

# DEVICE SPECIFICATION FOR PYRO-ELECTRIC IR-DETECTOR

Customer :  
Type : PYD 5790  
Part no. : 3702  
No. of samples:

Dual element detector, serial opposed format, two elements based on Lithium-Tantalate. The signal is converted to a digital value using Sigma-Delta and DSP techniques.

This specification is provided by

**Excelitas Technologies GmbH & Co. KG, Wiesbaden.**

It covers the complete technical data of a pyro-electric IR detector. In case of samples attached to this paper, these have been taken randomly from normal production output. All detectors have met the requirements of Excelitas test-specifications and passed outgoing inspection.

**We kindly ask for approval with the return of a signed copy.**

Checked:

Date: 08.10.2013

Customer approval:

Date:

**Electrical Configuration:**

The pyro-electric sensing elements are connected to a built-in IC, whose detailed description follows:

The ADC contains an on-chip low-power oscillator, an analogue-to-digital converter which generates a digital signal from the voltage level of the sensing elements, a digitalised temperature dependent voltage and a serial interface, which outputs the digital signal as a bitstream to DIRECT LINK. The ADC block diagram and the data transmission are shown below.

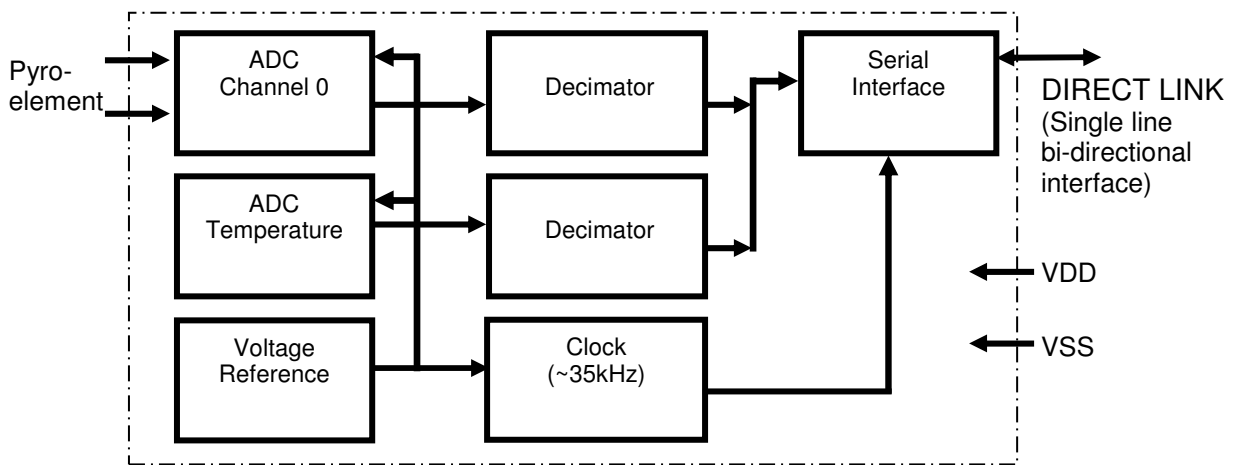


Fig. 1: Block Diagram

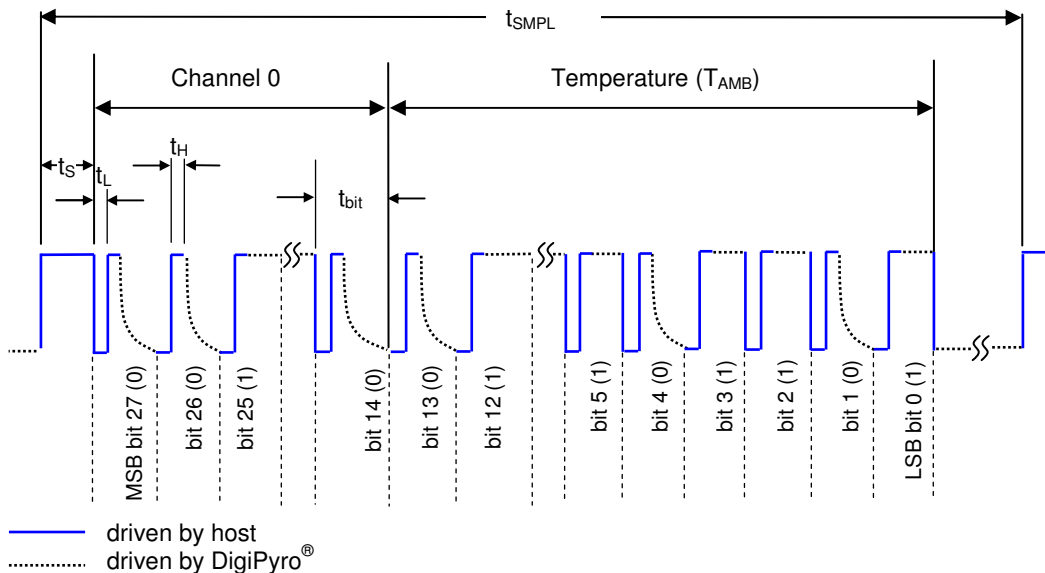


Fig. 2: Data Transmission Diagram

The serial interface has a 2 x 14 bit binary output format (Channel 0, Temperature) which allows a physical data value range from 0 ... 16383 for each channel. The DIRECT LINK pin is bi-directional data output and clock input.

The ADC converts signal samples continuously every 32  $f_{\text{clk}}$  cycles. New data is passed to the output latch of the serial interface if DIRECT LINK is LOW and not busy by a read operation.

#### Read Out Procedure:

Forcing DIRECT LINK to HIGH for at least 3  $f_{\text{CLK}}$  cycles ( $t_s$ ) will start the transmission from the DigiPyro<sup>®</sup>. After this setup time ( $t_s$ ) has passed the DigiPyro<sup>®</sup> expects a LOW to HIGH transition ( $t_L, t_H$ ) on the DIRECT LINK pin and will subsequently output the data bit state. When a bit has been read, the DigiPyro<sup>®</sup> waits for the next LOW to HIGH transition and the sequence will be repeated until all 28 bits are shifted out. After the last  $t_{\text{bit}}$  of bit[0] the host controller must force DIRECT LINK pin to LOW and subsequently release DIRECT LINK (High Z).

The time that the signal needs to settle to a LOW level depends on the capacitive load (e.g. PCB design) at the DIRECT LINK pin. Hence, it is recommended to start implementing the interface with  $t_{\text{bit}}$  close to but shorter than 25 $\mu\text{s}$  to ensure proper LOW level settling. In next steps reduce  $t_{\text{bit}}$  empirically to optimize for reliable data transmission at maximum transmission speed.

It has to be considered that  $t_{\text{bit}} - t_H$  must not exceed  $1/f_{\text{CLK}}$  (25 $\mu\text{s}$ ) to avoid data corruption. (Under no circumstances DIRECT LINK may be at LOW level for longer than 25 $\mu\text{s}$ ). Also, the total time to readout one data packet may not exceed 32 clock cycles (~800 $\mu\text{s}$ ).

In order to reduce settling effects, the data packets have to be read continuously with equal sampling intervals.

It is allowed to cancel the readout of a data packet after a certain number of bits have been read.

For example: reading only from bit[27] to bit[14], skips reading the temperature channel. After bit[14] has been read, DIRECT LINK must be held at LOW level and subsequently released (High Z).

Note: DL will be pulled HIGH every 512 clock cycles. The next data packet has to be read before this HIGH signal occurs.

To avoid saturation of the detector the DigiPyro<sup>®</sup> contains an out of range detection logic. The input of the ADC is shorted for a duration of 512 system clocks when the digital values are above 15872 counts or below 511 counts.

## Electrical Data:

Unless specified differently all data refers to 25 °C.

Tab. 1: Electrical data of ADC

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
Operating Voltage	$V_{DD}$	2.7	3.3	3.6	V	
Supply Current	$I_{DD}$		10	15	$\mu A$	$V_{DD} = 3.3V$
Input Low Voltage	$V_{IL}$			$0.2V_{DD}$	V	
Input High Voltage	$V_{IH}$	$0.8V_{DD}$			V	
Pull up Current			130		$\mu A$	Input to $V_{SS}$
Pull down Current			200		$\mu A$	Input to $V_{DD}$
Data Setup Time	$t_s$	110		200	$\mu s$	
Data Clock Low Time	$t_L$	200		2000	ns	$t_{bit} < 1/f_{CLK}$
Data Clock High Time	$t_H$	200		2000	ns	
Sample Time	$t_{SMPL}$	2.0		14.6	ms	$(32 \dots 512) / f_{CLK}$
Direct Link Bit Time	$t_{bit} - t_H$			25	$\mu s$	to avoid data corruption
ADC Counts of Bits			28		Bits	
ADC Resolution			14		Bits	Max Count = $2^{14} - 1$
ADC Sensitivity		6.0	6.5	7.1	$\mu V/Count$	
ADC Temperature Coefficient		-300		300	ppm/K	
ADC Output Offset		6500	8192	9800	Counts	in stable condition
Sensitivity of $T_{AMB}$		72	80	88	Counts/K	-20 °C to + 90 °C
Linearity of $T_{AMB}$		-5		5	%	-20 °C to + 90 °C
Counts at Ambient Temperature		5700	6700	7700	Counts	@ 25 °C
Internal Clock Frequency	$f_{CLK}$	29	32	35	kHz	- 20 °C to + 80 °C
Temperature Coefficient	$T_C (f_{CLK})$	-1000		+1000	ppm/K	- 20 °C to + 80 °C

The typical offset is 8192 counts, which is comparable to a DC voltage of ~53.3mV. The output signals can be in the range of 511 counts (3.32mV) to 15872 counts (103.2mV).

Since the output is not filtered it is strongly recommended to use a band pass filter within the user software.

The temperature value ( $T_{AMB}$ ) may vary from part to part at room temperature.

**Responsivity:**      **min.: 5.5 kV/W**                      **typ.: 10.0 kV/W**

Responsivity is measured within spectral range 7 - 14  $\mu\text{m}$  as per fig. 3 at 1Hz.

**Match:**                      **max.: 10 %**

Electrical balance (match) is measured with same test set up as responsivity, both elements exposed to radiation. A percent value is calculated as

$$\frac{100 \times s_m}{s}$$

$s_m$  : signal (match)

$s$  : signal of left or right element.

**Noise:**                      **max.: 200  $\mu\text{V}_{pp}$**       **typ.: 80  $\mu\text{V}_{pp}$**

After a 10 minute settling time, noise is monitored for the duration of 1500 sec. at a temperature of 25°C, shut from infrared energy, digital filter between 0.4 to 10Hz.

### Typical Responsivity vs. Frequency

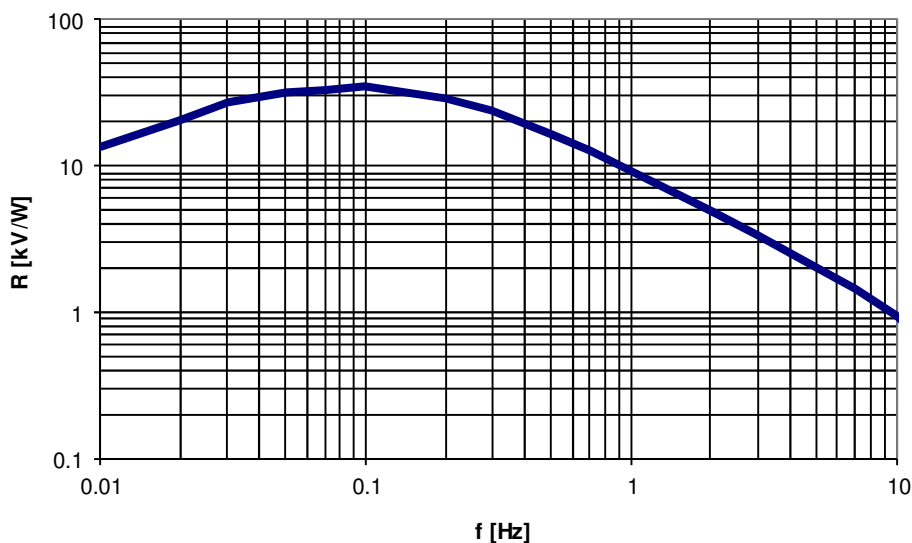


Fig. 3: Frequency response

### Spectral range:

The spectral range of the detector is determined by the built-in filter (window).

**Substrate:**                      Silicon, multilayer coated

**Cut – on:**                      5.5  $\pm$  0.3  $\mu\text{m}$

**Transmission:**                      T > 77% average between 7  $\mu\text{m}$  and 14  $\mu\text{m}$

**Blocking:**                      T < 0.1% for  $\lambda$  < 5  $\mu\text{m}$

## Physical Configuration:

**Housing:** SMD 5x5 mm ceramic housing with infrared transparent window

**Element size:** 1.5 x 0.5 mm<sup>2</sup>, spacing 0.5 mm, see also drawing: 2/71898

**Connections:** Refer to drawing: 2/71898

## Field of View

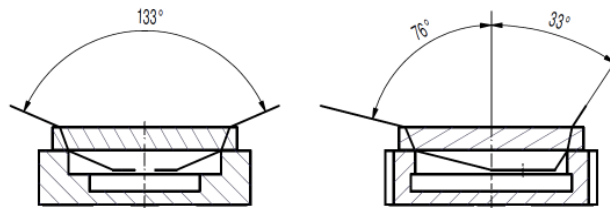


Fig. 4: Field of View

**Operating temperature:** -40 °C to +85 °C

The electrical parameters may vary from specified values accordance with their temperature dependence.

**Storage temperature:** -40 °C to +85 °C

Avoid storage under high humid environment.

**Microphonic noise:** max: 30  $\mu V_{rms}$  /g

**Excelitas** IR-detectors covered herein have passed qualification test for microphonic noise in x-y-z axis, exciting frequencies from 5Hz to 2kHz.

## Humidity:

The IR-detector shall not increase noise or decrease responsivity when exposed to 95% R.H. at 30 °C. Operation below dew point might affect performance.

## Hermetic seal:

This IR-detector is sealed to pass a He-leakage test with maximum leak rate of  $10^{-8}$  mbar $\cdot$ l $\cdot$ s<sup>-1</sup>.

## Quality:

**Excelitas Technologies** is a **QS 9000** certified manufacturer with established SPC and TQM. Detector out-going inspections include the parameters Responsivity, Match, Offset, Noise, Gross leak (Mil Std 883 method 1014C1). Individual data are not stored, statistical details can be disclosed on request.

### **Handling:**

Handle the detectors as ESD sensitive devices and protect them from electrostatic discharges. Working areas should be conductive and grounded. When handling detectors, operators shall be grounded. Avoid mechanical stress on the housing. Do not drop detectors on the floor. Avoid touching the detector window. To clean windows, only use ethyl alcohol with a cotton swab when necessary. Do not expose detector to aggressive detergents such as Freon, trichloroethylene, etc.

### **Soldering conditions:**

This device is a lead-free component and fully complies with the RoHS regulations, especially with existing roadmaps of lead-free soldering. Reflow soldering is recommended. A typical lead-free reflow profile is shown in figure 6. Specific reflow soldering parameters depend on the solder alloy used.

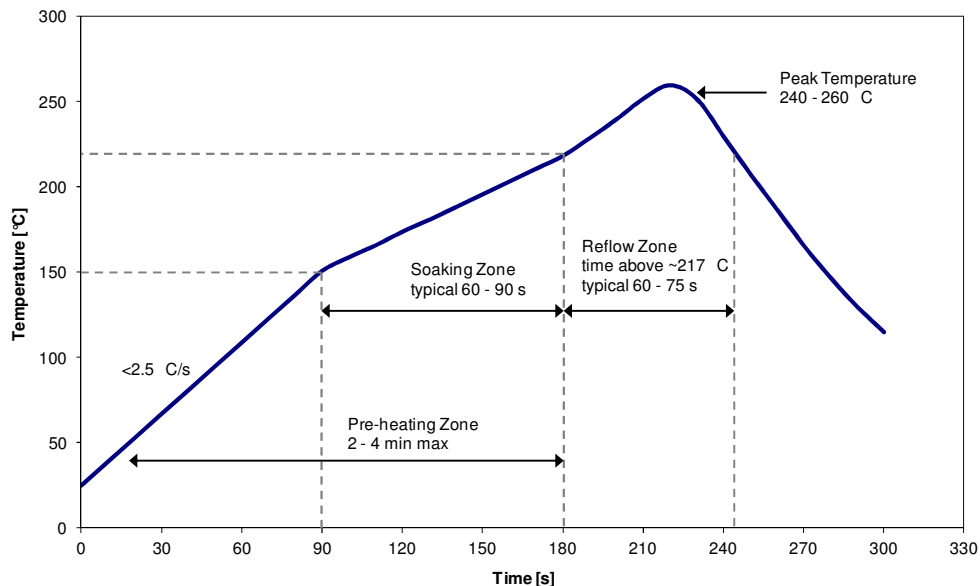


Fig. 5: Typical lead-free reflow profile

### **Product Safety & RoHS:**

Modern high-tech materials are applied in the production of our pyro-electric detectors. Some of these materials are sensitive to high temperature exposure or to specific forms of stress. Our parts are compliant with environmental regulations as can be reviewed on the Excelitas website. We recommend to always check your local regulations. Disposal shall only be carried out in accordance with the latest legislation and directives. In Europe, WEEE directives must be followed.

### **Performance Advice**

Before taking a reading, during testing, and / or operation the unit has to become thermally stable due to its nature as a thermal detector and the high sensitivity of the device. All data are specified at room temperature. When operating at other temperatures within the specified operating range, parameters may vary. The detectors might operate outside the quoted range but may have degraded performance.

