

Steam Mains Warm-up System with Pressure Maintaining and Pressure Reducing functionality



Advanced multi-function controller for:-

- automatic warming-through following a pre-programmed sequence to prevent water hammer,
- accurate pressure reducing control of the PRV, and simultaneously
- pressure maintaining of boiler pressure to ensure it does not fall below trip out value.

Built-in real time clock for setting the "on" and "off" times each day, with provision to remain "off" at weekends.

All pre-configured for "plug & play" system.

Adjustable warm-up time before main isolating valve opens.

Manual override to close main valve from the controller

Use of separate warming and isolation valves prevents 'wire drawing' and valve seat damage

Saves energy by allowing whole steam systems or sections to be shut down automatically.

General

This system will allow a controlled warming up of the steam mains at the start of the day, then control the steam pressure downstream of the steam valve to the required set point value, and shutdown the steam valve at the end of the process day or week. As the boiler is isolated, the heat and pressure are maintained in the shell in readiness for hot starting at the commencement of the daily working procedures.

As an additional feature, the system also monitors the steam boiler pressure, and should it drop below a preset value, the steam valves will automatically be throttled, to allow the boiler to recover its pressure.

The benefit of installing this system is increased production efficiency as the plant is ready for full production on the arrival of staff, and also less trip outs due to low boiler pressure when there are sudden excessive steam demand from the process.

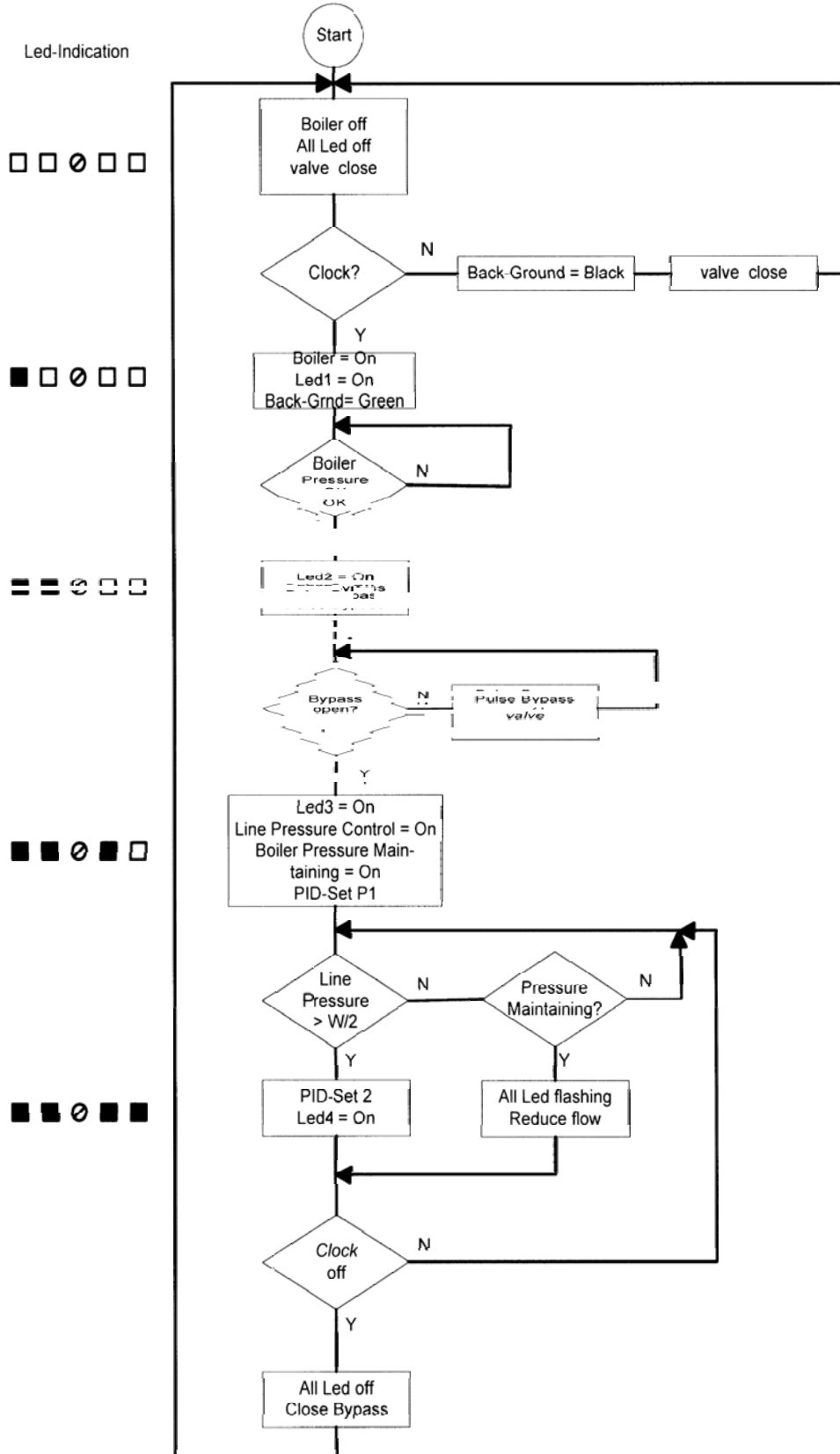
System principle

The steam main from the boiler is fitted with an electrically operated main isolation valve with a smaller isolation valve fitted on a bypass around it. Alternatively, a single main valve can be used which can be controlled to ramp up the valve on start-up and closing. Valve opening and closing is controlled by a programmable multi-controller with a built-in real time clock. The controller displays an LCD menu, each line selected via the front "UP" and "DOWN" push buttons and the "ENTER" key.

It is also possible to operate the main valve manually from the controller using one of the menus as shown overleaf.

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SIMPLIFIED FLOW CHART SHOWING SEQUENCE



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Wiring and connection requirements:

The control panel is to be connected to the steam main control valve, bypass valve and field instruments as shown in the wiring diagram, drawing number 108D-303509-01.

Please ensure that the following input signals are wired in, otherwise the "Signal Error" alarm will be activated and the display screen background will turn to red.

- 1) Boiler On-Off switch (digital input) - generally from the boiler panel on-off switch
- 2) Ambient temperature (resistance input) - from a Pt100 sensor
- 3) Steam main valve position feedback (4-20 mA input) - from the feedback transducer MU4524 fitted in the valve actuator head.
- 4) Limit switch of the steam bypass valve (digital input) - when the limit is made, the main valve will start to open.
- 5) Boiler pressure (4-20 mA input) - default range is 0 - 10 barg, used for pressure maintaining function.
- 6) Line pressure after the steam main valve (4-20 mA input) - default range 0 - 10 barg, used for pressure reducing function.

Setting the date and time:

On initial power on, the following screen will be displayed momentarily. Press the "UP" or "DOWN" key immediately to highlight the *Date, time* line before the screen goes to the next menu.



Press the enter key



This screen will be displayed with the *Year* highlighted. To change the year, press enter key and it will flash. Press "UP" or "DOWN" key to increase or decrease. Once the correct year is displayed, press enter key. It will stop flashing to confirm the correct year is set. Press the "DOWN" key to highlight the *Month*. Press the enter key to change to the correct month. Repeat the procedure as above. Carry on doing the same for *Day, Hour and Minute*. When completed, highlight *End* and press enter key to confirm all the settings.

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The screen will revert back to the *User menu*. Press the "DOWN" key to highlight End, then press enter key.

Operating Values and Start Sequence



The *Operating pages* menu is now displayed, and the *Operating Values* highlighted. Press enter key to view the current values.



The current operating values are displayed. If the time is within the start and stop time settings (see *Schedule* page), and the boiler On-Off switch is "On", the display will show *Boiler Start*. LED No. 1 lights up

The steam bypass and main valve will remain shut, until the boiler pressure is above the default setting of 7.5 barg.

The frost protection will come on if the ambient temperature falls below 2°C. This means that during the night or at the weekends when the process is off, but the boiler is left on, the frost protection will start the warm up cycle and then continue to heat up the line.

When ambient temperature is above 6°C, the *Frost Protection* will switch to *OFF*

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At boiler pressure above the default setting of 7.5 bar, the display shows *BoilerOk>WarmUp*. LED Nos. 1 and 2 at the top of the screen will light up.

The controller will now start to pulse the steam bypass valve to open, following the preset ramp and dwell sequence of operation. The default setting is to pulse open for 1 second, and pause for 15 seconds. It will take approximately 25 minutes for the steam bypass valve to fully open.



When the steam bypass valve is fully opened, the open limit switch contact in the actuator will be made. The display shows *ByeOpen>StrtMainV*. LED Nos. 1, 2 and 3 will light up.

The controller will start pulsing the steam main valve to open. The default setting is to pulse for 1 second, and pause for 30 seconds. It will take approximately 30 minutes for the steam main valve to fully open, but the controller will ensure that the downstream pressure is maintained at the default setting of 8 barg, so the main valve may not go to fully open if this set point is reached



Once the downstream set point pressure is reached, the display shows *Normal Operation*. Note that the steam main valve percentage opening is also displayed. All 4 LEDs will light up.

The controller is now functioning as line pressure reducing as well as boiler pressure maintaining control.

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If the boiler pressure drops below 7.5 barg the controller will throttle the steam main valve to allow the boiler to recover its pressure. The display will show *Boiler Limiting*. LEDs 1,3 and 2,4 will flash alternately together.

Once the boiler pressure reaches 7.5 barg, the display will revert back to *Normal Operation*.

Timeout Alarm



The controller has been configured in such a way that the total time allowed from *Boiler Start* to *Normal Operation* is 3 hours. Within this 3 hours, the controller expects to see a downstream line pressure of 7.5 barg at least once. Otherwise the *Timeout* facility will operate and the display background turns to red with the *Timeout* flashing on the *Alarm-Log* menu page.

At *Timeout*, the controller will shut down the steam main valve first and then the bypass valve, following the Stop sequence as at the end of the day.



The controller goes back to the beginning of the sequence and wait for *Boiler Start* signal and the line pressure is below 7 barg (or Stop sequence has been activated and the line pressure is above 7 barg). It will not start until the *Timeout* alarm is accepted and cancelled.

To cancel the *Timeout* alarm, ensure that it is highlighted and press the enter key. *Timeout* will stop flashing and the background reverts back to green.

Press the "DOWN" key to highlight *End* and then press the enter key. The display will now return to the *Operating Values* page. The *Timeout* timer will restart and the 3 hours countdown begins. The start sequence will begin unless it has already passed the Stop sequence time.

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Changing the daily Start and Stop Time schedule



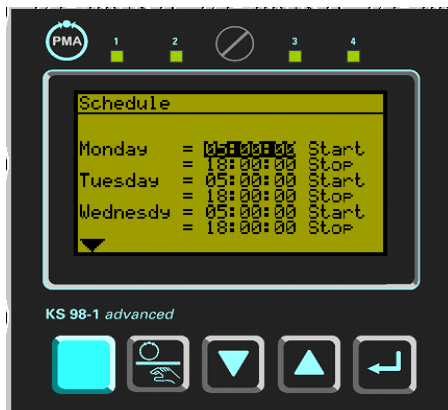
From the *Operating Values* page, return to the *Operating pages* by pressing the enter key.

Press the "DOWN" key to highlight *Schedule* and press the enter key.



The Schedule page will now be displayed.

To change the *Start* time for *Monday*, for example, press the "DOWN" key and entire *Monday Start* line will be highlighted.



To change the start time, press enter again and the displayed time will flash. Press the "UP" key to increase the time or the "DOWN" key to decrease the time. When the required time is shown, press enter key to confirm and the display will stop flashing. The entire *Monday Start* line will again be highlighted.

Press the "DOWN" key to highlight the *Monday Stop* time. Repeat the same procedure as above.



Repeat the procedure for the rest of the weekday. To scroll down to the next menu page, press the "DOWN" key until the *Arrow Down* display is highlighted and press the enter key.

Thursday to Saturday Start/Stop times are now displayed. Repeat the procedure for each day as above to change the times.

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Scroll down to the next page to display *Sunday Start/Stop* times.

To avoid starting the warm up system for any particular day, set the *Start* time higher than the *Stop* time, e.g. *Saturday = 18:00:00 Start, 06:00:00 Stop*.

To exit the *Schedule* menu, press the "DOWN" or "UP" key until no line is highlighted and press enter. This will return the display to the *Operating Pages*.

To change the downstream set-point line pressure



On the *Operating pages* menu, press the "DOWN" key until the *Ctrl:LinePress.* is highlighted. Press the enter key.

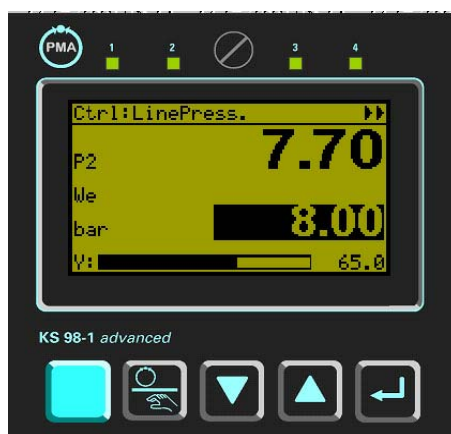


The *Ctrl:LinePress* page is displayed.

P2 is the actual downstream line pressure at 7.7 barg as illustrated.

The *set-point We* is the second line, set at 8.00 barg as illustrated.

Y: is a bar graph showing the steam main valve position, in this example the valve is open at 65%.



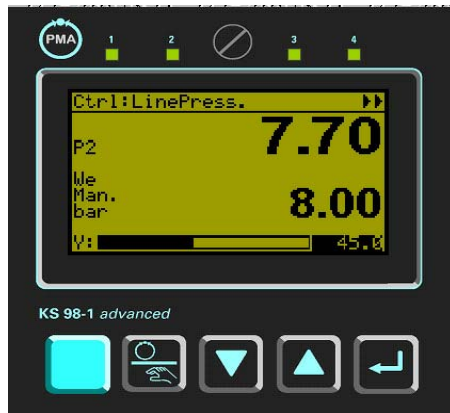
To change the set-point, press the "DOWN" key, the value is now highlighted.

Press the enter key, the value now flashes. Use the "UP" or "DOWN" key to increase or decrease the *set-point* value.

Press the enter key to confirm the new value, it will stop flashing. Press the "UP" key to remove any highlights and press enter key to return to the *Operating pages* menu.

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To operate the steam main valve in remote manual.



From the *Operating pages*, highlight the *Ctrl:LinePress* and press enter key to display the *Ctrl:LinePress* page as before.

Press the "Auto/Manual" key once. In the display *Man.* appears under *We*.

starts flashing. Press the "UP" or "DOWN" key to open or close the valve. Press enter key to confirm new valve position.

DO NOT FORGET TO PRESS THE "AUTO/MANUAL" KEY AGAIN TO RETURN TO AUTOMATIC CONTROL!

Relationship between Pressure Reducing and Pressure Maintaining Function



Under *Normal Operation* conditions the controller functions as a combined pressure maintaining and pressure reducing.

The priority is to safeguard the boiler pressure. The default setting for minimum boiler pressure is 7 barg. This can be viewed or altered by going into the *Ctrl:BoilPress* page.



The top line shows the actual boiler pressure. The second line is the minimum boiler pressure setting. To change this value, press the "DOWN" key once to highlight it. Press the enter key to make it flash and use the "UP" or "DOWN" key to increase or decrease the value. Press enter key to confirm, similar procedure as changing the line pressure set point described before.

Should boiler pressure falls below this minimum setting, the controller starts to throttle the steam main valve. How much the valve is throttled is determined by the PID control configured in the controller. The bar graph *Y:* in the *Ctrl:BoilPress* page shows the degree of influence this imposes on the line pressure control, e.g.. 54.1% in the illustration.



The effect can be seen on the *Ctrl:LinePress* page where the effective set-point has been shifted to a lower value dynamically, resulting in the throttling down of the steam main valve. This dynamic set-point shifting feature will allow the boiler pressure to recover quickly above the minimum setting.

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Shut down sequence



At the end of the operating day and the controller *Stop* time reached, the display background colour will turn to black, and status *Boiler = Off*.

The steam main valve will be powered to close first, and when this is completed, the bypass valve will be powered close.

The controller then waits for the next start time, or when the ambient temperature falls below 2°C. If either of these conditions occur, it will begin the start sequence again.

Other displays



From the *Operating* pages, press the "Down" key to highlight *Support*.

The display gives RTK Control System telephone number and e-mail address to contact if in need of support.



Similarly, when *Service* is selected, it will display the *Password* page. These passwords are only known by RTK and only required to access the engineering software for any major changes to various parameter settings and configuration data. For example, if the boiler pressure transmitter range is different from the default setting of 0 - 10 bar, a configuration change is necessary. Please ring RTK to carry out this change over the telephone when step by step guidance can be given.



All alarm will be logged in the *ALARM-LOG* page. To revert back to the *Operating* pages, press the "DOWN" key to highlight *End*, then press enter key.