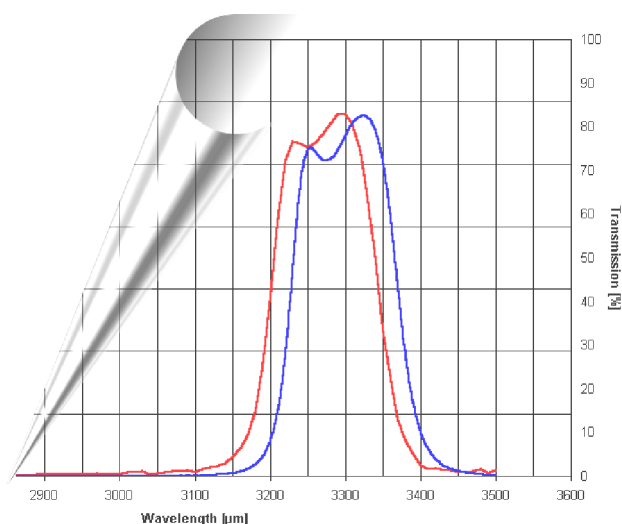


Pyroelectric and Multispectral Detectors

IR filters and windows



Pyroelectric and Multi-spectral
detectors

- IR filters and windows -

Pyroelectric and Multi-spectral
detectors

- Customer furnished
filters -

Pyroelectric and Multi-spectral
detectors

- Typical IR filters and
windows plots -

Pyroelectric and Multi-spectral
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- Spectral emission of IR
sources -

IR Filter and windows

Pyroelectric and Multi-spectral Detectors

IR filters and windows

Description:

The detector window has to fulfill two functions:

- Define the spectral sensitiveness of the pyroelectric chip according to the purpose of the application (between UV to far IR)
- Reliable hermetic seal of the optical interface between detector and environment (leakage rate < $5 \cdot 10^{-9}$ Pa·l/s Helium)

InfraTec detectors are available with the following window versions:

- Standard single crystal windows
- Windows on silicon
- Standard narrow band pass filters (NBP)
- Custom-designed filters or filters provided by the customer

The following pages will provide an overview of our standard filters and their typical spectral scans.

Standard crystal windows:

Type	Description	Transmission	Transmission range	Environment resistance
BaF ₂ 0.4mm thick	barium fluoride	+	UV ... 12μm	o
CaF ₂ 0.4mm thick	calcium fluoride	+	UV ... 9μm	o
CaF ₂ 0.7mm thick	calcium fluoride	+	UV ... 8μm	o
CsI 0.8mm thick	cesium iodide, protected	o	UV ... 50μm	-
KBr 0.8mm thick	potassium bromide, protected	+	UV ... 30μm	-
Sapphire 0.6mm thick	sapphire uncoated	-	UV ... 5μm	+

Standard silicon windows:

Type	Description	Transmission type	Transmission range	Environment resistance
Si ARC 2-5μm	coated silicon	antireflection	2 ... 5μm	+
Si ARC 3-14μm	coated silicon	antireflection	3 ... 14μm	+
Si LWP 5.3μm	silicon LWP	long wave pass	6 ... 15μm	+
Si LWP 6.5μm	silicon LWP	long wave pass	7 ... 14μm	+
Si LWP 7.3μm	silicon LWP	long wave pass	8 ... 15μm	+
Si WBP 8-14μm	silicon WBP	band pass	8 ... 14μm	+

Durability : Adhesion MIL-F-48616 / section 4.6.8.1.
 Humidity MIL-F-48616 / section 4.6.8.2.
 Abrasion resistance MIL-F-48616 / section 4.6.8.3.

Pyroelectric and Multi-spectral Detectors

IR filters and windows

Standard narrow band pass filters (NBP):

NBP Filters are made by default from silicon or germanium substrate. These filters feature an excellent blocking in the short-wave (UV to NIR). Please note that an out-of-band transmission in the range $> 10\mu\text{m}$ (long wave IR) is an always existing undesirable side effect and not shown in scans of this catalog.

Gas	CWL / μm	Tolerance of CWL / nm	HPBW / nm	Tolerance of HPBW / nm
CO	4.66	± 40	180	± 20
CO ₂ high AOI	4.27	± 30	170	± 20
CO ₂ long path	4.45	± 20	60	± 20
CO ₂ narrow	4.24	± 40	90	± 20
CO ₂ standard	4.24	± 40	180	± 20
HC	3.40	± 30	120	± 20
NO _x	5.30	± 40	180	± 20
Reference	3.95	± 40	90	± 20
SO ₂	7.30	± 40	200	± 30

Durability : Adhesion MIL-F-48616 / section 4.6.8.1.
 Humidity MIL-F-48616 / section 4.6.8.2.
 Abrasion resistance MIL-F-48616 / section 4.6.8.3.

Temperature shift of CWL: $+0.1 \dots +0.9 \text{ nm/K}$

CWL shift: -10 ... -30 nm at 15° AOI
 -40 ... -100 nm at 30° AOI
 -100 ... -180nm at 45° AOI

Extension code table - single element detectors:

(valid for standard and extended Products)

Description	Code	Description	Code	Description	Code
BaF ₂ 0.4mm thick	M	CO ₂ standard	D	Si LWP 5.3 μm	W
CaF ₂ 0.4mm thick	Q	HC	G	Si LWP 6.5 μm	N
CaF ₂ 0.7mm thick	A	KBr 0.8mm thick	J	Si LWP 7.3 μm	O
CsI 0.8mm thick	K	NO _x	L	Si WBP 8-14 μm	B
CO	I	Reference	H	SO ₂	U
CO ₂ high AOI	Z	Sapphire 0.6mm thick	R		
CO ₂ long path	E	Si ARC 2-5 μm	V		
CO ₂ narrow	T	Si ARC 3-14 μm	P		
				customized detectors	X###

Pyroelectric and Multi-spectral Detectors

IR filters and windows

Extension code table - multi-color detectors:

(valid for PyroMid® Detectors)

	Code	Channel 1	Channel 2	Channel 3	Channel 4	valid for
Dual channel detectors without beamsplitter	A	CO ₂ standard	CO			LIM-112; LIM-212; LIM-312; LIM-122; LIM-222; LIM-162; LIM-262; LMM-242
	B	CO ₂ standard	Reference			
	C	CO	Reference			
	D	HC	Reference			
	E	NO _x	Reference			
	F	CO ₂ long path	Reference			
	G	CO ₂ narrow	Reference			
	H	CO ₂ high AOI	Reference			
	X###	customized detectors				
Dual channel detectors with beamsplitter	F	CO ₂ high AOI	CO			LIM-012; LIM-032; LIM-052
	G	CO	Reference			
	H	HC	Reference			
	I	CO ₂ narrow	Reference			
	J	CO ₂ long path	Reference			
	K	CO ₂ high AOI	Reference			
	X###	customized detectors				
Quad channel detectors without beamsplitter	A	Reference	HC	CO ₂ standard	CO	LIM-114; LIM-214; LIM-314; LMM-244
	B	HC	CO ₂ standard	CO	NO _x	
	C	Reference	CO ₂ standard	CO	NO _x	
	D	Reference	HC	CO	NO _x	
	E	Reference	HC	CO ₂ standard	NO _x	
	F	Reference	HC	CO ₂ long path	CO	
	X###	customized detectors				
Quad channel detectors with beamsplitter	E	HC	CO ₂ high AOI	CO	NO _x	LIM-011; LIM-054
	F	Reference	HC	CO ₂ high AOI	CO	
	G	Reference	CO ₂ high AOI	CO	NO _x	
	H	Reference	HC	CO	NO _x	
	I	Reference	HC	CO ₂ long path	CO	
	X###	customized detectors				

Pyroelectric and Multi-spectral Detectors

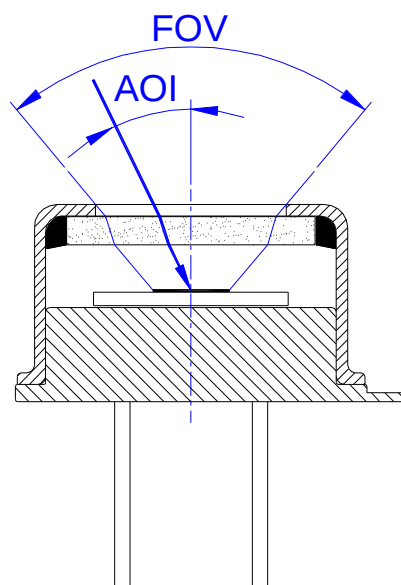
IR filters and windows

Field of view (FOV):

A detector's field of view (FOV) should be optimally chosen and specified in order to maximize useful incident radiation but also to minimize background or unwanted radiation. In other words, the FOV of a detector should be specified as large as necessary only to admit the maximum amount of useful radiation based on specific system characteristics and requirements.

Wide Angle of Incidence (AOI) shall be avoided for applications with narrow-band IR filters (typical for NDIR gas analysis). In this case the physical conditioned shift of cut-on and cut-off of the narrow-band IR filter will move towards shorter wavelength and will modify the desired spectral characteristics of the detector. Therefore InfraTec offers 3 special IR filter types with extreme low angle shift of approx. -15nm at 15° AOI (NBP 4.24µm/90nm „CO₂ narrow“, NBP 4.27µm/170nm „CO₂ high AOI“, NBP 4.66µm/180nm „CO“). A higher temperature drift of the CWL (approx. +0.5nm/K) will arise as a matter of principle for these three filters.

Furthermore please note that multi-spectral detectors with FOV's larger than 30 degrees might cause interference problems between channels (cross over).



Following are FOV's for some of our standard detectors:

Group	Type	FOV for different window substrates		
		Minimum value for every point of the sensitive element		
		Calcium or Barium fluoride 0.4mm thick	Silicon substrate 0.5mm thick	Germanium substrate 1.0mm thick
Standard Products	LIE-216	25°	30°	40°
	LIE-235	90°	100°	125°
	LME-316	65°	70°	85°
	LME-335	80°	85°	110°
	LME-502	60°	65°	85°
	LME-541	60°	65°	85°
Extended Products	LIE-309	35°		
	LIE-312	85°		
	LIE-332	100°		
	LME-353	80°	85°	110°
	LME-553	60°	65°	85°
Multi-color Products	LIM-011	not applicable	Maximum angle of incidence shall be 14° (±7°) otherwise internal reflexions may modify the channel ratio!	
	LIM-032			
	LIM-054		45°	60°
	LIM-212		45°	60°
	LIM-214		20°	25°
	LIM-222		30°	40°
	LIM-262		55°	80°
	LMM-244			

IR Filter and windows

Pyroelectric and Multi-spectral Detectors

Customer furnished filters

Requirements for Customer Furnished Filters for use in InfraTec pyroelectric detectors:

- Filters already cut to size are preferred. The correct size and tolerances for each detector type can be found in the Table below. Standard thickness for all filters is **0.60 +0.1/-0.2 mm**. The thickness range of 0.70 ... 1.10mm can be used on request partly for our Standard and Extended Product Line.
- Filter Quantity Required
 - ✓ Production orders: Desired quantity +10%
 - ✓ Sample orders under 10pcs: 2-3 additional filters
- Preferred packaging for the filters:
 - ✓ Waffle tray or
 - ✓ Wafer tape (blue tape foil)
- Filters provided must be clean without any ink point or other marking. Cleanliness is required for good adhesion and sealing of the filters to the pyroelectric detector package.
- InfraTec offers the option to assemble customer furnished filters supplied uncut in wafer format for production orders. Wafers can be cut for an additional charge. InfraTec cannot assume liability for peeling or chipping of filter layers or other problems that might occur during cutting. Please note that filters coated on germanium or hard substrates such as sapphire and quartz have an increased risk of damage during the cutting process.

Please note:

InfraTec limits the incoming inspection of the customer furnished filters to a visual check and the identification of the Centre Wavelength (CWL) and the Half Power Bandwidth (HPBW). The filter manufacturer (not InfraTec) must certify specification requirements.

InfraTec has extensive experience in processing filters. InfraTec cannot assume liability for any filter damage that may occur.

Please contact us if you have any questions!

Pyroelectric and Multi-spectral Detectors

Customer furnished filters

Mechanical dimension for Customer Furnished Filters:

Group	Type	Housing	Aperture [mm]	Standard filter sizes	
				for rectangular filters [mm]	for circular filters [mm]
Standard products	LIE-200 / LIE-201	TO18	ø2.3	2.65 +0.05/-0 x 2.65 +0.05/-0	ø3.3 ±0.1
	thickness range 0.70 ... 1.10 on request				
	LIE-202 / LIE-216	TO39	5.0 sq.	5.25 +0/-0.05 x 5.25 +0/-0.05 thickness range 0.70 ... 1.10 on request	ø6.5 ±0.1
	LIE-235 / LIE-241				
	LIE-245 / LIE-251				
	LIE-302 / LIE-316				
	LME-300 / LME-301				
	LME-302 / LME-316				
	LME-335 / LME-341				
	LME-345 / LME-351				
	LME-500 / LME-501				
	LME-502				
LME-541 / LME-551					
Extended Products	LIE-309 / LIE-329	TO8	ø9.5	not applicable	ø10.0 ±0.1
	LIE-312 / LIE-312f	TO39	ø5.0	5.25 +0/-0.05 x 5.25 +0/-0.05 thickness range 0.70 ... 1.10 on request	ø6.5 ±0.1
	LIE-332 / LIE-332f				
	LME-337 / LME-353		5.0 sq.		
	LME-392 / LME-553				
Multi-color Products	LIM-011 / LIM-012	TO8	ø4.0	channel filter: 2.70 +0/-0.1 x 2.00 +0.05/-0.1 aperture window: 5.25 +0/-0.05 x 5.25 +0/-0.05	channel filter: not applicable aperture window: ø6.5 ±0.1
	LIM-032	TO39	5.0 sq.		
	LIM-052 / LIM-054	TO8	ø4.0		
	LIM-112 / LIM-212 / LIM-312	TO8	ø3.5	4.20 ±0.1 x 4.20 ±0.1	not applicable
	LIM-114 / LIM-214 / LIM-314				
	LIM-122 / LIM-222	TO39	2.7x1.8	3.50 ±0.1 x 2.50 ±0.1	
	LIM-162 / LIM-262				
LMM-242 / LMM-244	TO8	ø3.5	4.20 ±0.1 x 4.20 ±0.1		

Standard thickness for all filters: **0.60**±0.1/-0.2 mm

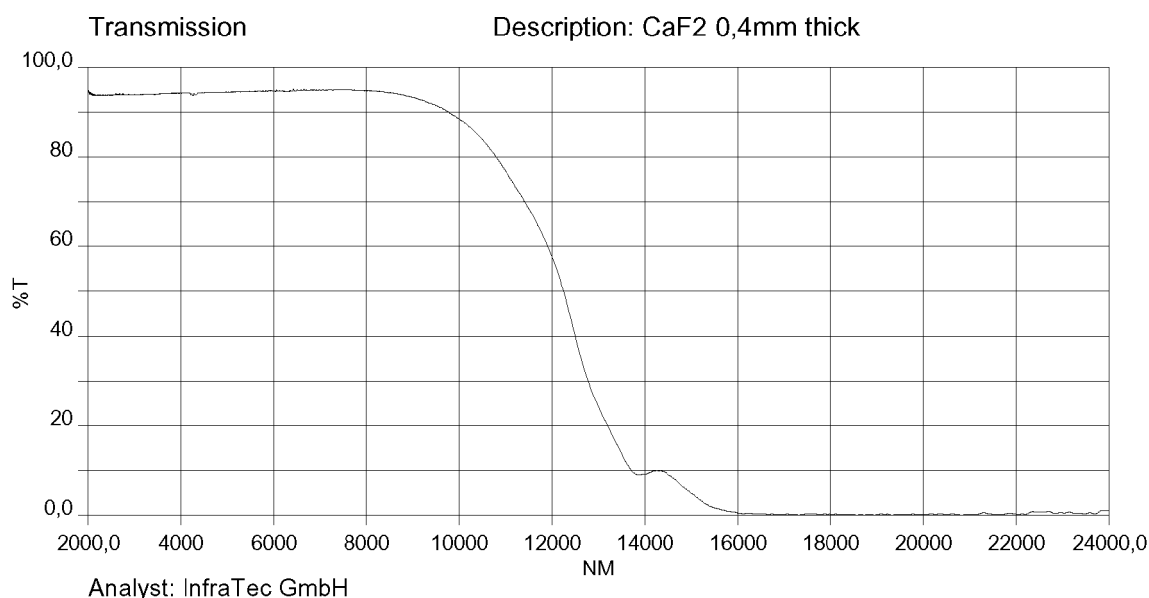
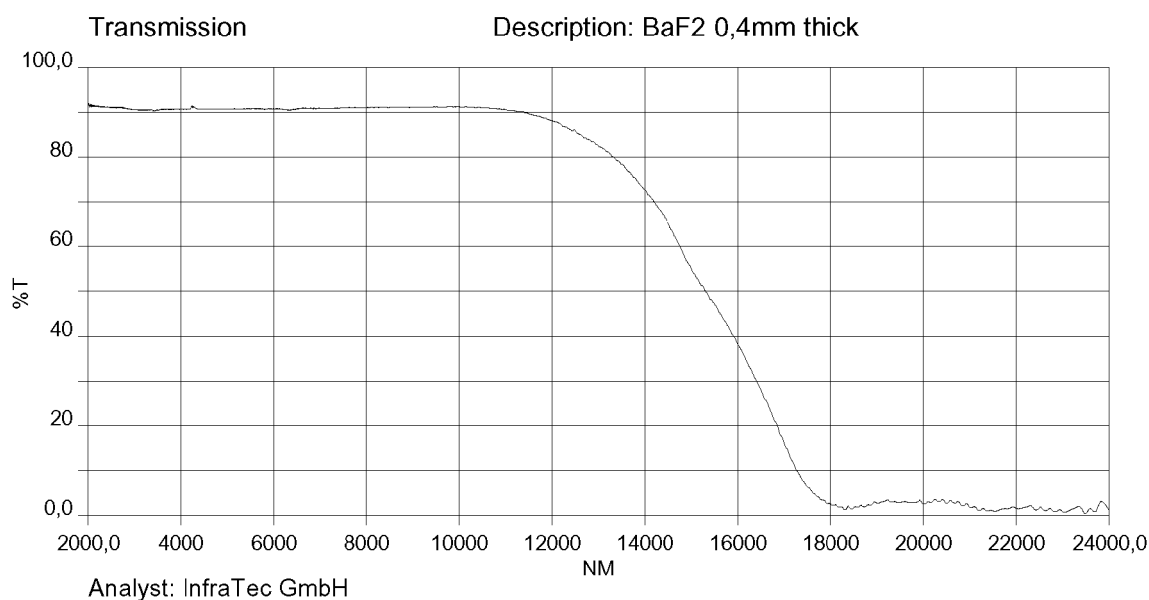
Please ask for using other filter sizes!

IR Filter and windows

Pyroelectric and Multi-spectral Detectors

Typical IR filters and windows plots

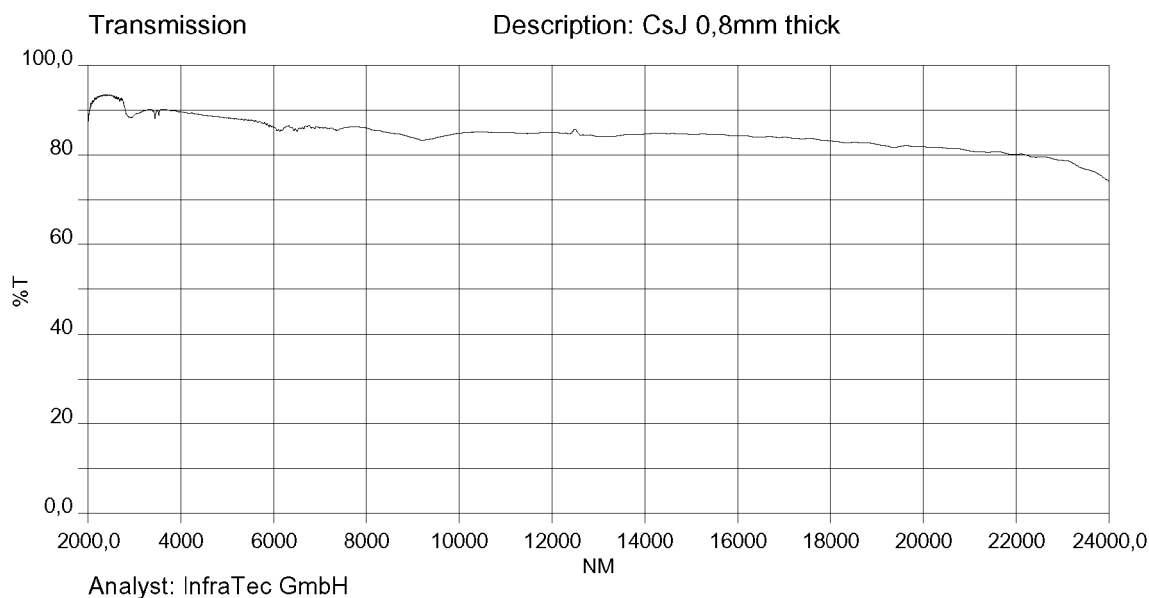
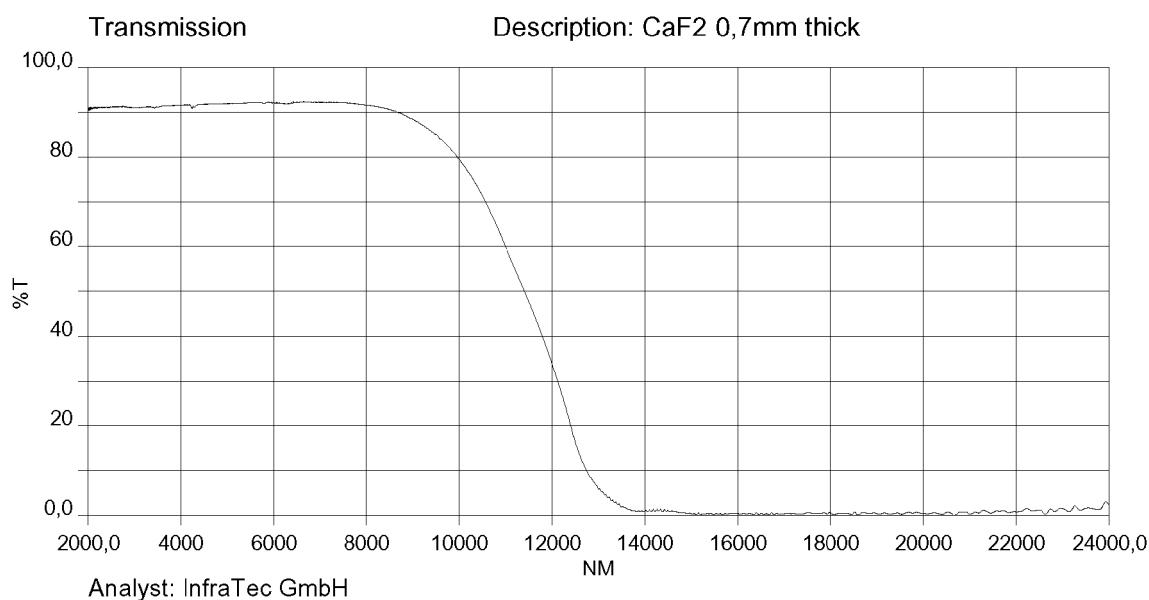
Standard crystal windows:



Pyroelectric and Multi-spectral Detectors

Typical IR filters and windows plots

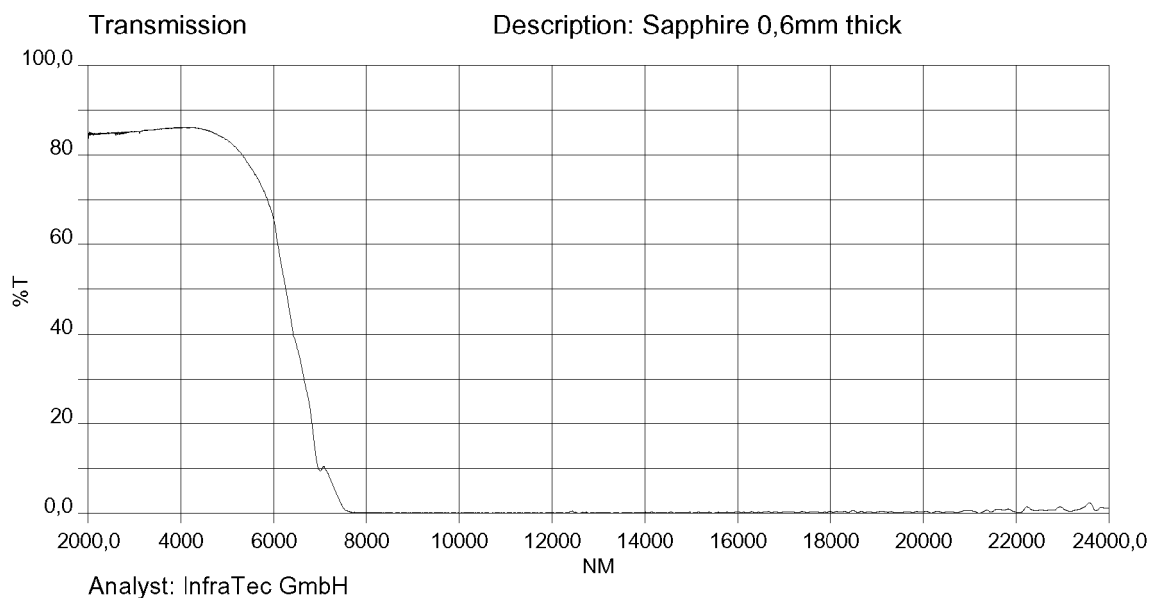
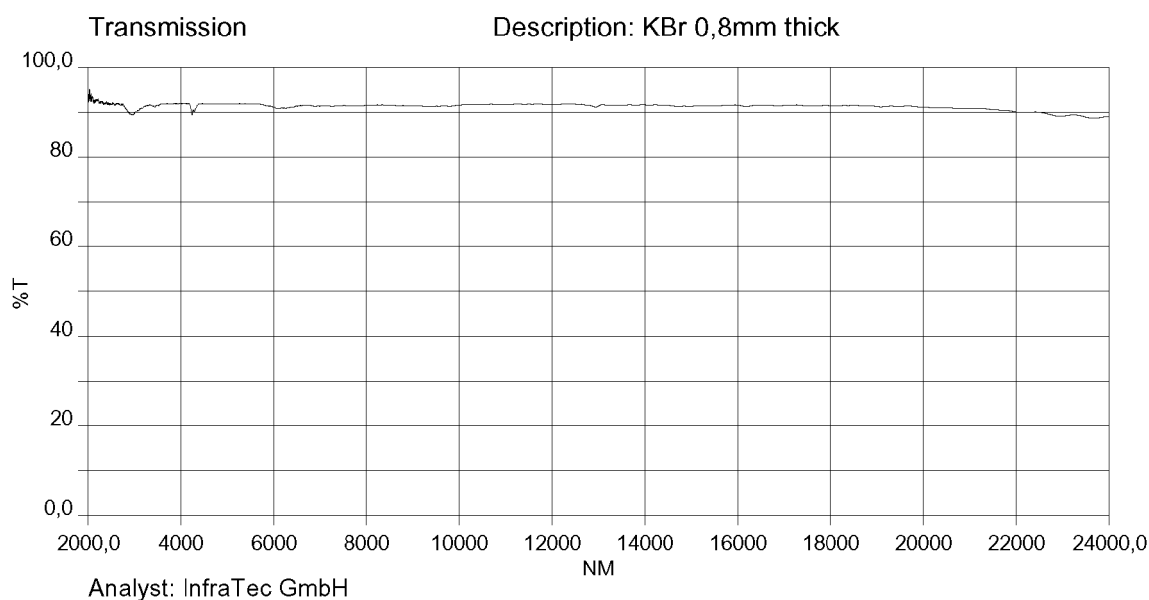
Standard crystal windows:



Pyroelectric and Multi-spectral Detectors

Typical IR filters and windows plots

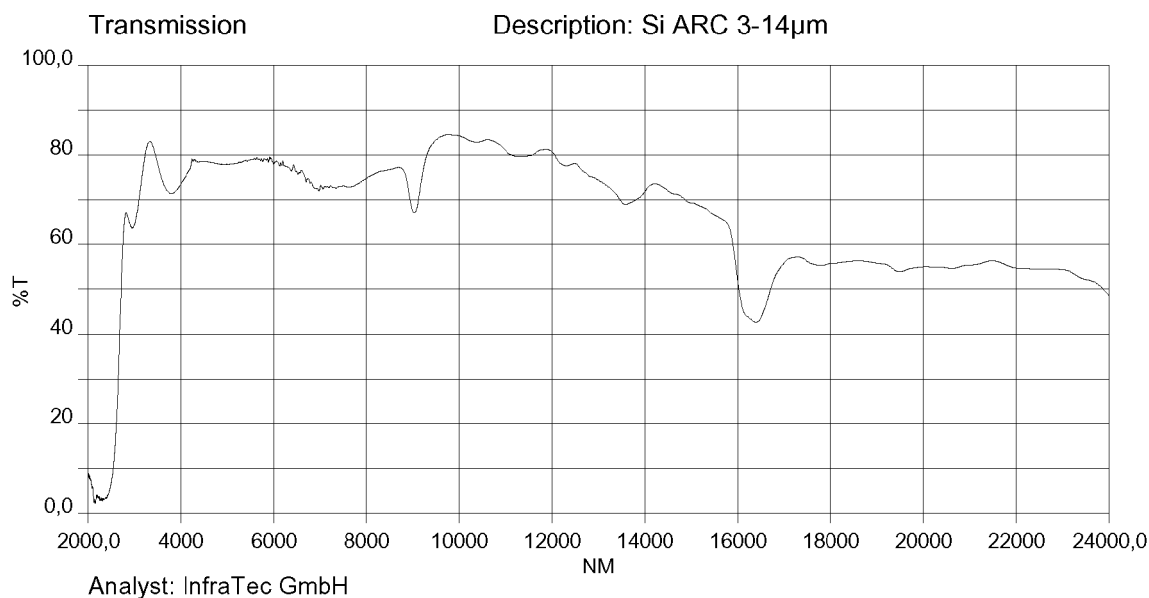
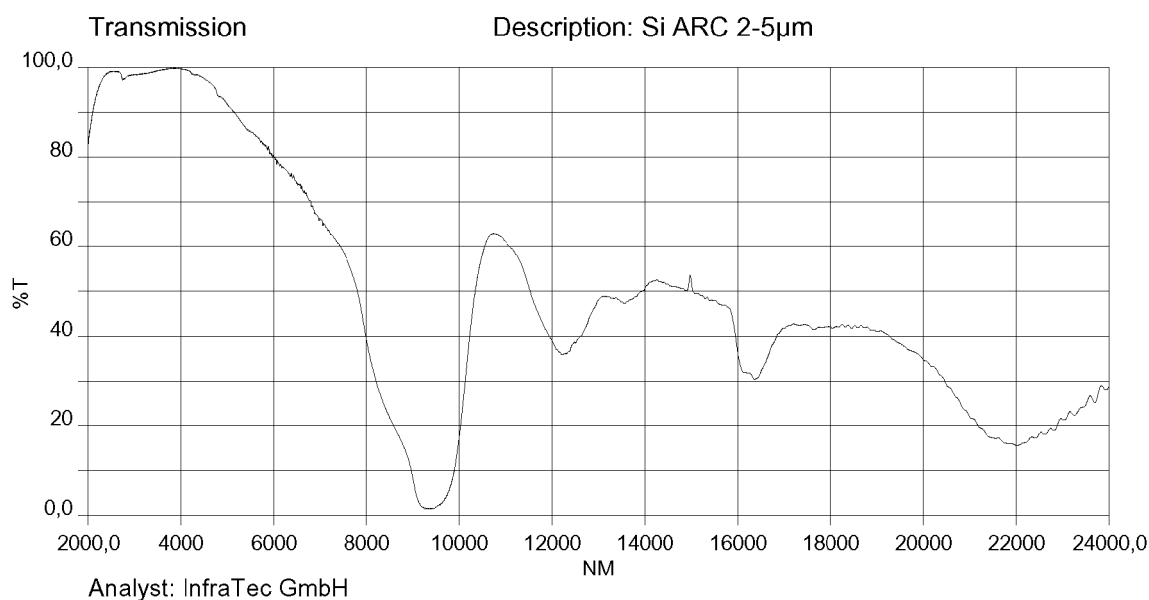
Standard crystal windows:



Pyroelectric and Multi-spectral Detectors

Typical IR filters and windows plots

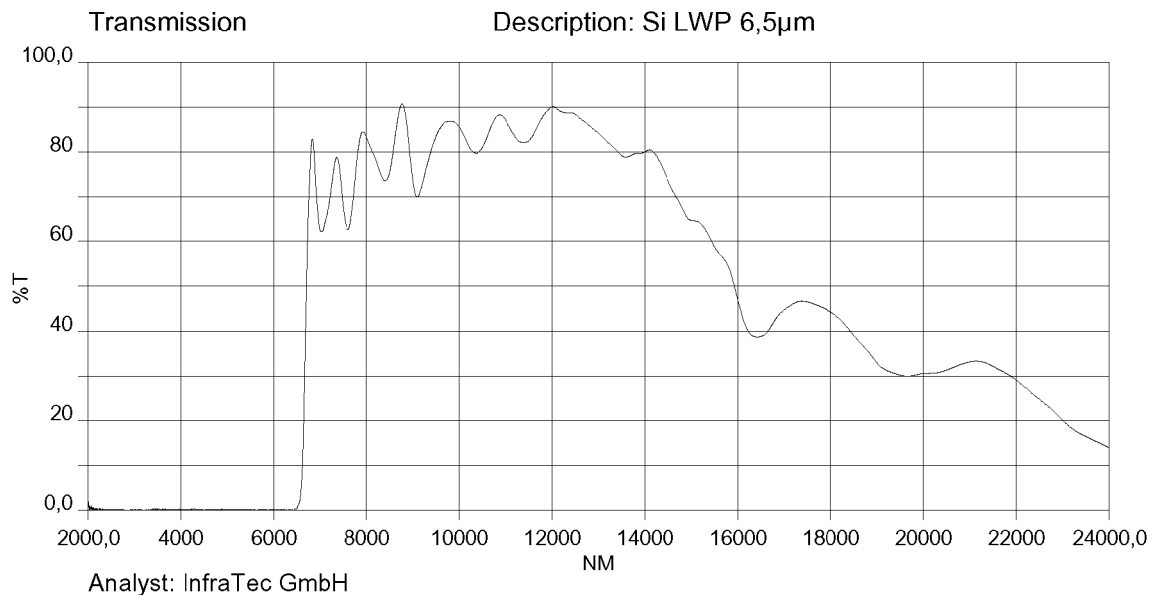
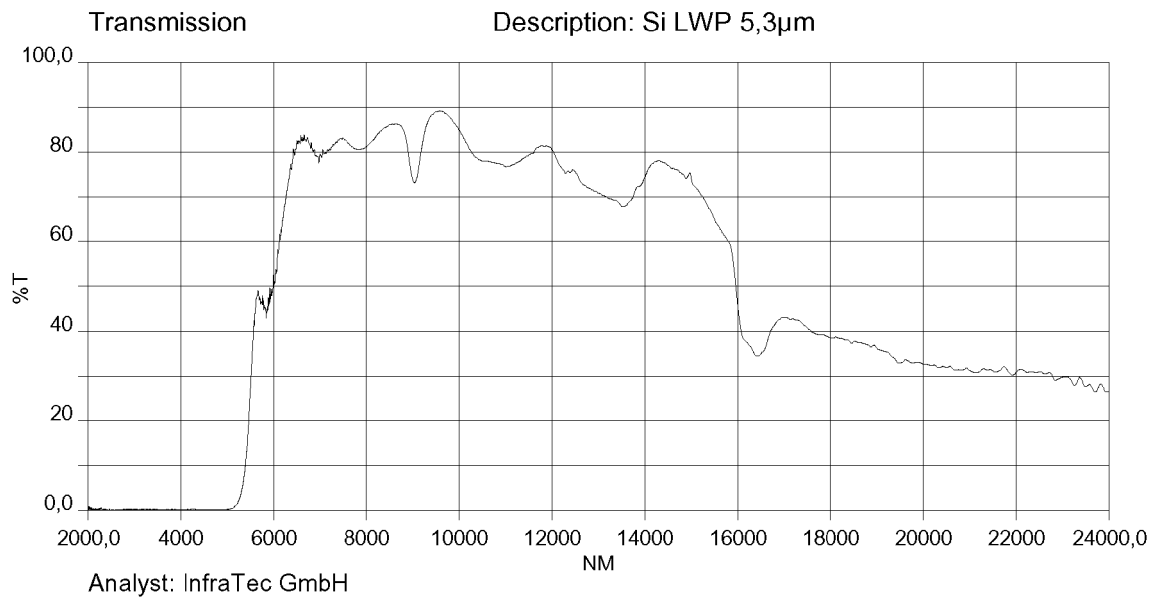
Standard silicon windows:



Pyroelectric and Multi-spectral Detectors

Typical IR filters and windows plots

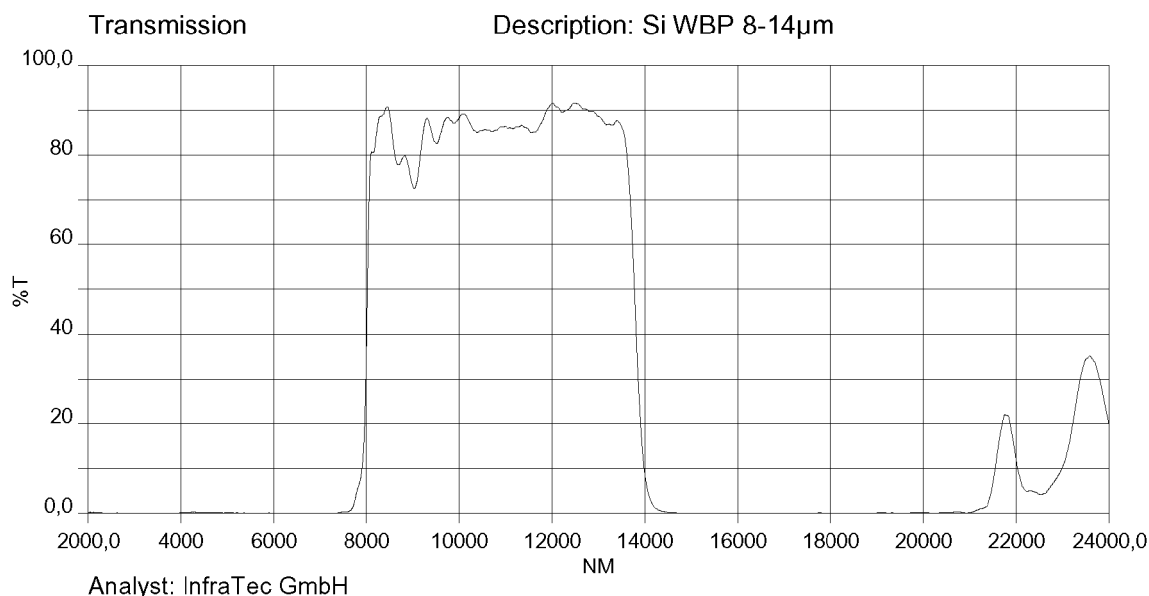
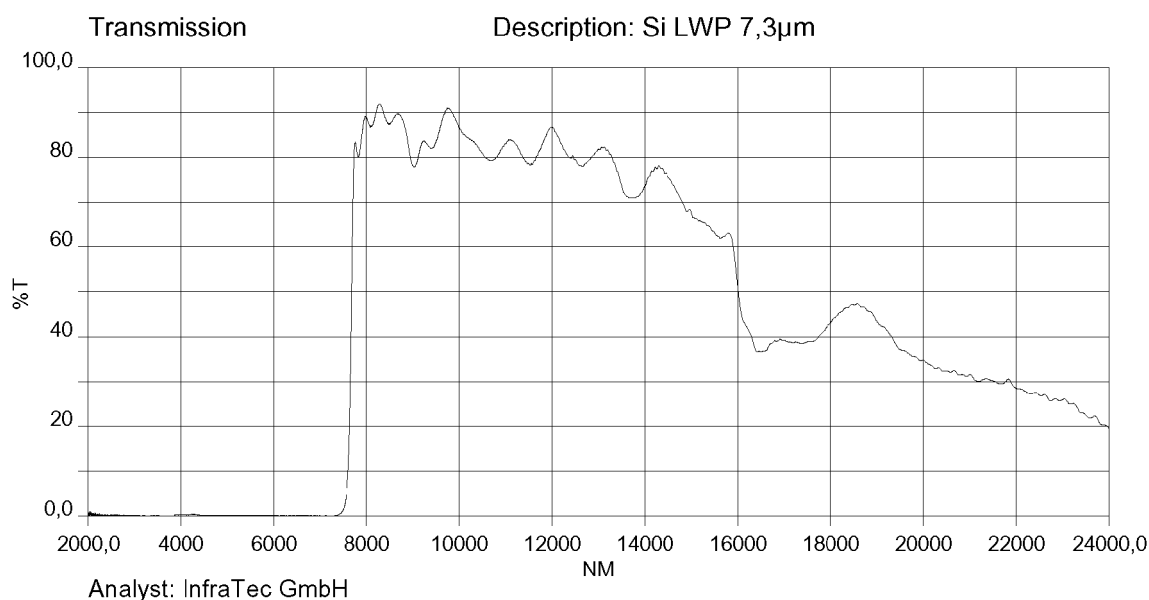
Standard silicon windows:



Pyroelectric and Multi-spectral Detectors

Typical IR filters and windows plots

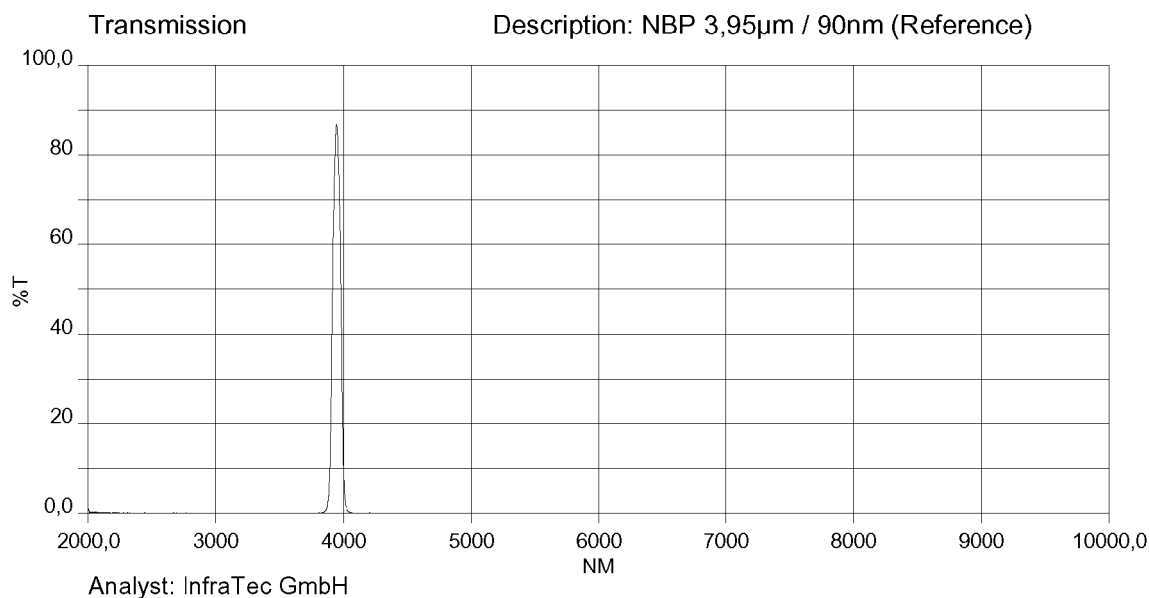
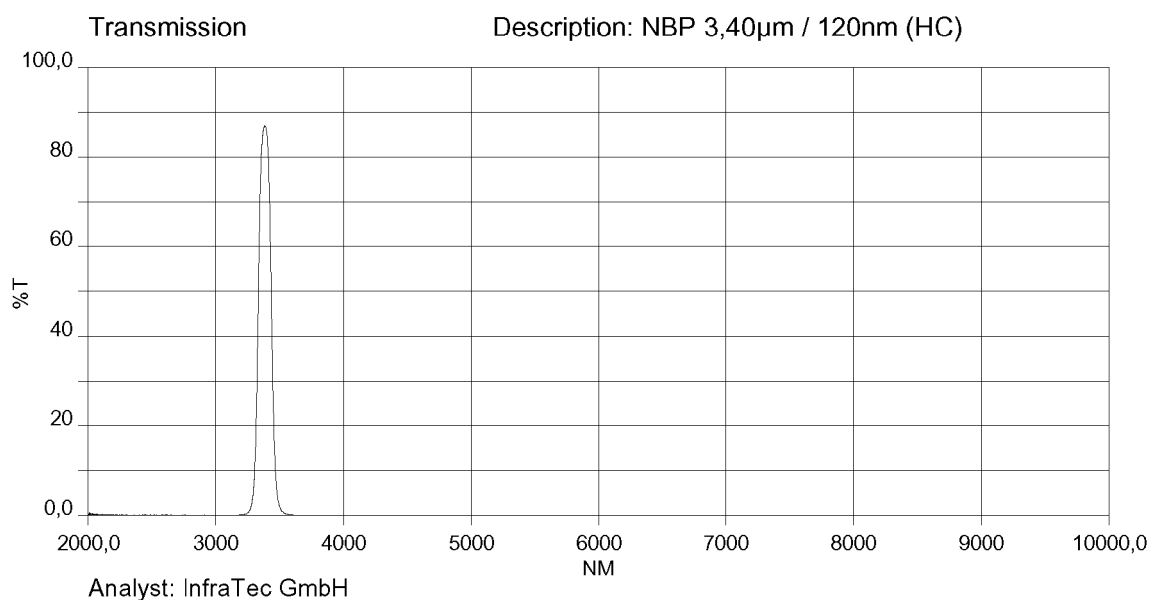
Standard silicon windows:



Pyroelectric and Multi-spectral Detectors

Typical IR filters and windows plots

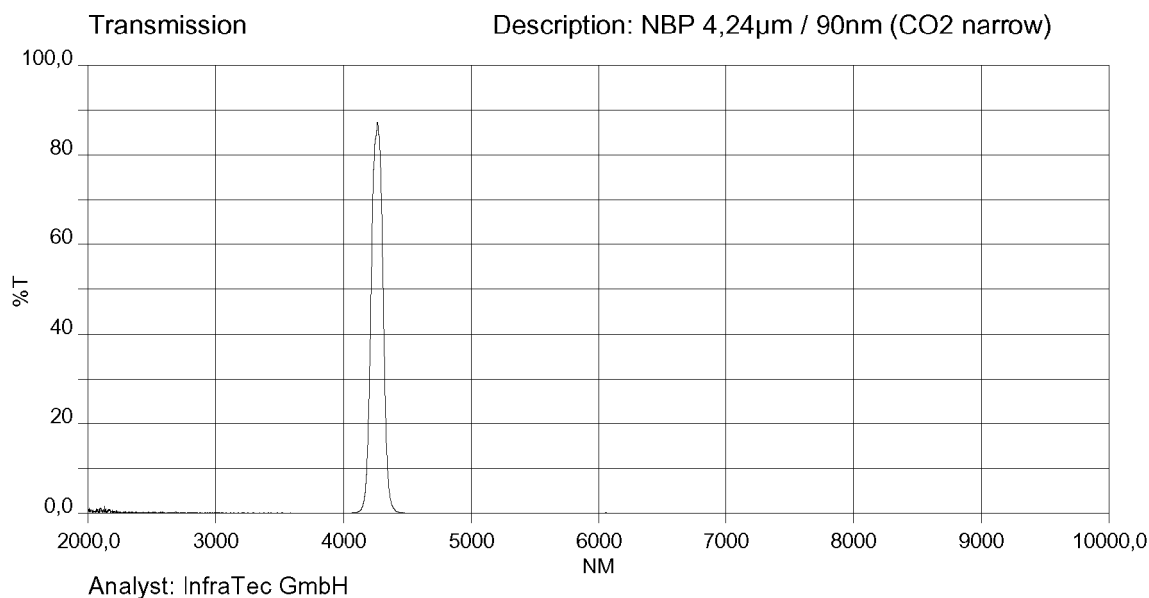
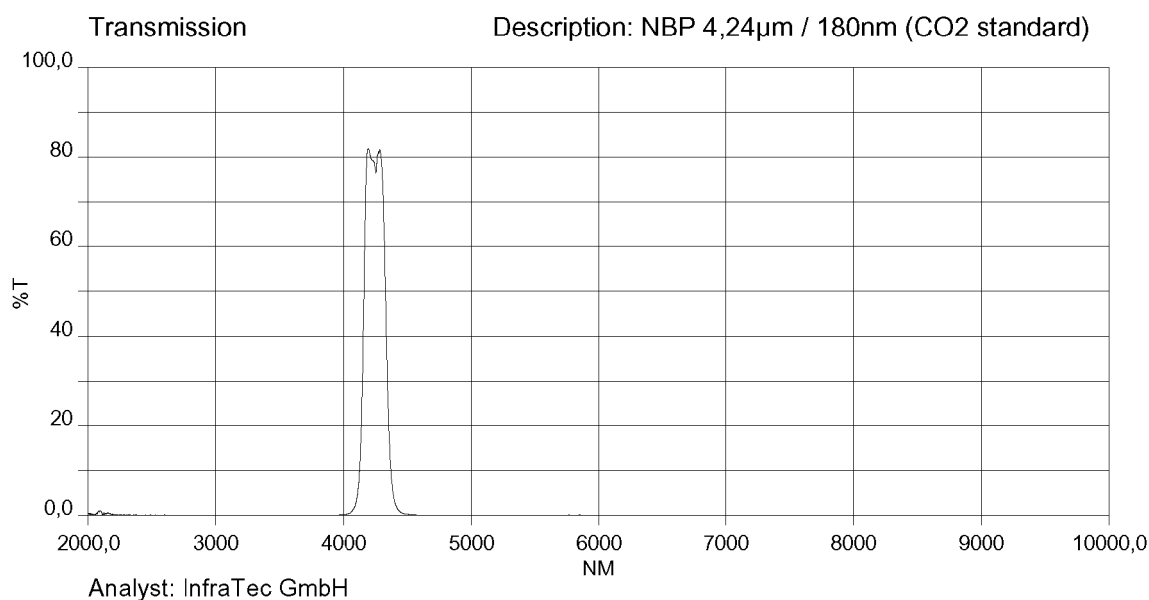
Standard narrow band pass filter (NBP):



Pyroelectric and Multi-spectral Detectors

Typical IR filters and windows plots

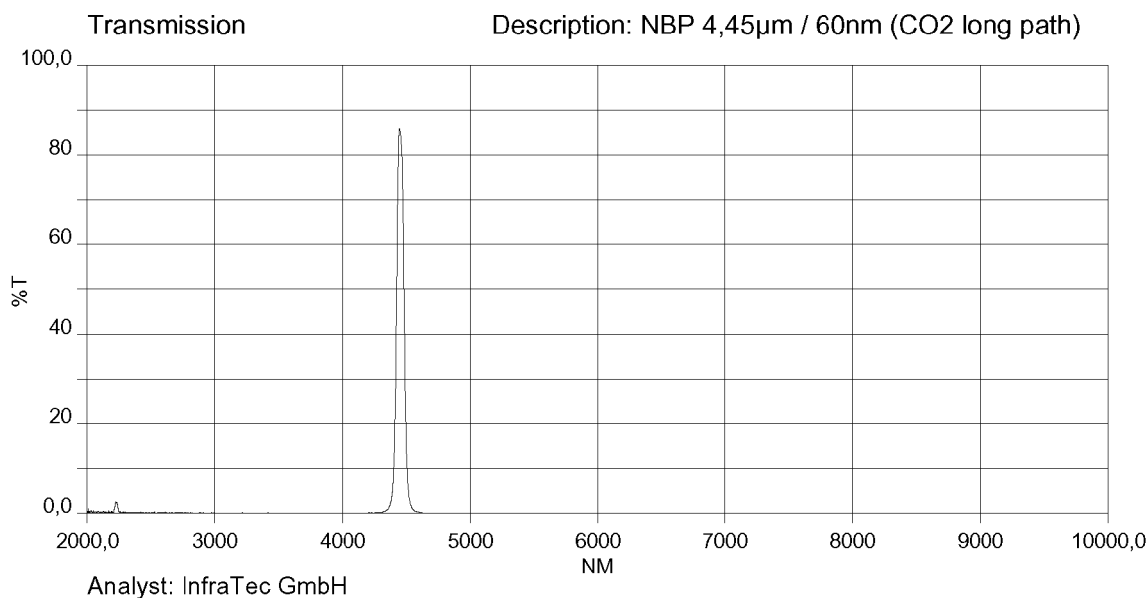
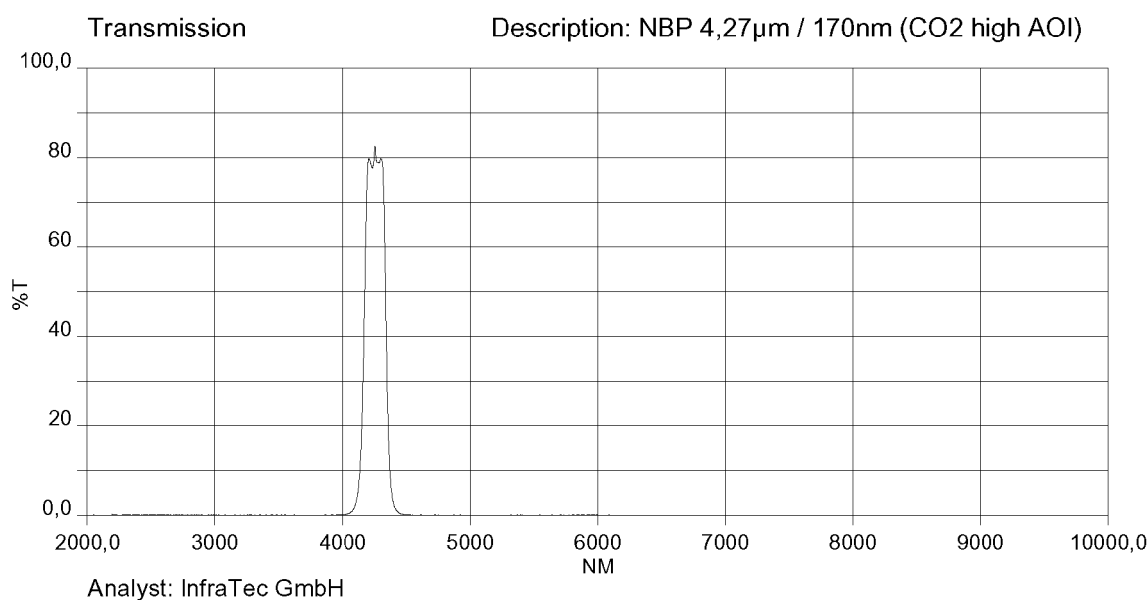
Standard narrow band pass filter (NBP):



Pyroelectric and Multi-spectral Detectors

Typical IR filters and windows plots

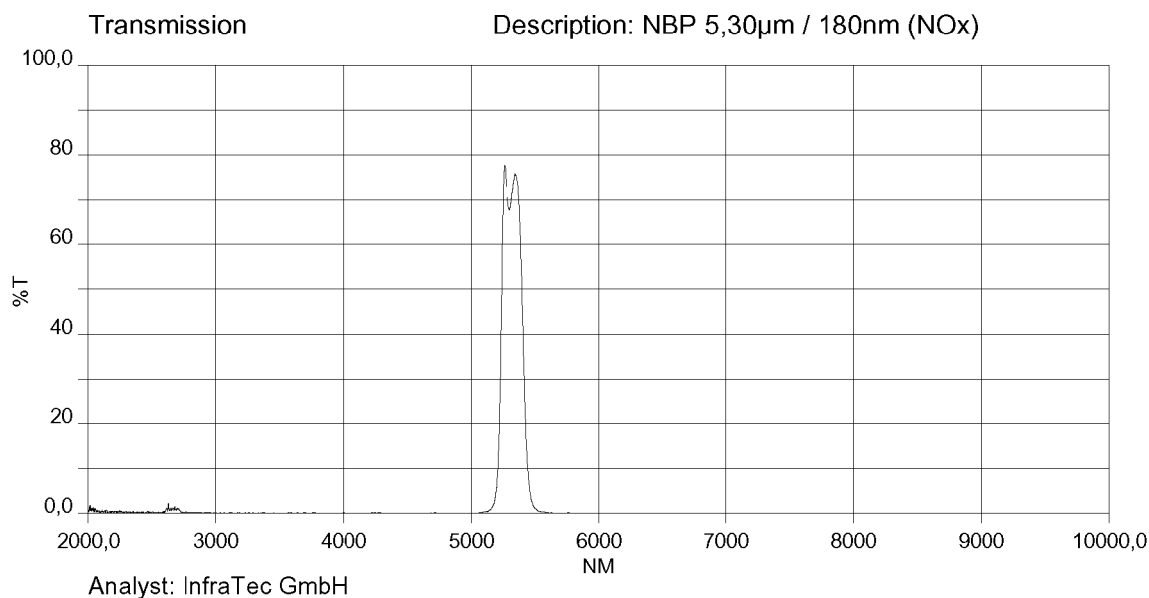
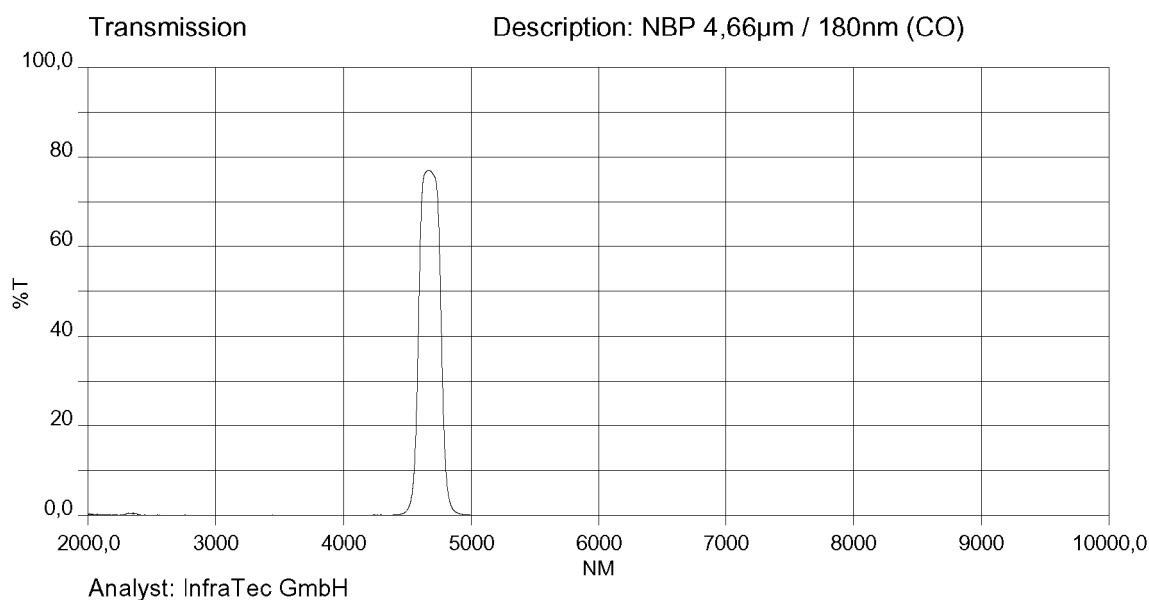
Standard narrow band pass filter (NBP):



Pyroelectric and Multi-spectral Detectors

Typical IR filters and windows plots

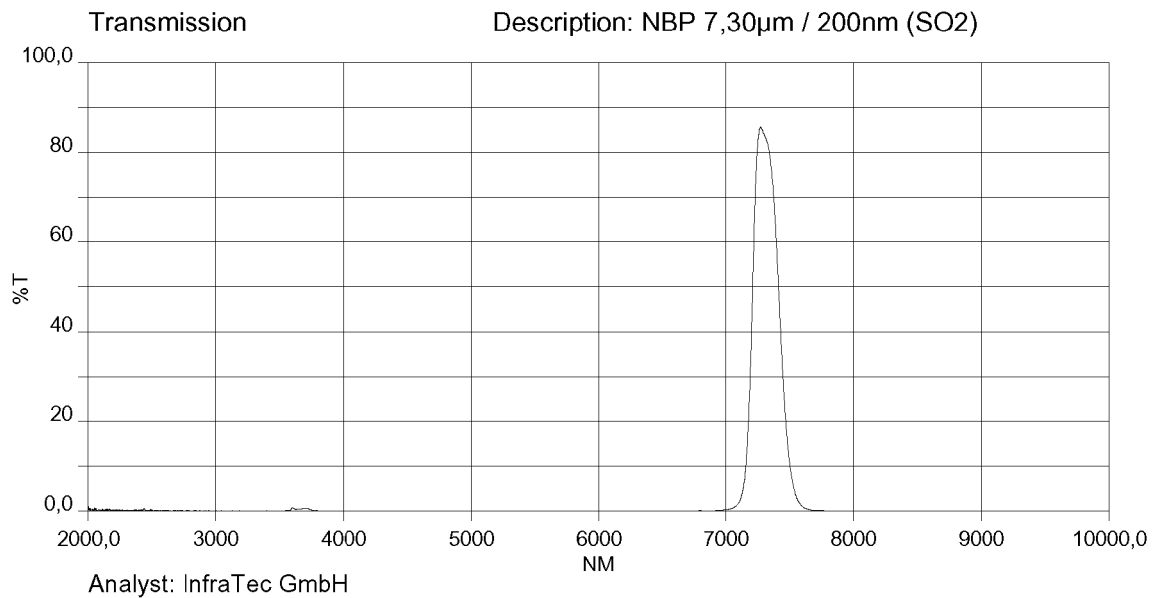
Standard narrow band pass filter (NBP):



Pyroelectric and Multi-spectral Detectors

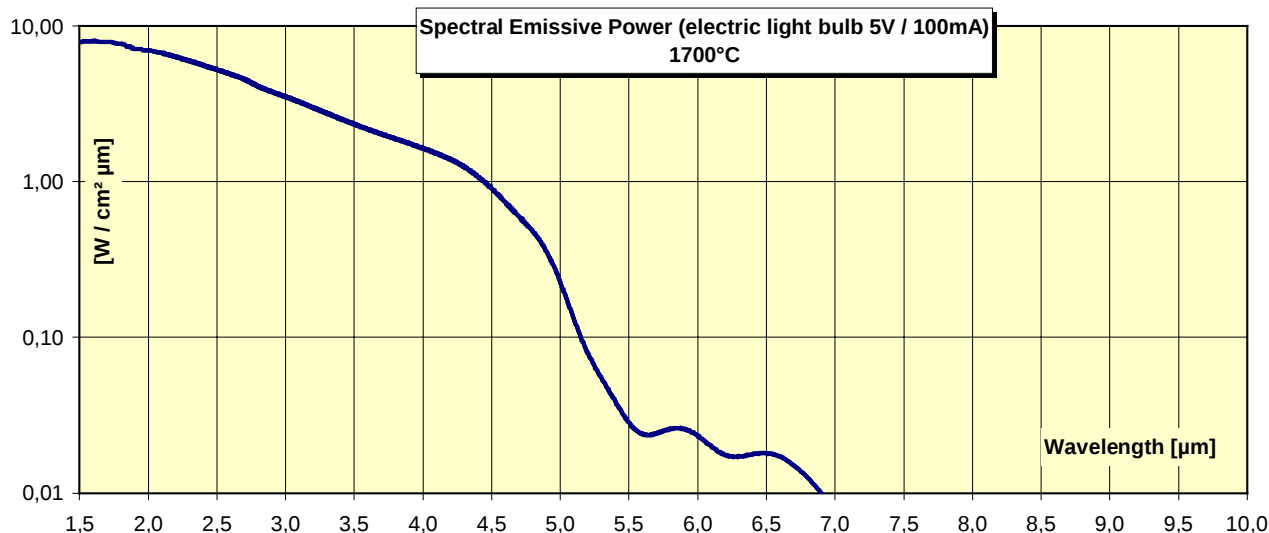
Typical IR filters and windows plots

Standard narrow band pass filter (NBP):



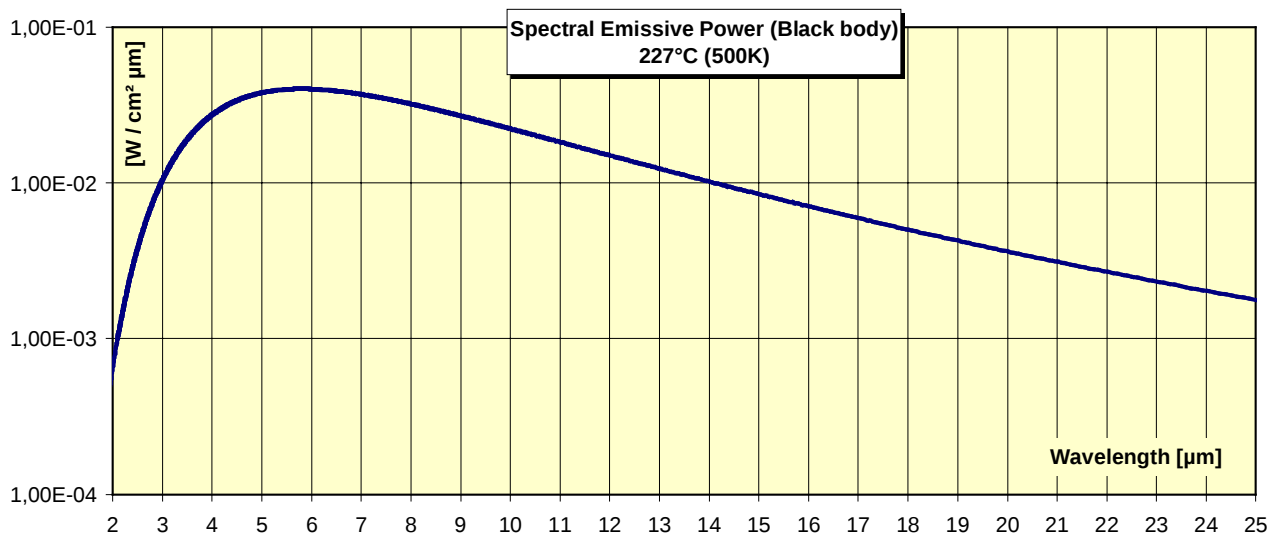
Pyroelectric and Multi-spectral Detectors

Spectral emission of IR sources

Fig.1 Spectral emissive power **M** of a micro lamp for gas analyzing instruments

$$M(4.0\mu\text{m}) = 1.65 \text{ W/cm}^2\mu\text{m}$$

$$M(10\mu\text{m}) = 0$$

Fig.2 Spectral emissive power **M** of a 227°C Black body

$$M(4.0\mu\text{m}) = 27.4 \text{ mW/cm}^2\mu\text{m}$$

$$M(10\mu\text{m}) = 22.3 \text{ mW/cm}^2\mu\text{m}$$

Pyroelectric and Multi-spectral Detectors

Spectral emission of IR sources

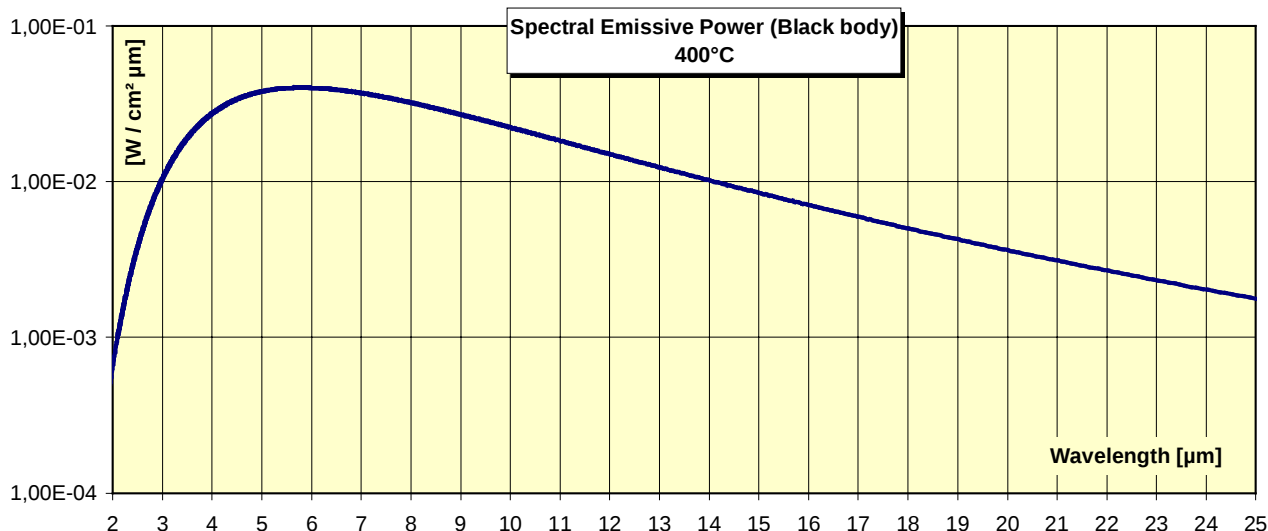


Fig.3 Spectral emissive power **M** of a 400°C Black body

$$M(4.0\mu\text{m}) = 175 \text{ mW/cm}^2\mu\text{m}$$

$$M(10\mu\text{m}) = 50 \text{ mW/cm}^2\mu\text{m}$$

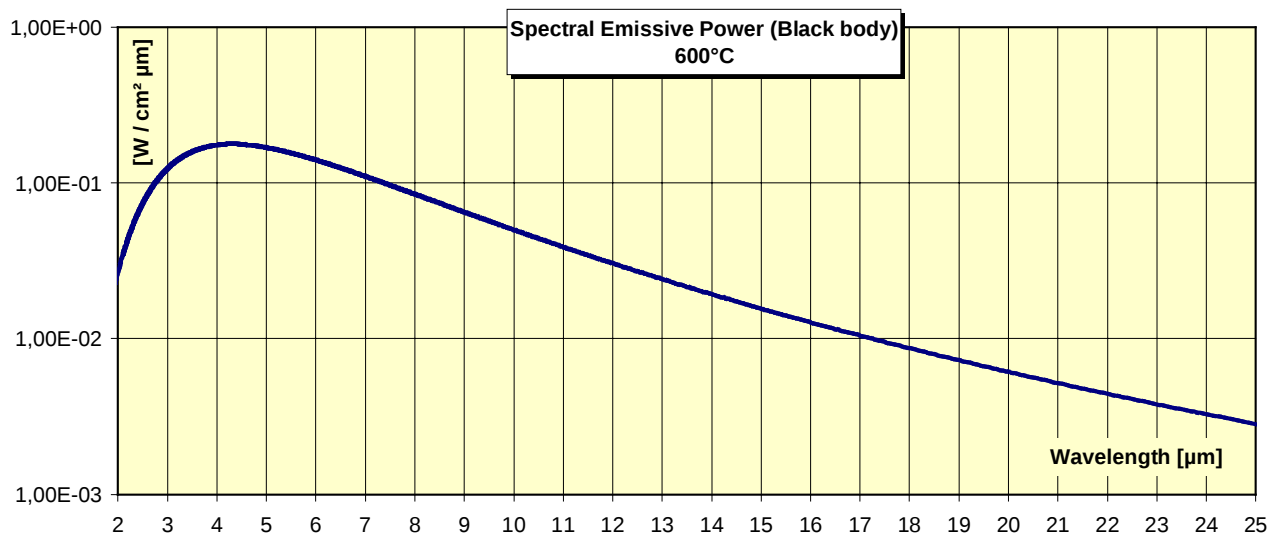


Fig.4 Spectral emissive power **M** of a 600°C Black body

$$M(4.0\mu\text{m}) = 604 \text{ mW/cm}^2\mu\text{m}$$

$$M(10\mu\text{m}) = 89.2 \text{ mW/cm}^2\mu\text{m}$$

InfraTec reserves the right to change these specifications at any time without notification!

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