New digital 80x64 infrared array sensor

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Abstract

The recent years showed an increasing demand of low cost and medium resolution infrared arrays. These arrays can be used for various applications e.g. thermal imaging, industrial process control and person detection. Heimann Sensor created a new fully digital infrared array sensor consisting of a single 80x64 pixel chip, that fits inside a TO8 housing.

Key words: Thermopile array, 80x64 pixels, infrared detection, true shutterless, medium resolution

Introduction

Heimann Sensor has developed the first fully monolithic thermopile array and the world smallest thermopile sensor in TO housing [1].

These thermal arrays are competitive solutions against other technologies, wherever a thermal picture is needed and low to medium spatial resolutions are sufficient, such as person detection, body temperature measurement from distance, surveillance of temperature critical surfaces, hotspot detection, energy management, hand-held thermal imagers and security cameras. Other applications can be found in the general industry for process control and predictive maintenance, in automotive and buildings for air condition control [2].

The benefits of this technology are low manufacturing costs, low power consumption as well as the avoidance of thermal stabilizers or shutters to compensate drift effects.

The new thermopile array module shows an increased number of sensitive pixels compared to the HTPA64x62. The low cost array can be operated without expensive vacuum packaging and provides digital output with good NETD and Sensitivity.

Functional description of the 80x64 sensor

The 80x64 sensor has several internal amplifiers (OPA) for signal conditioning and Analog to Digital Converters (ADC) with a resolution of 16 bit for digitizing.

In addition two proportional to ambient temperature circuits (Vtemp) are placed on the chip to measure the ambient temperature.

An SPI Interface is used to allow a fast readout with up to 20 MHz in a 6 pin package.
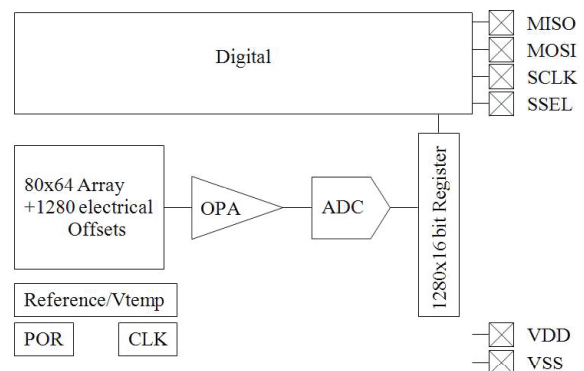
Readout of the 80x64 sensor

Thanks to the internal 16 bit ADC and an integrated EEPROM inside the TO package with optics, the complete array can be provided as fully calibrated array with a 6 pin package. Over the same SPI interface the calibration data and the stream of the pixel data can be read out.
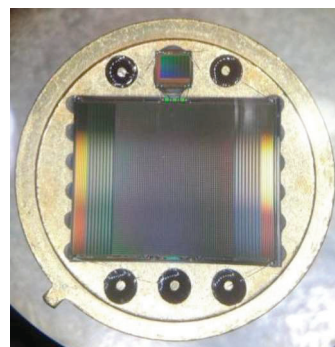

Fig. 1. The 80x64 pixel chip is mounted on a 6 pin TO8 header together with an EEPROM chip. The optics is mounted inside the TO cap.
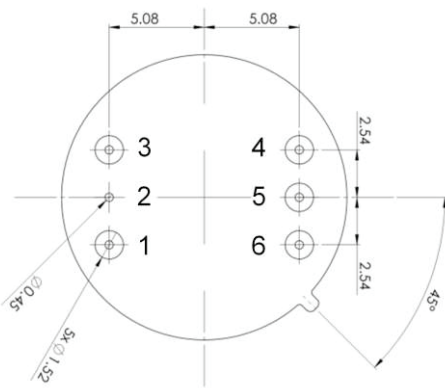
Fig. 2. Bottom view of the 6 pin TO8 header with the pin connections

Pin	Function
1	3.3 V supply
2	Ground
3	SSEL
4	MISO
5	MOSI
6	SCLK

Optical design of the 80x64 sensor

There are currently 4 different optics designed and available for this sensor. The field of view (FoV), the F-number and the materials are listed in the table below.

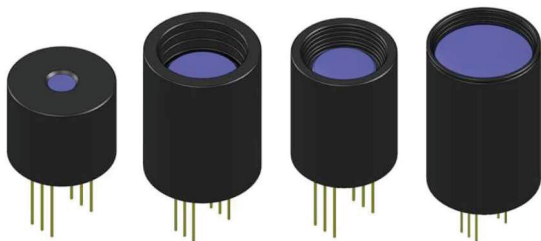| Optics	L5.0	L10	L11	L22.5
FoV [°]	75x62	41x33	38x30	18x14
F-number	0.95	0.7	1.0	1.0
Material	Ge	Ge	Si	Ge

Fig. 3. The sensor equipped with different optics.

Measurement results and settings

The frame rate can be chosen up to 22 Hz with the full 16 bit resolution and can achieve >100 Hz for a lower ADC resolution. If only one

quarter of the picture needs to be fetched then the frame rate is a factor 4 faster.

ADC-Resolution	max. frame rate [Hz]*
8 Bit	226.6
9 Bit	218.6
10 Bit	204.2
11 Bit	180.4
12 Bit	146.3
13 Bit	106.1
14 Bit	68.5
15 Bit	40.1
16 Bit	21.9

*: maximum possible frame rate with a SPI-clock of 20 MHz for the full readout of the sensor

NETD values reach 150….300 mK depending on optics.

Special optics allow to measure temperatures up to 1000 °C and above.

Applications of the 80x64 module

There is a wide range of different applications for the 80x64 Sensor. Besides industrial imaging, maintenance, process and traffic control, it can be used for security, person, fire, fever and hot spot detection.
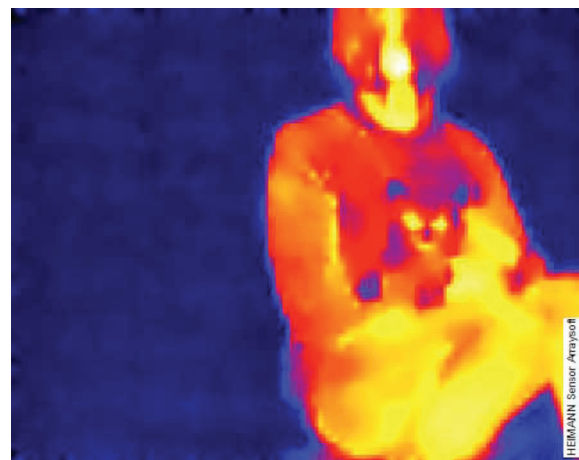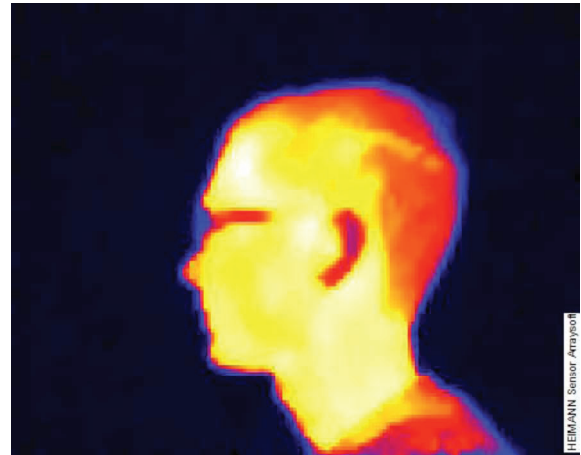

Fig. 4. Pictures showing rabbits.

Fig. 5. Picture showing a cat sitting on the lap of a person.

Fig. 6. *Infrared picture of a horse*

Application set

For customer´s application support we developed an application set allowing thermal imaging direct to any connected PC. These application sets allow the operation and comparison of different optical FOV as seen in Fig. 3.

References

[1] W. Leneke, J. Schieferdecker, M. Schulze, M. Simon, K. Storck, B. Forg, F. Völklein: "Thermopile Linear Array Sensors and Modules with Short Time Constant and High Sensitivity"; *Sensor Conference 2007*, Proc. Vol.1, Nürnberg, Germany, pp. 329-333

[2] B. Forg, W. Leneke, J. Schieferdecker, M. Schulze, M. Simon, K. Storck: "Thermopile Sensor Arrays with Internal Amplifiers and Digital Out"; *Sensor & Test 2008*, Proceedings, Nürnberg, Germany, pp. 249-252.