QGS Pyroelectric Infrared Gas Sensors, I²C-SMD

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 saving significantly 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 them ideal for highly demanding automotive or medical applications.

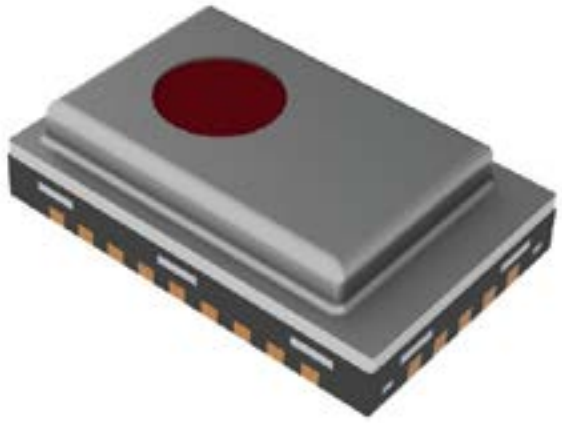
For additonal sources of information, please refer to https://ec.kemet.com/environmental-sensors/

Applications

- Gas and gas flues
- HVAC (refrigerant or CO_2-driven ventilation system)
- Industrial process and safety
- Medical capnography and anesthesia
- Handheld breath analysis and breath rate measurement
- Breath actuated dispenser
- Automotive cabin air quality
- Exhaust (CO_2 content)
- Home and building technology
- Environmental monitoring (ambient CO_2 level)
- Pollution air quality in home, office and car (excessive CO_2 level)

Benefits

- High sensitivity with fast response time
- High dynamic range
- Small SMD package
- I²C communication
- Digital output
- Programmable gain and filltering
- Various optical filter options
- Integrated configurable amplifier, filter and ADC
- Low power comsumption
- Sensor modules and digital evaluation kit available for easy evaluation and quick prototype development (ref QGSM Series)



Ordering Information

USE	QGS	E	A	C821	8	0
Product Family	Series	Sensor Type	Mounting Type	Specification	Packaging	Version
Sensors	QGS = SMD IR Gas Sensors	E = Serial output	A = Sensor only, low profile H = Sensor only, high profile	C821 = CO_2 CH41 = CH_4 N8L1 = NO 9501 = 9.50 µm	8 = 7" Tape & Reel	0

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 (QGC, QGS & QGSM 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).

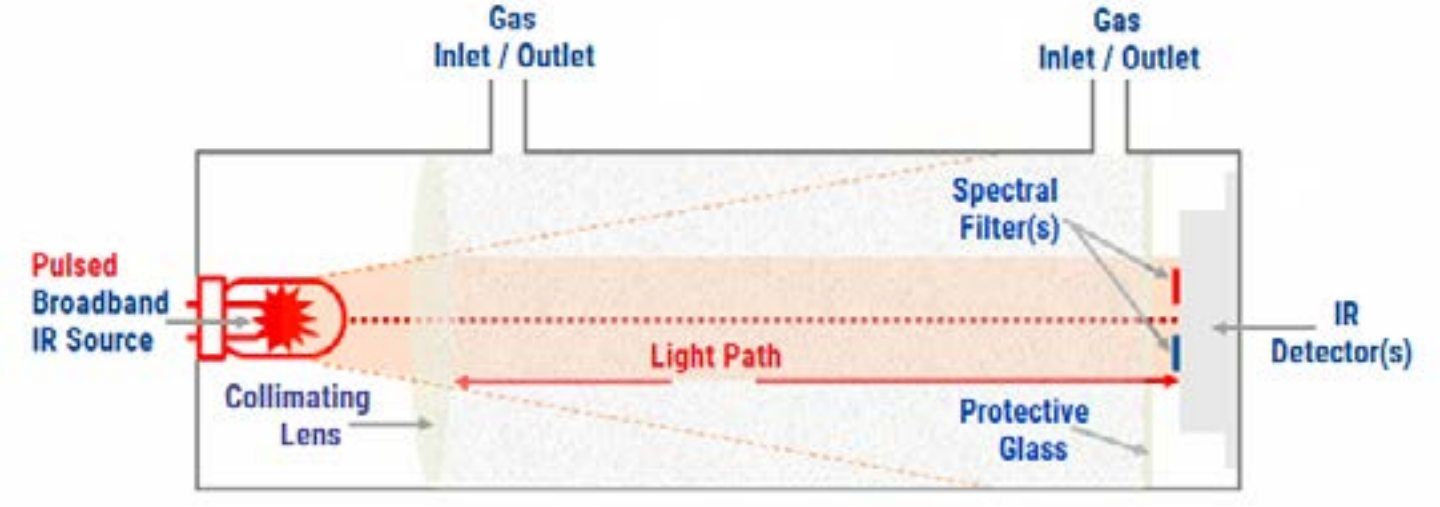
3. Regarding the safety of the gas sensors (Piezoceramic products):
The Piezoceramic that is used in this product becomes ceramic by sintering powder containing PZT as the main ingredient. It is chemically stable, with minimum risks toward the human body or environment within the intended use of the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

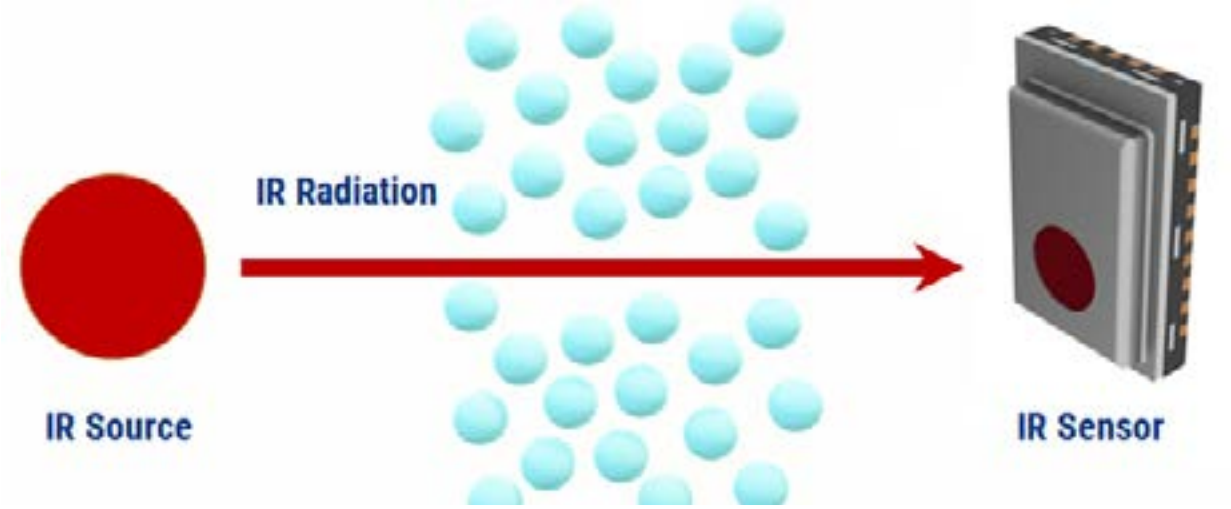
5. The responsibility of piezoceramic manufacturers:
Piezoceramic manufacturers report information regarding PZT containment in their products to the customers to obey the article 33 of the REACH regulation.

Infrared Spectroscopy

KEMET Infrared Sensors work in the MID Infrared Spectrum. They are a critical component -- but not the only component -- in a gas analysis system. An IR heat source and a suitable gas path "mechanical enclosure" are also required in order to complete the gas analysis system.



IR Absorption - Active IR Sensing

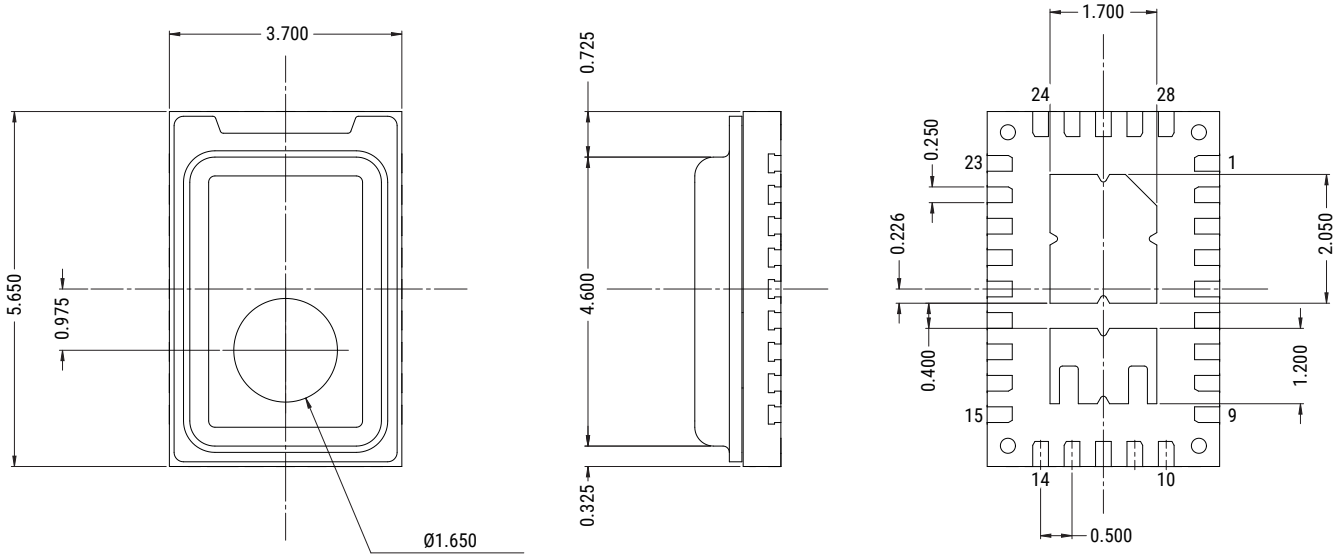


The IR source is directed as energy towards the sensor like an IR spotlight. Depending on the specific gas of interest or gas concentration levels between the IR source and the pyroelectric sensor, the IR transmitted is absorbed by the presence of the gas by a small amount. Understanding how much IR is being optically transmitted versus how much is received can indicate gas concentration levels.

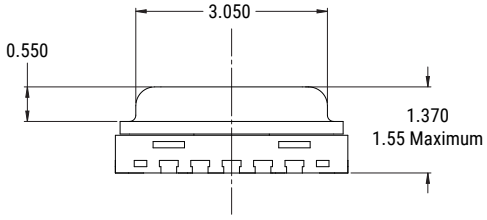
Filters are used to shorten the optical spectrum of the sensor to specifically match the gas of interest. These filters are usually included within the sensor, but for special cases KEMET can make optimised filters to suit customers specific gas requirements.

Dimensions – Millimeters

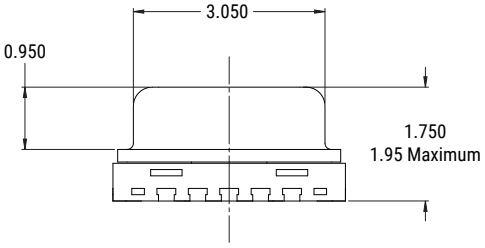
Sensor



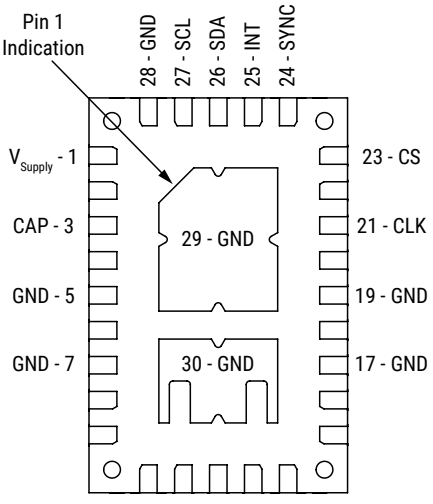
USEQGSEA**** Low Profile**



USEQGSEH**** High Profile**



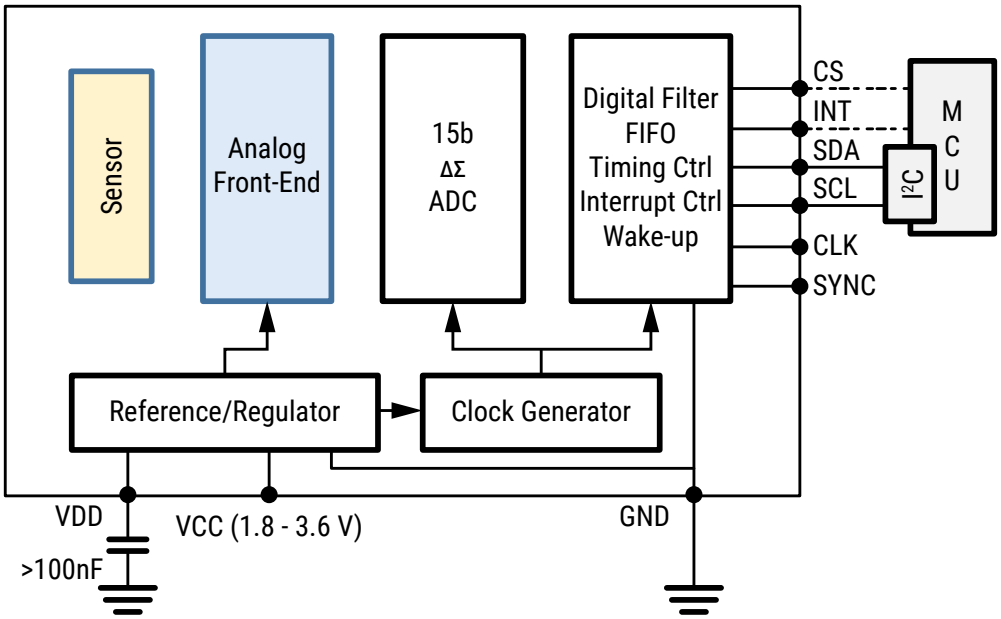
Pin Configuration of the Sensor



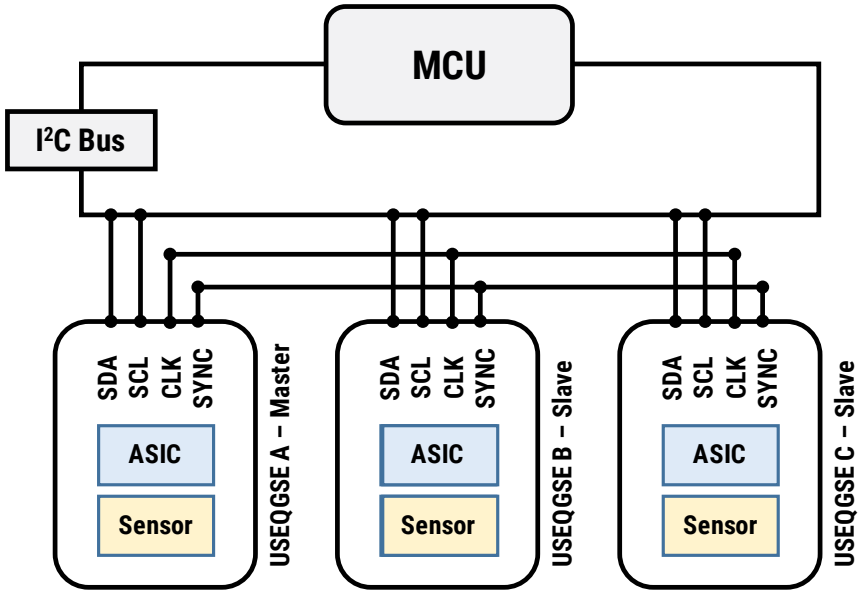
Transparent Top View

Recommended Circuit Diagram

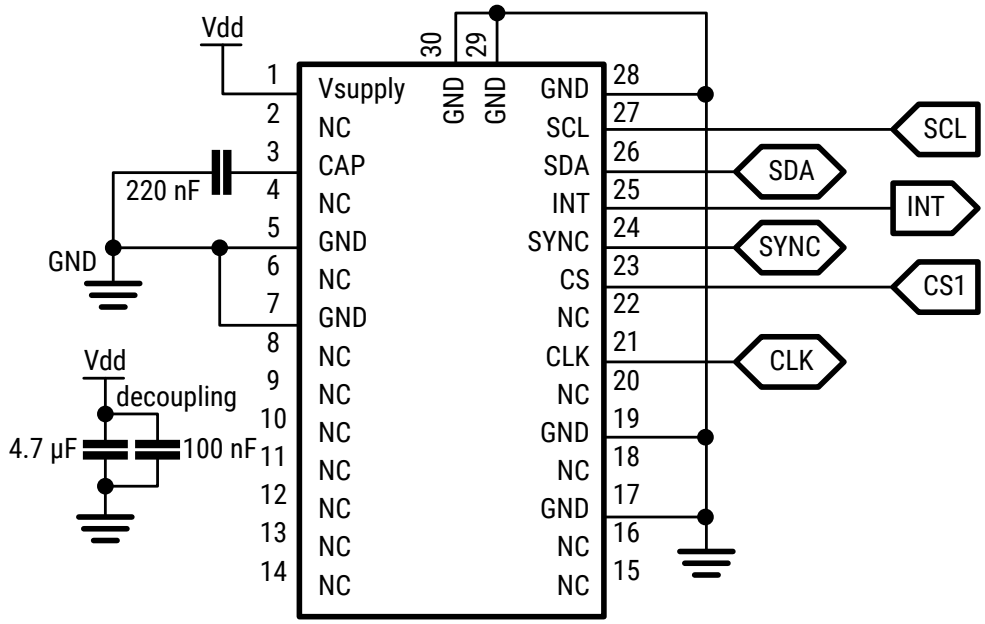
Single Device Block Diagram



Three Devices with Synchronised Sampling

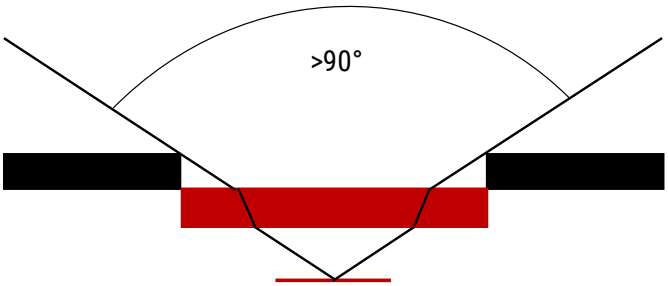


Recommended Circuit Diagram cont.

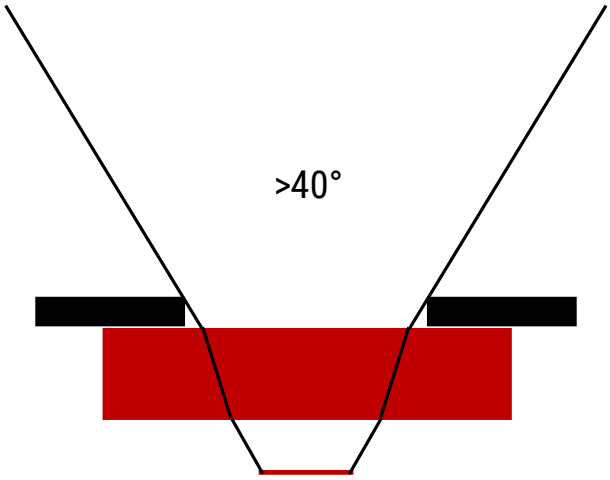


Field of View

USEQGSEA****** Low Profile



USEQGSEH****** High Profile



Performance Characteristics

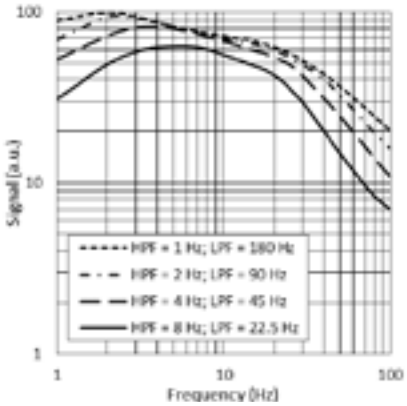
Signal Filtering & Power Modes

Power Mode (base sample rate)	High Pass Filter – Analog (Hz)					Fixed Analog Low Pass Filter (Hz)	Fixed Digital Low Pass Filter (Hz)	Digital Low Pass Filter (Hz)				Maximum ADC Sampling Rate (sps)
Normal Power Mode	Off	1.0	2.0	4.0	8.0	600	250	180.0	90.0	45.0	22.5	1,000
Low Power Mode	Off	0.17	0.33	0.66	1.30	100	42	30.00	15.00	7.50	3.75	166

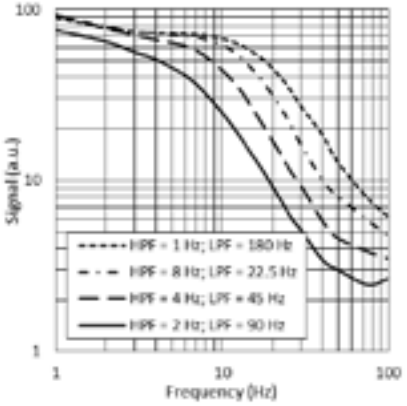
Item	Mode	Description	Typical Current Consumption (1.8 V, room temperature)
Power consumption	Normal Power Mode	Normal power consumption, 1 kHz maximum sample rate	22 µA
	Low Power Mode	Low power consumption, 166 Hz maximum sample rate	3.5 µA
Operational state	Normal Operation Mode	Sensor signal readout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

Infrared Frequency Characteristics

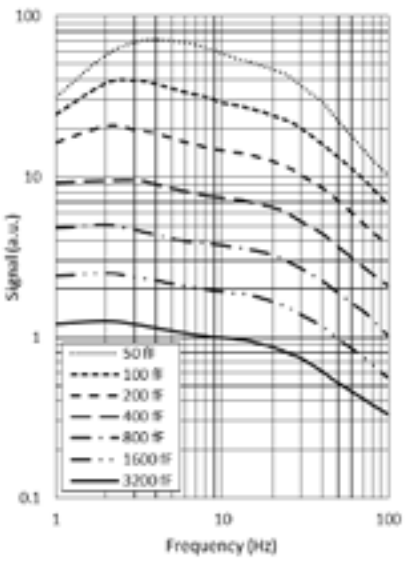
Typical Frequency Response in Normal Power Mode



Typical Frequency Response in Low Power Mode



Typical Frequency Response at Different Gain Settings



Part Number Specifications

Sensor Characteristics

Filter Aperture (mm)	Element Size (mm^2)	SMD Package (mm)	D*[1] (cm√Hz/W) Typical	NEP[1] (W/√Hz) Typical	Time Constant (ms) at 10-20 Hz peak	Field of View
φ 1.65	0.64 x 0.64	5.65 x 3.70 x 1.55	2.5×10^{8}	2.7×10^{-10}	~10	~90°

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

Electrical Characteristics

Supply Voltage (V)	Supply Current (µA) Typical	Digital I/O	ΔΣ ADC at 1 ksp	Operating Temperature Range (°C)	Storage Temperature Range (°C)	Sensor Read-out	Configurable
1.75 to 3.60	1 to 23	I²C (FM+ compatible)	15 bit	−40 to +85	−40 to +110	Current mode	Gain Digital filtering Sampling rate Power modes

Part Number (Sensor)

Part Number	Filter (µm)	Filter BW (nm)	Use	Weight (gr)
USEQGSEAC82180	4.26	180	CO_2	0.07
USEQGSEACH4180	3.30	160	CH_4	0.07
USEQGSEAN8L180	5.30	180	NO	0.07
USEQGSEH950180	9.50	400	Sugar, Ethanol	0.08

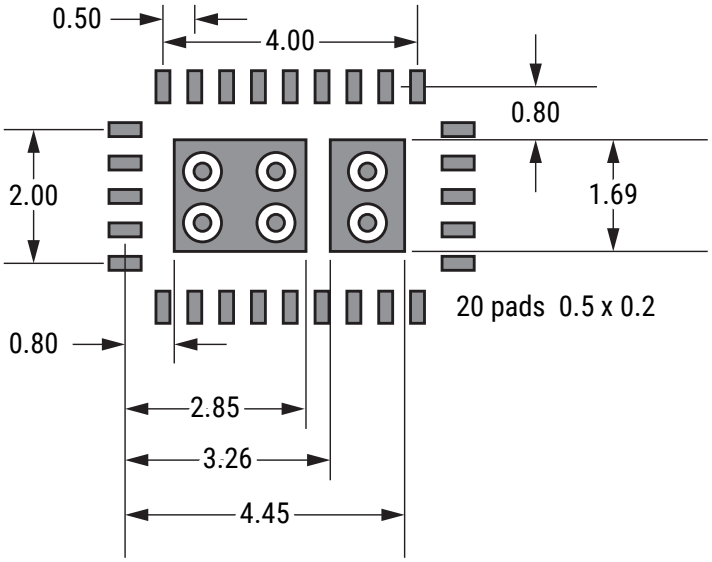
Below flame sensors from the QFS series can also be used for gas detection or analysis, more details about these products available on https://content.kemet.com/datasheets/KEM_SE0211_QFS.pdf

Part Number	Filter (µm)	Filter BW (nm)	Use	Weight (gr)
USEQFSEA391180	3.91	90	Reference	0.07
USEQFSEA22L180 [1]	2.20	Long pass	Broadband	0.07
USEQFSEA50L180 [1]	5.00	Long pass	Broadband	0.07
USEQFSEA464180 [2]	4.64	180	CO	0.07

[1] *Used with bespoke, customer or application-specific (narrowband) filters mounted externally.*
[2] *Used as gas or active filter.*

Landing Pattern

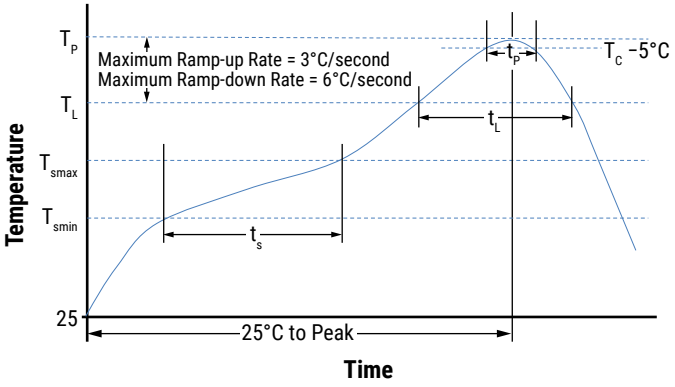
Recommended PCB Landing Pattern – Millimeters



Soldering Process

Recommended Reflow Soldering Profile

Profile Feature	Pb-Free Assembly
Preheat/Soak	
Temperature Minimum (T_{Smin})	150°C
Temperature Maximum (T_{Smax})	200°C
Time (t_s) from T_{smin} to T_{smax}	60 – 120 seconds
Ramp-Up Rate (T_L to T_P)	3°C/second maximum
Liquidous Temperature (T_L)	217°C
Time Above Liquidous (t_L)	60 – 150 seconds
Peak Temperature (T_P)	260°C
Time within 5°C of Maximum Peak Temperature (t_P)[1]	30 seconds maximum
Ramp-Down Rate (T_P to T_L)	6°C/second maximum
Time 25°C to Peak Temperature	8 minutes maximum

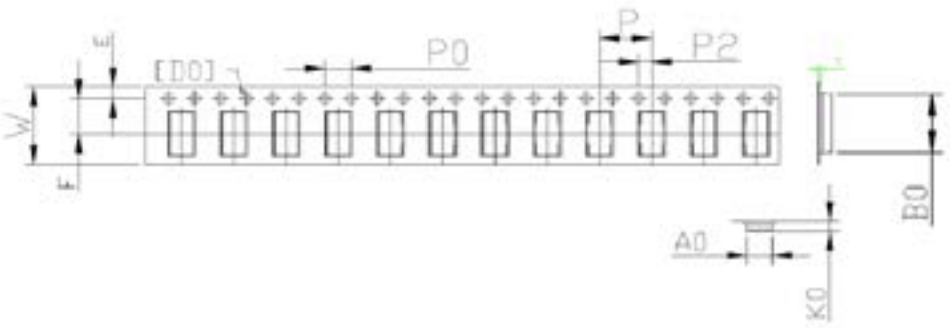


[1] *Tolerance for peak profile temperature (TP) is defined as a supplier minimum and as a user maximum.*

Packaging

Part Number	Packaging Type	Pieces Per Reel
USEQGS********	7" Tape & Reel	800

Taping Specification



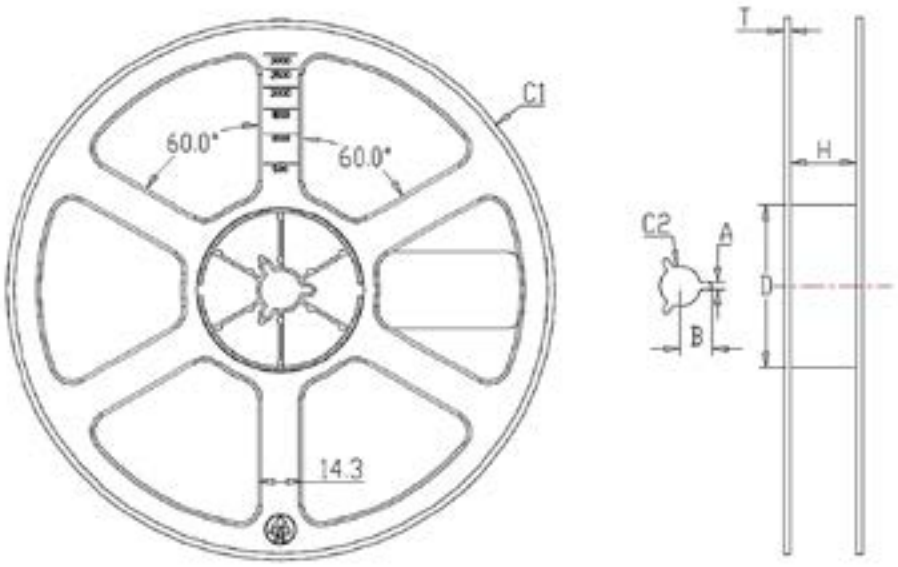
USEQGSEA**** Low Profile**

	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

USEQGSEH**** High Profile**

	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	2.05	1.65	5.40	1.50
Typical	4.00	8.00	0.30	2.00	12.00	4.00	5.95	2.15	1.75	5.50	1.50
Maximum	4.10	8.10	0.35	2.10	12.30	4.10	6.05	2.25	1.85	5.60	1.60

Reel Specification



	Dimensions (mm)						
	C1	C2	A	B	H	T	D
Tolerance	±1.0	±0.2	±0.2	±0.2	±0.5	±0.2	±0.5
Nominal	Ø178	13.5	2.3	10.4	12.5	1.6	Ø54

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.

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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.

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