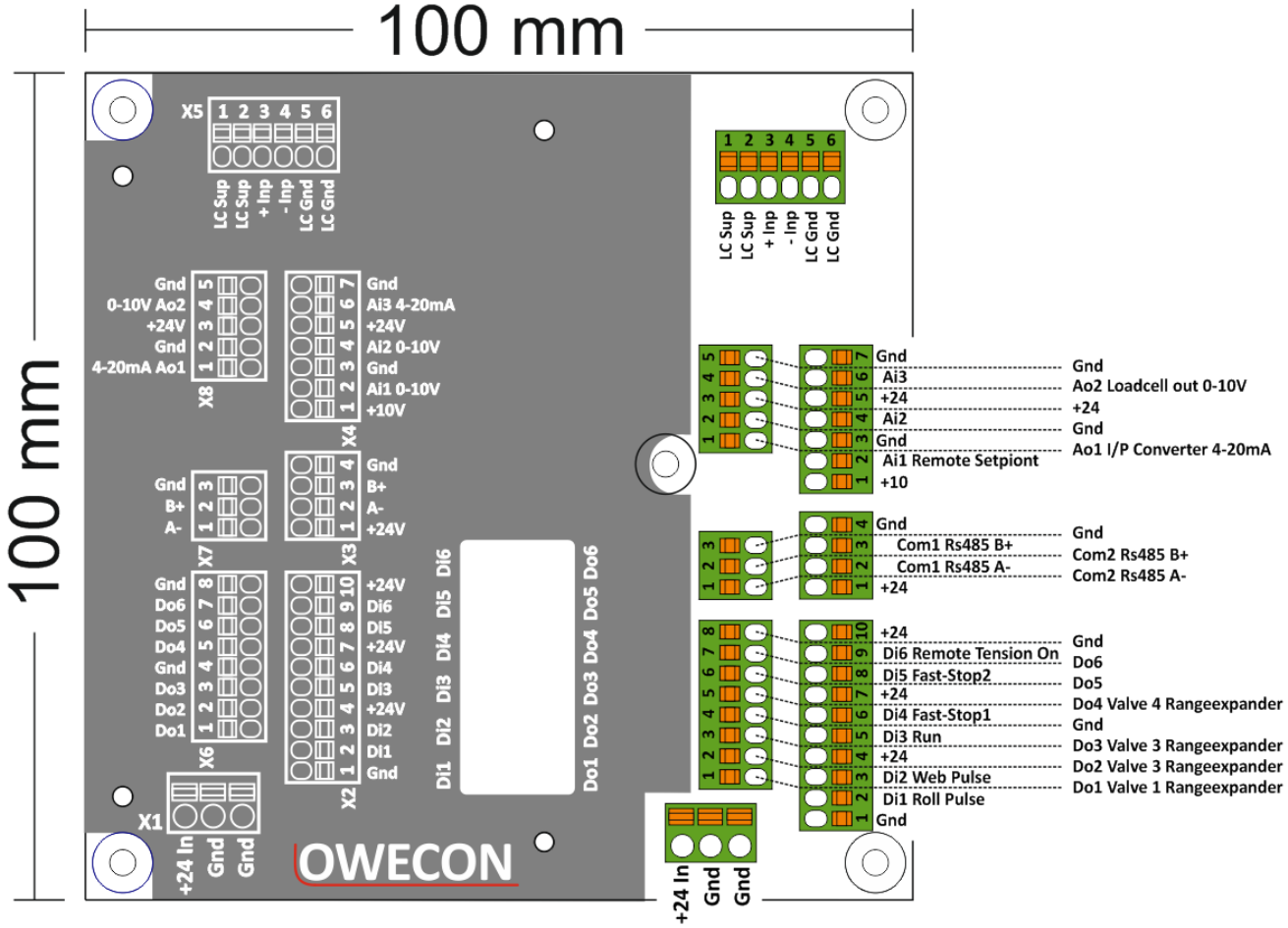
Press:



8 Apendix a

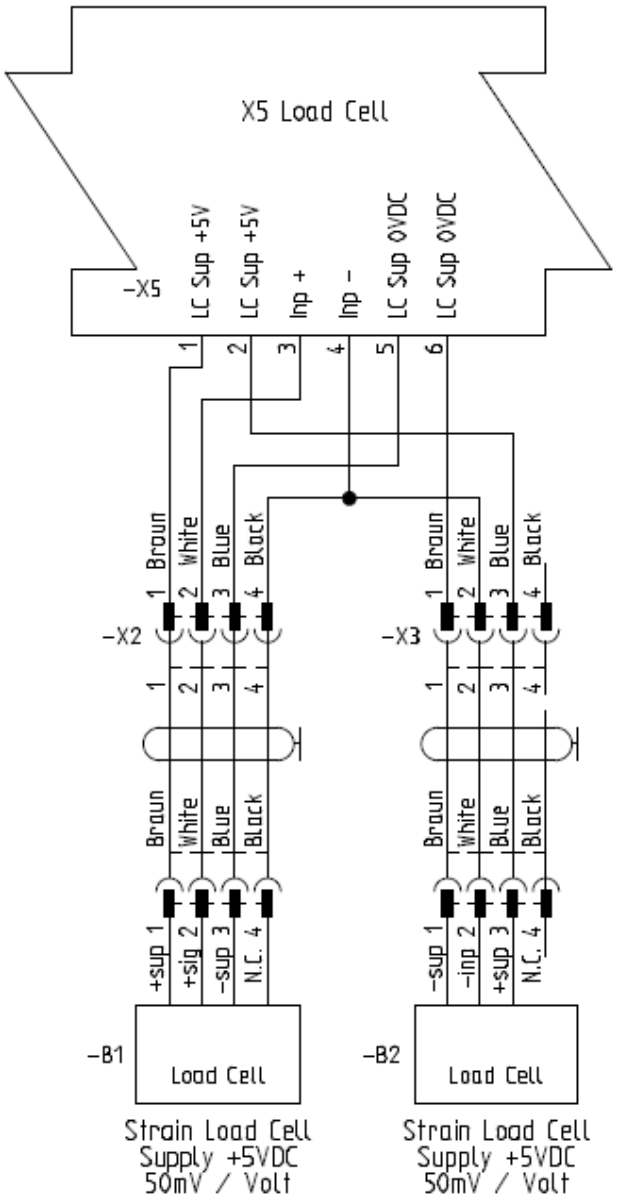
8.1 Wiring Diagrams

8.1.1 PCB Comtroller terminals

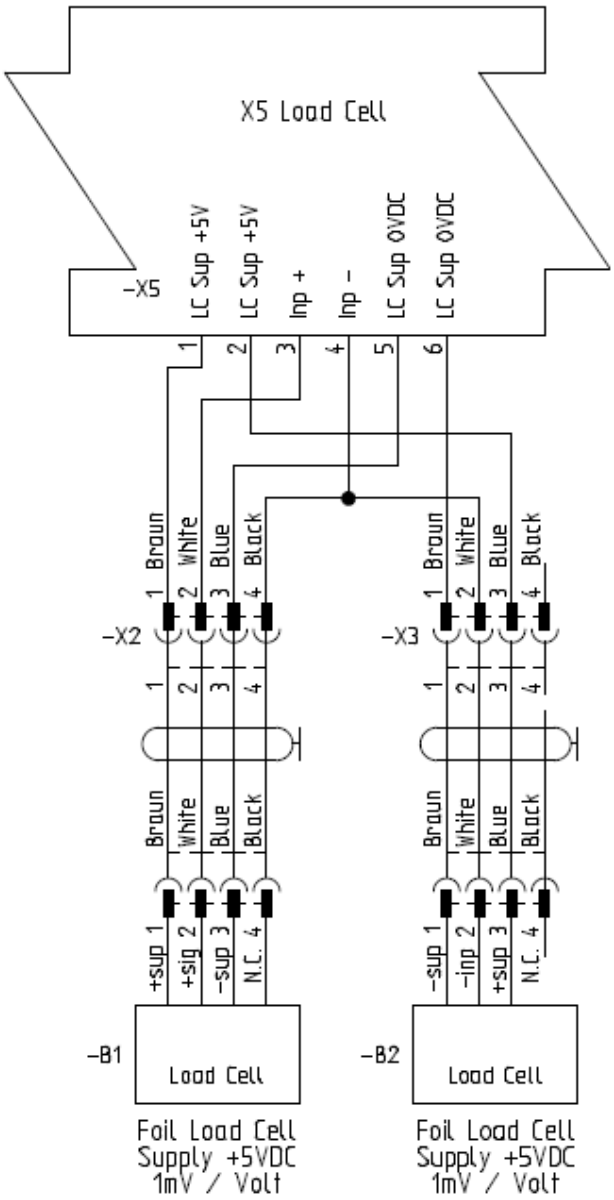


8.1.2 Load cell diagram

Strain Load cell

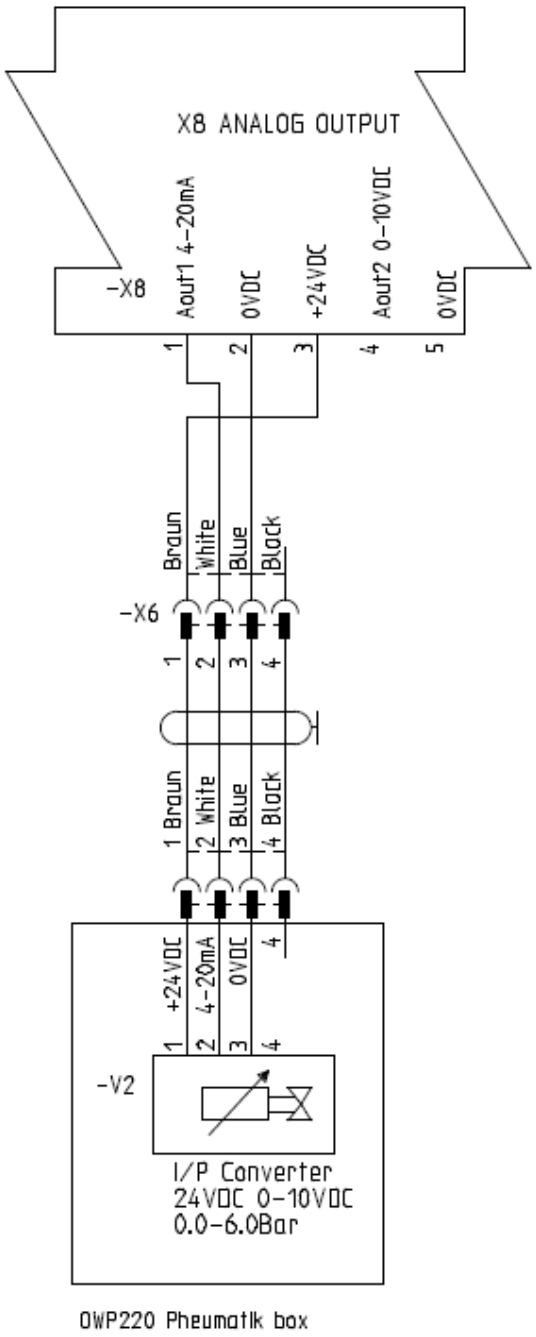


Foil Load cell

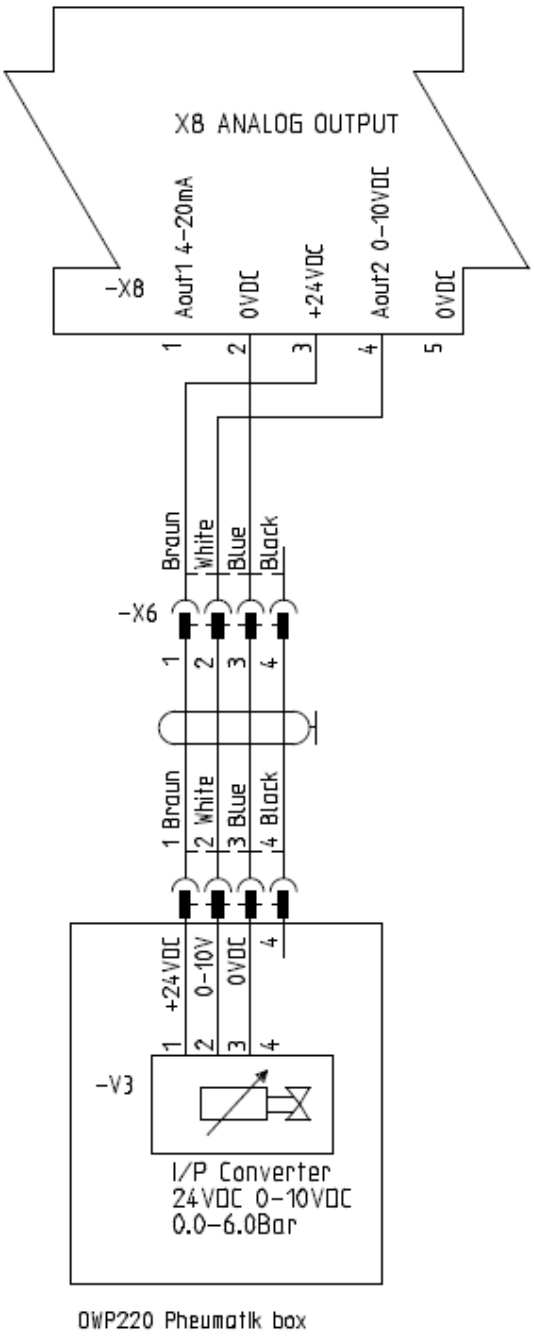


8.1.3 IP Converter diiagram

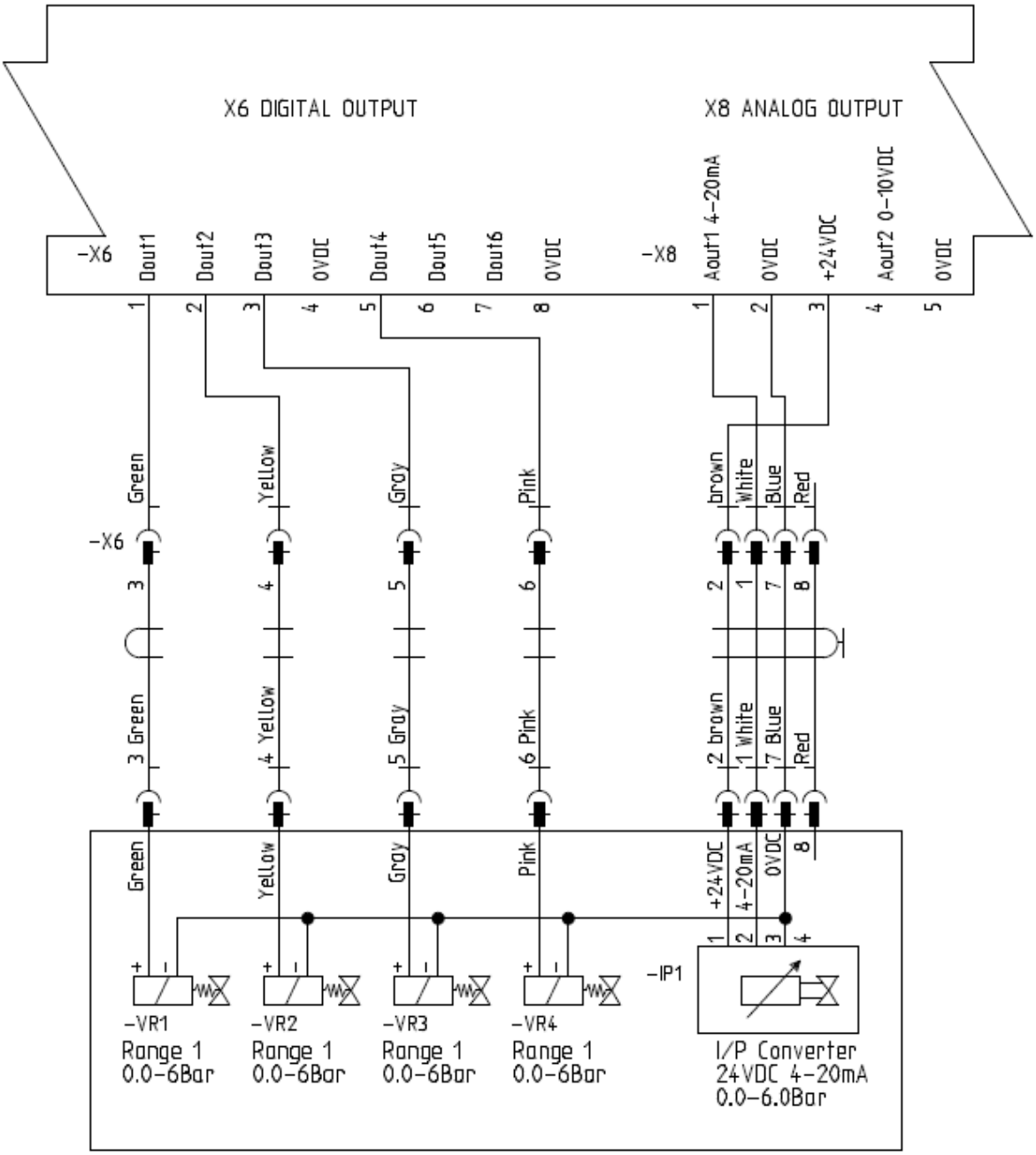
4-20mA Connection



0-10VDC Connection

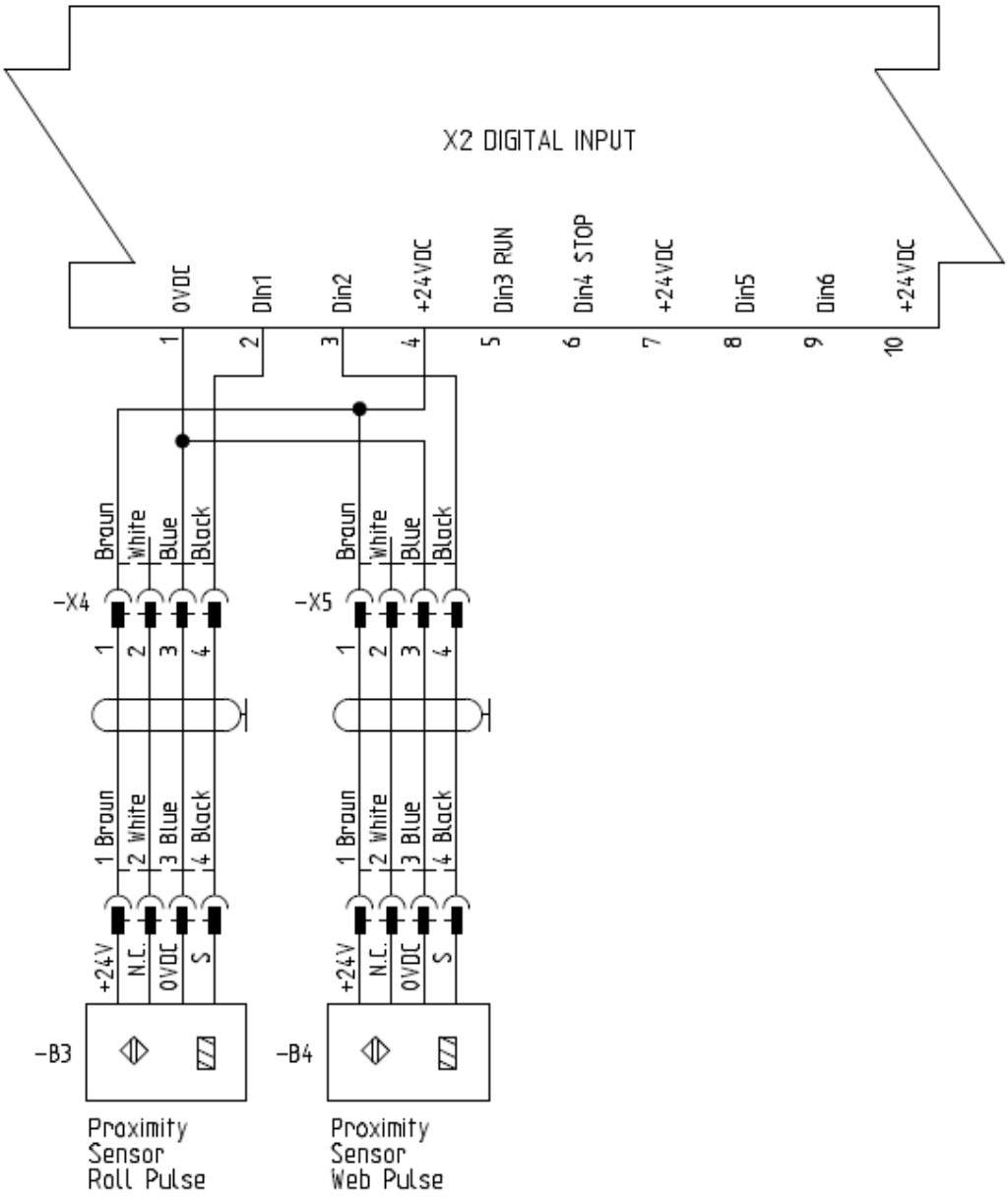


8.1.4 Range expander diagram



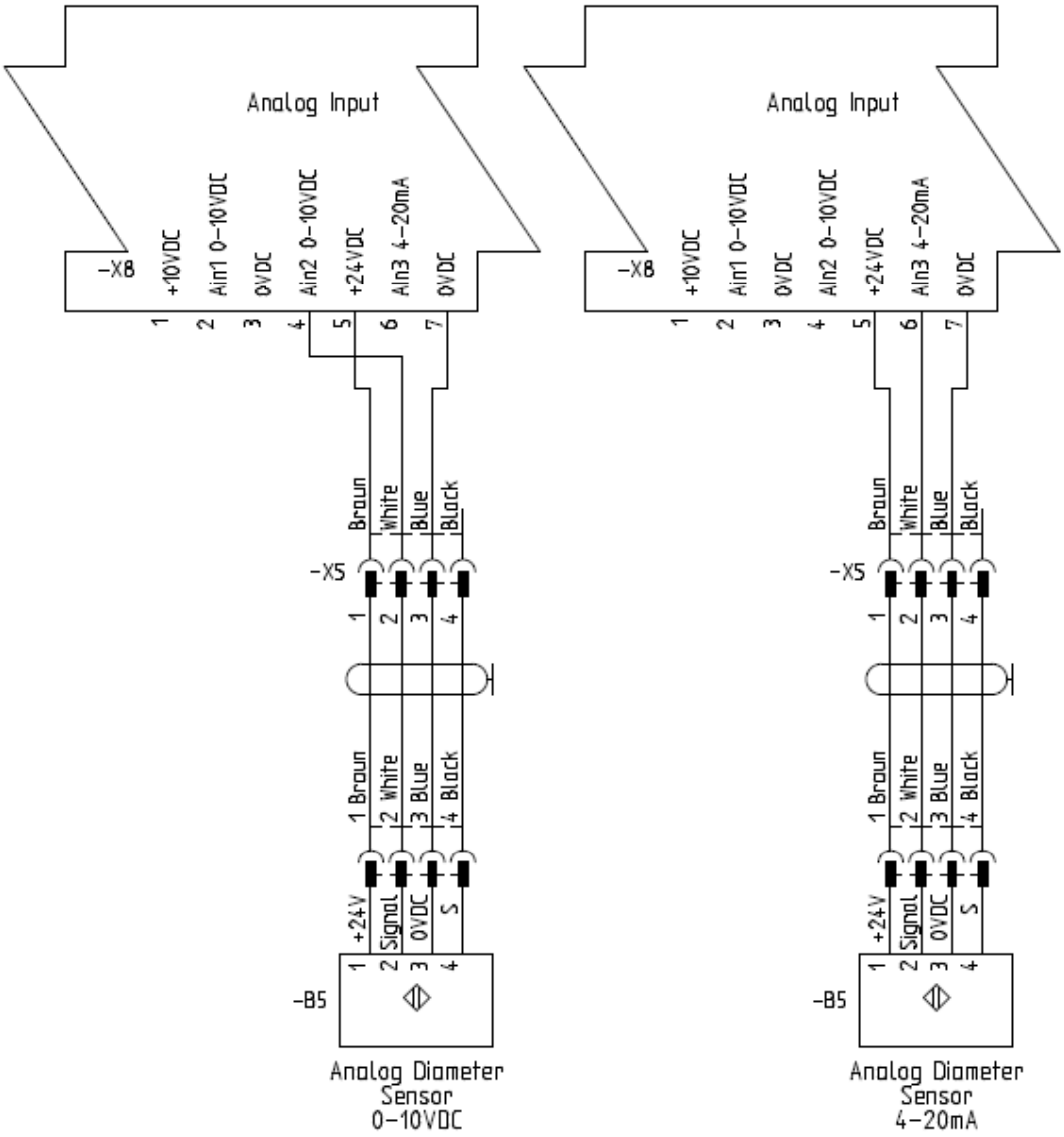
OWP224 Pneumatik box with Range valves and IP Converter

8.1.5 Proximity sensor Puls diameter



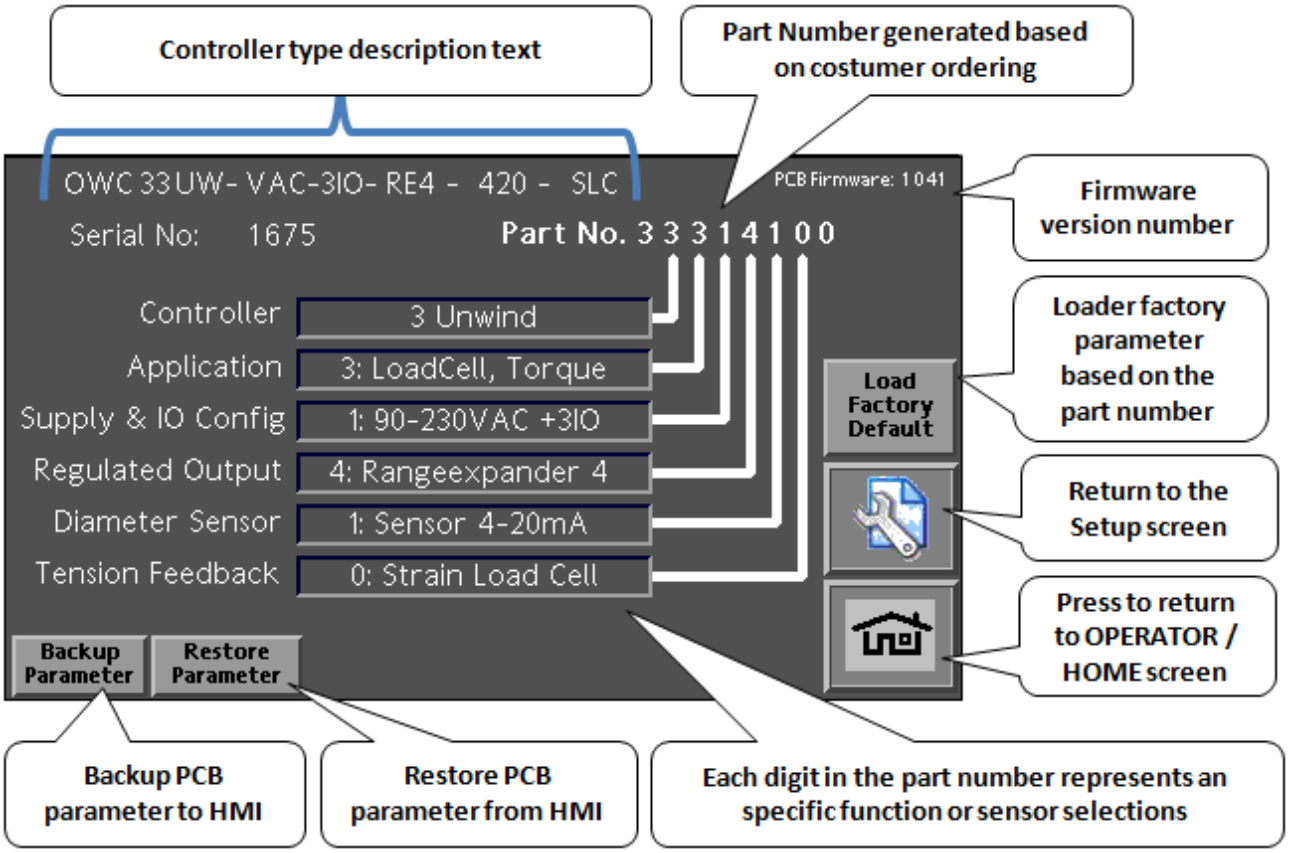
8.1.6 Analog Diameter Sensor

mk



9 Part Number and ordering info

9.1 Part Number Screen



The controller configuration is based on the part number to insure optimal costumer configuration and spare parts handling

In case of an defective PCB or operator HMI the system is capable of re programming the components for further information contact costumer service

9.2 Part Number Selection plan