RIT Gas Flow Sensor
Dr. Lynn Fuller, Jessica Marks

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Constant heat (power in watts) input and two temperature measurement resistors, one upstream, one downstream. At zero flow both sensors will be at the same temperature. Flow will cause the upstream sensor to be at a lower temperature than the downstream sensor.
GAS FLOW SENSOR

GAS FLOW SENSOR

Diode
Temperature Sensor

R1
Upstream
Resistor Sensor

600 ohm

Heater

R2
Downstream
Resistor Sensor

<table>
<thead>
<tr>
<th>Gas Flow Sensor - Jessica Marks, 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heater Voltage</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>15</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>25</td>
</tr>
</tbody>
</table>

Graph:
- Heater Power
- Diode Voltage
- Temperature/100

Winter 2008

Jessica Marks Gas Flow Sensor
FLOW SENSOR ELECTRONICS

Constant Power Circuit for the Heater

+6 Volts

R2

Downstream Resistor

Upstream Resistor

R1

Vout

-Gnd

-6 Volts

Vout near Zero so that it can be amplified

Rochester Institute of Technology
Microelectronic Engineering

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MULTIPLIER

Internally Trimmed
Precision IC Multiplier

AD534

FEATURES
- Pretrimmed to ±0.25% max 4-Quadrant Error (AD534L)
- All Inputs (X, Y and Z) Differential, High Impedance for
  \[ \frac{(X_1 - X_2) (Y_1 - Y_2)}{10 V_1 + Z_2} \] Transfer Function
- Scale-Factor Adjustable to Provide up to X100 Gain
- Low Noise Design: 90 µV rms, 10 Hz–10 kHz
- Low Cost, Monolithic Construction
- Excellent Long Term Stability

APPLICATIONS
- High Quality Analog Signal Processing
- Differential Ratio and Percentage Computations
- Algebraic and Trigonometric Function Synthesis
- Wideband, High-Crest rms-to-dc Conversion
- Accurate Voltage Controlled Oscillators and Filters
- Available in Chip Form

PRODUCT DESCRIPTION
The AD534 is a monolithic laser trimmed four-quadrant multiplier divider having accuracy specifications previously found only in expensive hybrid or modular products. A maximum multiplication error of ±0.25% is guaranteed for the AD534L without any external trimming. Excellent supply rejection, low temperature coefficients and long term stability of the on-chip thin film resistors and buried Zener reference preserve accuracy even under adverse conditions of use. It is the first multiplier to offer fully differential, high impedance operation on all inputs, including the Z-input, a feature which greatly increases its flexibility and ease of use. The scale factor is pretrimmed to the standard value of 10.00 V. by means of an external resistor, this
MULTIPLIER AND DIVIDER CONFIGURATION

Figure 3. Basic Multiplier Connection

Figure 6. Basic Divider Connection
TEST SET UP FOR GAS FLOW SENSOR
EXPERIMENTAL SETUP

1. How can we control the flow? Pressure?
2. How can we calibrate the flow?

MFC

Gas Flow In Water
Dr. Lynn Fuller

Rotometer
MEASUREMENTS

Constant voltage on the heater (15 volts)

Vout set to ~zero with no flow by adjusting the -6 Volt supply slightly.

Measure Vout with a Digital Multimeter
For various gas flows from 0 to 200 sccm.

<table>
<thead>
<tr>
<th>Gas Flow (sccm)</th>
<th>R upstream</th>
<th>R downstream</th>
<th>Vout</th>
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<tbody>
<tr>
<td>0</td>
<td>10,000</td>
<td>10,000</td>
<td>0</td>
</tr>
<tr>
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<td></td>
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<tr>
<td>100</td>
<td></td>
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<td>150</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>200</td>
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### HONEYWELL GAS FLOW SENSOR

<table>
<thead>
<tr>
<th>Digi-Key Part Number</th>
<th>Price Break</th>
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<th>Extended Price</th>
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<tr>
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**Manufacturer**: Honeywell Sensing and Control

**Description**: SENSOR AIRFLOW AMP 200 SCCM

**Lead Free Status / RoHS Status**: Lead free / RoHS compliant

All prices are in US dollars.
Posifa Microsystems, Inc., a leader in Advanced MEMS Sensor Development, today unveiled its new line of Low-flow Mass Air Flow Sensors. The PMF2000 family, which incorporates the latest MEMS and microelectronics innovations, eliminates the field failures associated with pressure shock, humidity and contamination that have for years plagued other manufacturers. By replacing the common “membrane-cavity” structure with a proprietary “solid-state” thermal isolation structure on the sensor die, Posifa’s sensors bring new levels of reliability to their customer’s applications. Additionally, the sensor die incorporates a pair of thermopiles surrounding a central heating element to detect changes in temperature gradient caused by mass flow, delivering ultra-high signal-to-noise, and unsurpassed repeatability.

By using a high-caliber internal microcontroller, the PMF2000 family delivers 2% full scale (max.) accuracy, linear output for each of their respective ranges of 10, 30, 200, 1,000 and 2,000 sccm (standard cubic centimeter per minute). This expanded set of ranges gives customers an ability to choose a range best suited to their application for improved overall performance.

The sensors are fully calibrated and compensated over the temperature range of 0°C to +50 °C. Offering a 4 volt linear output range (1 to 5 Vdc), the sensors provide better than 2% F.S. accuracy over the entire output range. The new line of Sensors also offer extremely high repeatability of less than 0.5% F.S. per year null drift, making field replacements a calibration-less task.

Posifa Microsystems Inc.
http://www.posifamicrosystems.com/
REFERENCES

1. Digikey.com
2. Honeywell Sensing
HOMEWORK – RIT GAS FLOW SENSOR

1. Write a 150 word abstract for Jessica Marks gas flow sensor and results.
2. Make up some reasonable data for the table on page 9 that illustrates the operation of the gas flow sensor.