QFS Pyroelectric Infrared Flame Sensors, I²C-SMD

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 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 a linear series for synchronized sampling across devices.

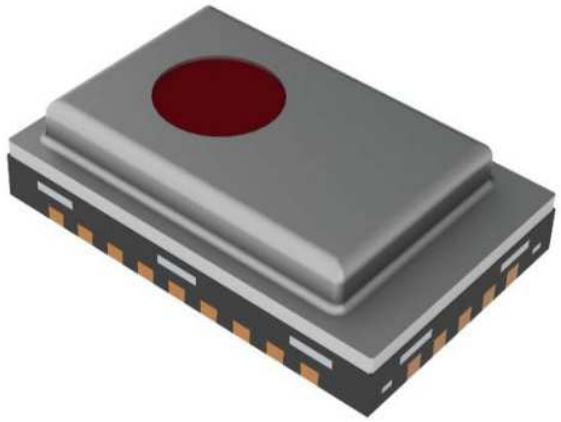
Their long and maintenance-free operational lifetime and various low power modes make these sensors ideal for any smart or IoT type of applications.

Applications

- Smart home
- Smart building
- Industrial IoT
- Transportation

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 comsumption



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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 M = Serial Module K = Evaluation Kit	A = Sensor Only 1 = Module Type 1 or Kit Type 1	0000 = Fixed 22L1 = 2.2 µm long pass (broadband flame detection) 50L1 = 5.00 µm long pass (human motion rejection) 3911 = 3.91 µm (rejection channel) 4641 = 4.64 µm (flame channel with wide FoV) 4481 = 4.48 µm (flame channel with main detector)	0 = Bulk 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 & 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).

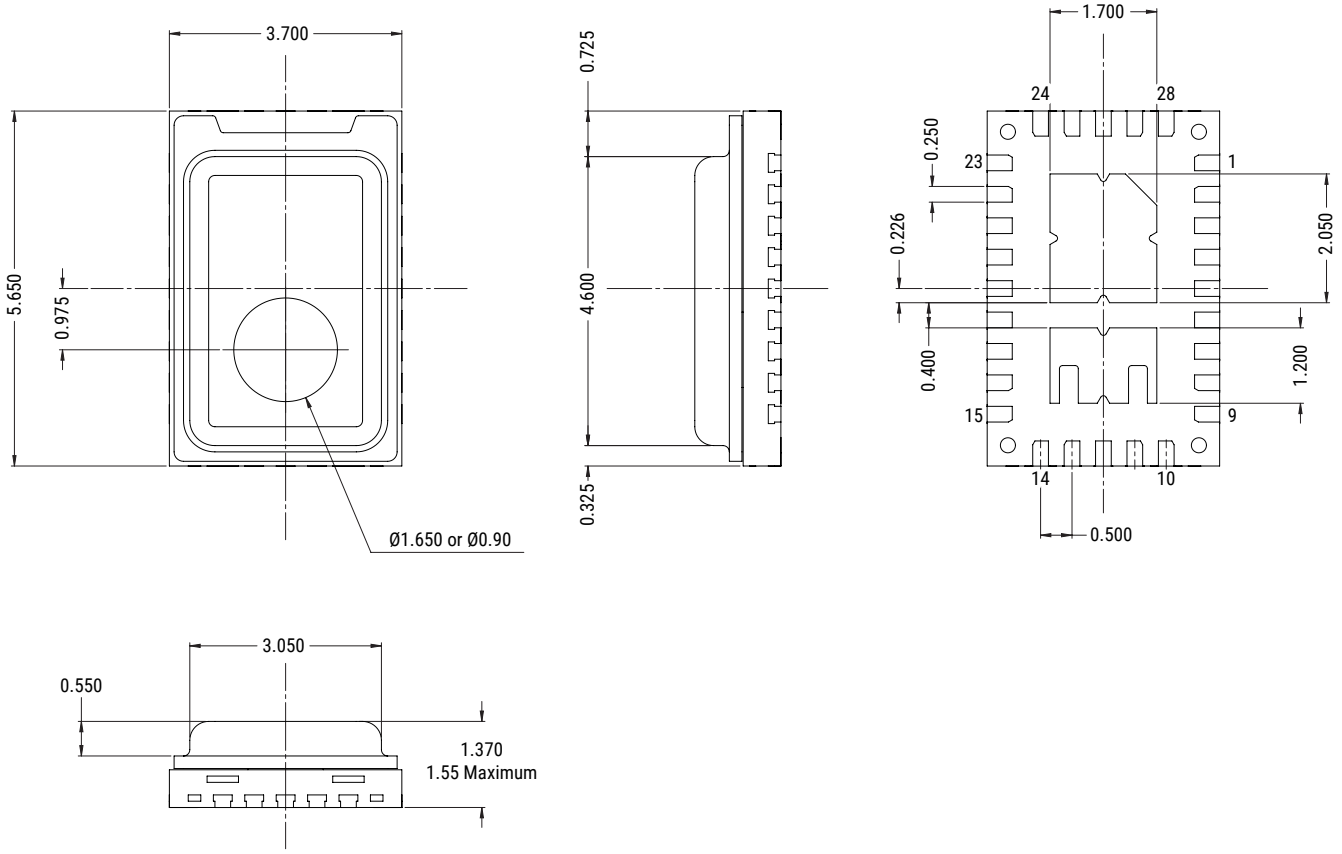
3. Regarding the safety of the flame sensors (Piezoceramic products):
The Piezoceramic that is used in this product becomes ceramic by sintering powder containing PZT as the main ingredient. It is chemically stable, with minimum risks toward the human body or environment within the intended use of the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

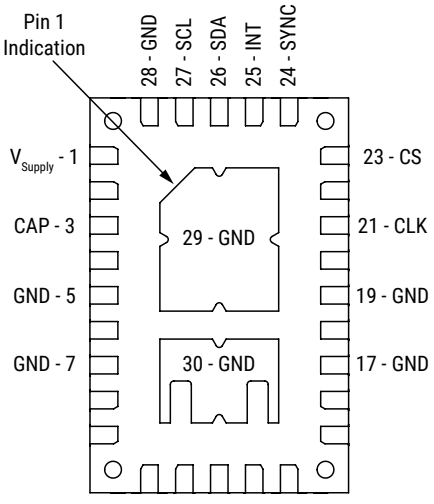
5. The responsibility of piezoceramic manufacturers:
Piezoceramic manufacturers report information regarding PZT containment in their products to the customers to obey the article 33 of the REACH regulation

Dimensions – Millimeters

Sensor



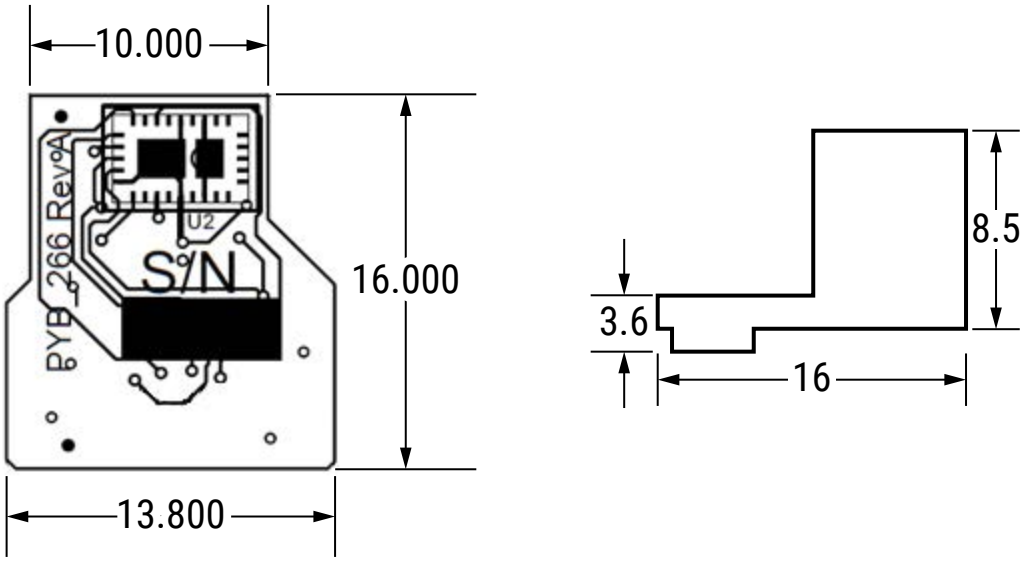
Pin Configuration of Sensor



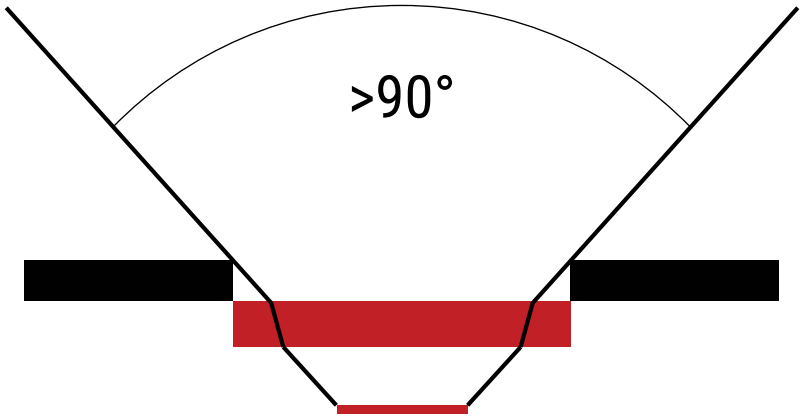
TRANSPARENT TOP VIEW

Dimensions – Millimeters cont.

Module



Field of View



Performance Characteristics

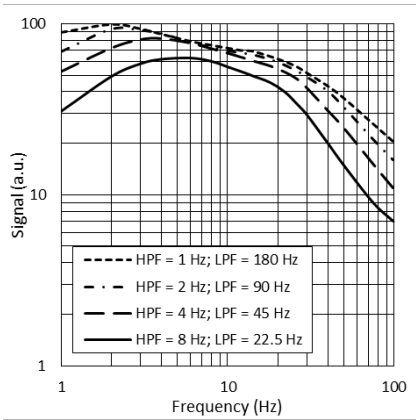
Signal Filtering & Power Modes

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

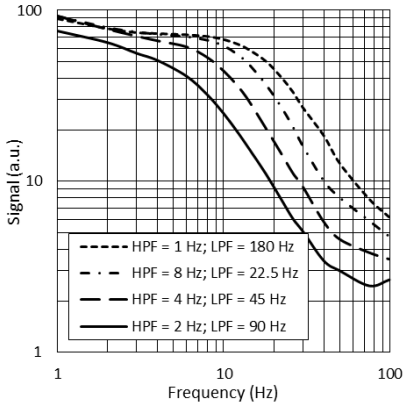
Item	Mode	Description	Typical Current Consumption (1.8 V, room temperature)
Power consumption	Normal Power Mode	Normal power consumption, 1 kHz maximum sample rate	22 µA
	Low Power Mode	Low power consumption, 166 Hz maximum sample rate	3.5 µA
Operational state	Normal Operation Mode	Sensor signal readout over I^2C	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

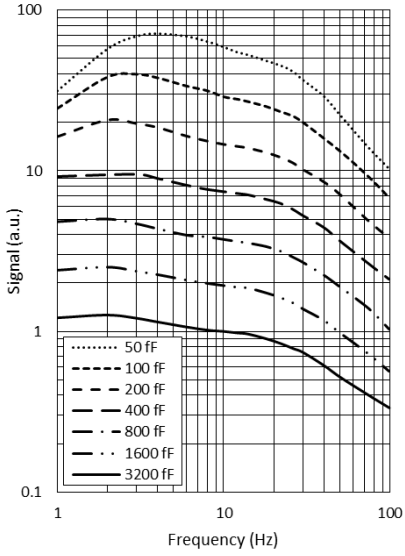
Typical Frequency Response in Normal Power Mode



Typical Frequency Response in Low Power Mode



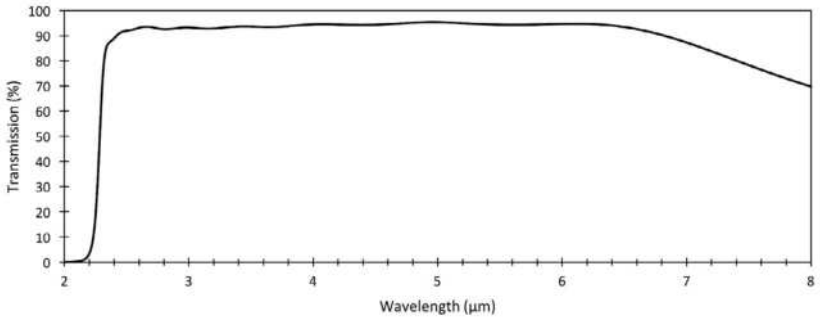
Typical Frequency Response at Different Gain Settings



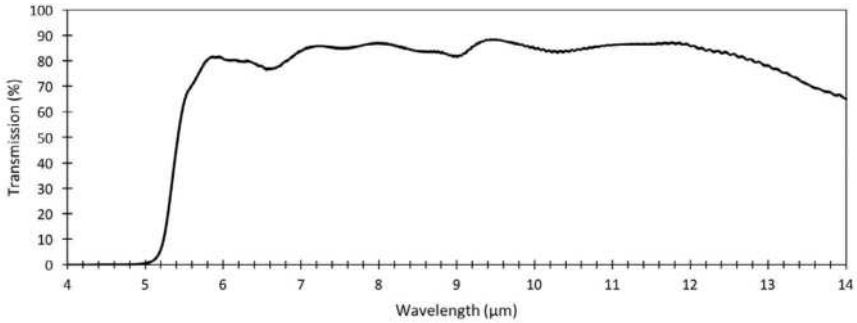
Performance Characteristics cont.

Filter Transmission Profiles

Typical 2.2 µm LP Filter Transmission



Typical 5.0 µm LP Filter Transmission



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	I^2C (FM+ compatible)	15 bit	−40 to +85	−40 to +110	Current mode	Gain Digital filtering Sampling rate 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
USEQFSEA391180	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

Part Number (Module)

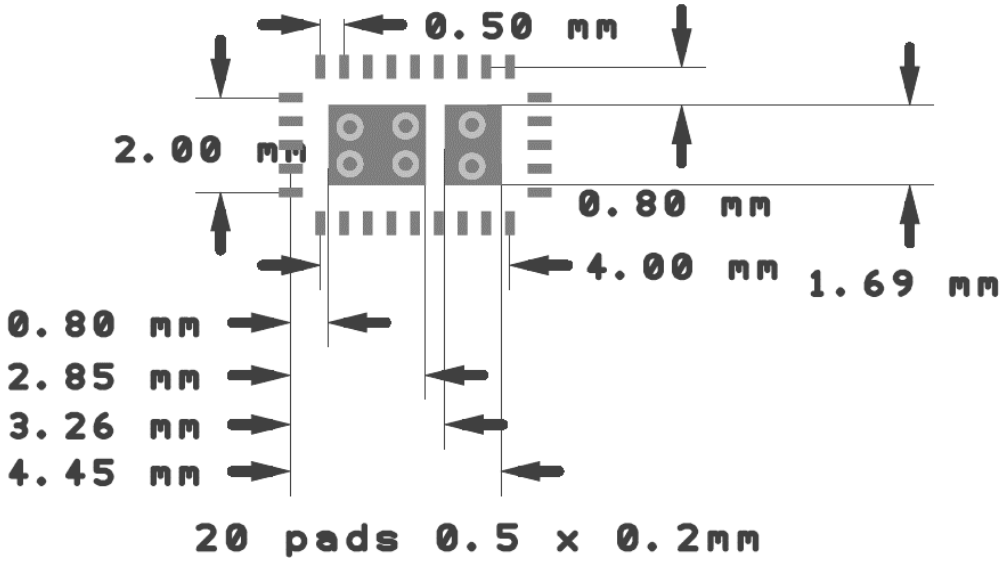
Part Number	Comment	Weight (gr)
USEQFSM122L100	Includes sensor: USEQFSEA22L180	5.40
USEQFSM150L100	Includes sensor: USEQFSEA50L180	5.40
USEQFSM1391100	Includes sensor: USEQFSEA391180	5.40
USEQFSM1464100	Includes sensor: USEQFSEA464180	5.40
USEQFSM1448100	Includes sensor: USEQFSEA448180	5.40

Part Number (Evaluation Kit)

Part Number	Comment	Weight (gr)
USEQFSK1000000	Includes 4 sensors: USEQFSEA50L180, USEQFSEA391180, USEQFSEA464180 and USEQFSEA448180	350
USEQCSK0000000	Control board for modules, maximum 4 modules can be connected on one control board	250

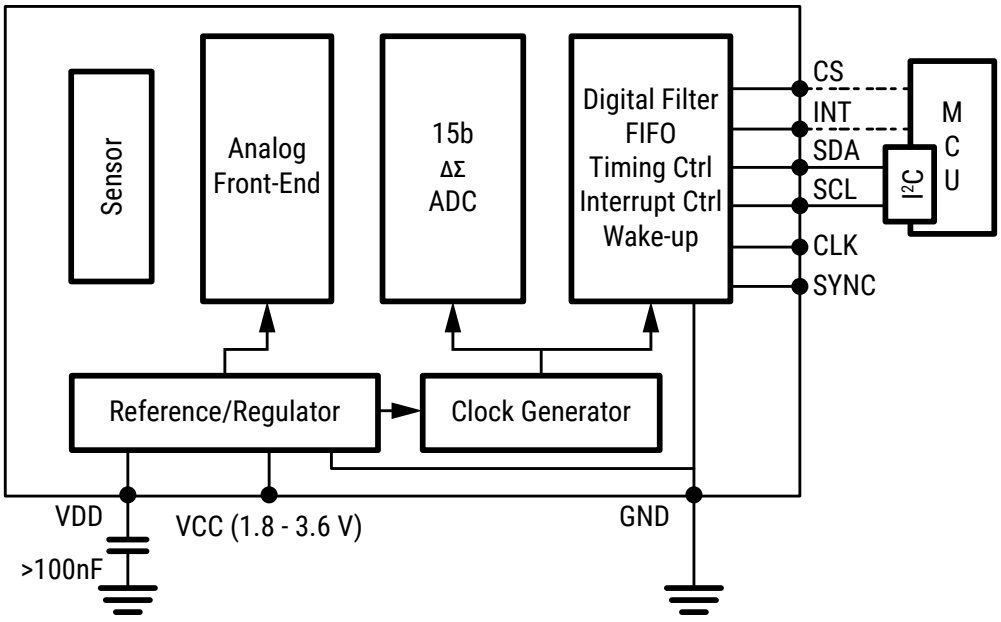
Landing Pattern

Recommended PCB Landing Pattern



Part Schematic

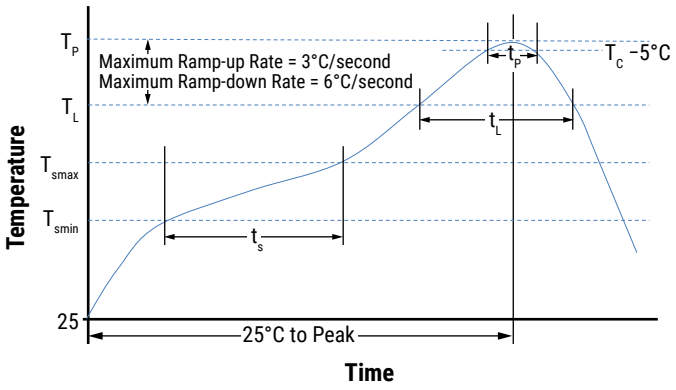
Block Diagram



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

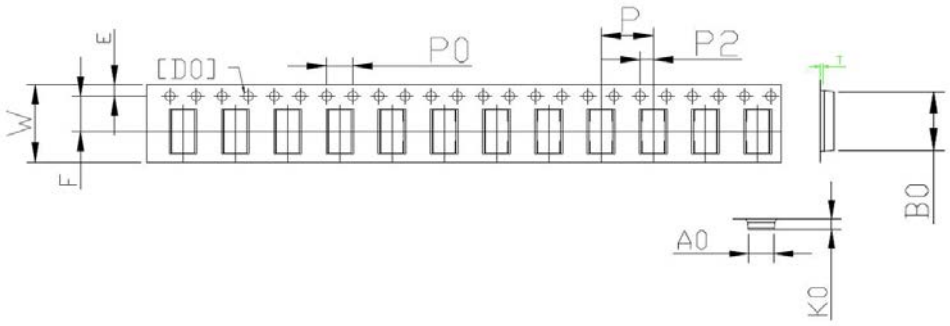


[1] *Tolerance for peak profile temperature (TP) is defined as a supplier minimum and as a user maximum.*

Packaging

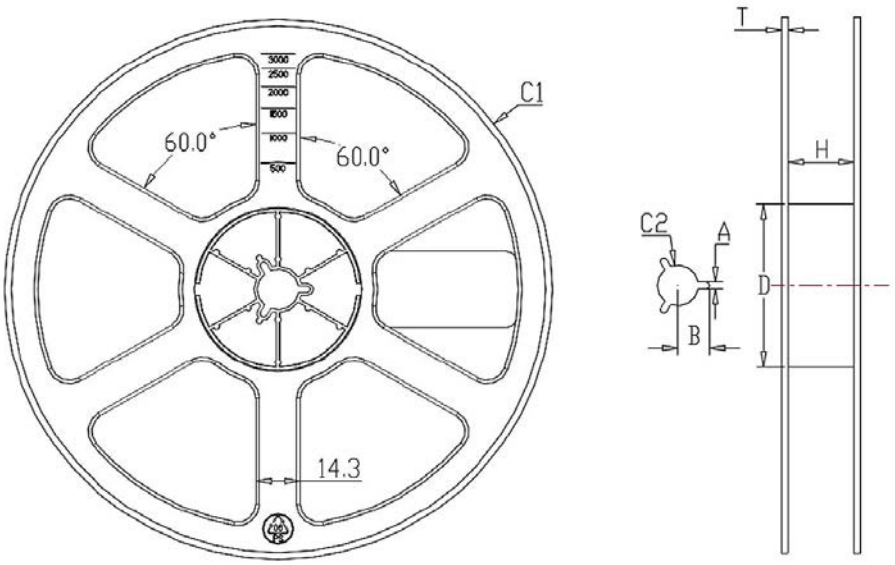
Series	Packaging Type	Pieces per Reel
QFS	7" Tape & Reel	800

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.

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