

# Single-Element Pyro Detectors For Gas Monitoring And Measuring



## PYS 3798 TC – (1+1) Channel DigiPyro®

### Target Applications

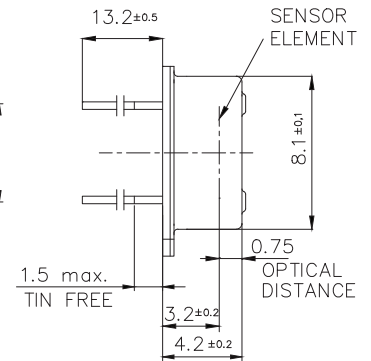
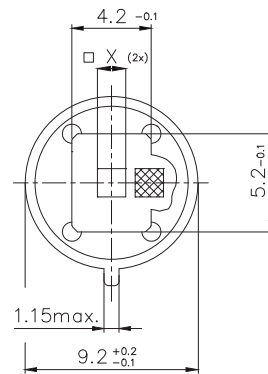
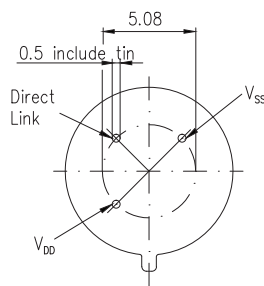
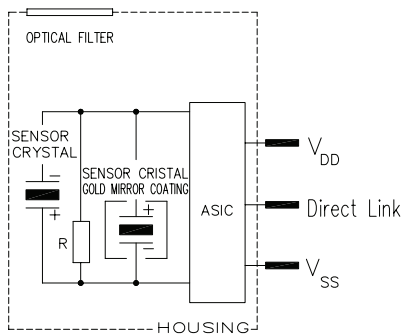
- Gas Sensing and Monitoring

### Features and Benefits

- Digital Output
- Internal Temperature reference
- Thermally compensated
- TO-5 metal housing
- Selection of narrow band pass filters

### Product Description

Excelitas extends the family of DigiPyro® detectors to applications in Gas Sensing. The PYS 3798 TC is the digital equivalent to LHi 807 TC. It includes additionally the temperature reference as a separate output. The two signals are presented in one 28-bit digital bit stream communicated via a single wire "Direct Link" interface to a suitable host microprocessor.



### PYS 3798

Parameter	Symbol	PYS 3798	Unit	Remarks
Responsivity, min.	$R_{min}$	2,2	kV/W	$f = 1$ Hz
Responsivity, typ.	R	3,5	kV/W	$f = 1$ Hz
Field of View, horizontal	FoV	135°		unobstructed
Field of View, vertical	FoV	122°		unobstructed
Operating Voltage	$V_{DD}$		V	
Supply Current	$I_{DD}$	10	$\mu$ A	typical, $V_{DD} = 3,3$ V
Noise, max.		52	$\mu$ Vpp	0,4...10Hz/20°C
<b>Digital Data</b>				
Sample Time	$t_{SAMPL}$	2	ms	min.
ADC Resolution		14	Bits	max. Count = $2^{14}$
Output Data Format		14	Bits	for both channels
ADC Sensitivity		6...7,1	$\mu$ V/count	
ADC Output Offset		6500...9800	counts	
ADC Output Offset, typ.		8192	counts	
<b>Temperature Reference</b>				
Gain (Temperature)		80	Counts/K	-20°C to +80°C, typ.
Linearity		-5...+5	%	-20°C to +80°C
<b>Filter, Signal Processing</b>				
Digital Filter, cut off		8	Hz	

# Infrared Basics

## Infrared Basics

All solid bodies when having temperatures above the absolute zero (-273 C) emit electromagnetic waves. The range of longer wave lengths beyond the visual spectrum is referenced as infrared radiation. The scientist Wilhelm Wien (1864–1928) has described the relation between a solid body's temperature and its emitting peak wave length by following equation:

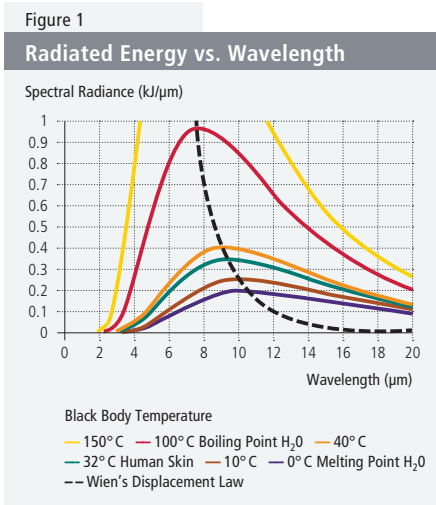
$$\lambda_{\max} = 2898 / T$$

T = Temperature in K (Kelvin)

$\lambda$  = Wavelength in  $\mu\text{m}$

Using this law we can calculate the specific peak emission wave length of any material or body: A human body, of a surface temperature of approx. 35°C or 308 K calculates into a peak wavelength of 9,4  $\mu\text{m}$ ; a cat of 38°C temperature into 9,3  $\mu\text{m}$ . According to Max Planck (1858 – 1947) the intensity curve of all emitted wave lengths for a solid body is rather broad. For our example above this means we cannot distinguish human from the cat by their infrared spectrum.

For various temperatures of an ideal black body radiator the intensity curves of radiated energy versus wave length are shown below.



A hot body of 2000 K emits a lot of energy, some in the visible light range, some in the infrared (it glows red or white-hot). A body of 500 K emits radiation in the invisible part of the spectrum, the infrared range, which we can feel, but not see.

## Infrared Detectors

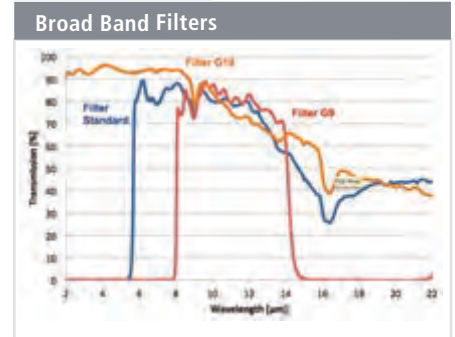
With detectors for the infrared spectrum there are two major classes by their physical principles: Photon Detectors and Thermal Detectors. Photon detectors convert radiation directly into electrons, Thermal Detectors receive radiation, transfer it to raising temperature of the sensing material which changes it's electrical property in response to the temperature rise. Photon detectors such as Photodiodes and Phototransistors range from visible to near infrared, Thermal Detectors have a broad response from below visible light up to over 100  $\mu\text{m}$ . Fitted with special infrared windows as spectral filters they work in the mid to far infrared range without ambient visible light interference.

## Filters for Infrared Sensors

The spectral sensitive range of the detectors is defined by a filter window. Common applications in infrared reference wavelengths from 2 to 20  $\mu\text{m}$ . Infrared windows for pyrometric applications are defined for the atmospheric window 5-14 $\mu\text{m}$ , which is our standard filter window. Long range pyrometers apply a sharp cut-on/cut-off window of 9-14 $\mu\text{m}$  (G9) as per fig.2.

For the special application of Gas sensing by infrared absorption we offer narrow band filters to detect specific gas absorption lines. The appropriate narrow band optical filters enable detection of Carbon Monoxide, Carbon Dioxide, Natural Gas and other environmental gases, as well as some technical gases.

Figure 2



In Fig.2 we show the graph for standard infrared window and the pyrometric window "G9". As to narrow band Infrared filters, the range of available filters and specifications is given in Table 1 below:

## Optical Properties

With respect to optical parameters of Detectors and Sensors, there are some interesting items to be mentioned: the optical bandwidth, transmission and blocking characteristics of the optical filter and, as major selection criteria, the sensor field of view, and performance of the detector within the field of view. The corresponding charts are given for the various sensors and types.

Table 1

Narrow Band Filters

Filter Type	Application	CWL	HPB
G1	CO	4.64 $\mu\text{m}$	180 nm
G2	CO <sub>2</sub>	4.26 $\mu\text{m}$	180 nm
G2.2	CO <sub>2</sub>	4.43 $\mu\text{m}$	60 nm
G2.5	CO <sub>2</sub>	4.33 $\mu\text{m}$	160 nm
G2.6	N <sub>2</sub> O	4.53 $\mu\text{m}$	85 nm
G3	CO+CO <sub>2</sub>	4.48 $\mu\text{m}$	620 nm
G4	NO	5.3 $\mu\text{m}$	180 nm
G5	HC	3.35 $\mu\text{m}$ -3.4 $\mu\text{m}$	190 nm
G5.1	HC	3.46 $\mu\text{m}$	163 nm
G5.2	HC	3.28-3.31 $\mu\text{m}$	160 nm
G5.3	HC	3.09 $\mu\text{m}$	160 nm
G5.5	HC	3.32-3.34 $\mu\text{m}$	160 nm
G5.6	HC	3.42 $\mu\text{m}$ -3.451 $\mu\text{m}$	160 nm
G5.7	HC	3.30-3.32 $\mu\text{m}$	160 nm
G5.9	HC	3.375 $\mu\text{m}$ -3.4 $\mu\text{m}$	190 nm
G7.1	R12	11.3 $\mu\text{m}$	200 nm
G7.2	R134a	10.27 $\mu\text{m}$	210 nm
G7.3		12.4 $\mu\text{m}$	180 nm
G20	Reference	3.95 $\mu\text{m}$	90 nm