**Overview**

KEMET’s QGS thin film digital pyroelectric IR sensors for gas detection and concentration measurement combine high sensitivity with fast response times and high dynamic range to ensure rapid and accurate detection of target gases.

These high quality sensors, in their small SMD package, integrate a digital, current mode read-out that enables lower IR-emitter duty cycles, thereby savingsignificantly on system level power consumption, while maintaining high SNR. Industry standard I2C communication enables plug-and-play connectivity to microcontrollers and allows easy tuning and calibration. Programmable gain and filtering offer maximum flexibility in system design, and various optical filter options are also available. These sensors can be connected together in linear series to allow synchronized sampling across devices.

Their long and maintenance-free operational lifetime makes it ideal for high demanding automotive or medical applications.

**Benefits**

- High sensitivity with fast response time
- High dynamic range
- Small SMD package
- I2C communication compatible
- Digital and analog output
- Programmable gain and filtering
- Various optical filter options
- Integrated configurable amplifier, filter and ADC
- Low power consumption

**Applications**

- Automotive
- Medical
Ordering Information

<table>
<thead>
<tr>
<th>USE</th>
<th>QGS</th>
<th>E</th>
<th>A</th>
<th>REF1</th>
<th>8</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensors</td>
<td>QGS = SMD Gas Sensors</td>
<td>E = Serial output M = Serial module K = Evaluation kit</td>
<td>A = Sensor only 1 = Module type 1 3 = Kit type 3</td>
<td>0000 = Fixed REF1 = Reference C821 = CO₂ CH41 = CH₄ N8L1 = NO</td>
<td>0 = Bulk 8 = 7” Tape &amp; Reel</td>
<td>0</td>
</tr>
</tbody>
</table>

Environmental Compliance

All KEMET Gas Sensors are RoHS and REACH Compliant.

Article 33(1) of the REACH Regulation states that manufacturers and importers of articles (products) are required to notify their customers of the presence of any Substances of Very High Concern (SVHC) in their products exceeding 0.1% by weight and provide instructions on safe use of the product.

KEMET Corporation reports regarding the Article 33(1) of REACH Regulation as follows:

1. Applicable Product: Gas Sensors (QFC & QFS series)

2. Report for the content of REACH SVHC list:
The product(s) above contains a substance by more than 0.1wt% per product weight that was published in the 8th update of the REACH SVHC substances (December 19, 2012).

3. Regarding the safety of the gas sensors (Piezoceramic products):
The Piezoceramic that is used in this product becomes ceramic by sintering powder containing PZT as the main ingredient. It is chemically stable, with minimum risks toward the human body or environment within the intended use of the product. Please note that risks could occur in the case of inhalation or accidental oral uptake of powder ceramics.

4. Technical product information on the gas sensors (Piezoceramic products):
The manufacturing technique of the “piezoceramic products” whose main ingredient is Lead Titanium Zirconium Oxide (PZT) has been established, and there is no alternative material that can exhibit superior performance than PZT at this moment. Please note that the piezoceramic is listed as an exempt on RoHS (2011/65/EU) AnnexIII (7c.1).

5. The responsibility of piezoceramic manufacturers:
Piezoceramic manufacturers report information regarding PZT containment in their products to the customers to obey the article 33 of the REACH regulation.
Gas Sensors – QGS Pyroelectric Infrared Gas Sensors, I2C-SMD

Dimensions – Millimeters

Sensor

Pin Configuration of Sensor

TRANSPARENT TOP VIEW
Dimensions – Millimeters cont.

Module

Field of View
Performance Characteristics

Signal Filtering & Power Modes

<table>
<thead>
<tr>
<th>Power Mode (base sample rate)</th>
<th>High Pass Filter – Analog (Hz)</th>
<th>Fixed Analog Low Pass Filter (Hz)</th>
<th>Fixed Digital Low Pass Filter (Hz)</th>
<th>Digital Low Pass Filter (Hz)</th>
<th>Maximum ADC Sampling Rate (sps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Power Mode</td>
<td>Off</td>
<td>1.0</td>
<td>2.0</td>
<td>4.0</td>
<td>8.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>250</td>
<td>180.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>45.0</td>
</tr>
<tr>
<td>Low Power Mode</td>
<td>Off</td>
<td>0.17</td>
<td>0.33</td>
<td>0.66</td>
<td>1.30</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>42</td>
<td>30.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7.50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>Mode</th>
<th>Description</th>
<th>Typical Current Consumption (1.8 V, room temperature)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power consumption</td>
<td>Normal Power Mode</td>
<td>Normal power consumption, 1 kHz maximum sample rate</td>
<td>22 µA</td>
</tr>
<tr>
<td></td>
<td>Low Power Mode</td>
<td>Low power consumption, 166 Hz maximum sample rate</td>
<td>3.5 µA</td>
</tr>
<tr>
<td>Operational state</td>
<td>Normal Operation Mode</td>
<td>Sensor signal readout over I²C</td>
<td>22 µA</td>
</tr>
<tr>
<td></td>
<td>Sleep Mode</td>
<td>Hardware interrupt on infrared trigger</td>
<td>21 µA (Normal Power Mode) 3.5 µA (Low Power Mode)</td>
</tr>
<tr>
<td></td>
<td>Power Down Mode</td>
<td>Sensor is disabled</td>
<td>1.1 µA</td>
</tr>
</tbody>
</table>

Infrared Frequency Characteristics

Typical Frequency Response in Normal Power Mode

![Graph showing frequency response in normal power mode]

Typical Frequency Response in Low Power Mode

![Graph showing frequency response in low power mode]

Typical Frequency Response at Different Gain Settings

![Graph showing frequency response at different gain settings]
### Part Number Specifications

#### Sensor Characteristics

<table>
<thead>
<tr>
<th>Filter Aperture (mm)</th>
<th>Element Size (mm²)</th>
<th>SMD Package (mm)</th>
<th>$D^{+1}$ (cm√Hz/W) Typical</th>
<th>NEP¹ (W/√Hz) Typical</th>
<th>Time Constant (ms) at 10-20 Hz peak</th>
<th>Field of View</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ø 1.65</td>
<td>0.64 x 0.64</td>
<td>5.65 x 3.70 x 1.55</td>
<td>2.5 x 108.0</td>
<td>2.7 x 10.0-10.0</td>
<td>~10</td>
<td>~90°</td>
</tr>
</tbody>
</table>

¹ 10 Hz, 500 K, room temperature, without window and optics.

#### Electrical Characteristics

<table>
<thead>
<tr>
<th>Supply Voltage (V)</th>
<th>Supply Current (μA) Typical</th>
<th>Digital I/O</th>
<th>$\Delta$Σ ADC at 1 ksp</th>
<th>Operating Temperature Range (°C)</th>
<th>Storage Temperature Range (°C)</th>
<th>Sensor Read-out</th>
<th>Configurable</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.75 to 3.60</td>
<td>1 to 23</td>
<td>I2C (FM+ compatible)</td>
<td>15 bit</td>
<td>-40 to +85</td>
<td>-40 to +110</td>
<td>Current mode</td>
<td>Gain Digital filterin Sampling rate Power modes</td>
</tr>
</tbody>
</table>

#### Part Number (Sensor)

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Filter (μm)</th>
<th>Filter BW (nm)</th>
<th>Gas</th>
<th>Weight (gr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>USEQFSEA391180 ¹</td>
<td>3.91</td>
<td>90</td>
<td>Reference</td>
<td>0.07</td>
</tr>
<tr>
<td>USEQGSEAC82180</td>
<td>4.26</td>
<td>180</td>
<td>CO₂</td>
<td>0.07</td>
</tr>
<tr>
<td>USEQGSEACH4180</td>
<td>3.3</td>
<td>160</td>
<td>CH₄</td>
<td>0.07</td>
</tr>
<tr>
<td>USEQGSEAN8L180</td>
<td>5.3</td>
<td>180</td>
<td>NO</td>
<td>0.07</td>
</tr>
</tbody>
</table>

¹ From the QFS Flame Sensors series, used for reference.

#### Part Number (Module)

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Comment</th>
<th>Weight (gr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>USEQFSM1391100 ¹</td>
<td>Includes sensor: USEQFSEA391180</td>
<td>5.40</td>
</tr>
<tr>
<td>USEQGSM1C82100</td>
<td>Includes sensor: USEQGSEAC82180</td>
<td>5.40</td>
</tr>
<tr>
<td>USEQGSM1CH4100</td>
<td>Includes sensor: USEQGSEACH4180</td>
<td>5.40</td>
</tr>
<tr>
<td>USEQGSM1N8L100</td>
<td>Includes sensor: USEQGSEAN8L180</td>
<td>5.40</td>
</tr>
</tbody>
</table>

¹ From the QFS Flame Sensors series, used for reference.

#### Part Number (Evaluation Kit)

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Comment</th>
<th>Weight (gr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>USEQGSK3000000</td>
<td>Includes 2 sensors: USEQFSEA391180 and USEQGSEAC82180</td>
<td>300</td>
</tr>
<tr>
<td>USEQCSK0000000</td>
<td>Control board for modules, maximum 4 modules can be connected on one control board</td>
<td>250</td>
</tr>
</tbody>
</table>
Landing Pattern

Recommended PCB Landing Pattern

Part Schematic

Block Diagram

Sensor
Analog Front-End
15b ∆Σ ADC
Digital Filter
FIFO
Timing Ctrl
Interrupt Ctrl
Wake-up
Reference/Regulator
Clock Generator

CS
INT
SDA
SCL
CLK
SYNC

VDD
VCC (1.8 - 3.6 V)
GND

>100nF

© KEMET Electronics Corporation • KEMET Tower • One East Broward Boulevard
Fort Lauderdale, FL 33301 USA • 954-766-2800 • www.kemet.com
Soldering Process

Recommended Reflow Soldering Profile

<table>
<thead>
<tr>
<th>Profile Feature</th>
<th>Pb-Free Assembly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preheat/Soak</td>
<td></td>
</tr>
<tr>
<td>Temperature Minimum ($T_{smin}$)</td>
<td>150°C</td>
</tr>
<tr>
<td>Temperature Maximum ($T_{smax}$)</td>
<td>200°C</td>
</tr>
<tr>
<td>Time ($t_s$) from $T_{smin}$ to $T_{smax}$</td>
<td>60 – 120 seconds</td>
</tr>
<tr>
<td>Ramp-Up Rate ($T_s$ to $T_p$)</td>
<td>3°C/second maximum</td>
</tr>
<tr>
<td>Liquidous Temperature ($T_L$)</td>
<td>217°C</td>
</tr>
<tr>
<td>Time Above Liquidous ($t_L$)</td>
<td>60 – 150 seconds</td>
</tr>
<tr>
<td>Peak Temperature ($T_p$)</td>
<td>260°C</td>
</tr>
<tr>
<td>Time within 5°C of Maximum Peak Temperature ($t_P$)</td>
<td>30 seconds maximum</td>
</tr>
<tr>
<td>Ramp-Down Rate ($T_p$ to $T_L$)</td>
<td>6°C/second maximum</td>
</tr>
<tr>
<td>Time 25°C to Peak Temperature</td>
<td>8 minutes maximum</td>
</tr>
</tbody>
</table>

Maximum Ramp-up Rate = 3°C/second
Maximum Ramp-down Rate = 6°C/second

Tolerance for peak profile temperature ($T_P$) is defined as a supplier minimum and as a user maximum.

Packaging

<table>
<thead>
<tr>
<th>Series</th>
<th>Packaging Type</th>
<th>Pieces per Reel</th>
</tr>
</thead>
<tbody>
<tr>
<td>QGS</td>
<td>7” Tape &amp; Reel</td>
<td>800</td>
</tr>
</tbody>
</table>
Taping Specification

| Dimensions (mm)          | P0  | P   | T   | P2  | W   | A0  | B0  | K0  | E   | F   | D0  |
|-------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Minimum                 | 3.90| 7.90| 0.25| 1.90| 11.70| 3.90| 5.85| 1.65| 1.65| 5.40| 1.50|
| Typical                 | 4.00| 8.00| 0.30| 2.00| 12.00| 4.00| 5.95| 1.75| 1.75| 5.50| 1.50|
| Maximum                 | 4.10| 8.10| 0.35| 2.10| 12.30| 4.10| 6.05| 1.85| 1.85| 5.60| 1.60|

Reel Specification

<table>
<thead>
<tr>
<th>Dimensions (mm)</th>
<th>C1</th>
<th>C2</th>
<th>A</th>
<th>B</th>
<th>H</th>
<th>T</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tolerance</td>
<td>±1.0</td>
<td>±0.2</td>
<td>±0.2</td>
<td>±0.2</td>
<td>±0.5</td>
<td>±0.2</td>
<td>±0.5</td>
</tr>
<tr>
<td>Nominal</td>
<td>Ø178</td>
<td>13.5</td>
<td>2.3</td>
<td>10.4</td>
<td>12.5</td>
<td>1.6</td>
<td>Ø54</td>
</tr>
</tbody>
</table>
Handling Precautions

Pyroelectric Infrared Sensors should be kept away from indirect and direct sunlight, the headlights of cars, wind, and exposure to strong vibration and strong shock.
Do not use in water, alcohol ETA, corrosive gas or under sea breeze.
Do not be expose to corrosive substances.
Do not drop or apply any mechanical stress.

The performance of this device can be affected by ESD. Precautions should be used when handling and installing the sensor. Precision devices such as this sensor can be damaged or caused not to meet published specification due to ESD. Please note that there is limited ESD protection built-in as the device is optimised for low power consumption and low noise operation. Human Body Model (HBM), per JS-001: 2,000 V.

Pyroelectric Infrared Sensors should be stored in normal working environments.
Solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long-term storage.

KEMET recommends that ambient storage conditions are < 30°C and < 60% relative humidity and that maximum storage temperature does not exceed 110°C. Atmospheres should be free of chlorine and sulfur-bearing compounds. Temperature fluctuations should be minimized to avoid condensation on the parts.

For optimized solderability sensors stock should be used promptly, preferably within 24 months of receipt.
KEMET Electronics Corporation Sales Offices

For a complete list of our global sales offices, please visit www.kemet.com/sales.

Disclaimer

All product specifications, statements, information and data (collectively, the “Information”) in this datasheet are subject to change. The customer is responsible for checking and verifying the extent to which the Information contained in this publication is applicable to an order at the time the order is placed. All Information given herein is believed to be accurate and reliable, but it is presented without guarantee, warranty, or responsibility of any kind, expressed or implied.

Statements of suitability for certain applications are based on KEMET Electronics Corporation’s (“KEMET”) knowledge of typical operating conditions for such applications, but are not intended to constitute – and KEMET specifically disclaims – any warranty concerning suitability for a specific customer application or use. The Information is intended for use only by customers who have the requisite experience and capability to determine the correct products for their application. Any technical advice inferred from this Information or otherwise provided by KEMET with reference to the use of KEMET’s products is given gratis, and KEMET assumes no obligation or liability for the advice given or results obtained.

Although KEMET designs and manufactures its products to the most stringent quality and safety standards, given the current state of the art, isolated component failures may still occur. Accordingly, customer applications which require a high degree of reliability or safety should employ suitable designs or other safeguards (such as installation of protective circuitry or redundancies) in order to ensure that the failure of an electrical component does not result in a risk of personal injury or property damage.

Although all product–related warnings, cautions and notes must be observed, the customer should not assume that all safety measures are indicted or that other measures may not be required.

When providing KEMET products and technologies contained herein to other countries, the customer must abide by the procedures and provisions stipulated in all applicable export laws and regulations, including without limitation the International Traffic in Arms Regulations (ITAR), the US Export Administration Regulations (EAR) and the Japan Foreign Exchange and Foreign Trade Act.

KEMET is a registered trademark of KEMET Electronics Corporation.