

# Remote Shut Off in Flow Meters is Instrumental for Smart Utility Deployment

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## Remote Shut Off features in Smart Gas, Heat, and Water Meters provide tangible benefits to society, utilities, and consumers for conservation, efficiency, and protection

Global demand for resources is rising, and related the need for resource conservation is becoming more and more important. Smart Meters service the last stage of resource distribution through measurement, and features like Remote Shut Off contribute to improved resource distribution and efficiency. Flow Meters, which distribute water, heat, and gas show increasing popularity in implementing the Remote Shut Off not only for conservation efforts, but to improve utility company business efficiency and provide consumers with additional benefits.

This white paper discusses the Remote Shut Off feature found in Flow Meters, which is a category of Smart Meters including Gas Meters, Heat Meters, and Water Meters. The paper will explain what this feature is, what the feature is used for, and how it can be implemented simply.

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## 1 Introduction

Flow Meters are by nature distributing and monitoring a liquid (water) or gas (methane) to an end consumer. These Smart Meters are battery powered, so low power consumption is critical in order to achieve a lifetime over ten years. Flow meters can be classified by their metrology type, either using a mechanical sensor or an ultrasonic sensing scheme.

*Gas Meters* measure fuel gasses, typically natural gas

*Water Meters* deal with distributed water to be consumed by the end user

*Heat Meters* are also called thermal meters or BTU meters and measure heating water flow



**Figure 1. Electronic Heat Meter**

## 2 Remote Shut Off Function

The remote shut off function is a relatively simple feature: a latching valve (also called bidirectional or bi-stable) is driven between two or more positions. The simplest valve has the two states: ON and OFF. The valve is actuated electronically using a latching solenoid or a small brushed-DC motor. Smart meters implement a wireless communication, either short range or long range, allowing for remote reading of the utility consumption and remote control of the latching valve. Some meters (especially dealing with gas) integrate sensors like vibration and can automatically shut off in situations like earthquakes.

## 3 Beneficiaries of Remote Shut Off

There are three levels of beneficiaries to the remote shut off function, Society, Utility, and Consumer. Since the key concerns for each entity is different, the benefits each can receive through the remote shut off function is different:

*Society* is a wide reaching term to describe the community, municipality, state, country, and so forth. This entity cares about macro-level trends, primarily resource conservation. At this level, the objective is to reduce the overall resource use or improve the efficiency of the resource distribution so wasted resources are minimal. Also, large events like natural disasters have an effect on the society as a whole, so actions should be taken to mitigate the effects of large-scale calamities.

The *Utility* Company is the business that distributes the resource (water, heat, gas) to the end consumer, and makes money through this distribution. The Utility will want to minimize business costs while maximizing profits. A large impact on profit is non-revenue water, gas, or heat which describes resources that are put into the distribution system but are not charged to consumers. Non-revenue resources can be caused by leaks or tampering. In the example of water utilities, non-revenue water is globally 30-35%, contributing to a major loss in profits. Impacts on costs are employee man-hours, transportation, and repair costs.

Consumers are the end-users of the resource and want to have as continuous of a resource supply as possible. Events that stop supply of water, gas, or heat cause customer disruptions and are met with contempt. Consumers will also be concerned with the ease of interfacing with the utility, ideally being easy to turn on or turn off the service. Finally, consumers are invested in their property and want to take measures to protect that property from damage.

## 4 Remote Shut Off Situations and Benefits

**Table 1. Situations to enact remote shut off**

Situation	Society Care-About	Utility Care-About	Consumer Care-About
Pipe leaks	✓	✓	
Pipe burst		✓	✓
Natural disaster	✓	✓	✓
Meter tampering		✓	
Turn on & turn off event		✓	✓
Accident in the home			✓

### 4.1 Pipe Leaks

These leaks can be present in the distribution network (for example underground) or inside homes. These leaks, while small, contribute to a large amount of total water losses because they can be left without a fix for long periods of time. Gas meters can be particularly dangerous in the event of a reported leak.

### 4.2 Pipe Bursts

Burst events result in damage to a pipe and loss of water or gas. In the event of a burst, the broken pipe needs to be shut down to prevent further water loss and to allow maintenance. The burst may result in reduced pressure for consumers in other parts of the network. Considering technician response to such a surprise event may be slow, having remote shut off capability can provide a quick, tactical response.

### 4.3 Natural Disaster

The destructive nature of these events makes it critical to mitigate risks to life and property. For example, when a hurricane is forecasted, residents are told to turn off the water and gas utilities before evacuating. If the resident has to contact the city for shut-off, and a technician needs to be dispatched, this could take a significant amount of time and distract from other emergency preparations. A remote shut off saves time for the consumer and for the employees of the utility. Other natural disasters are not as predictable, and mitigation plans are more related to containment. After an earthquake or tornado, broken gas lines can lead to explosions. As such, it is important to turn off water and gas utilities until it has been deemed safe to reactivate them. Water supply contamination is a rare but serious disaster which cannot be contained unless the water distribution grid is shut off quickly.

### 4.4 Meter Tampering

Theft of water or gas results in loss of profits for the utility company. A smart distribution system can help prevent loss due to theft by shutting off flow in the event that someone is tampering with the meter.

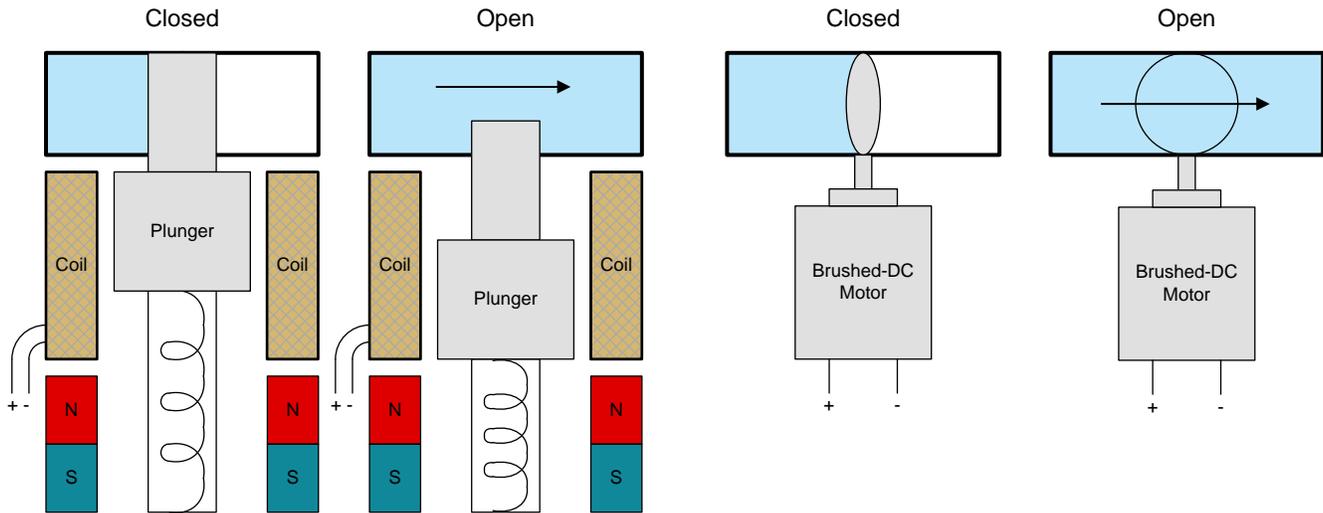
### 4.5 Turn On and Turn Off Events

When a consumer activates or deactivates service with a particular provider, a utility not utilizing smart meters needs to send a technician out to the location to turn on or turn off flow. A large number of turn-off events are due to non-payment, meaning the consumer has failed to make payment to the utility for a certain period of time. Turn on and turn off events have a cost in man hours as well as equipment and fuel. Remote shut off allows utilities to remotely turn on or turn off the service, allowing for technicians to spend more time on productive things like system repairs. Consumers can also benefit from remote shut off because it enables turning on or turning off of service outside of regular business hours.

### 4.6 Accident in The Home

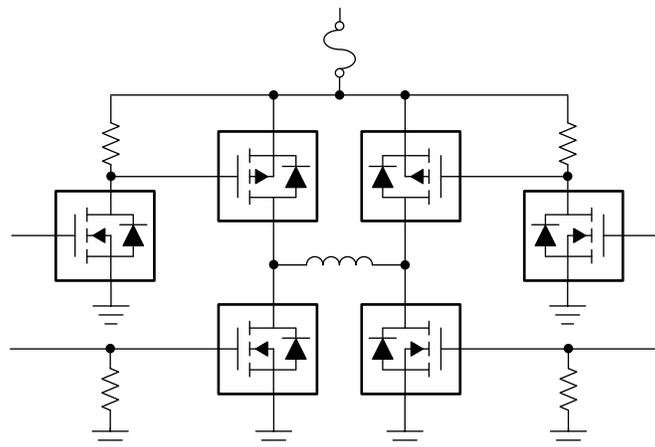
Remote shut off allows for a quick response in the event that an accident poses a threat to damage property. For example, in the case of a plumber breaking a water pipe it can take time to respond to the immediate threat of flooding the property and causing water damage. If the utility is able to control the shut off remotely, a simple accident can be prevented from ballooning into a bigger issue.

## 5 Remote Shut Off Implementation



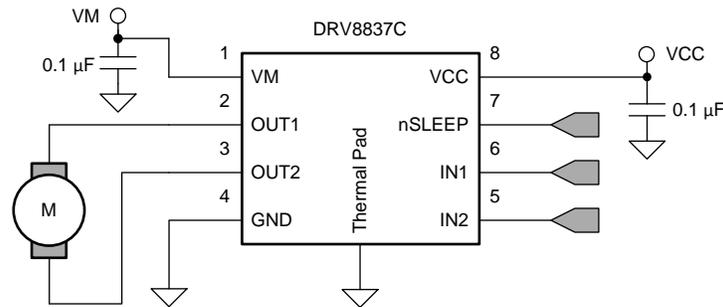
**Figure 2. Solenoid Latching Valve and Motor Valve**

In order to actuate either a solenoid valve or a motor valve, the drive circuit is the same. An H-bridge is used to apply current in the positive or negative direction through the valve. In flow meters, which are battery powered, low voltage valves are common so that they can be run directly off of the battery. A solenoid drive circuit can be implemented discretely, using n-channel and p-channel MOSFETs combined with several resistors. Alternatively, NPN BJTs can be used to create an H-bridge. [Figure 3](#) implements a simple control circuit.



**Figure 3. H-Bridge Discrete Circuit Using MOSFETs**

While a discrete circuit is normally thought of as the cost-optimized solution, this is actually untrue in most cases. The value of the discrete components combined with the cost of assembly (pick & place) and component test can exceed that of a simple low-voltage integrated H-bridge. In addition, there can be protection circuits like fuses which add even more cost to a discrete solution, since these are not required using an integrated circuit with overcurrent protection. Some designers may be constrained on board space or not have the know-how to optimize a discrete circuit for cross-conduction prevention, making an integrated solution even more valuable.



**Figure 4. H-Bridge Integrated Circuit**

## 6 References

Refer to these resources for additional information:

1. Kamstrup, [Building a Smart Distribution Network – Your 4-Step Guide](#)
2. Sensus, [How Remote Shutoff Applications Reduce Cost and Enhance Customer Service](#)
3. Texas Instruments, [Gas Meter End Equipment Reference Diagram](#)
4. Texas Instruments, [Heat Meter End Equipment Reference Diagram](#)
5. Texas Instruments, [Water Meter End Equipment Reference Diagram](#)
6. Texas Instruments, [DRV8837C 1-A Low-Voltage H-Bridge Driver data sheet](#)

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