

## 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.

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

## 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
- Evaluation kit 6 including linear array evaluation board
- Evaluation kit 7 for ATR spectrometer
- Evaluation kit 8 for transmission spectrometer



## 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 6 = Kit type 6 7 = Kit type 7 7 = Kit type 8	5101 = AR Silicon (510 ch) 255S = AR Silicon (255 ch) 128S = AR Silicon (128 ch) 128L = LVF 5.5 – 11.0 μm (128 ch) 1285 = LVF 2.5 – 5.0 μm (128 ch) 128W = LVF 5.5 – 11.0 μm 128A = LVF 5.5 – 11.0 μm 0000 = Without sensor	0 = Bulk	0

## Environmental Compliance

All KEMET Food, General IR Spectroscopy & Oil Monitoring 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 (QDA & QDC 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):*

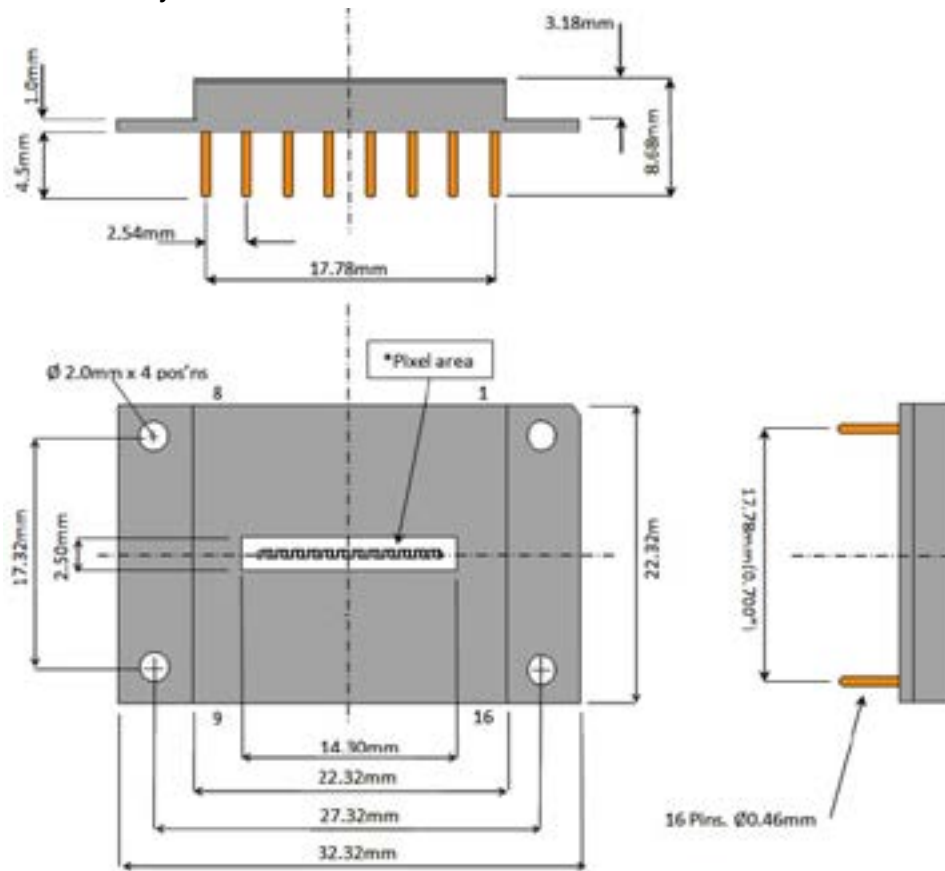
*The manufacturing technique of the "piezoceramic products" whose main ingredient is Lead Titanium Zirconium Oxide (PZT) has been established, and there is no alternative material that can exhibit superior performance than PZT at this moment. Please note that the piezoceramic is listed as an exempt on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

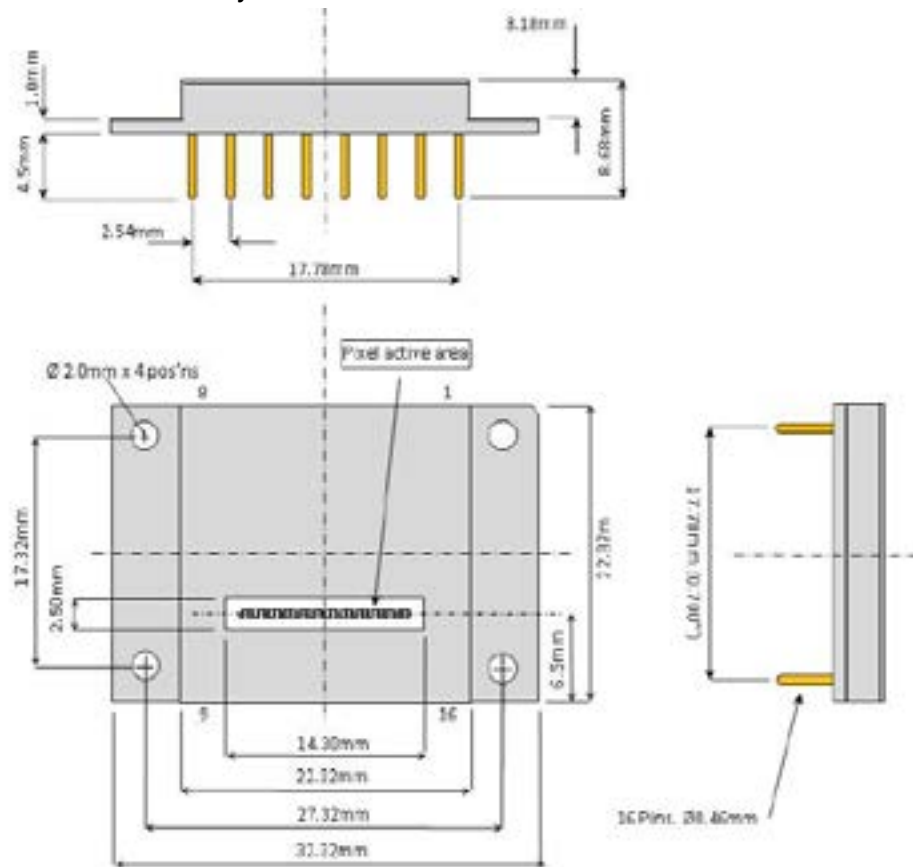


### Pin Configuration of Sensor - 510 Element Line Sensor Array

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

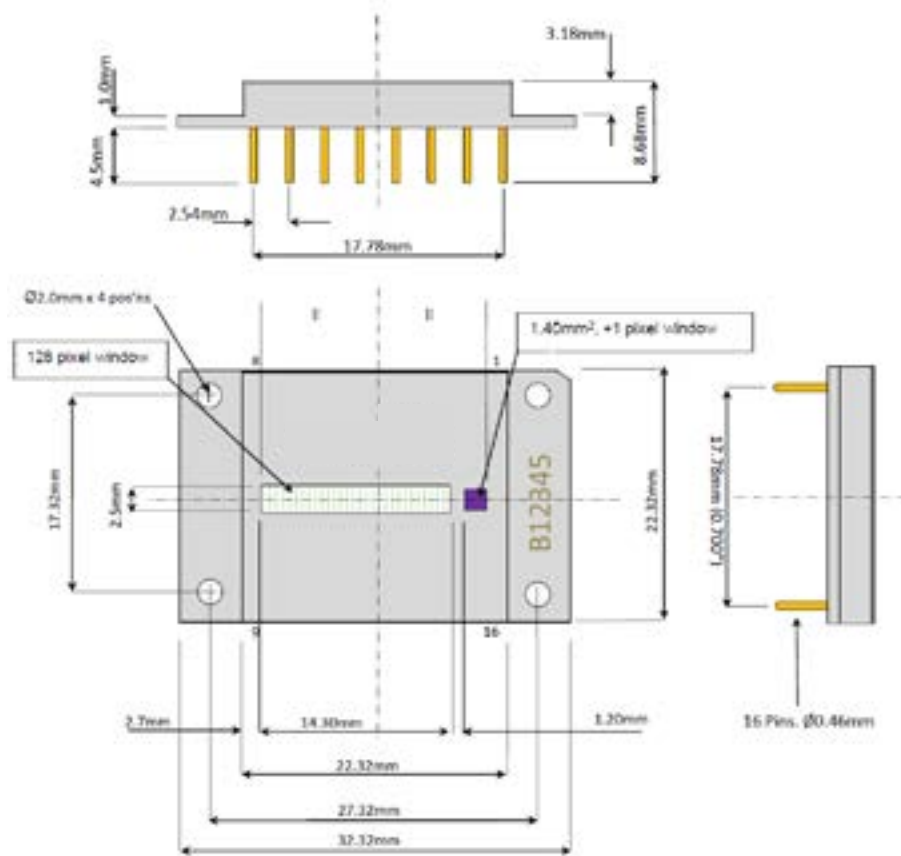


### Pin Configuration of Sensor - 255 and 128 Element Line Sensor Array

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 $t_{RES}$	$1/2 t_{CLK}$	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>  $t_{Ch\ low} = t_{Ch\ high}$

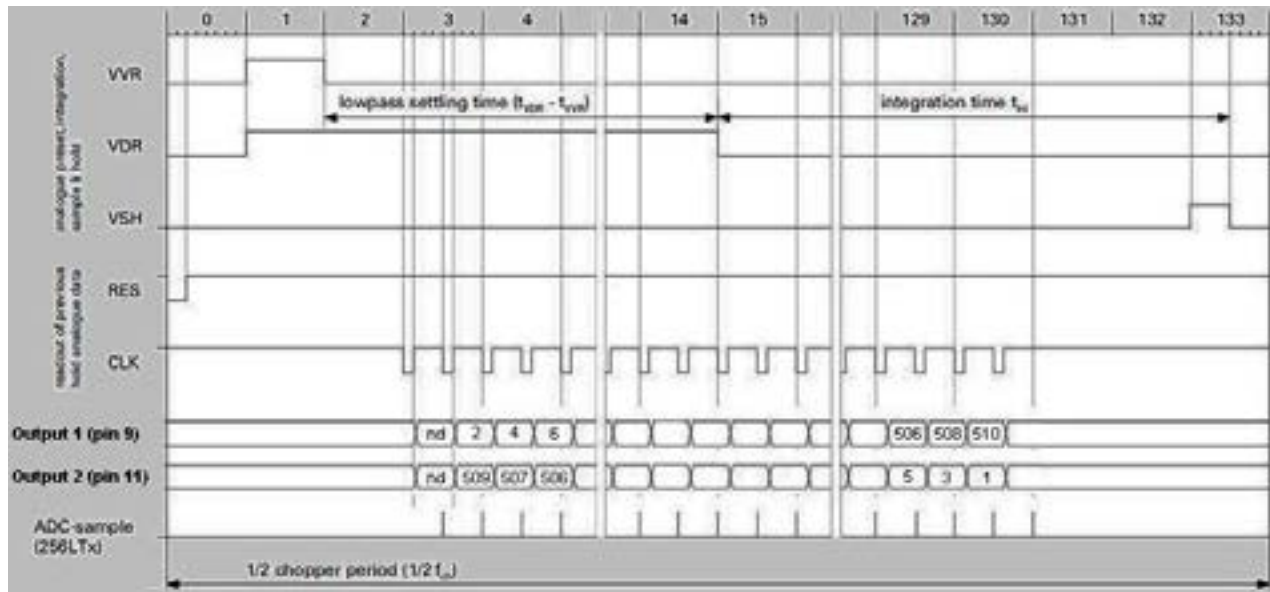
Maximum Settling Time at output tout is 1  $\mu$  second.

## 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.

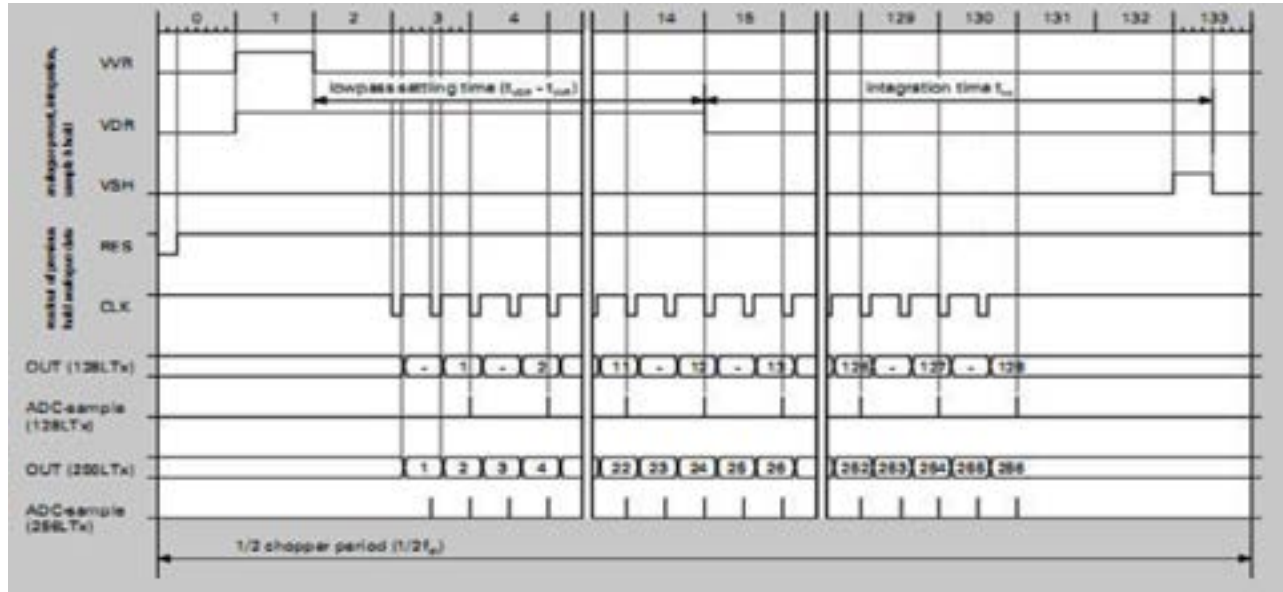
Pixel 1 is the nearest pin 1 of the device.



## 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 25 µm pitch	98	Broadband (AR Silicon)	-	11
USEQDAAA255S00	255	50.0 x 417.5 µm pixels in 2 lines of 128 pixels Vertical separation between lines: 45 µm In line pixel pitch: 100 µm	96	Broadband (AR Silicon)	-	11
USEQDAAA128S00	128	60 x 500 µm 100 µm pitch	96	Broadband (AR Silicon)	-	11
USEQDAAA128L00	128	60 x 500 µm 100 µm pitch		Linear Variable Filter	5.5 – 11.0 (cwl 2%)	11
USEQDAAA128500	128	60 x 500 µm 100 µm pitch		Linear Variable Filter	2.5 – 5.0 (cwl 2%)	11
USEQDAAA128W00	128 +1	60 x 500 µm 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 +1	60 x 500 µm 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.

## Evaluation Kits

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



There are three different types of Linear Array demo kits. The simplest is USEQDAK6000000, a microprocessor powered board which interfaces to a PC and allows the user to test and evaluate the linear arrays listed in the table. These supported sensors are not included in the kit.

Part Number	Supported Sensor	Includes	Weight (gr)
USEQDAK6000000	USEQDAAA510100	Linear Array evaluation board	350
	USEQDAAA255S00	9 V DC power supply	
<b>Use</b>	USEQDAAA128S00	USB communications cable	
Demo Board for Evaluation	USEQDAAA128L00		
	USEQDAAA128500		



## Evaluation Kits cont.

The second set of kits proposes the same demo board in an ATR (Attenuated Total Reflection) spectrometer configuration with emitters and spectrometer software. The spectrometers are designed to be used as proof of principle demonstrations and as reference designs for the user's design work. The units are based on the pyroelectric Linear Array sensors with the use of Linear Variable filters (LVF) as solid state dispersion gratings. Using this technical approach it is possible to take near, mid, or far IR spectral readings (dependent on the LVF used) in a few seconds, and in almost any working environment.



ATR spectroscopy is one method for analysing the infra-red spectrum absorbance of liquids. It provides a very simple way to sample liquids onto the sample surface of the ATR spectrometer and quickly take measurements.

Part Number	Use	Supported Sensor	Includes	Weight (gr)
USEQDAK7000000	Evaluation Kit for ATR Mode	USEQDAAA128S00	Linear Array evaluation board and ATR spectrometer	1,000
		USEQDAAA128L00	9 V DC power supply	
		USEQDAAA128500	USB communications cable	

Part Number	Use	Supported Sensor	Includes	Weight (gr)
USEQDAK7128L00	Evaluation Kit for ATR Mode	USEQDAAA128S00	Linear Array evaluation board and ATR spectrometer	1,000
		USEQDAAA128L00	USEQDAAA128L00, LVF 5.5 – 11.0 $\mu\text{m}$	
		USEQDAAA128500	9 V DC power supply	
			USB communications cable	

Part Number	Use	Supported Sensor	Includes	Weight (gr)
USEQDAK7128500	Evaluation Kit for ATR Mode	USEQDAAA128S00	Linear Array evaluation board and ATR spectrometer	1,000
		USEQDAAA128L00	USEQDAAA128500, LVF 2.5 – 5.0 $\mu\text{m}$	
		USEQDAAA128500	9 V DC power supply	
			USB communications cable	

## Evaluation Kits cont.

The third set of kits uses again the demo board, this time in a transmission spectrometer configuration with emitters and spectrometer software. The spectrometers are designed to be used as proof of principle demonstrations and as reference designs for the user's design work. The units are based on the pyroelectric Linear Array sensors with the use of Linear Variable filters (LVF) as solid state dispersion gratings. Using this technical approach it is possible to take near, mid, or far IR spectral readings (dependent on the LVF used) in a few seconds, and in almost any working environment.



For the transmission spectrometer mode, it is necessary to prepare sample for analysis in a transmission cell, which are available from a variety of suppliers. The transmission sample cell can be placed in the spectrometer unit by sliding it into the black draw in the transmission kit. The cell can be used to record a background reading and then filled with sample material to record a spectrum.

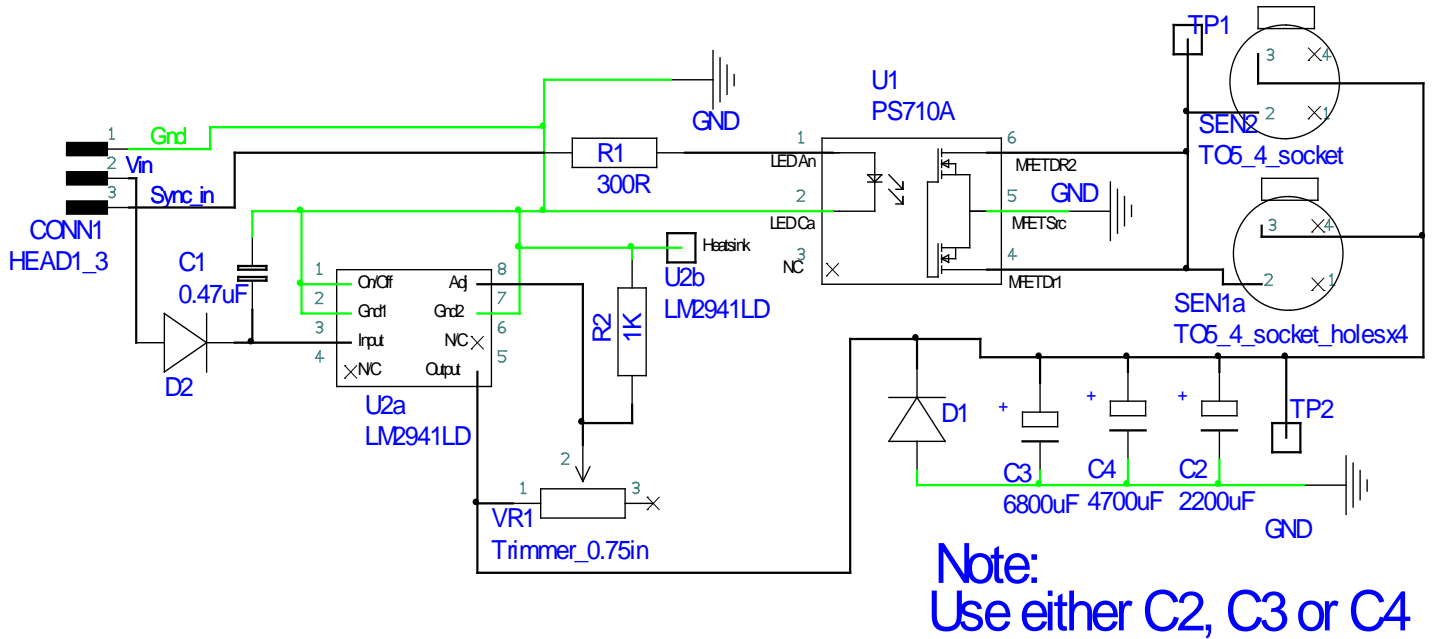
Part Number	Use	Supported Sensor	Includes	Weight (gr)
USEQDAK8000000	Evaluation Kit for Transmission Mode	USEQDAAA128S00	Linear Array evaluation board & transmission spectrometer	1,000
		USEQDAAA128L00	9 V DC power supply	
		USEQDAAA128500	USB communications cable	

Part Number	Use	Supported Sensor	Includes	Weight (gr)
USEQDAK8128L00	Evaluation Kit for Transmission Mode	USEQDAAA128S00	Linear Array evaluation board & transmission spectrometer	1,000
		USEQDAAA128L00	USEQDAAA128L00, LVF 5.5 – 11.0 μm	
		USEQDAAA128500	9 V DC power supply USB communications cable	

Part Number	Use	Supported Sensor	Includes	Weight (gr)
USEQDAK8128500	Evaluation Kit for Transmission Mode	USEQDAAA128S00	Linear Array evaluation board & transmission spectrometer	1,000
		USEQDAAA128L00	USEQDAAA128500 LVF 2.5 – 5.0 μm	
		USEQDAAA128500	9 V DC power supply USB communications cable	

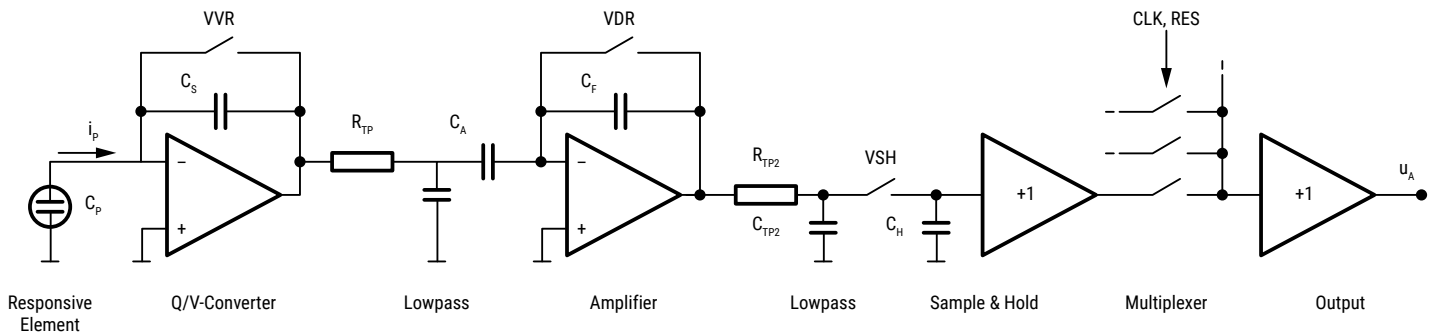
## Evaluation Kits cont.

### Transmission Emitter Drive Schematic



## 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	Piece per Box
QDA	Cardboard Box	1

## 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.