

## Pilot Operated Pressure Relief Valve – Remote Control

### Fundamentals

In this experiment we wish to simulate the remote control of a pilot operated pressure relief valve. When we place a relief valve in the X-port we are working on the principle that oil takes the path of least resistance. This means that the spring setting of the main relief will act as a maximum pressure limiter. If the pressure at the P-port rises higher than this main spring setting then the valve will open safely relieving any overpressure to the tank.


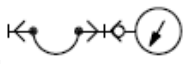
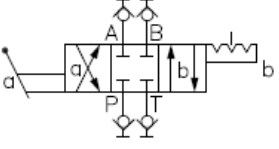
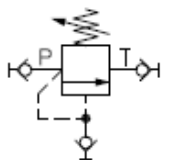
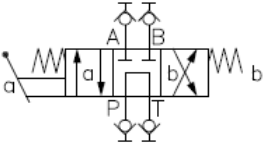
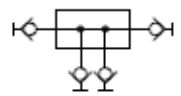
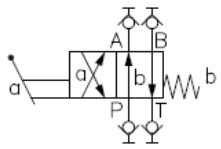
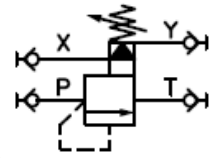
For our experiment we will utilize a 4/3 manually operated directional control valve and two direct operated pressure relief valves to make a multiple pressure setting circuit. That is, that by changing the position of the spool valve we can have a possibility of three different pressure settings. This would typically be used when a machine is to be programmed with multiple part possibilities and thus has a different pressure setting for each part requirement. Further details regarding the operation of a pilot operated pressure relief valve can be found in the Using Industrial Hydraulics textbook.

### Description of exercise

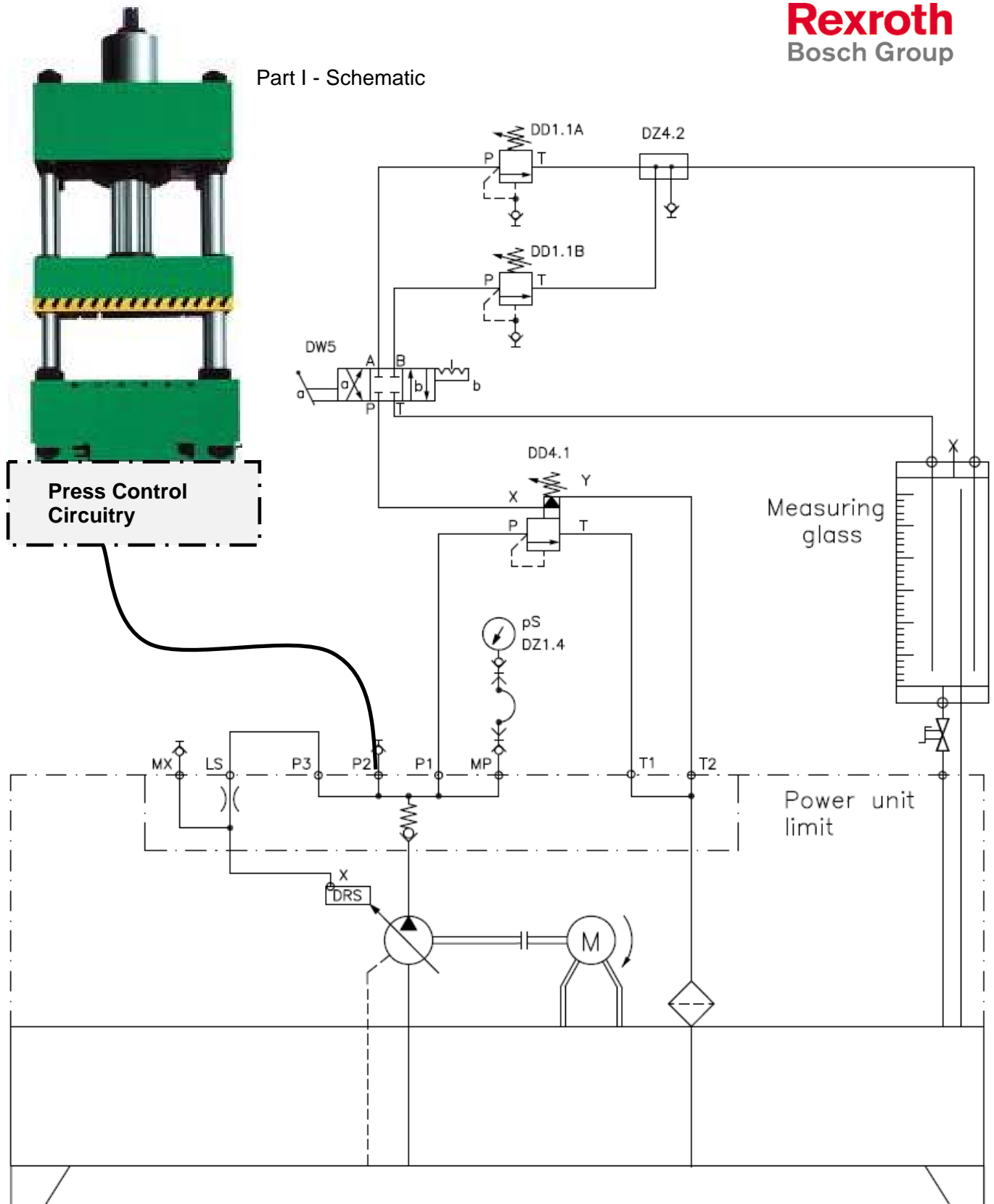
The following page shows a circuit that can be used to allow remote selection of the system pressure setting. Pressure relief valve DD4.1 controls the main system pressure. The setting of this valve is dependent on the position of the directional control valve DW5 and thus the selection of either of the two remote pressure relief valves (DD1.1/A or DD1.1/B). By changing the position of the directional control valve we thereby ultimately change the pressure level in the hydraulic system based on the setting of the remote relief valve.

### Components:

You will require the following components

Hose assembly		1X Pressure gauge DZ1.4	
1X Directional control valve DW5 (part I)		2X Pressure relief valve DD1.1	
1X Directional control valve DW4 (part II)		1X Connection piece DZ4.2	
1X Directional control valve DW3 (part III)		1X Pilot operated pressure relief DD4.1	

Part I - Schematic



Before beginning the experiment read the **Rules for hydraulic trainer operation** sheet.

### **Setting up the experiment**

Set up the circuit observing the following points:

1. Make sure the pump is switched off and the hydraulic circuit is not pressurized.
2. Mount the required components on the grid and lock them
3. Connect the separate units with pressure hoses according to the connection diagram. Take care that the connection hoses are not kinked or under undue stress.

### **Experimental procedure**

Steps in the experimental procedure:

1. Has your instructor checked the constructed circuit?
2. Check again that all connection hoses are firmly coupled. (pull/turn to test)
3. Back out the settings of all of the relief valves completely (CCW)
4. Open the shut-off valve on the measuring glass to allow it to drain to tank.
5. Ensure the red E-STOP button is not engaged on either of the starters. (rotate the button to reset)
6. Switch on the pump via the green START push button

## Experiment

Remote control of a pilot operated pressure relief valve

### Part I

- With the 4/3-directional control valve DW5 in the center condition (position 0) set the maximum system pressure to 600 PSI via pressure relief valve DD4.1
- Set the 4/3-directional control valve DW5 to position b. since it has a detent stop it will stay in this position.
- Set the system pressure to 400 PSI via pressure relief valve DD1/A.
- Set the 4/3-directional control valve DW5 to position a. since it has a detent stop it will stay in this position.
- Set the system pressure to 300 PSI via pressure relief valve DD1/B.
- These settings remain unchanged for the remainder of the experiment.**

### Evaluation Part I

A circuit of the type that we have built would have a typical application as a selectable tonnage level in a press which produces a variety of different products. By changing the position of the directional control valve you are able to change between three different pressure levels.

Try changing the handle position of the 4/3-directional valve and confirm that you are able to achieve pressure settings of 300 PSI, 400 PSI and 600 PSI.

What happens to the pressure level when you shift the 4/3-directional valve to the various positions?

Lever shifted to the left (position 'a')       $p =$  \_\_\_\_\_

Lever in the centre (position '0')       $p =$  \_\_\_\_\_

Lever shifted to the right (position 'b')       $p =$  \_\_\_\_\_

Shift the lever of the 4/3-directional valve to achieve a pressure of 400 PSI on the gauge.  
Now release the handle and describe what happens to this pressure level.

Explain what you observe.

Shut off the hydraulic trainer via the red STOP push button and bleed down any trapped pressure by shifting the 4/3-directional control valve.

## Part II

Without changing any of the circuit settings replace the 4/3-directional control DW5 with a 4/3-directional control valve type DW4 per the connection diagram on the following page.

### Evaluation Part II

As was the case with part I the circuit we have built might be applied as a selectable tonnage level in a press which produces a variety of different products. By changing the position of the directional control valve you are able to change between two different pressure levels and unloading of the pump flow. This would be advantageous if the machine has a dwell time where no product is being produced and therefore no hydraulic power is required. Instead of shutting off the electric motor we can simply allow the oil to flow straight to tank at minimal pressure and therefore consuming minimal power.

Try changing the handle position of the 4/3-directional valve and explain the difference that you see in the pressure levels when compared to part I.

What happens to the pressure level when you shift the 4/3-directional valve to the various positions?

Lever shifted to the left (position 'a')       $p =$  \_\_\_\_\_

Lever in the centre (position '0')       $p =$  \_\_\_\_\_

Lever shifted to the right (position 'b')       $p =$  \_\_\_\_\_

How does this differ from part 1?

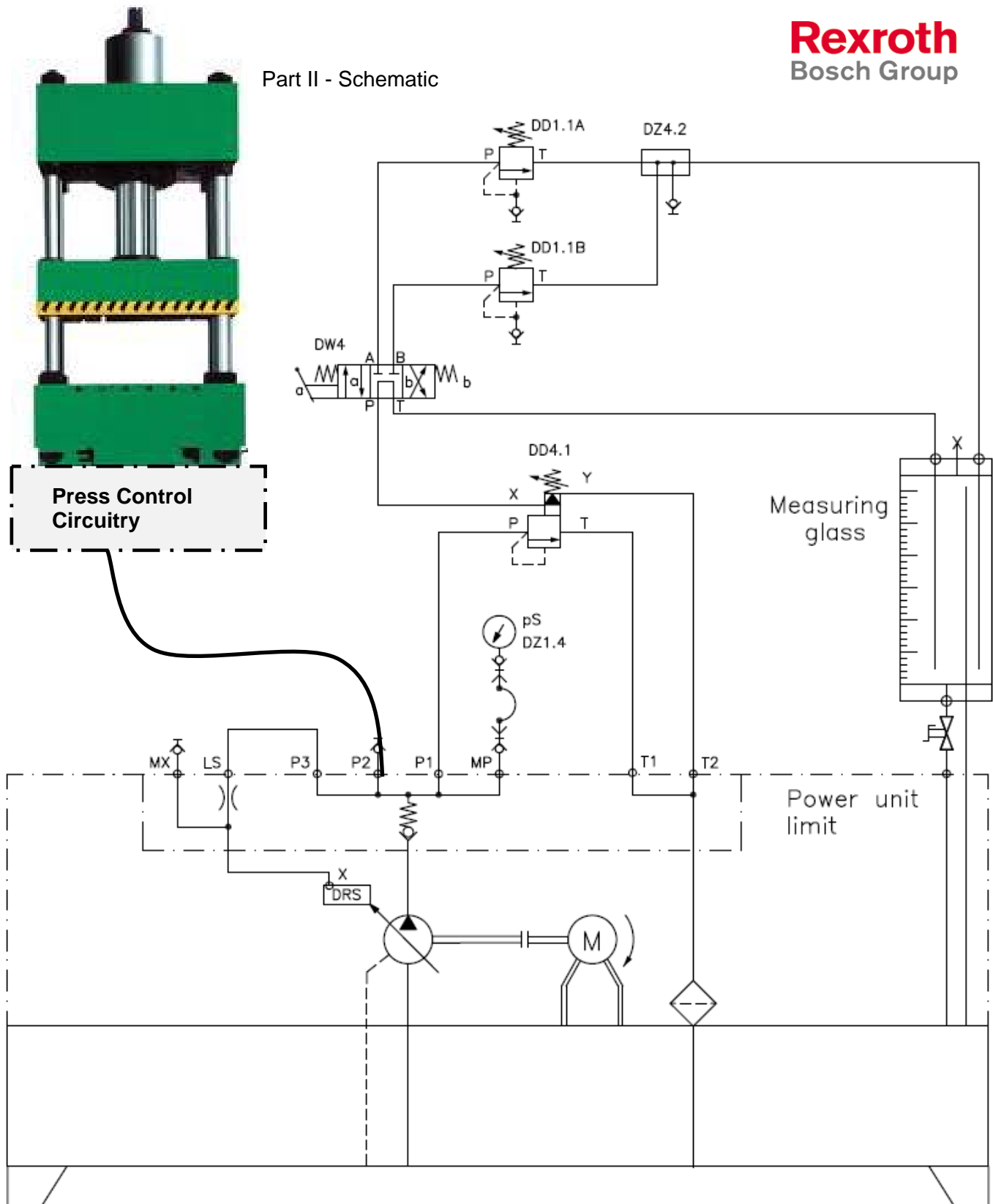
Relate your observations to the schematic symbology of the directional control valve shown on the schematic diagrams

Shift the lever of the 4/3-directional valve to achieve a pressure of 400 PSI on the gauge.  
Now release the handle and describe what happens to this pressure level.

Explain what you observe.

Shut off the hydraulic trainer via the red STOP push button and bleed down any trapped pressure by shifting the 4/3-directional control valve.

Part II - Schematic



### Part III

In order to produce a particular product it may be required to have a press which is capable of having variable tonnage levels. Hydraulic presses are particularly suitable for this requirement. A typical application would be the pressing of wood laminates or OSB where it is required to pre-press at a low tonnage and then change over to full-tonnage and reverse this sequence for de-compression. Let us now take the opportunity to try operating our press in this manner.

Using the circuit in part II try simulating this multi-pressure function by changing the position of the directional control valve so that you alternate between pressure settings of 300 PSI and 400 PSI. i.e. move the lever of the directional control valve DW4 to change directly from position a to position b without stopping in the intermediate position.

Note and record what happens to the system pressure while you are changing the handle position. Does the pressure level at the gauge change smoothly between the 300 PSI and 400 PSI pressure settings?

If not, explain what you observe and why this happens.

Exchange the 4/3-directional valve so that the circuit is the same as was used in part I of the lab. Try once again to simulate this multi-pressure function by changing the position of the directional control valve so that you alternate between pressure settings of 300 PSI and 400 PSI. i.e. move the lever of the directional control valve DW5 to change directly from position a to position b without stopping in the intermediate position.

Note and record what happens to the system pressure while you are changing the handle position. Does the pressure level at the gauge change smoothly between the 300 PSI and 400 PSI pressure settings?

If not, explain what you observe and why this happens.

Can you offer a solution on the following page which may alleviate the problem that you have seen?

Hint:

There is one directional valve supplied with the training stand that we have not utilized yet. Perhaps it will solve this problem.

Complete the schematic on the following page and try this new circuit to confirm functionality.

Does your new circuit allow smooth switching between 300 PSI and 400 PSI pressure settings without the overshoot and undershoot that was seen in parts I and II?

Part III - Schematic

