## PURPOSE

This document provides a reference design to incorporate the Vision BV2000 flow meter into an existing circuit. Customers have the option to include a microcontroller into the circuit that would be used to monitor and possibly display the rate of flow and total accumulated flow.

HARDWARE DESIGN

For reference purposes, a development kit was used in this illustration. The development kit includes a discovery board with a microcontroller and many built-in peripherals including a 24 segment LCD display. For this design, the ST Microelectronics STM32L-Discovery board was used. The data sheet for the discovery board can be found at: **http://www.st.com/st-web-ui/static/active/ en/resource/technical/document/data_brief/DM00027566.pdf**

There are many free firmware development Toolchain options available to develop on the STM discovery board.

The following is a circuit that could be used to interface the microcontroller into a circuit containing the meter.

$$R1 = R2 * (V\ Source / 3) - R2$$
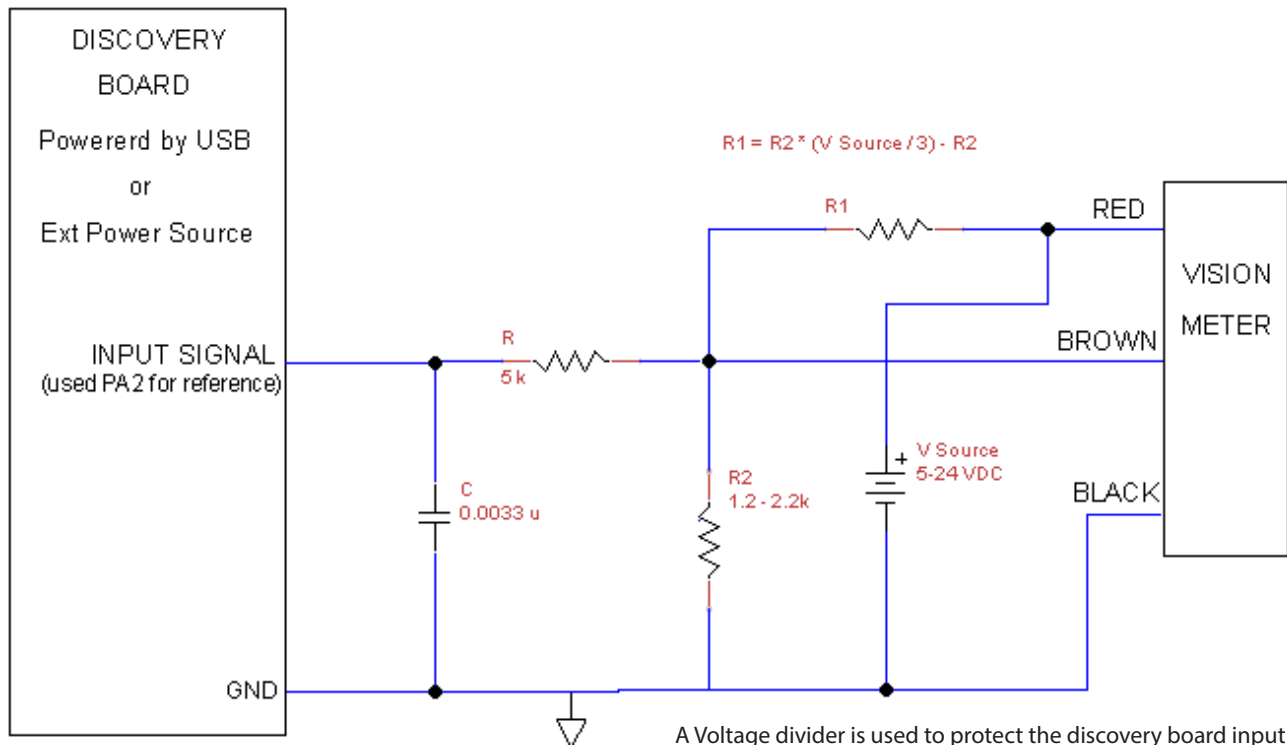
A Voltage divider is used to protect the discovery board input pin from a voltage exceeding 5 Volts. Also, a low-pass filter is used to block out external noise that may be coming in on the data line (brown wire).

Badger Meter

Reference Design

FIRMWARE DESIGN

The firmware in this example was developed using the Keil uVision5 compiler. The interface to the discovery board was over USB-A to mini USB-B cable using the ST-Link Debugger driver. The firmware was developed to execute the following functions:

- Display/Scroll Welcome message upon board power up
- Calculate and display the totalizer value
- Calculate and display the current flow
- Use the "USER" push button to advance screens
- Use the "RESET" push button to reset totalizer and flow and re-display the welcome message

A majority of the code was provided by ST-Microelectronics to run their discover project, which is standard to this version of discovery board. The code can be found on ST's website at **http://www.st.com/web/catalog/tools/PF250990**. This code is used to run the initialization and setup of the discovery board (LCD screen, memory, etc…), but can also be modified to set up an external interrupt driven by the rising and/or falling edges of the pulses generated by the Vision flow meter.

Some basic code snippets (in C/C++) to drive the totalizer count and flow calculation can be seen below:

Updating the Totalizer:

```
void Update_Total(void) {
        if (Flow % PPL == 0)
                Totalizer++;
}
```

Flow is the variable used to track the number of pulses generated by the meter.
PPL represents how many pulses there are to make one liter (given by data sheet of meter).
Totalizer is the variable used to store the value of the totalizer.

Updating the Current Flow Rate:

```
void Update_Rate(void)
{
        if(prev_rate >= Flow)
        {
                Flow_Rate = 0;
                return;
        }
        Flow_Rate = Flow - prev_rate;
        prev_rate = Flow;
}
```

Prev_rate is the temporary value of the previous rate of flow.
Flow_Rate is the current flow rate.
Flow is the variable representing pulses coming from the meter.

The code works in the following manner: if pulses are coming in from the meter, display the flow rate then wait for ~1 second. Store the flow rate as the previous flow rate, then check how many pulses are coming in and store as the Flow_Rate. Display the difference between the current flow rate (Flow_Rate) and the flow rate from 1 second earlier (prev_rate). Repeat until pulses are no longer being collected at the input.

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