EMIRS200 with Reflector 1

Thermal MEMS Based Infrared Source

1. Infrared Source

Axetris infrared (IR) sources are micro-machined, electrically modulated thermal infrared emitters featuring true blackbody radiation characteristics, low power consumption, high emissivity and a long lifetime. The patented design is based on a resistive heating element deposited onto a thin dielectric membrane which is suspended on a micro-machined silicon structure.

2. Infrared Gas Detection Applications

Measurement Principles

Non-dispersive infrared spectroscopy (NDIR), photo- acoustic infrared spectroscopy (PAS) or attenuated-total-reflectance FTIR spectroscopy (ATR)

Target Gases

CO, CO_2, VOC, NO_X, NH_3, SO_X, SF_6, hydrocarbons, humidity, anesthetic agents, refrigerants, breath alcohols

Medical

Capnography, anesthesia gas monitoring, respiration monitoring, pulmonary diagnostics, blood gas analysis

Industrial Applications

Combustible and toxic gas detection, refrigerant monitoring, fruit ripening monitoring, SF_6 monitoring, semiconductor fabrication

Environmental

Heating, ventilating and air conditioning (HVAC), indoor air quality and VOC monitoring, air quality monitoring

Automotive

Automotive refrigerant monitoring, alcohol detection & interlock, cabin air quality

3. Features

- Reflector 1 optimized for a source to detector distance[1] of up to 15 mm.[2]
- Large modulation depth at high frequencies
- Broadband emission: true black body radiation (2 to >17 µm)
- Very fast electrical modulation (no chopper wheel needed)
- Long lifetime
- Suitable for portable and very small applications
- Rugged MEMS design

[1] Measured from the top of the reflector.

[2] Can be optimized with additional optical elements (or a reflective inner surface of the gas cell).

4. Electrical Parameters (T_A = 22 °C)

Parameter	Symbol	Unit	Value Typical	Value Range
Electrical cold resistance[3]	R_{C22}	Ω	45	35–55
Frequency	F	Hz	5	5–50
Duty cycle of rectangular V_E pulse	D	%	50	30–70

5. Recommended Operating Conditions (ROC) at T_A = 22 °C

Parameter	Symbol	Unit	Values or Equation
Frequency	f	Hz	5
Duty cycle of rectangular V_E pulse	D	%	50
Electrical Power for R_{C22} range	P_E	mW	450
Voltage for R_{C22} = 45 Ω	V_E	V	5.6
Voltage computation	V_E (R_{C22})	V	0.052 V/Ω × R_{C22} + 3.3 V

Operation mode power control

- Drive the EMIRS200 with the recommended electrical power P_E = 450 mW at a frequency of 5 Hz and a duty cycle of 50 %.

Operation mode voltage control

- Determine the cold resistance R_{C22}
- Compute the recommended operating voltage V_E (R_{C22}) using the equation "Voltage computation".
- Apply a square wave signal (0 V to V_E) at 5 Hz frequency and 50 % duty-cycle.

Non-modulated (DC) and operation mode current control are not recommended.

The Labkit and the Power Control PCB supplied by Axetris allow quick experimenting. A detailed technical note describing advanced operation modes is available upon request.

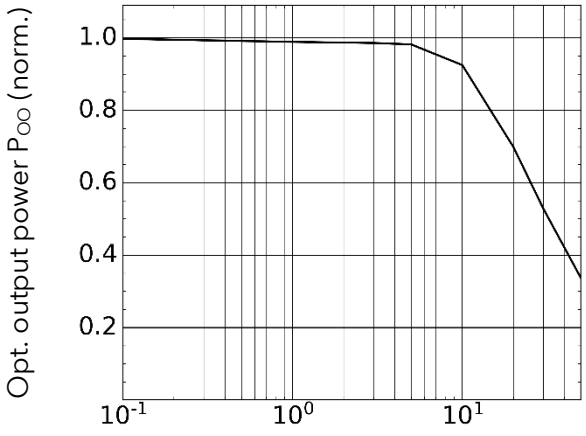
[3] Value at delivery date

6. Ratings at Recommended Operating Conditions (ROC)

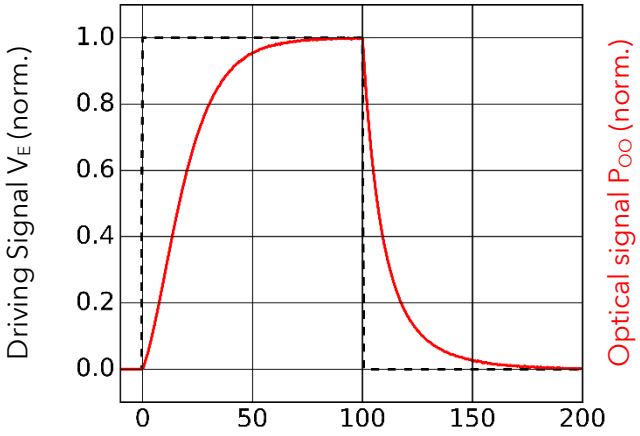
f = 5 Hz, duty-cycle 50 % at T_A = 22 °C

Parameter	Symbol	Unit	Typical Rating
Optical output power [4] [5] (hemispherical) for article without window	P_{OO}	mW	28
Emissivity (2 µm–17 µm)	ϵ	–	> 0.85
On time constant of optical output power P_{OO} (0 % – 63 %)	τ_{on}	ms	22 ± 1
Off time constant of optical output power P_{OO} (100 % – 37 %)	τ_{off}	ms	11 ± 2
Electrical hot resistance computation	R_H (R_{C22})	Ω	1.5×R_{C22} + 2.8 Ω
Package temperature (TO Header)[6]	T_P	°C	< 80

7. Typical Dynamic Characteristics



Normalized max-min values of optical output power P_{OO} versus frequency f with fixed V_E



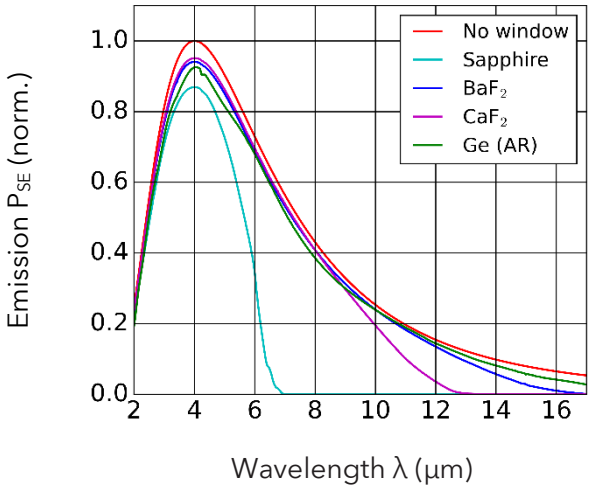
Normalized (to ROC) electrical driving signal V_E (t) (black, dashed), optical response P_{OO} (t) (red, solid)

[4] For pulsed operation: peak to peak signal

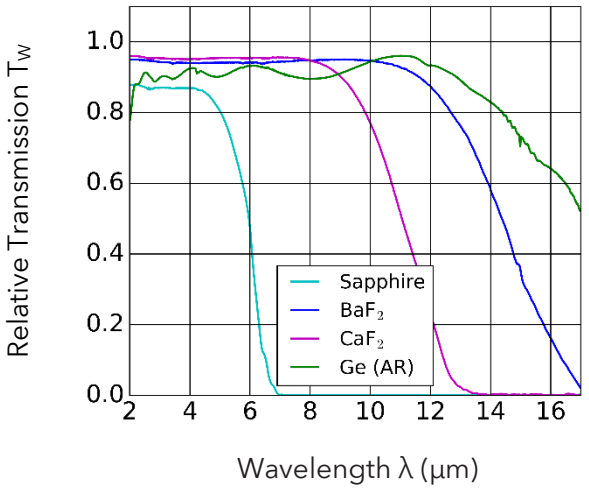
[5] Refers to the measured value at ROC. The influence of the reflector geometry is based on simulation. Driving at higher V_H or P_H leads to an increase of P_{OO}, however with detrimental effects on lifetime.

[6] TO Header vertically oriented, free convective cooling to air

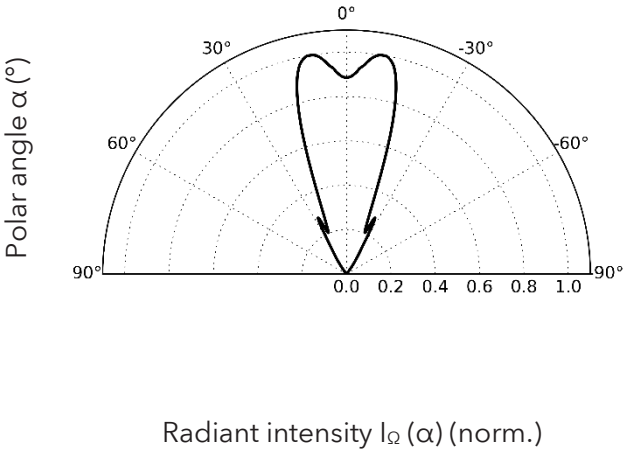
8. Typical Optical Characteristics (ROC)



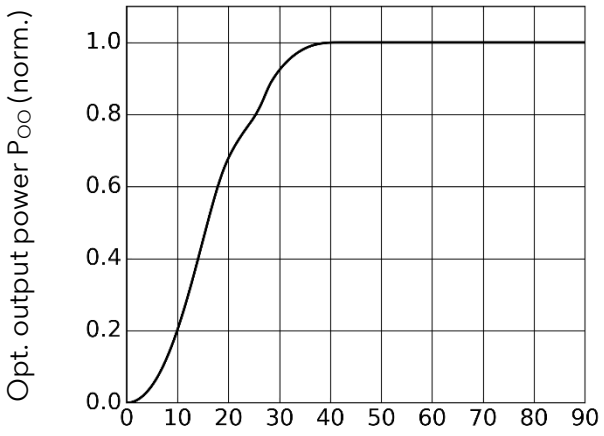
Emission spectrum P_{SE} (λ) without window and with windows of different materials



Window transmission spectra T_W (λ) of different materials



Directivity plot showing radiant intensity[7] $I_Ω$ (α) emitted per polar angle α



Normalized optical output power[7] P_{OO} (integral from 0° to α) versus opening angle α

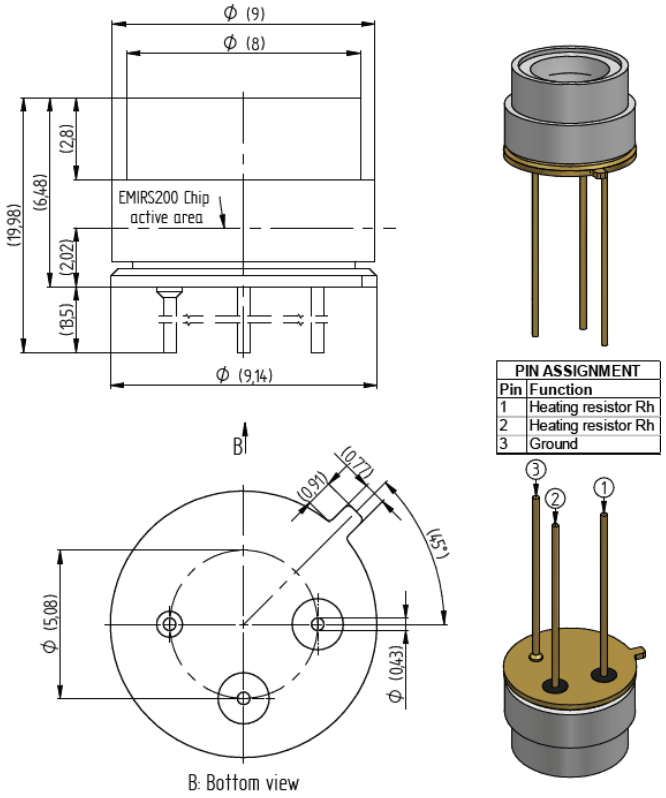
[7] Simulated data

9. Article Overview and Dimensions

Article Type	Window Material	Art. No. Front-Vented[8]	Art. No. Back-Vented[9]
Reflector 1 on TO39 header	No window	600.451	–
	BaF_2	602.992	602.964
	CaF_2	602.993	602.965
	Sapphire	602.994	602.966
	Ge (AR)	602.989	602.961

Membrane area: 2.0 × 2.0 mm²

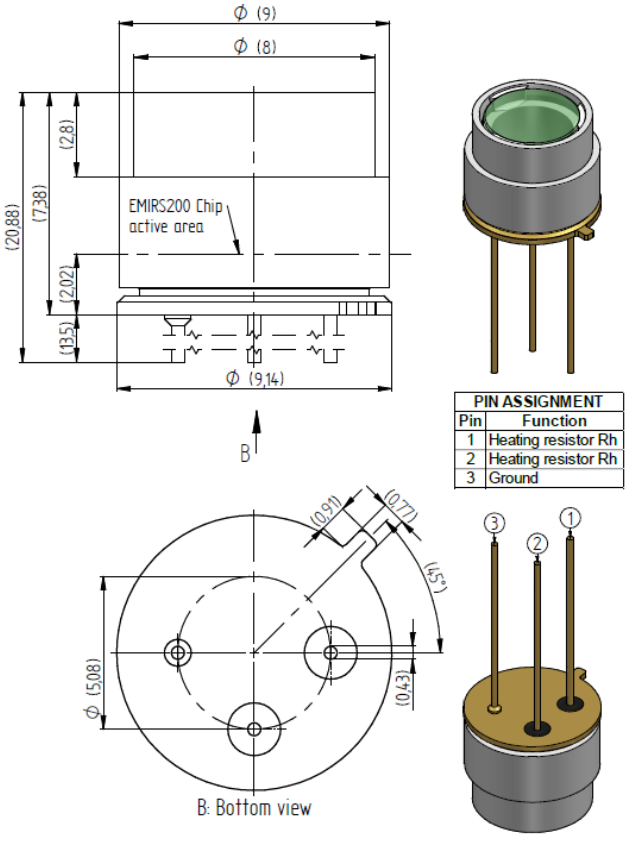
Art. 600.451



[8] Window (if fitted) glued at 3 points to allow venting.

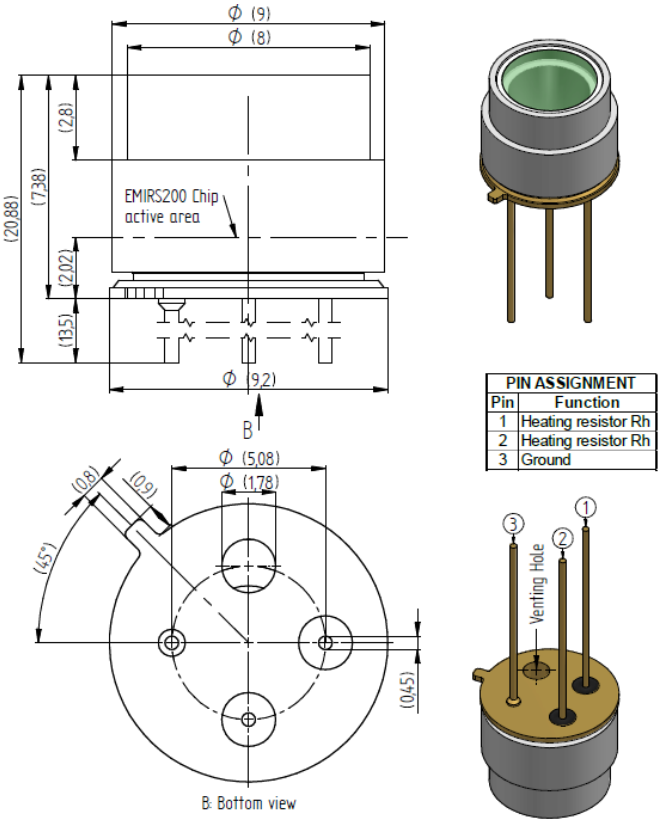
[9] Window (if fitted) glued circumferentially. Gas tightness between window and the remainder of the IR source is not tested or guaranteed.

Art. 602.989, 602.992, 602.993, 602.994



PIN ASSIGNMENT	
Pin	Function
1	Heating resistor Rh
2	Heating resistor Rh
3	Ground

Art. 602.961, 602.964, 602.965, 602.966



PIN ASSIGNMENT	
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10. Environmental Information

Parameter	Symbol	Rating	Unit
Storage temperature	T_S	–40 to +125	°C
Operating temperature	T_O	–40 to +85	°C
Relative humidity	RH	0 to 85 non-condensing	%

11. Reliability Information

- Lifetime: >100000 h MTTF[10] at ROC
- ESD: Devices are not sensitive to electro-static discharge.
- Mechanical shock and vibration tests were performed according to IEC 60601-1:2005 and ISO 80601-2-55:2018 in accordance with the following methods:
  - Mechanical shock: IEC 60068-2-27:2009, according to IEC 60721-4-7:1995, Class 7M3
  - Vibration broadband random: IEC 60068-2-27:2009, according to IEC 60721-4-7:1995, Class 7M3.

  All tested devices passed.
- Environmental stress tests:
  - Temperature cycling shock (non-operating) tests were performed according to JESD22-A104C:2005, Test condition G: –40 °C to +125 °C.
  - Temperature humidity tests during operation were performed according to IEC 60068-2-67:2019, Test Cy: Severity I, Damp heat, 85 °C, 85 % RH.

  All tested devices passed.
- Additional testing was performed, detailed information is available upon request.
- Drift of electrical resistance and optical output power:
  - Operating the EMIRS200 in either modulated or continuous mode results in an irreversible steady increase in the electrical resistance over time that eventually saturates. The electrical resistance drift is accompanied by a change in optical output power.
  - We recommend regular or continuous recalibration of the detector signal to mitigate the influence of resistance and output power drift.
  - The electrical resistance drift is minimized by modulating the source during operation. When operating in DC, enhanced levels of drift in electrical resistance and optical output are observed.

  More information and guidance available upon request.
- The EMIRS200 should not be sealed hermetically. For solutions or questions regarding hermetical sealing please contact our application engineering.

[10] MTTF: mean time to failure, i.e. the time until 63 % of the devices have failed.

12. Handling Precautions

- Do not touch the chip surface.
- Do not clean the sources.
- Process under cleanroom conditions.
  Use suitable gloves (nitril or powder-free Latex) for handling.

13. Conformity assessment

The IR sources are developed and produced in compliance with the standard EN ISO9001:2015 (see website).

RoHS and REACH compliance

The IR source falls under the directive of the restriction of the use of certain hazardous substances in electrical and electronic equipment 2011/65/EC. A copy of the latest RoHS and REACH Compliance documents as well as the documents for Conflict Minerals Reporting (CMRT) and Extended Minerals Reporting (EMRT) are available on request.

14. Disclaimer

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