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## Water-conservation device and method

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## WATER-CONSERVATION DEVICE AND METHOD

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### I. INTRODUCTION

In the current solution to control the flow of water (i.e., a hand-operated faucet in, e.g., a shower), it is not practically possible to automatically shut off the flow as may be needed depending on temperature, human presence or time elapsed. To help conserve water which is becoming a scarce resource, there is a need of a device and method that will do exactly this.

### II. DISCUSSION

Figure 1 illustrates a shower tile with colored arrow etched or printed on its surface and a glass-filled metal plug to conduct light and heat to the back of the tile. The back of the tile has one or more Qorvo MEMS+ASIC chips attached to it. A single chip as the capability to sense force, infrared and temperature, has an internal timer and the ability to send control signals to a relay to open and close a ball valve.

Figure 2 illustrates a force-sensing operation of a single sensor chip. Figure 3 illustrates an application of two sensor chips to determine a 1-D location of force. Figure 4 illustrates a example shower panel with combined flow and temperature control. Figure 5 illustrates an example of a combined flow & temperature control and a control bar with indicator. Figure 6 illustrates application of four sensor chips to determine 2-D location of force. Figure 7 illustrates an example shower panel with separate flow and temperature controls. Figure 8 illustrates examples of flow selection and temperature selection.

Figure 9 illustrates a block diagram of components in a wall tile with combined flow and controls. Figure 10 illustrates a block diagram of components in a wall tile with separate flow and temperature control. Figure 11 illustrates a flow chart of an operation of a combined flow and temperature controls. When the flow and temperature controls are separate, the operation is similar as Figure 11 but with added force measurements by Chip 3 and Chip 4 to determine  $T_s=g(Y)$ .

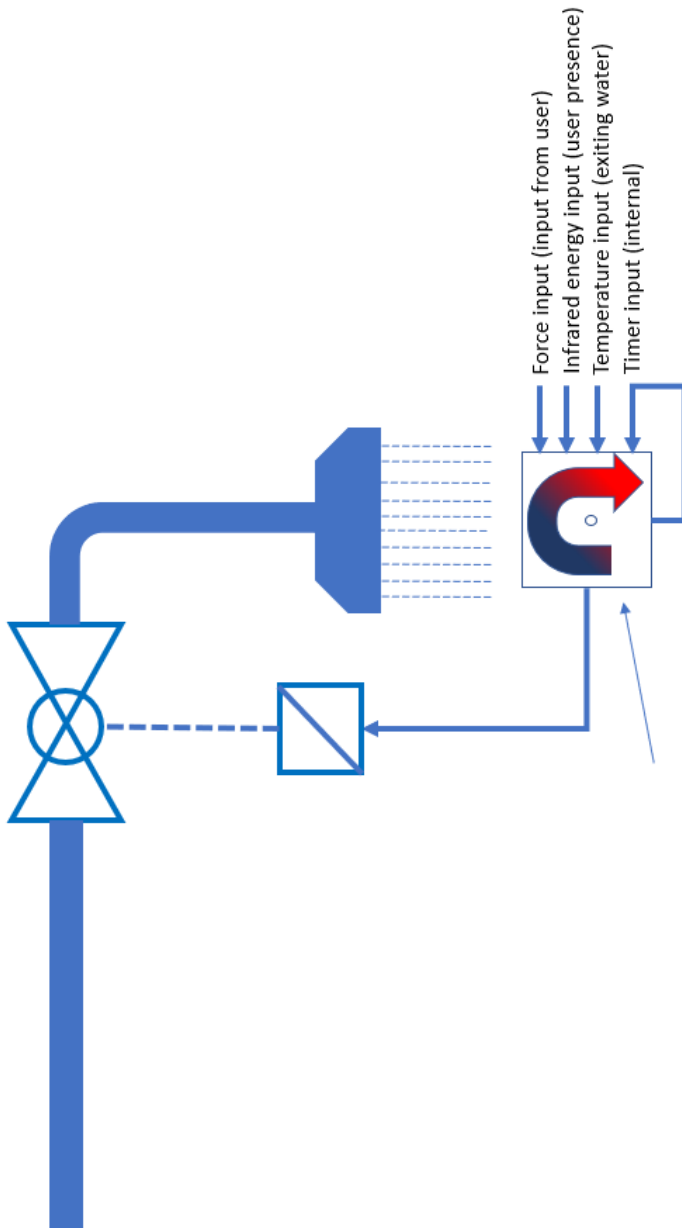


Figure 1

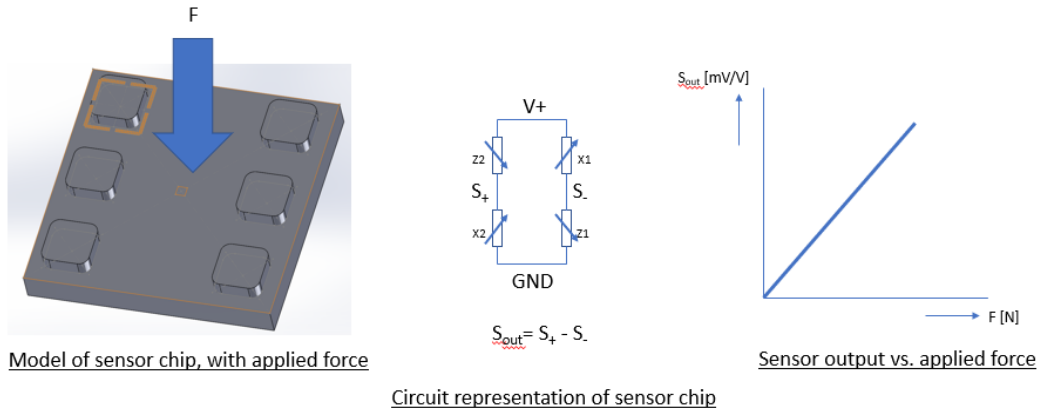


Figure 2

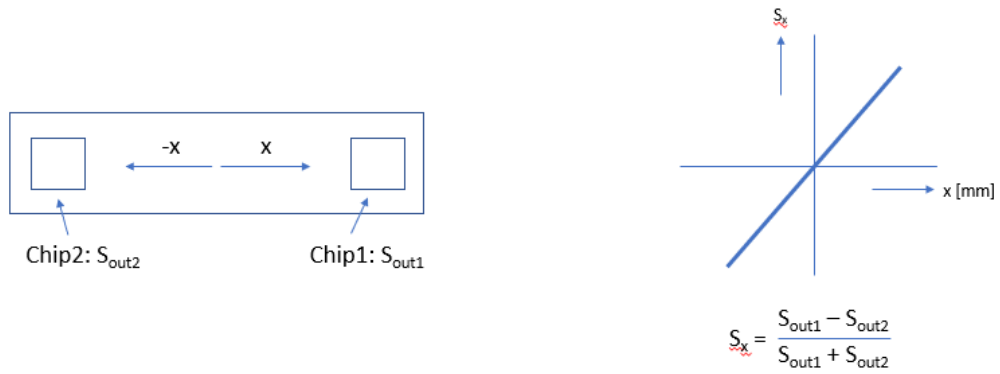


Figure 3

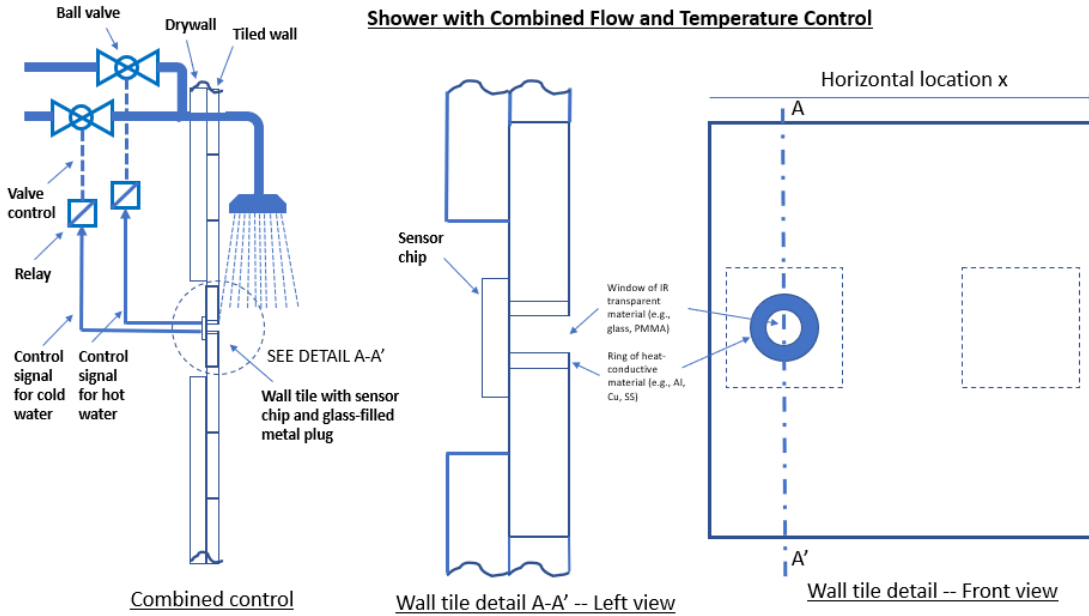
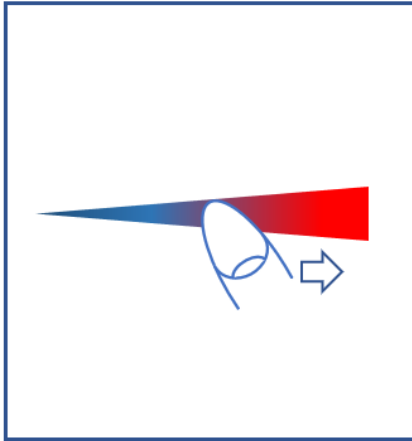


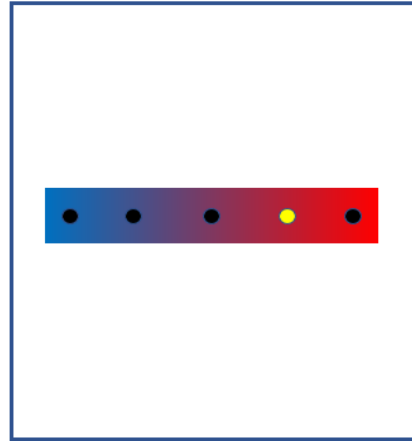
Figure 4



Front view of wall tile



Example of combined flow&temperature control



Example of control bar with indicator

Figure 5

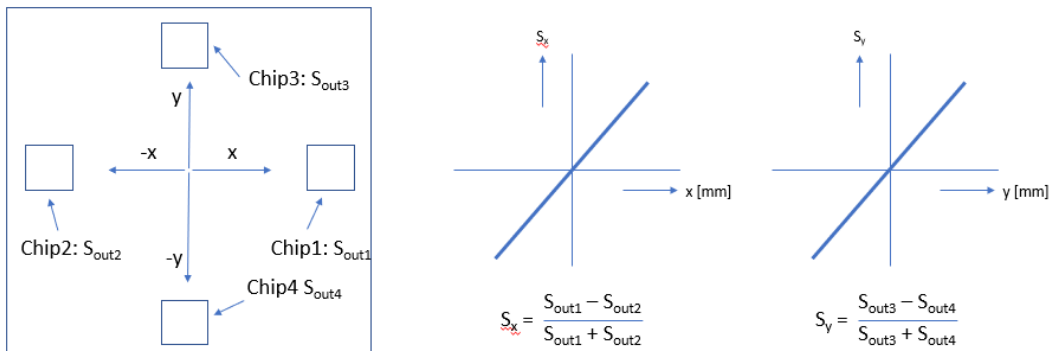


Figure 6

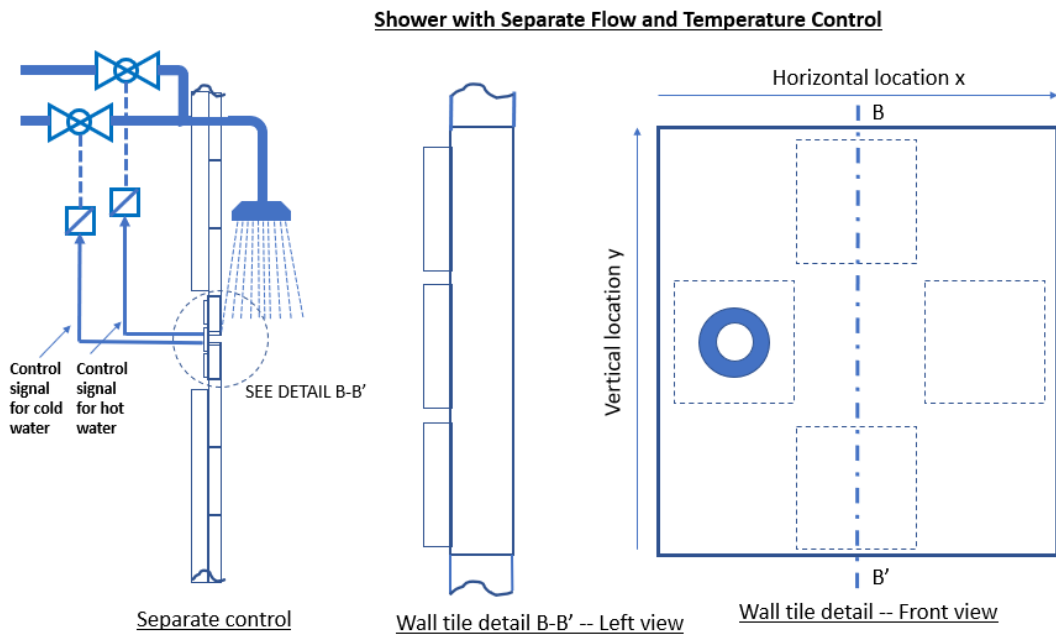


Figure 7

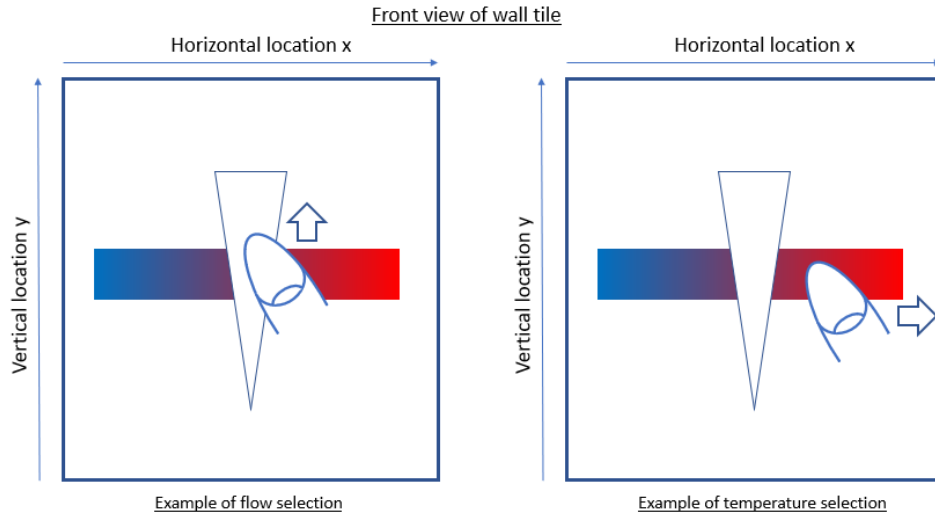
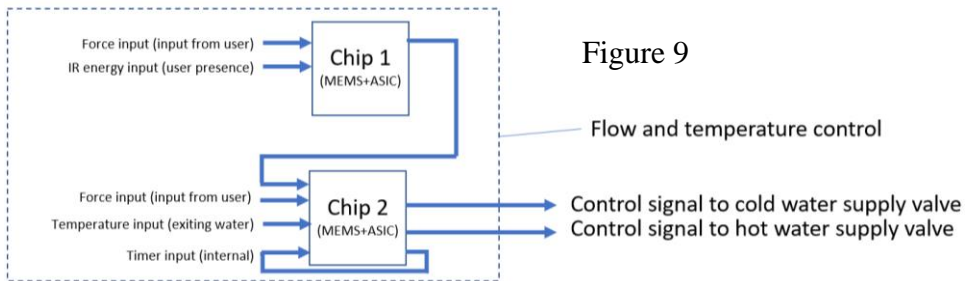


Figure 8





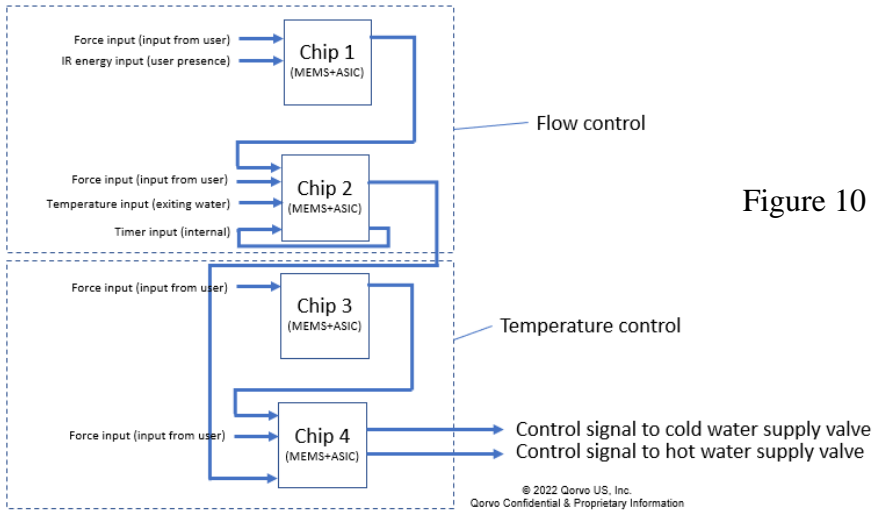
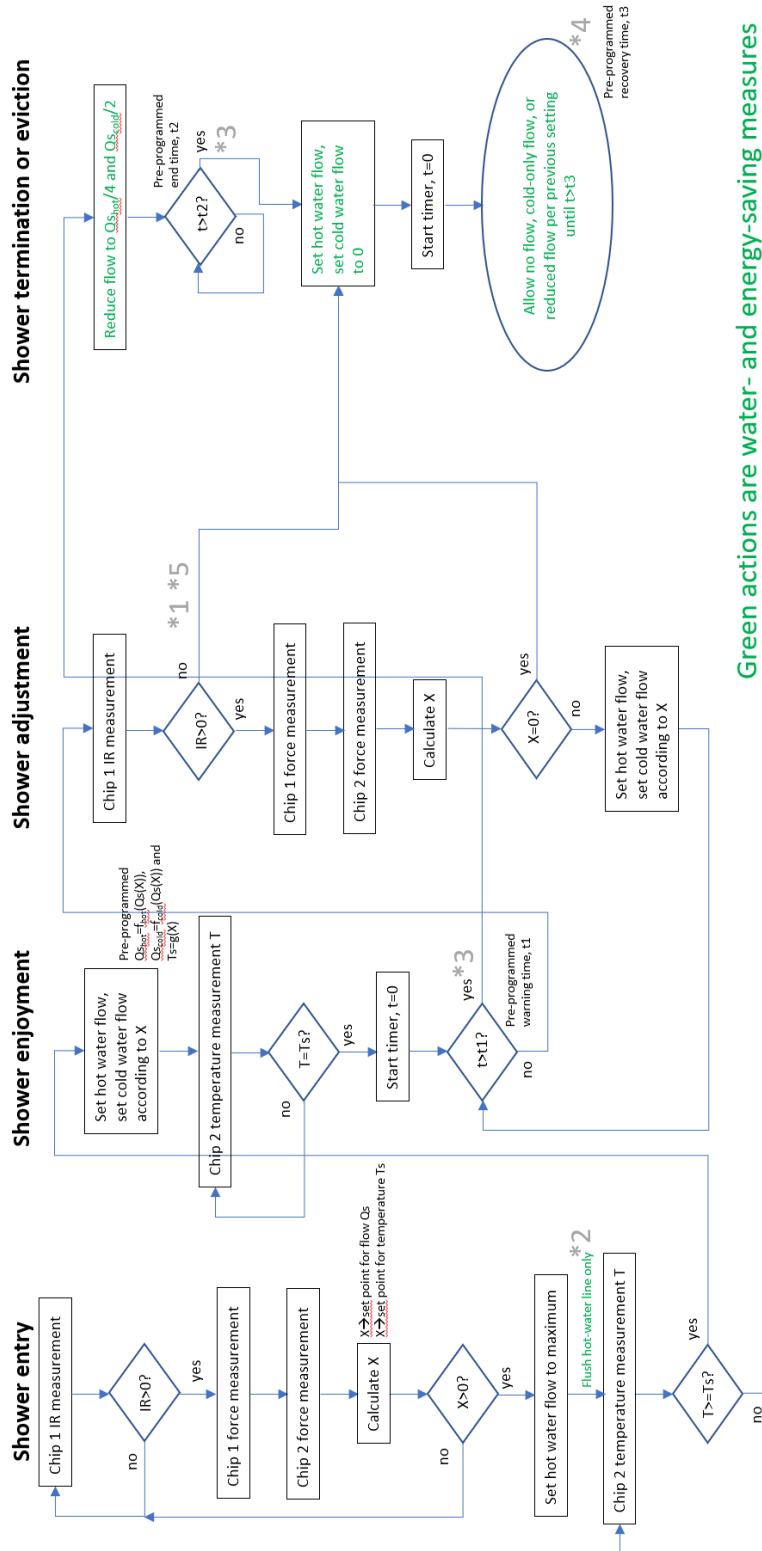


Figure 10



Green actions are water- and energy-saving measures

Figure 11