

## Overview

KEMET's QFS pyroelectric flame sensors combine high sensitivity with fast response times and high dynamic range to ensure rapid and accurate detection of small and large flames, nearby or over larger distances.

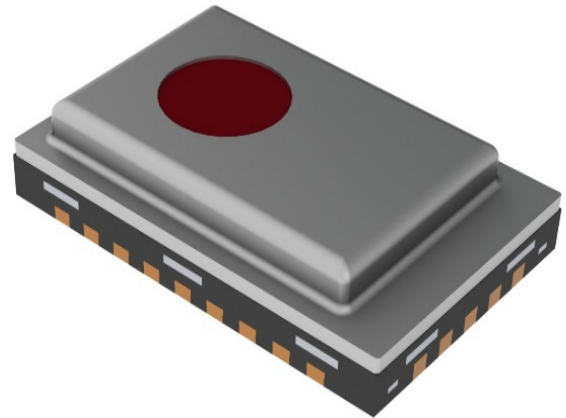
These high quality sensors, in their small SMD package, integrate a digital, current mode read-out offering high responsivity over the full frequency range of flame flicker from 3 – 30 Hz. Industry standard I<sup>2</sup>C communication enables plug-and-play connectivity to microcontrollers and allows 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 a linear series for synchronized sampling across devices.

Their long and maintenance-free operational lifetime and various low power modes make these sensors ideal for any smart or IoT type of applications.

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

## Applications

- Smart home
- Smart building
- Industrial IoT
- Transportation



## Benefits

- High sensitivity with fast response time
- High dynamic range
- Small SMD package
- Digital output and I<sup>2</sup>C communication
- Programmable gain and filtering
- Various optical filter options
- Integrated configurable amplifier, filter and ADC
- Low power consumption
- Sensor modules and digital evaluation kit available for easy evaluation and quick prototype development (ref QFSM Series)

## Ordering Information

| USE            | QFS                        | E                 | A               | 22L1                                                                                                                                                                                                                                                                | 8                  | 0       |
|----------------|----------------------------|-------------------|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|---------|
| Product Family | Series                     | Sensor Type       | Mounting Type   | Specification                                                                                                                                                                                                                                                       | Packaging          | Version |
| Sensors        | QFS = SMD IR Flame Sensors | E = Serial output | A = Sensor only | 0000 = Fixed<br>22L1 = 2.2 µm long pass (broadband flame detection)<br>50L1 = 5.00 µm long pass (human motion rejection)<br>3911 = 3.91 µm (rejection channel)<br>4641 = 4.64 µm (flame channel with wide FoV)<br>4481 = 4.48 µm (flame channel with main detector) | 8 = 7" Tape & Reel | 0       |

## Environmental Compliance

All KEMET Flame 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: Flame Sensors (QFC, QFCE, QFS & QFSM 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 flame 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 flame sensors (Piezoceramic products):

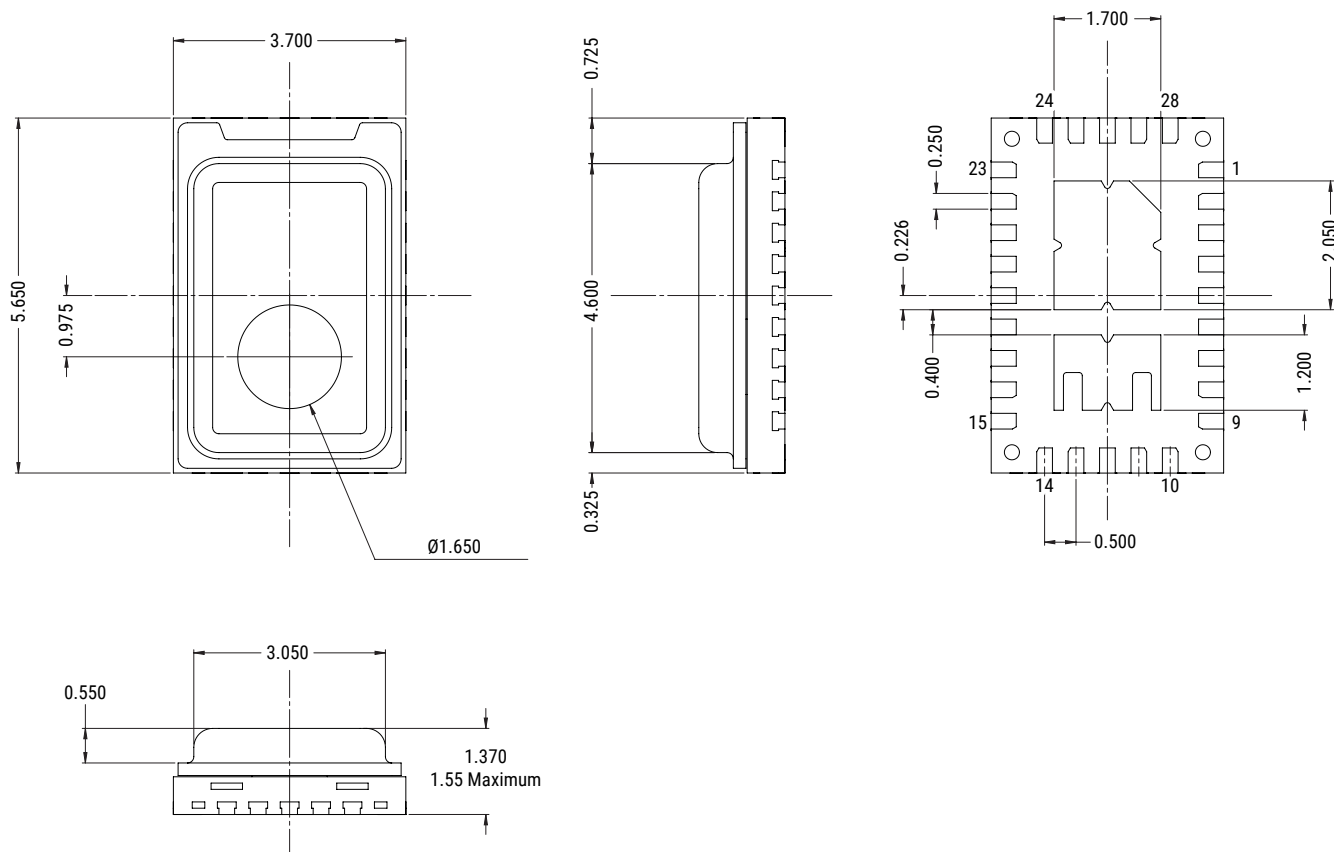
The manufacturing technique of the "piezoceramic products" whose main ingredient is Lead Titanium Zirconium Oxide (PZT) has been established, and there is no alternative material that can exhibit superior performance than PZT at this moment. Please note that the piezoceramic is listed as an exempt on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

5. The responsibility of piezoceramic manufacturers:

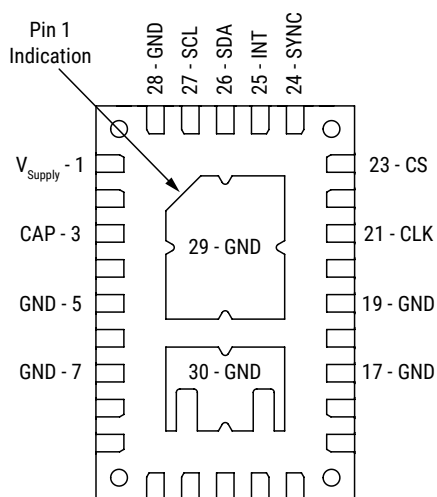
Piezoceramic manufacturers report information regarding PZT containment in their products to the customers to obey the article 33 of the REACH regulation

## Dimensions – Millimeters

### Sensor



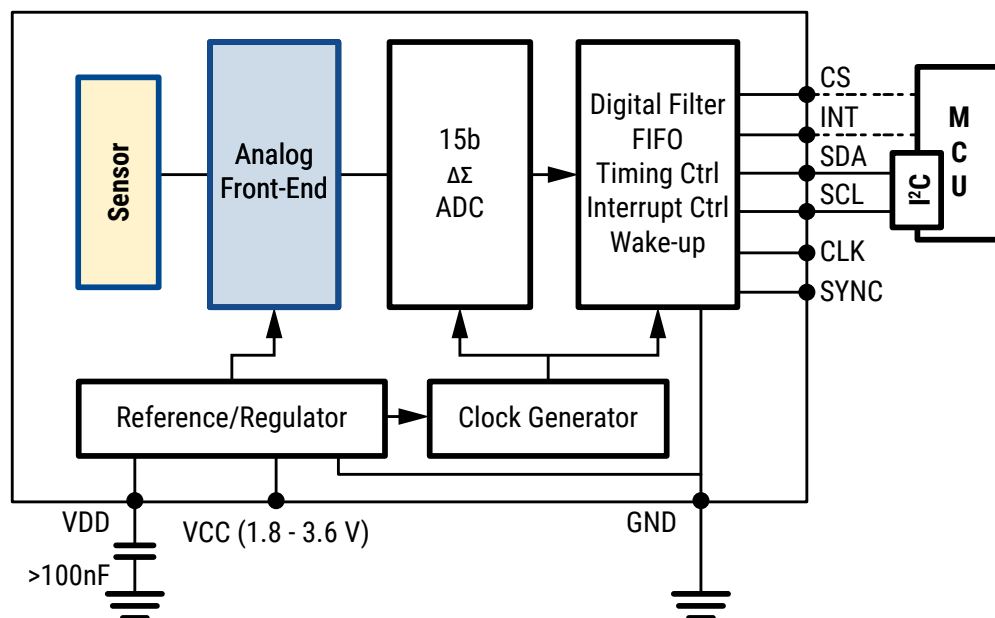
### Pin Configuration of Sensor



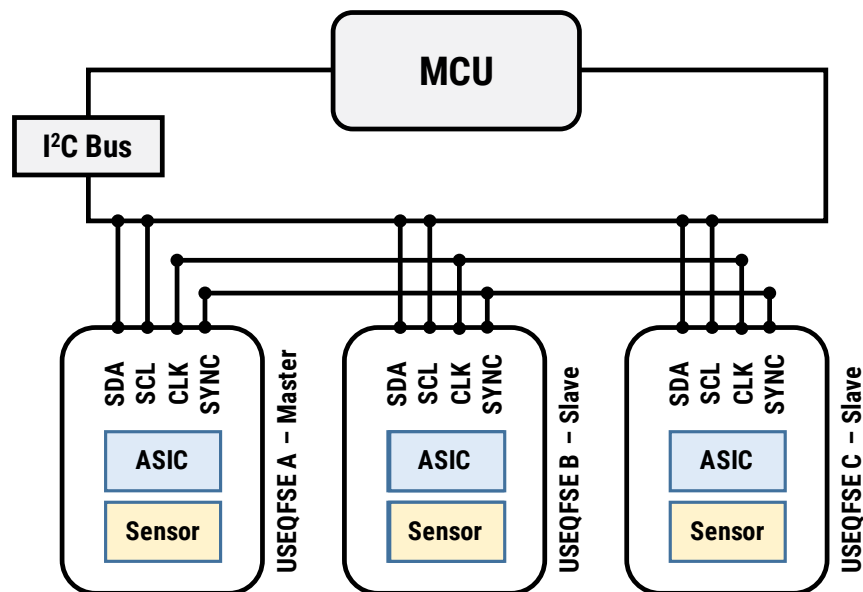
Transparent Top View

## Recommended Circuit Diagram

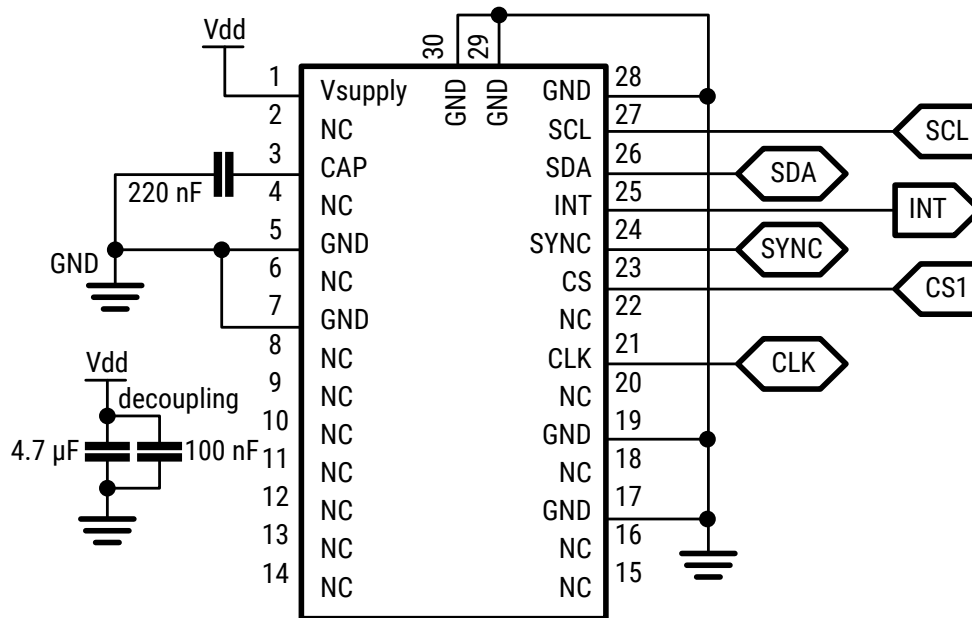
### Single Device Block Diagram



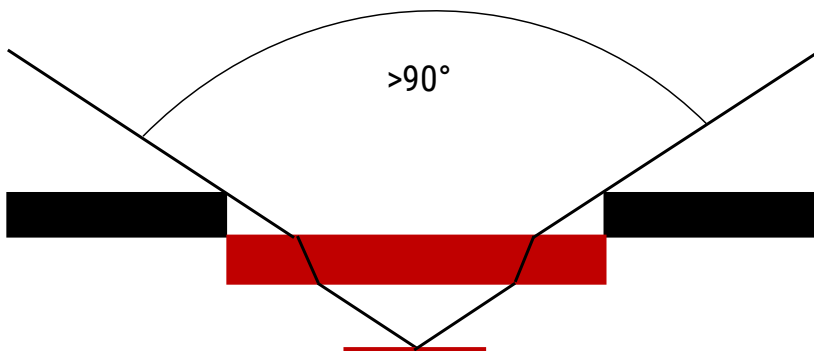
### Three Devices with Synchronised Sampling



## Recommended Circuit Diagram cont.



## Field of View



## Performance Characteristics

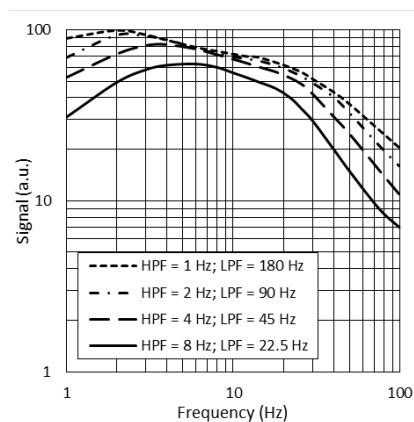
### Signal Filtering & Power Modes

| 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                                      |

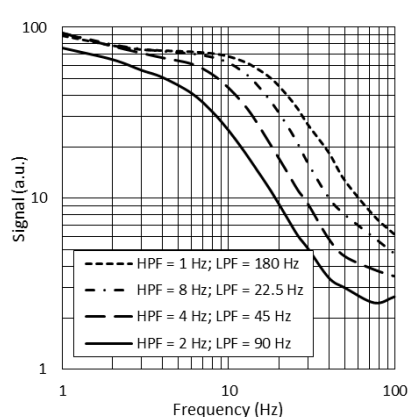
| Item              | Mode                  | Description                                         | Typical Current<br>Consumption<br>(1.8 V, room temperature)    |
|-------------------|-----------------------|-----------------------------------------------------|----------------------------------------------------------------|
| 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

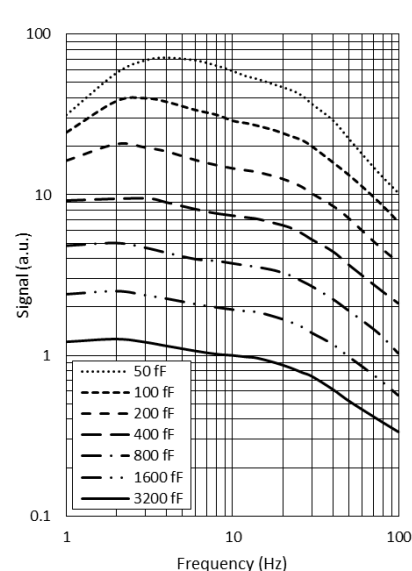
Typical Frequency Response in  
Normal Power Mode



Typical Frequency Response in  
Low Power Mode



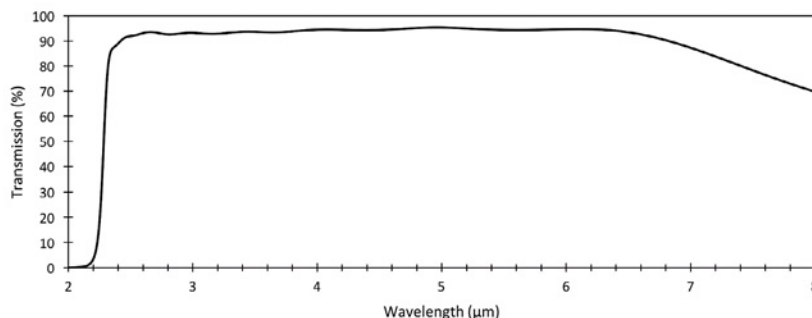
Typical Frequency Response at  
Different Gain Settings



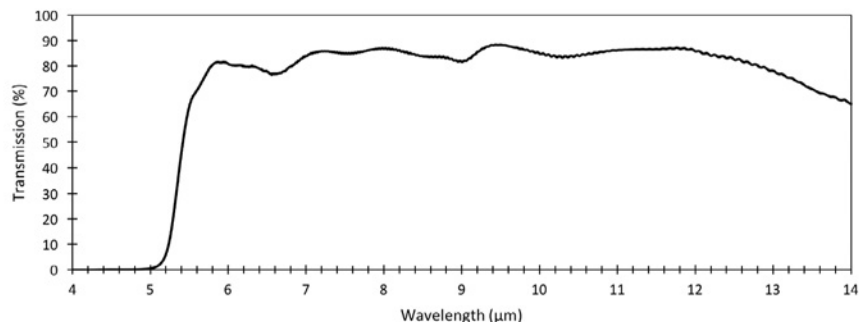
## Performance Characteristics cont.

### Filter Transmission Profiles

Typical 2.2  $\mu\text{m}$  LP Filter Transmission



Typical 5.0  $\mu\text{m}$  LP Filter Transmission



## Part Number Specifications

### Sensor Characteristics

| Filter Aperture (mm) | Element Size (mm <sup>2</sup> ) | SMD Package (mm)   | D* <sup>1</sup> (cm $\sqrt{\text{Hz/W}}$ ) Typical | NEP <sup>1</sup> (W/ $\sqrt{\text{Hz}}$ ) Typical | Time Constant (ms) at 10-20 Hz peak | Field of View |
|----------------------|---------------------------------|--------------------|----------------------------------------------------|---------------------------------------------------|-------------------------------------|---------------|
| $\varnothing$ 1.65   | 0.64 x 0.64                     | 5.65 x 3.70 x 1.55 | $2.5 \times 10^8$                                  | $2.7 \times 10^{-10}$                             | ~10                                 | ~90°          |

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

### Electrical Characteristics

| Supply Voltage (V) | Supply Current ( $\mu\text{A}$ ) 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 |

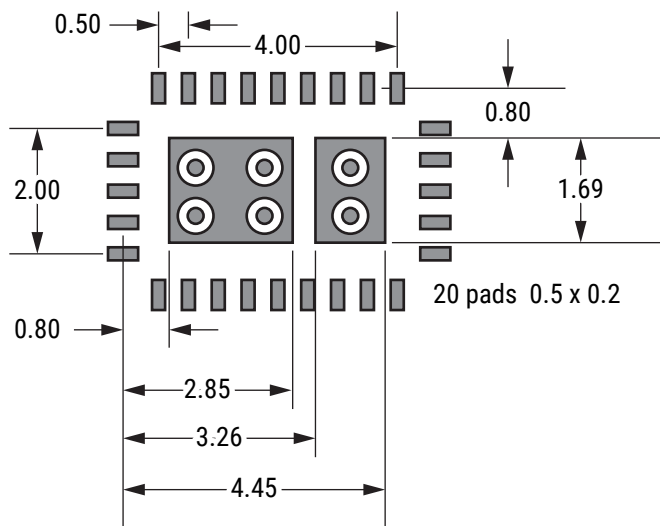
## Part Number Specifications cont.

### Part Number (Sensor)

| Part Number    | Filter(μm) | Filter BW (nm) | Comment                       | Weight (gr) |
|----------------|------------|----------------|-------------------------------|-------------|
| USEQFSEA22L180 | 2.20       | Long pass      | Broadband flame detection     | 0.07        |
| USEQFSEA50L180 | 5.00       | Long pass      | Human motion rejection        | 0.07        |
| USEQFSEA39I180 | 3.91       | 90             | Rejection channel             | 0.07        |
| USEQFSEA464180 | 4.64       | 180            | Flame channel (wide FoV)      | 0.07        |
| USEQFSEA448180 | 4.48       | 620            | Flame channel (main detector) | 0.07        |

## Landing Pattern

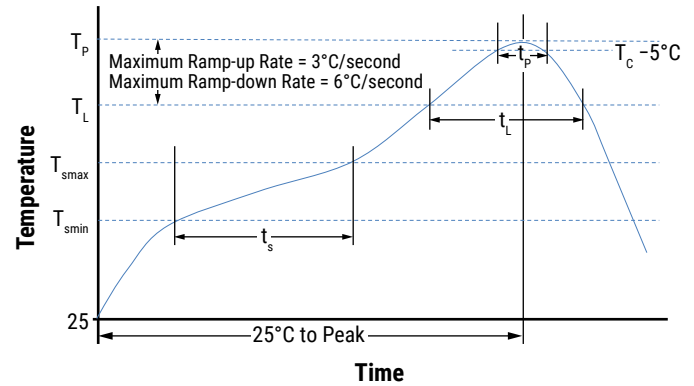
### Recommended PCB Landing Pattern - Millimeters



## Soldering Process

### Recommended Reflow Soldering Profile

| Profile Feature                                                    | Pb-Free Assembly   |
|--------------------------------------------------------------------|--------------------|
| <b>Preheat/Soak</b>                                                |                    |
| 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 ( $t_p$ ) <sup>1</sup> | 30 seconds maximum |
| Ramp-Down Rate ( $T_P$ to $T_L$ )                                  | 6°C/second maximum |
| Time 25°C to Peak Temperature                                      | 8 minutes maximum  |

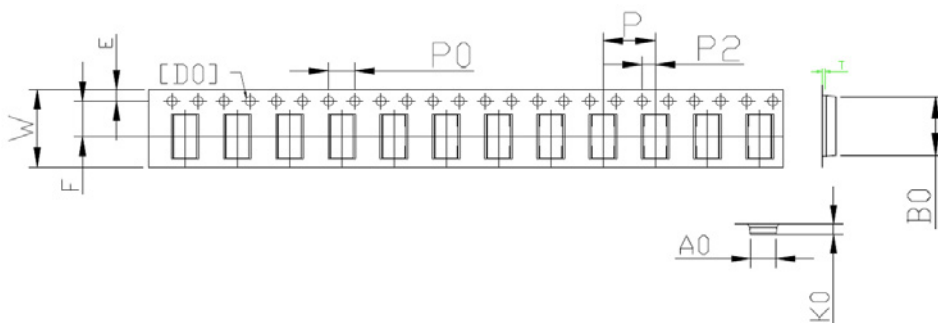


<sup>1</sup> Tolerance for peak profile temperature (TP) is defined as a supplier minimum and as a user maximum.

## Packaging

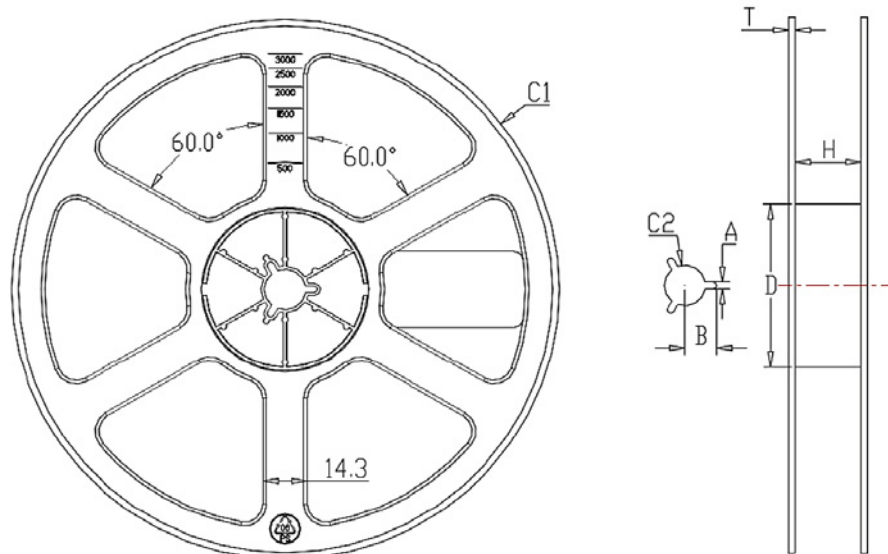
| Series | Packaging Type | Pieces per Reel |
|--------|----------------|-----------------|
| QFS    | 7" Tape & Reel | 800             |

## 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



|           | 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.

The sensor is classed as Moisture Sensitivity Level 3 (MSL-3). The package should be handled according to IPC/JEDEC J-STD-20.

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](http://www.kemet.com/sales).

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