

# QMSM Pyroelectric Infrared Motion Sensor Modules, I<sup>2</sup>C-SMD

## Overview

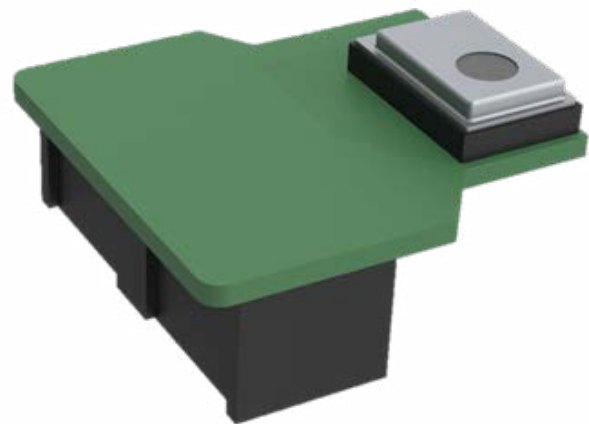
KEMET's QMSM thin film digital pyroelectric IR sensor modules combine high sensitivity with fast response times to ensure rapid and accurate motion detection, and high dynamic range to allow motion detection nearby or over larger distances. The 2x2 pixel version of this device allows users to determine direction of motion.

The motion sensor modules consist of a breakout board, on which a SMD motion sensor is mounted, ideal for easy evaluation and quick prototype development. These sensors integrate a digital, current mode read-out, with industry standard I2C communication enabling plug-and-play connectivity to microcontrollers and allows easy tuning. Programmable gain and filtering offer maximum flexibility in system design, and various low power modes, including a wake-up by motion feature, are also available. These sensors can be connected together in linear series to allow synchronized sampling across devices. To allow for further in-depth testing of these motion and gesture sensing solutions, KEMET is proposing 4 different evaluation kits.

For additional sources of information, please refer to the [Environmental Sensors page on KEMET.com](#)

## Applications

- Contactless switching
- Office automation equipment
- Home appliances
- Lighting
- Display products
- Air-conditioners
- TV
- PC monitors
- Rice cookers
- Smart toilets



## Benefits

- High sensitivity with fast response time and high dynamic range
- Digital output and I2C communication
- Programmable gain and filtering
- Various pixel and aperture configurations
- Ultra-low power consumption and standby modes, motion triggered wake-up
- Sensor modules for easy evaluation and quick prototype development
- Evaluation kit for long range gesture sensing
- Evaluation kit for medium range gesture sensing
- Evaluation kit for motion sensing
- Evaluation kit for directional motion sensing
- Easy to install and user-friendly software

## Ordering Information

| USE            | QMS                         | E                                       | A                                                             | 0116                                                                                                                                                       | 8         | 0       |
|----------------|-----------------------------|-----------------------------------------|---------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|---------|
| Product Family | Series                      | Sensor Type                             | Mounting Type                                                 | Specification                                                                                                                                              | Packaging | Version |
| Sensors        | QMS = SMD IR Motion Sensors | M = Serial module<br>K = Evaluation kit | 1 = Module type 1 or kit type 1<br>L = Lens<br>S = Small lens | 0116 = 1x1 pixel, 1.65 aperture, 5.0 µm Long Pass<br>2216 = 2x2 pixel, 1.65 aperture, 5.0 µm Long Pass<br>2209 = 2x2 pixel, 0.9 aperture, 5.0 µm Long Pass | 0 = Bulk  | 0       |

## Environmental Compliance

All KEMET Motion 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: Motion Sensors (QMS and QMSM 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 motion 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 motion sensors (Piezoceramic products):*

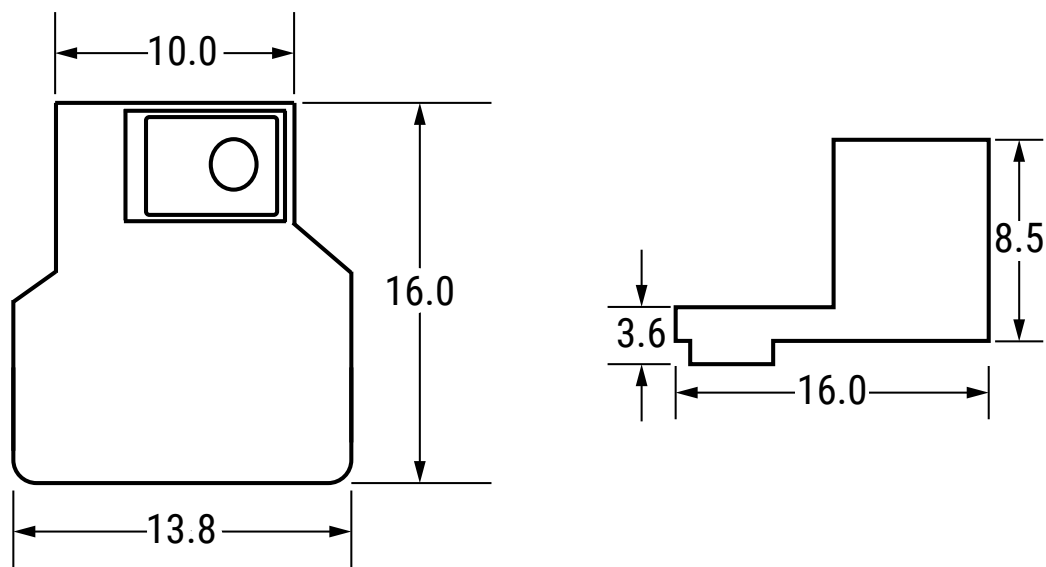
*The manufacturing technique of the "piezoceramic products" whose main ingredient is Lead Titanium Zirconium Oxide (PZT) has been established, and there is no alternative material that can exhibit superior performance than PZT at this moment. Please note that the piezoceramic is listed as an exempt on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

5. *The responsibility of piezoceramic manufacturers:*

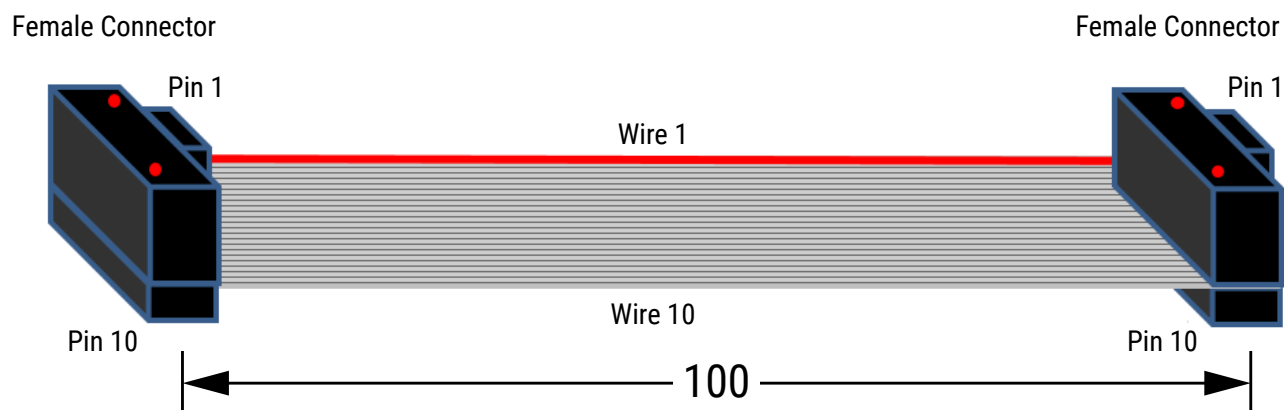
*Piezoceramic manufacturers report information regarding PZT containment in their products to the customers to obey the article 33 of the REACH regulation*

## Dimensions – Millimeters

### Module



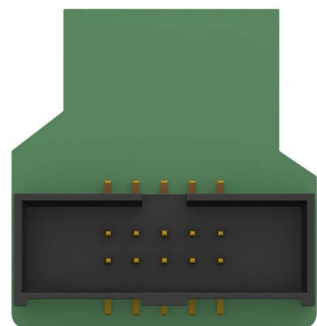
### Cable



## Dimensions – Millimeters cont.

### Pin Configuration of the Module

Outfitted with all necessary components for the 1.8-3.6 V power supply of the device, all functionality of the sensor is routed out to a 10-pin 1.27 mm pitch IDC connector on the back side of the 16 x 13.8 mm PCB. The build height including the socket is 9 mm. They provide up to 1 MHz Fast Mode+ I<sup>2</sup>C communication to configure the sensor and read data from it.

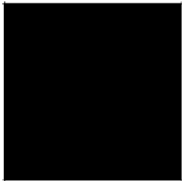
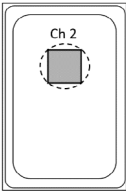
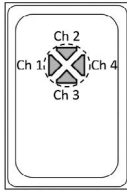
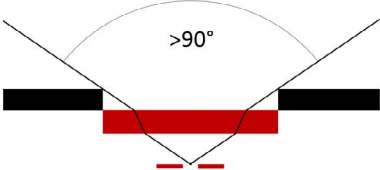
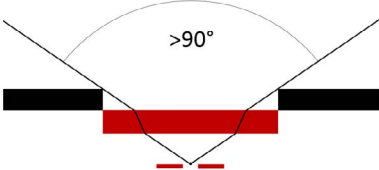
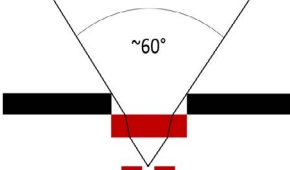


|     |    |    |    |    |
|-----|----|----|----|----|
| •9  | •7 | •5 | •3 | •1 |
| •10 | •8 | •6 | •4 | •2 |

| Pin | Symbol                 | Type           |
|-----|------------------------|----------------|
| 1   | V <sub>supply</sub>    | Power supply   |
| 2   | Unassigned             | -              |
| 3   | SCL (I <sup>2</sup> C) | Digital in/out |
| 4   | SDA (I <sup>2</sup> C) | Digital in/out |
| 5   | CS                     | Digital in     |
| 6   | INT                    | Digital out    |
| 7   | SYNC                   | Digital in/out |
| 8   | CLK                    | Digital in/out |
| 9   | Unassigned             | -              |
| 10  | GND                    | Ground         |

There is a chip select/enable pin and an interrupt output available. The CLK/SYNC pins can be used to feed an external clock signal in to the board or, alternatively, distribute the clock signal of one board to several other boards, thereby creating a synchronized “network” of sensors.

## Field of View

|                | Single Element                                                                     | 2x2 Array                                                                                                                                                                                                                                 |
|----------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sensor Element |   |                                                                                                                                                        |
| Pixel Mapping  |   |                                                                                                                                                        |
| Field of View  |  |   <div> <div>Large Aperture</div> <div>Small Aperture</div> </div> |

## Performance Characteristics

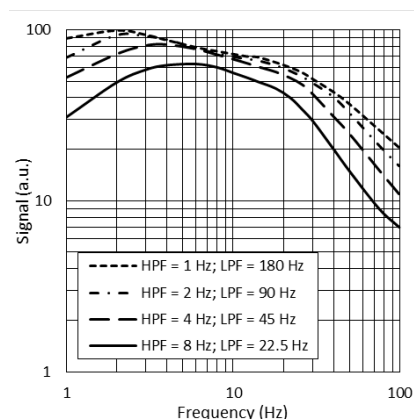
### Signal Filtering & Power Modes

| Power Mode<br>(base sample rate) | High Pass Filter – Analog<br>(Hz) |      |      |      |      | Fixed Analog<br>Low Pass<br>Filter (Hz) | Fixed Digital Low<br>Pass Filter<br>(Hz) | Digital Low Pass<br>Filter (Hz) |       |      |      | Maximum<br>ADC<br>Sampling Rate<br>(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                                      |

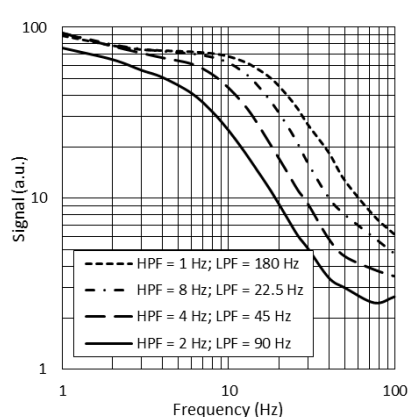
| Item              | Mode                  | Description                                         | Typical Current<br>Consumption<br>(1.8 V, room temperature)    |
|-------------------|-----------------------|-----------------------------------------------------|----------------------------------------------------------------|
| Power consumption | Normal Power Mode     | Normal power consumption, 1 kHz maximum sample rate | 22 $\mu$ A                                                     |
|                   | Low Power Mode        | Low power consumption, 166 Hz maximum sample rate   | 3.5 $\mu$ A                                                    |
| Operational state | Normal Operation Mode | Sensor signal readout over I <sup>2</sup> C         | 22 $\mu$ A                                                     |
|                   | Sleep Mode            | Hardware interrupt on infrared trigger              | 21 $\mu$ A (Normal Power Mode)<br>3.5 $\mu$ A (Low Power Mode) |
|                   | Power Down Mode       | Sensor is disabled                                  | 1.1 $\mu$ A                                                    |

### Infrared Frequency Characteristics

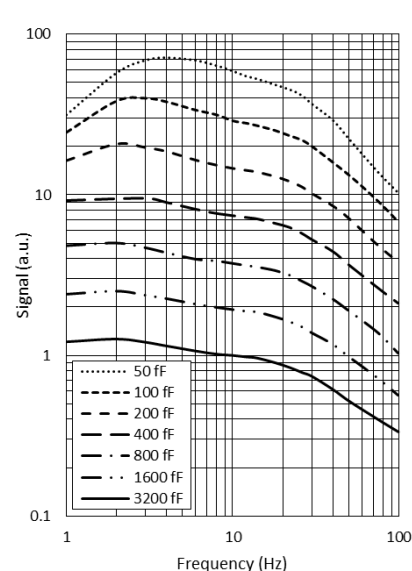
Typical Frequency Response in  
Normal Power Mode



Typical Frequency Response in  
Low Power Mode



Typical Frequency Response at  
Different Gain Settings



## Part Number Specifications

### Electrical Characteristics

| Supply Voltage (V) | Supply Current (μA) Typical | Digital I/O                       | $\Delta\Sigma$ ADC at 1 ksp | Operating Temperature Range (°C) | Storage Temperature Range (°C) | Sensor Read-out | Configurable                                              |
|--------------------|-----------------------------|-----------------------------------|-----------------------------|----------------------------------|--------------------------------|-----------------|-----------------------------------------------------------|
| 1.75 to 3.60       | 1 to 23                     | I <sup>2</sup> C (FM+ compatible) | 15 bit                      | -40 to +85                       | -40 to +110                    | Current mode    | Gain<br>Digital filtering<br>Sampling rate<br>Power modes |

### Part Number (Module)

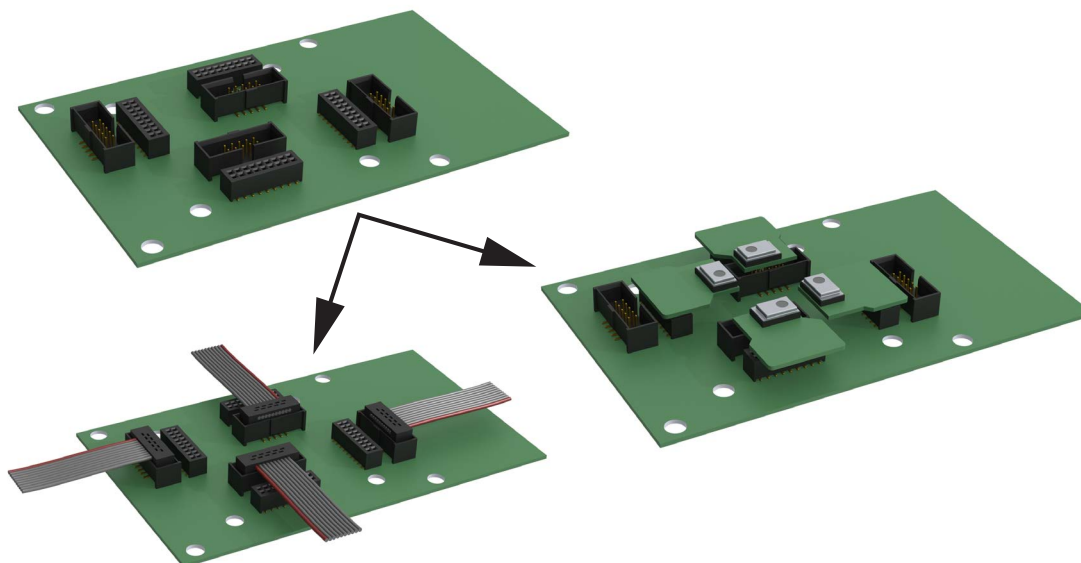
| Part Number    | Including Sensor | Filter Aperture (mm) | Element Size (mm <sup>2</sup> ) | D* <sup>1</sup> (cm·√Hz/W) Typical | NEP <sup>1</sup> (W/√Hz) Typical | Time Constant (ms) at 10–20 Hz peak | Filter           | Weight (gr) |  |  |
|----------------|------------------|----------------------|---------------------------------|------------------------------------|----------------------------------|-------------------------------------|------------------|-------------|--|--|
| USEQMSM1011600 | USEQMSEA011680   | φ 1.65               | 0.410 (1 pixel)                 | 2.5 x 10 <sup>8</sup>              | 2.7 x 10 <sup>-10</sup>          | ~10                                 | 5.0 μm Long Pass | 5.40        |  |  |
| USEQMSM1221600 | USEQMSEA221680   | φ 1.65               | 4 x 0.057 (4 pixel)             | 5.5 x 10 <sup>8</sup>              | 0.4 x 10 <sup>-10</sup>          |                                     |                  | 5.40        |  |  |
| USEQMSM1220900 | USEQMSEA220980   | φ 0.90               | 4 x 0.057 (4 pixel)             |                                    |                                  |                                     |                  | 5.40        |  |  |

<sup>1</sup> 10 Hz, 500 K, room temperature, without window and optics.

## Evaluation Kits

### Control Board for Module

| Part Number    | Use                       | Includes                                                                                       | Weight |
|----------------|---------------------------|------------------------------------------------------------------------------------------------|--------|
| USEQCSK0000000 | Control Board for Modules | Preassembled backplane PCB<br>USB communications cable<br>Ribbon cable, optional use (up to 4) | 250 gr |



USEQCSK0000000 can flexibly host up to four modules. With no hardware design work required, a combination of this backplane board and any of the attached SMD sensors can produce infrared sensor signal measurements out of the box in the early evaluation and design stages. This control board is provided with PC software allowing the user to configure and read out each of the SMD sensors connected. The sensor data is visualised in real time on a scope plot in the user interface. A csv file capture facility records the digital signals from the sensors for further processing by the user.

### Evaluation Kits

- Quick prototype development
- Easy way to evaluate
- Easy to install software
- Digital output

KEMET offers a 4 different evaluation kits which have the sensor products at their core, to allow for low cost, low power, non-contact mid IR motion, presence and gesture detection, with or without Fresnel lenses. These evaluation kits can be connected to PCs over a micro-USB port.

All evaluation systems are provided with Windows PC software, which allows sensor configuration, sensor signal visualisation and data capture to CSV, and also additional application related functions in some cases.

## Evaluation Kits cont.

| Part Number                                                                                         | Use                                  | Includes                                                                                   | Weight |
|-----------------------------------------------------------------------------------------------------|--------------------------------------|--------------------------------------------------------------------------------------------|--------|
| <br>USEQMSKL011600 | Motion Sensing,<br>with Fresnel Lens | SMD Motion Sensing Kit<br>Sensor USEQMSEA011680 1px 5.0 μm LWP<br>USB communications cable | 300 gr |

| Part Number                                                                                         | Use                                              | Includes                                                                                   | Weight |
|-----------------------------------------------------------------------------------------------------|--------------------------------------------------|--------------------------------------------------------------------------------------------|--------|
| <br>USEQMSKL221600 | Directional Motion Sensing,<br>with Fresnel Lens | SMD Motion Sensing Kit<br>Sensor USEQMSEA221680 2x2 5.0 μm LWP<br>USB communications cable | 300 gr |

| Part Number                                                                                          | Use                                              | Includes                                                                                                       | Weight |
|------------------------------------------------------------------------------------------------------|--------------------------------------------------|----------------------------------------------------------------------------------------------------------------|--------|
| <br>USEQMSKS221600 | Long Range Gesture Sensing,<br>with Fresnel Lens | SMD Motion Sensing Kit<br>Sensor USEQMSEA221680 2x2 5.0 μm LWP<br>(large aperture)<br>USB communications cable | 300 gr |

| Part Number                                                                                           | Use                                        | Includes                                                                                                       | Weight |
|-------------------------------------------------------------------------------------------------------|--------------------------------------------|----------------------------------------------------------------------------------------------------------------|--------|
| <br>USEQMSK1220900 | Medium Range Gesture Sensing,<br>no optics | SMD Motion Sensing Kit<br>Sensor USEQMSEA220980 2x2 5.0 μm LWP<br>(small aperture)<br>USB communications cable | 300 gr |

## Packaging

| Part Number  | Packaging Type     | Piece per Bag |
|--------------|--------------------|---------------|
| USEQMSM***** | ESD Protective Bag | 1             |

| Part Number    | Packaging Type | Piece per Box |
|----------------|----------------|---------------|
| USEQCSK0000000 | Cardboard Box  | 1             |
| USEQMSKL011600 |                |               |
| USEQMSKL221600 |                |               |
| USEQMSKS221600 |                |               |
| USEQMSK1220900 |                |               |

## 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 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. Do not expose to high temperatures, high humidity, corrosive atmospheres, and avoid 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. The stock of sensors should be used promptly, preferably within 24 months of receipt.

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