

## QDA Pyroelectric Infrared Food, General IR Spectroscopy & Oil Monitoring Sensors, Array

### Overview

KEMET's QDA line sensor arrays, or linear arrays, utilize unique thin-film pyroelectric PZT material to offer outstanding resolution and performance across a wide infrared wavelength range.

The ASIC readout electronics output is a multiplexed, amplified and filtered analogue signal for each sensor element. The sensor is housed in a low profile sealed metal package along with a temperature sensor, and can be fitted within a choice of filter windows.

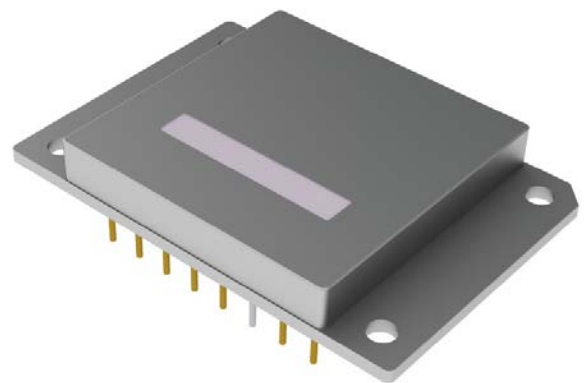
An additional "+1" sensor element can provide higher sensitivity on a discrete wavelength, typically for lubrication oil or foodstuffs. This +1 sensor is located for ATR and transmission use.

### Applications

- General IR spectroscopy (portable, robust spectral engines)
- Lubricating oil and fuel monitoring (quality, wear, adulteration)
- Foodstuffs (constitution, adulteration, milk tampering, decay)
- Industrial process and safety
- Process monitoring (wind turbine, petrochemical, pharmaceutical)
- Engine condition monitoring
- Temperature measurement (non-contact line scanning measurement)
- Flame, material, gas and gas flues analysis
- HVAC and refrigerants
- Home and building technology
- Environmental and pollution monitoring
- Laser calibration
- Imaging (line scanning)
- Medical capnography
- Markers in blood and body fluids

### Benefits

- Small package
- Excellent resolution and performance across a wide infrared wavelength
- Broadband and LVF range can be selectable
- No cooling required
- No moving parts



## Ordering Information

| USE            | QDA   | A           | A   | 5101   | 0         | 0       |
|----------------|---|-------------|---|--|-----------|---------|
| Product Family | Series  | Sensor Type | Mounting Type   | Specification  | Packaging | Version |
| Sensors        | QDA = IR Sensor for Food Analysis, General IR Spectroscopy and Oil Monitoring | A = Array   | A = Sensor only<br>6 = Kit type 6<br>7 = Kit type 7<br>7 = Kit type 8 | 5101 = AR Silicon (510 ch)<br>255S = AR Silicon (255 ch)<br>128S = AR Silicon (128 ch)<br>128L = LVF 5.5 – 11.0 $\mu\text{m}$ (128 ch)<br>1285 = LVF 2.5 – 5.0 $\mu\text{m}$ (128 ch)<br>128W = LVF 5.5 – 11.0 $\mu\text{m}$<br>128A = LVF 5.5 – 11.0 $\mu\text{m}$<br>0000 = Without sensor | 0 = Bulk  | 0       |

## Environmental Compliance

All KEMET Food 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: Food 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 food 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 food sensors (Piezoceramic products):**

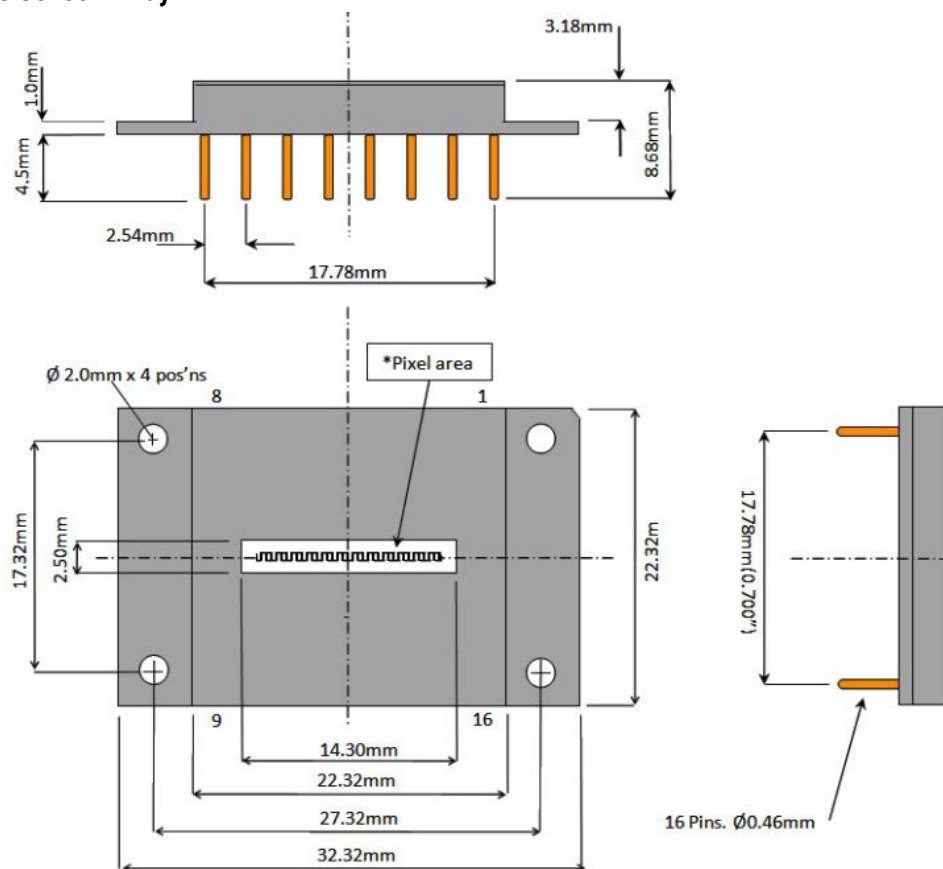
The manufacturing technique of the "piezoceramic products" whose main ingredient is Lead Titanium Zirconium Oxide (PZT) has been established, and there is no alternative material that can exhibit superior performance than PZT at this moment. Please note that the piezoceramic is listed as an exempt on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

### 510 Element Line Sensor Array

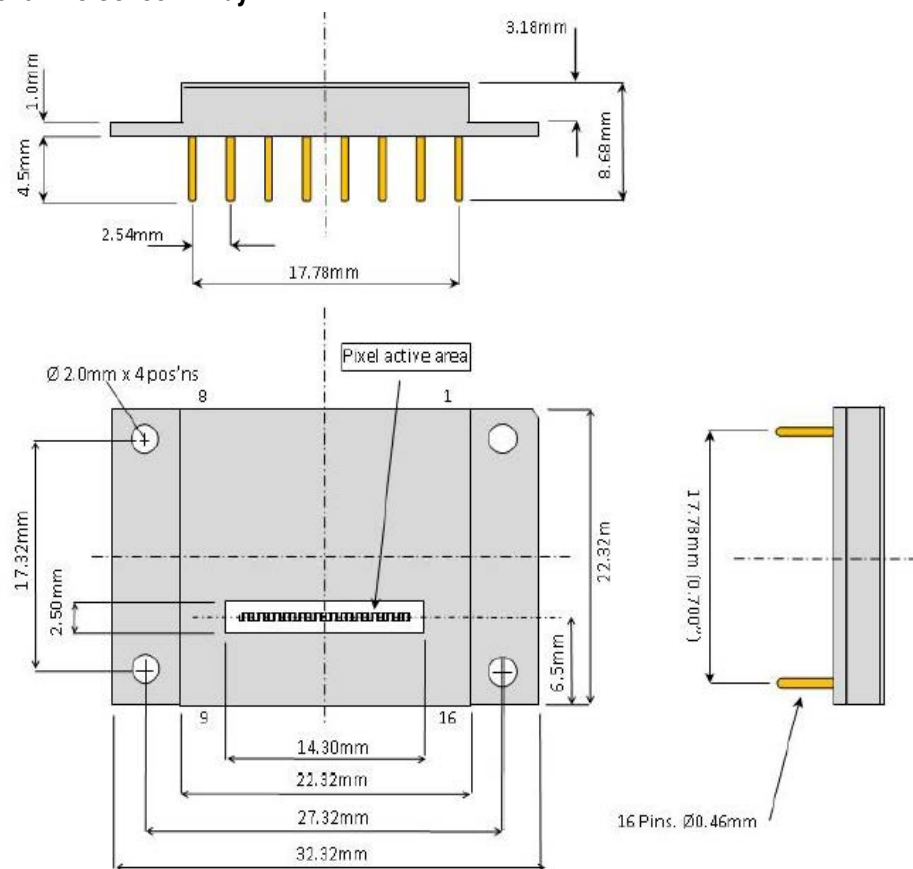


### Pin Configuration of Sensor - 510 Element Line Sensor Array

| No. | Name | Comment                                  |
|-----|------|--|
| 1   | CLK  | Input clock CLK (trigger on rising edge) |
| 2   | RES  | Input clock RES (active low)             |
| 3   | VVR  | Input clock VVR (active high)            |
| 4   | VDR  | Input clock VDR (active high)            |
| 5   | VSH  | Input clock VSH (active high)            |
| 6   | VD2  | Operating voltage (+2.5 V)               |
| 7   | AVDD | Operating voltage (+5 V)                 |
| 8   | VD2  | Operating voltage (+2.5 V)               |
| 9   | OUT1 | Analogue signal output                   |
| 10  | AGND | Ground                                   |
| 11  | OUT2 | Analogue signal out                      |
| 12  | T+   | Temperature sensor                       |
| 13  | T-   | Temperature sensor                       |
| 14  | case | Case                                     |
| 15  | DGND | Ground                                   |
| 16  | DVDD | Operating voltage (+5 V)                 |

## Dimensions – Millimeters cont.

### 255 and 128 Element Line Sensor Array

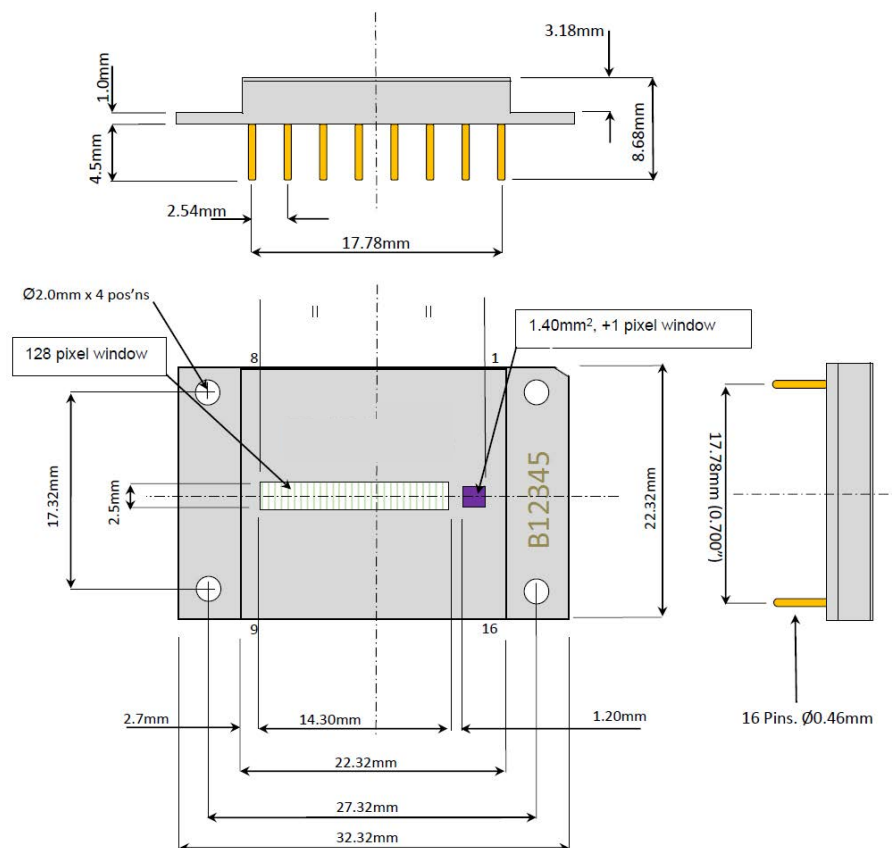


### Pin Configuration of Sensor - 255 and 128 Element Line Sensor Array

| No. | Name | Comment                                  |
|-----|------|--|
| 1   | CLK  | Input clock CLK (trigger on rising edge) |
| 2   | RES  | Input clock RES (active low)             |
| 3   | VVR  | Input clock VVR (active high)            |
| 4   | VDR  | Input clock VDR (active high)            |
| 5   | VSH  | Input clock VSH (active high)            |
| 6   | VD2  | Operating voltage (+2.5 V)               |
| 7   | AVDD | Operating voltage (+5 V)                 |
| 8   | VD2  | Operating voltage (+2.5 V)               |
| 9   | OUT1 | Analogue signal output                   |
| 10  | AGND | Ground                                   |
| 11  | n.c. | Not connected                            |
| 12  | T+   | Temperature sensor                       |
| 13  | T-   | Temperature sensor                       |
| 14  | case | Case                                     |
| 15  | DGND | Ground                                   |
| 16  | DVDD | Operating voltage (+5 V)                 |

## Dimensions – Millimeters cont.

### 128+1 Element Line Sensor Array



### Pin Configuration of Sensor - 128+1 Element Line Sensor Array

| No. | Name  | Comment                       |
|-----|-------|-------------------------------|
| 1   | CLK   | Input clock CLK (rising edge) |
| 2   | RES   | Input clock RES (active low)  |
| 3   | VVR   | Input clock VVR (active high) |
| 4   | VDR   | Input clock VDR (active high) |
| 5   | VSH   | Input clock VSH (active high) |
| 6   | N/C   | Not Connected                 |
| 7   | AVDD  | Operating voltage (+5 V)      |
| 8   | VD2   | Operating voltage (+2.5 V)    |
| 9   | OUT   | Analogue output (128 array)   |
| 10  | AGND  | Ground                        |
| 11  | OUT 1 | Analogue output (+1 element)  |
| 12  | T+    | Temperature sensor            |
| 13  | T-    | Temperature sensor            |
| 14  | case  | Case                          |
| 15  | N/C   | Not Connected                 |
| 16  | DVDD  | Operating voltage (+5 V)      |

## Clock Parameters

Thin-film pyroelectric line sensor array responds to and detects a change in infrared radiation intensity. It therefore requires a pulsed source of infrared radiation for measurement purposes.

| Parameter <sup>1</sup>                          | Relative Value        | Minimum Values | Recommended Value |
|---|-----------------------|----------------|-------------------|
| Chopping Frequency <sup>2</sup> $f_{Ch}$        |                       | 10 Hz          | 128 Hz            |
| Read-out Clock CLK $f_{CLK} = 2 * f_{Ch} * 268$ | $1/t_{CLK}$           | 5.36 KHz       | 69 KHz            |
| Reset clock low-impulse duration $t_{RES}$      | $\frac{1}{2} t_{CLK}$ | 1.8 $\mu s$    | 7.5 $\mu s$       |
| Clock VVR high-impulse duration $t_{VVR}$       | $2 t_{CLK}$           | 7.5 $\mu s$    | 30 $\mu s$        |
| Clock VDR high-impulse duration $t_{VDR}$       | $28 t_{CLK}$          | 200 $\mu s$    | 400 $\mu s$       |
| Clock VSH high-impulse duration $t_{VSH}$       | $1 t_{CLK}$           | 3.5 $\mu s$    | 15 $\mu s$        |

<sup>1</sup> All values for VDD = 5.0 V, VD2 = 2.5 V.

<sup>2</sup>  $t_{Ch low} = t_{Ch high}$

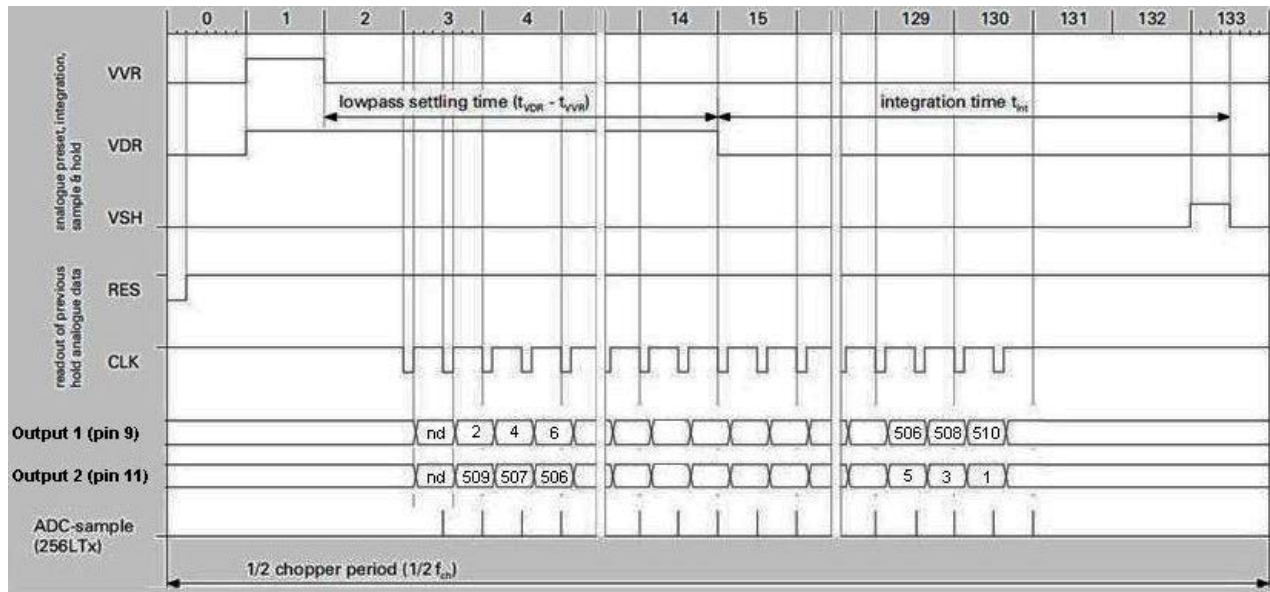
Maximum Settling Time at output tout is 1  $\mu$  second.

## Clock Diagram

### 510 Element Line Sensor Array

The 510 channel line sensor contains two multiplexed analogue outputs, each one providing data from 255 channels. The first output (pin 9) provides data from all the even numbered pixels, counting upwards from 2 to 510. The second output (pin 11) provides data from all the odd numbered pixels, starting at pixel 509 and counting downwards to pixel 1. The clock diagram below shows which pixel numbers are available from each output as the device is clocked.

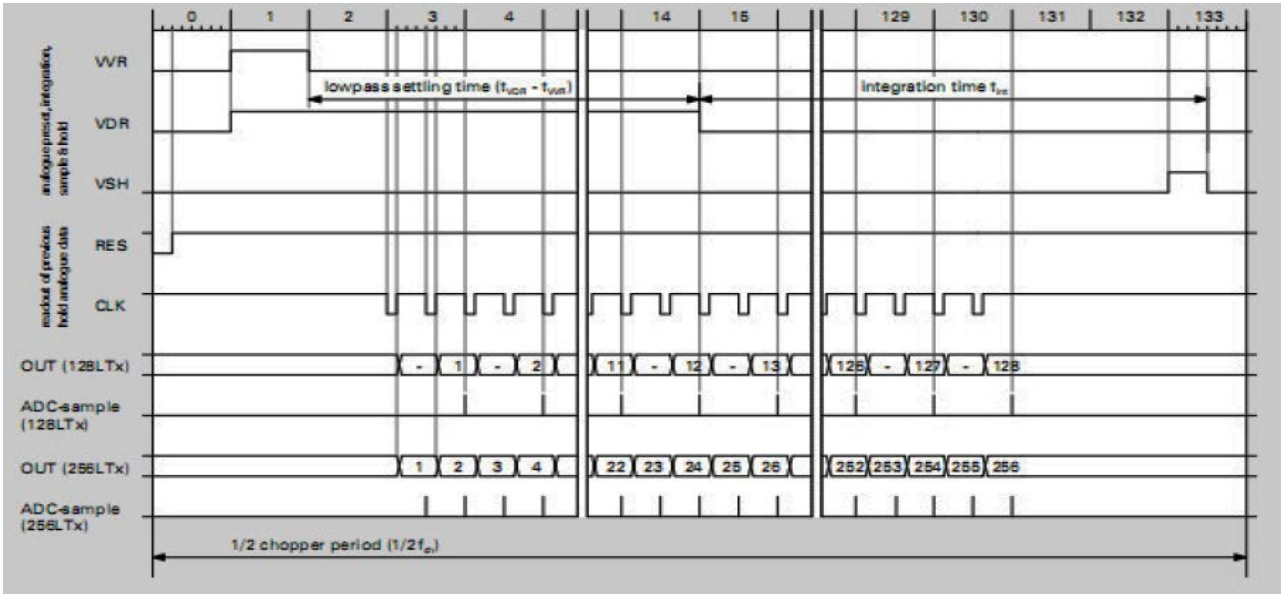
Pixel 1 is the nearest pin 1 of the device.



Clock Diagram cont.

255, 128 and 128+1 Element Line Sensor Array

Pixel 1 is the nearest pin 1 of the device.



Part Number Specifications

Characteristics

| Wavelength Range (um) | Operating Temperature | Dynamic Range (dB) | Scan Speed (Hz) |
|-----------------------|-----------------------|--------------------|-----------------|
| 0.1 – 100.0           | Un-cooled operation   | > 75 dB            | 10 – 1,000      |

## Part Number Specifications cont.

### Part Number

| Part Number    | Number of Pixels (Sensor Elements) | Pixel Size   | Pixel Operability <sup>1</sup> (%) | Filter Type                        | Transmission Wavelength (μm) | Weight (gr) |
|----------------|------------------------------------|--|------------------------------------|------------------------------------|------------------------------|-------------|
| USEQDAAA510100 | 510                                | 10 x 867 μm<br>25 μm pitch   | 98                                 | Broadband (AR Silicon)             | -                            | 11          |
| USEQDAAA255S00 | 255                                | 50.0 x 417.5 μm pixels in 2 lines of 128 pixels<br>Vertical separation between lines: 45 μm<br>In line pixel pitch: 100 μm | 96                                 | Broadband (AR Silicon)             | -                            | 11          |
| USEQDAAA128S00 | 128                                | 60 x 500 μm<br>100 μm pitch  | 96                                 | Broadband (AR Silicon)             | -                            | 11          |
| USEQDAAA128L00 | 128                                | 60 x 500 μm<br>100 μm pitch  |                                    | Linear Variable Filter             | 5.5 – 11.0 (cwl 2%)          | 11          |
| USEQDAAA128500 | 128                                | 60 x 500 μm<br>100 μm pitch  |                                    | Linear Variable Filter             | 2.5 – 5.0 (cwl 2%)           | 11          |
| USEQDAAA128W00 | 128<br>+1                          | 60 x 500 μm<br>100 μm pitch  | 96                                 | Linear Variable Filter             | 5.5 – 11.0 (cwl 2%)          | 11          |
|                |                                    | 1 mm <sup>2</sup> (33x larger than array pixels)   |                                    | 2.90 μm/300 nm for water content   |                              |             |
| USEQDAAA128A00 | 128<br>+1                          | 60 x 500 μm<br>100 μm pitch  |                                    | Linear Variable Filter             | 5.5 – 11.0 (cwl 2%)          | 11          |
|                |                                    | 1 mm <sup>2</sup> (33x larger than array pixels)   |                                    | 5.75 μm/100 nm for fat “A” content |                              |             |

<sup>1</sup> No more than 2 bad in any 10. This is an additional criterion to the pixel operability to limit the occurrence of bunched up faults.

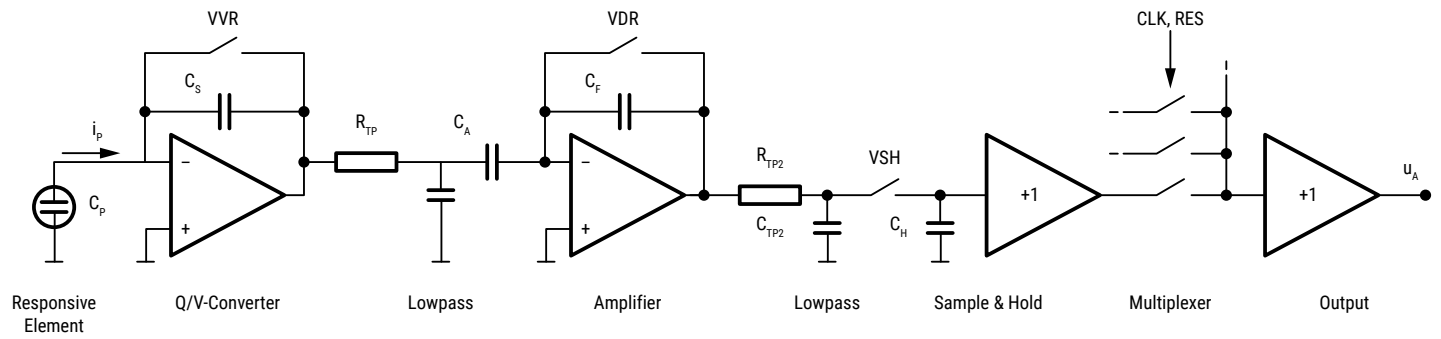
### Part Number (Evaluation Kit)

| Part Number    | Supported Sensor   | Sensor Included in the Kit | Use   | Weight (gr) |
|----------------|--|----------------------------|---|-------------|
| USEQDAK6000000 | USEQDAAA510100<br>USEQDAAA255S00<br>USEQDAAA128S00<br>USEQDAAA128L00<br>USEQDAAA128500 | -                          | Demo board for evaluation kit                             | 350         |
| USEQDAK7000000 | USEQDAAA128S00   | -                          | Evaluation kit for ATR (Attenuated Total Reflection) mode | 1,000       |
| USEQDAK7128L00 | USEQDAAA128L00   | USEQDAAA128L00             |   | 1,000       |
| USEQDAK7128500 | USEQDAAA128500   | USEQDAAA128500             |   | 1,000       |
| USEQDAK8000000 | USEQDAAA128S00   | -                          | Evaluation kit for transmission mode                      | 1,000       |
| USEQDAK8128L00 | USEQDAAA128L00   | USEQDAAA128L00             |   | 1,000       |
| USEQDAK8128500 | USEQDAAA128500   | USEQDAAA128500             |   | 1,000       |



Circuit Diagram

The amplification circuit consists of low-noise preamplifiers for each individual sensor elements, analogue switches and an output amplifier. The pre-amplifiers transform the signal charges measured at each sensor element into a conditioned voltage. The amplified signal is then passed to sample and hold, multiplexer output buffer for the read-out process. The digital inputs are CMOS compatible. A 10k NTC thermistor is integrated within the package to monitor the line sensor temperature.



Packaging

| Series | Packaging Type |
|--------|----------------|
| QDA    | Bulk           |

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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