DEVICE SPECIFICATION
FOR
PYRO-ELECTRIC IR-DETECTOR

Customer   :

Type   : PYS 3828 TC G5/G20

Part no.   : 3296

No. of samples:

Thermally compensated two channel single detector with centred lithium-tantalate crystal as sensing element. 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. 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: 19.09.2017

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.
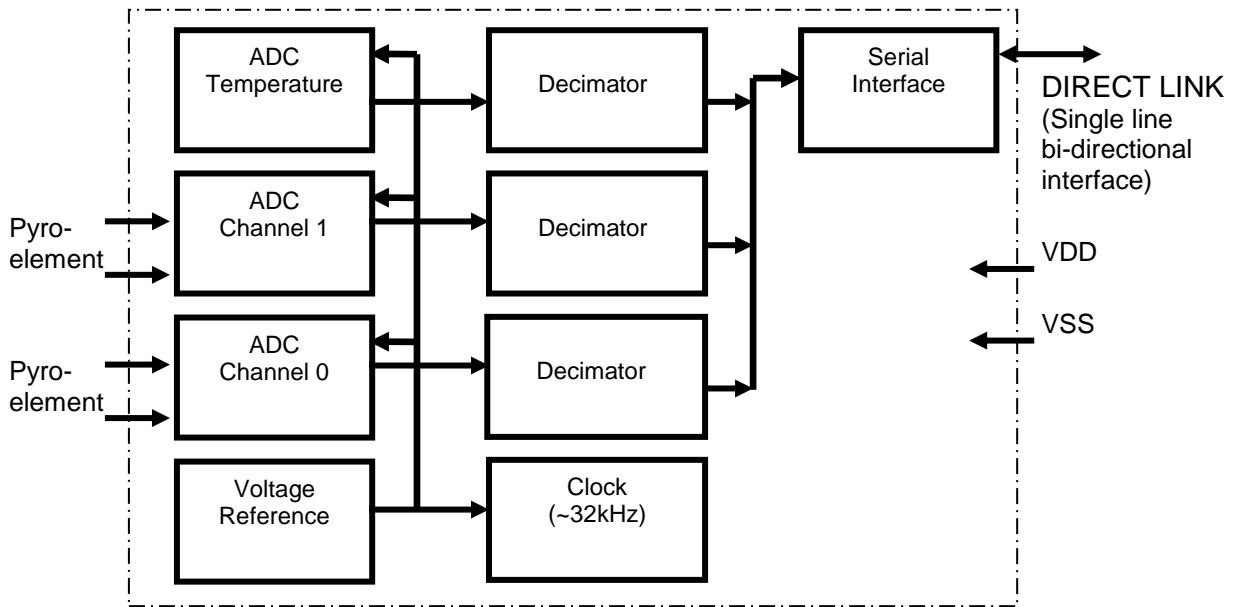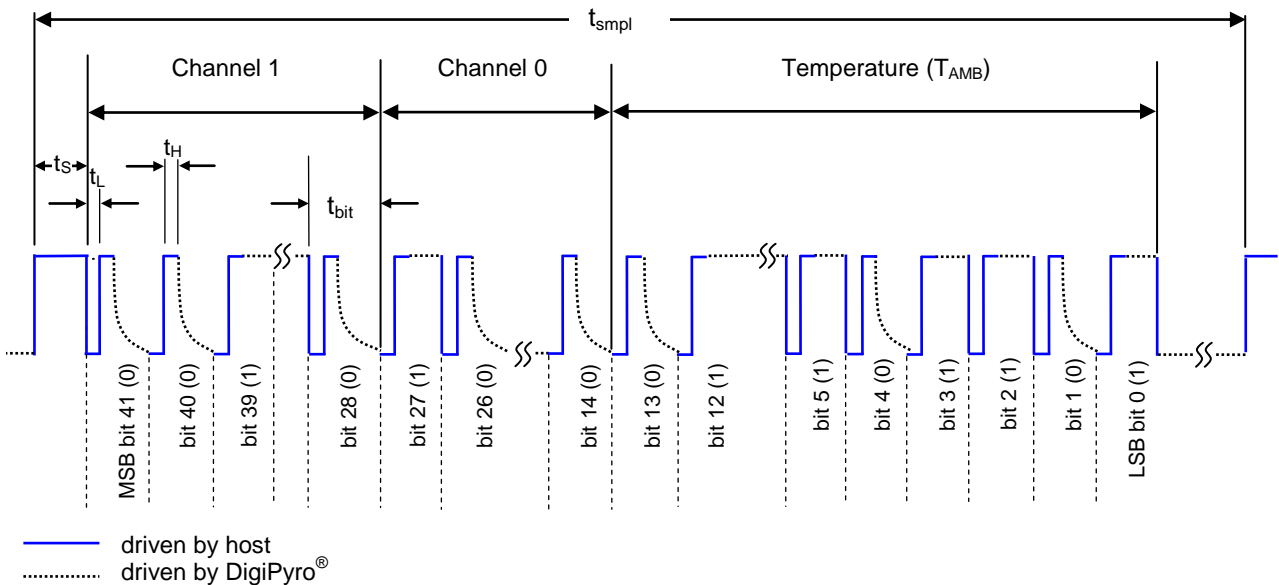

Fig. 1: Block Diagram

Fig. 2: Data Transmission Diagram

The serial interface has a 3 x 14 bit binary output format (Channel 1, 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_{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_{CLK} cycles (t_s) will start the transmission from the DigiPyro®. After this setup time (t_s) has passed the DigiPyro® 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® waits for the next LOW to HIGH transition and the sequence will be repeated until all 42 bits are shifted out. After the last t_{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_{bit} close to but shorter than 25µs to ensure proper LOW level settling. In next steps reduce t_{bit} empirically to optimize for reliable data transmission at maximum transmission speed.

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

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[41] 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® contains an out of range detection logic. The input of the ADC is shorted for a time 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	VDD	2.7	3.3	3.6	V	
Supply Current	IDD			18	µA	VDD = 3.3V
Input Low Voltage	V_{IL}			$0.2V_{DD}$	V	
Input High Voltage	V_{IH}	$0.8V_{DD}$			V	
Pull up Current			130		µA	Input to V_{SS}
Pull down Current			200		µA	Input to V_{DD}
Data Setup Time	t_s	110		200	µs	
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		12.0	ms	
Direct Link Bit Time	$t_{bit} - t_H$			25	µs	To avoid data corruption
ADC Counts of Bits			42		Bits	
ADC Resolution			14		Bits	Max Count = 2^{14} -1
ADC Sensitivity		6.0	6.5	7.1	µV/Count	
ADC Temperature Coefficient		-300		300	ppm/K	
ADC Output Offset		7000	8192	9200	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}	28	32	40	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.: 2.2 kV/W**   typ.: 3.5 kV/W

 Responsivity is measured within spectral range 7 - 14 μm as per fig. 3 at 1Hz.

Noise: **max.: 50 μV$_{pp}$**   typ.: 15 μV$_{pp}$

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.
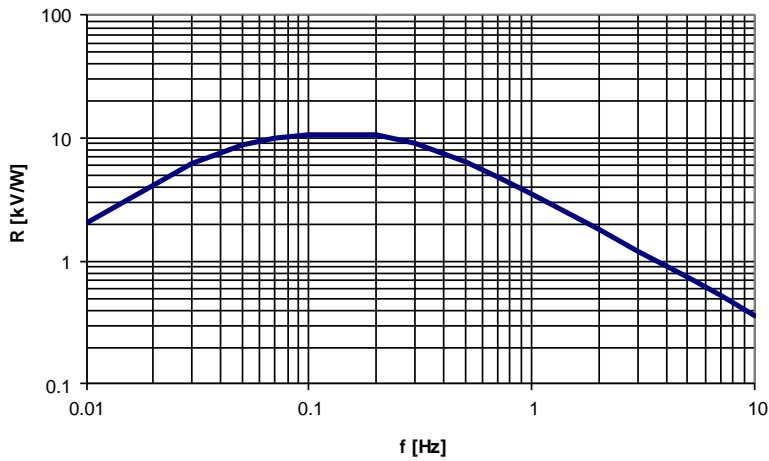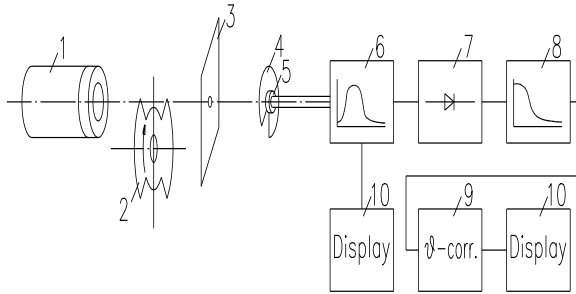
Typical Responsivity vs. Frequency

Fig.2: Frequency response

Test Set up

1: Black Body Radiator 373K = 100°C
2: 1 Hz Chopper
3: Aperture
4: Cover plate
5: Detector
6: Bandpass filter 1 Hz
7: Rectifier
8: Lowpass filter
9: Temperature compensation
10: Display

Fig. 3: Test Set – up

Spectral range:

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

Substrate: Silicon, multilayer coated

Filter (A;B)	Application	Centre wave length (µm)	Half power bandwidth (µm)
G20	Reference	3.95 ± 0.04	0.09 ± 0.02
G5	HC	3.40 ± 0.07	0.18 ± 0.02
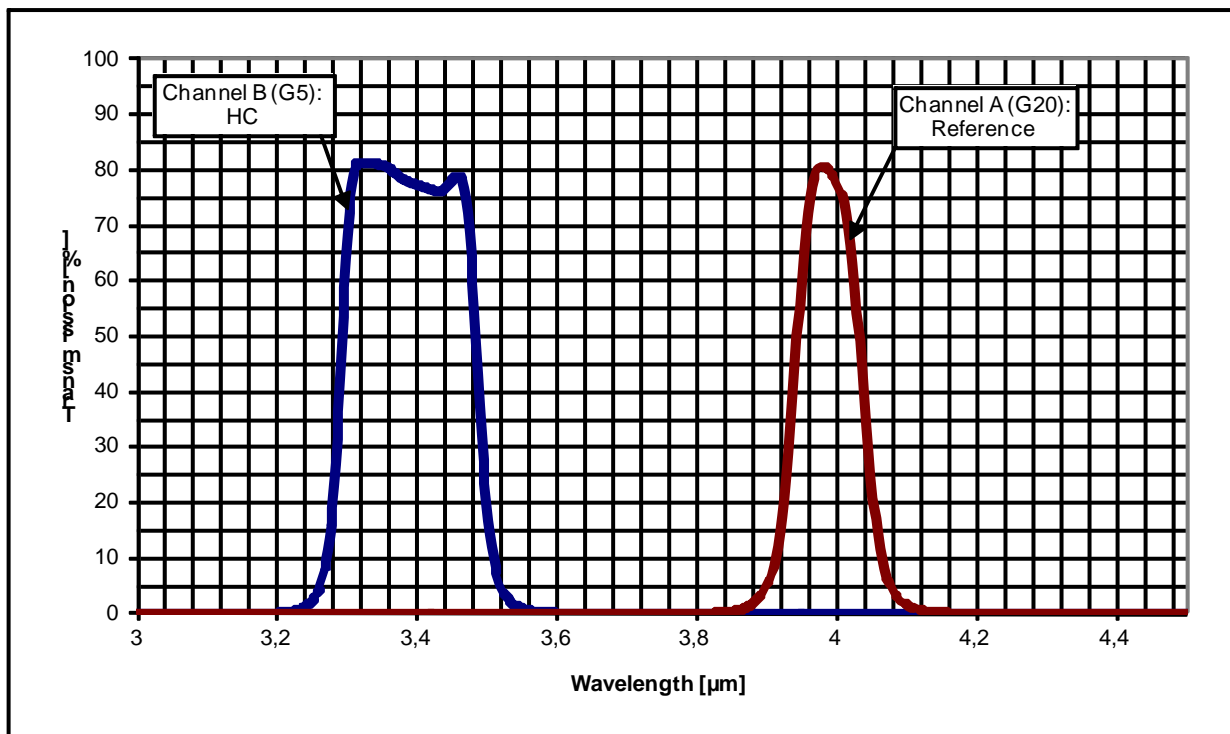
Fig. 4: Filter Transmission

Physical Configuration:

Housing: TO- 5 metal housing with infrared transparent window

Element size: 1.5 x 1.5, see also drawing: 2/71779

Connections: Refer to drawing: 2/71779
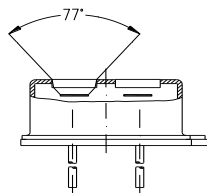
Field of View

Fig. 5: 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 μV_{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·l·s^{-1}.

Quality:
Excelitas Technologies is a **ISO 9001** 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 and especially on the leads. Be careful when cutting or bending leads to avoid damage. Do not bend leads less than 5 mm from their base. 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:
For the soldering of the detectors within PCBs, the typically applied and recommended process is wave soldering. The soldering temperature should not exceed 285° C with a maximum exposure time of 5 seconds. During the automatic wave solder process we strongly advise to restrict preheating when the detector is directly exposed to the radiation of such heaters. In this case, the detector should be protected from the heat.

Manual soldering is also possible when maintaining similar temperature profiles. Reflow soldering is not possible due to the high temperature profiles of the process.

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.

The leads of these detectors have been pre-tinned with lead free tin process and may be applied through lead-free solder processes. As such the detectors will enable the design of RoHS compliant products.

Marking:
The marking of the detector includes the principal type plus a 4 digit number that represents the Excelitas storage and specification number (3XXX) or (7XXX) and a date code, consisting of years and week detail. The marking is on the top or side of the detector.
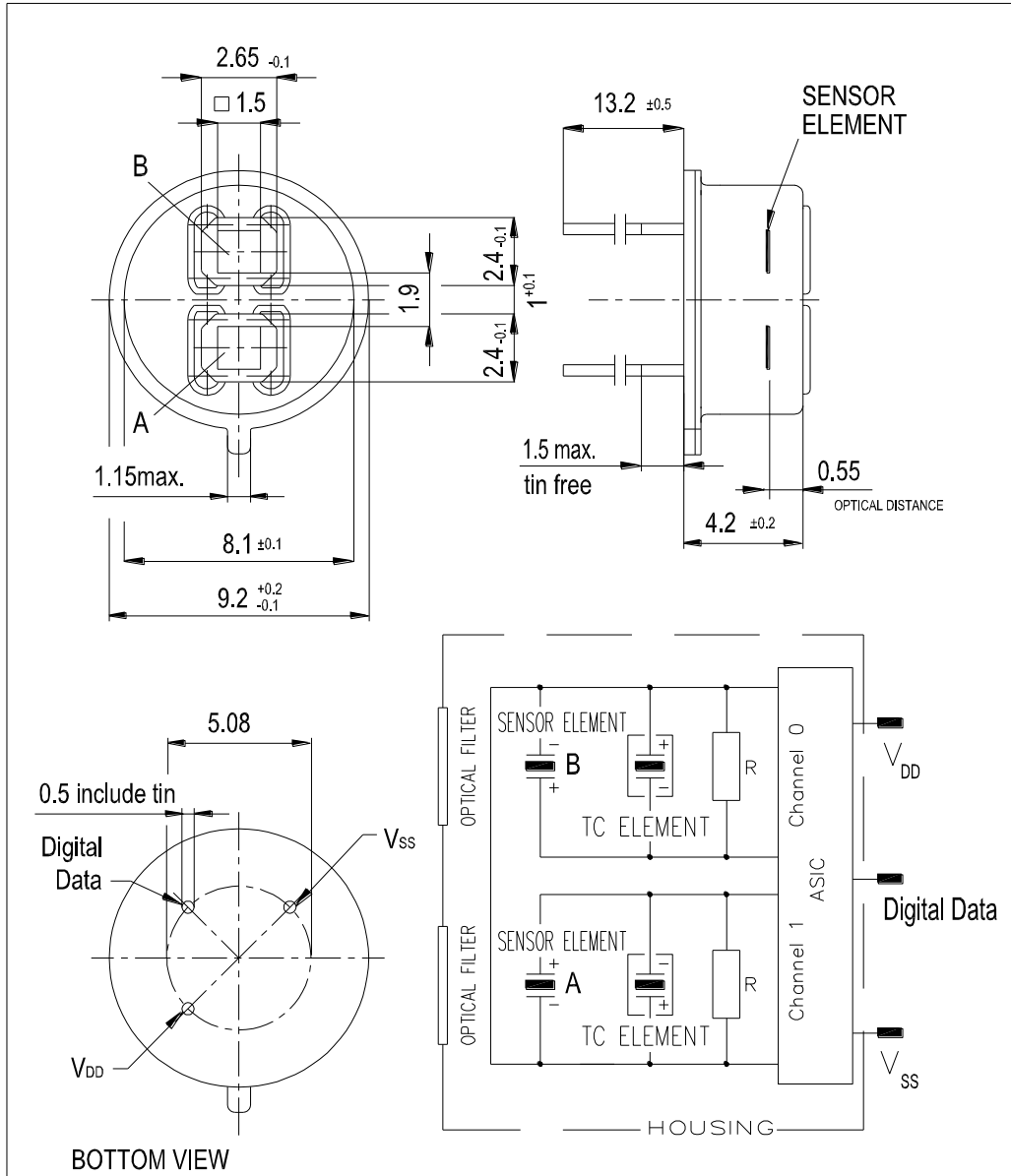
Performance Advice
Before taking a reading, during testing, and / or operation the unit has to become thermally stable due to its nature as a thermal detector and the high sensitivity of the device.

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.

2.65 -0.1

□ 1.5

B

1.9

2.4 -0.1

1 +0.1

2.4 -0.1

A

1.15max.

8.1 ±0.1

9.2 +0.2 -0.1

13.2 ±0.5

SENSOR ELEMENT

1.5 max. tin free

4.2 ±0.2

0.55

OPTICAL DISTANCE

5.08

0.5 include tin

Digital Data

V_{SS}

V_{DD}

BOTTOM VIEW

OPTICAL FILTER

SENSOR ELEMENT

B

TC ELEMENT

R

OPTICAL FILTER

SENSOR ELEMENT

A

TC ELEMENT

R

Channel 0

Channel 1

ASIC

V_{DD}

Digital Data

V_{SS}

H O U S I N G