DeXter RESEARCH CENTER

We're Everywhere
It Matters…

Blackbody Spectral Radiance

1. Blackbody radiance for three spectral regions*

$$L = \int_{\lambda_1}^{\lambda_2} \frac{C_1}{\pi\lambda^5} \bullet [e^{(C_2/\lambda T)} - 1]^{-1} d\lambda \quad W/cm^2 sr$$

L	-30	-20	-10	0	10	20	30	37	40	50	^oC
8-13µm	1.58	1.98	2.44	2.96	3.55	4.21	4.93	5.49	5.73	6.60	$\frac{mW}{cm^2 sr}$
7-15.5µm	2.6	3.2	3.9	4.7	5.6	6.6	7.7	8.6	8.9	10.3	
1.8-25µm	5	6	7	8	9	11	13	14	15	17	

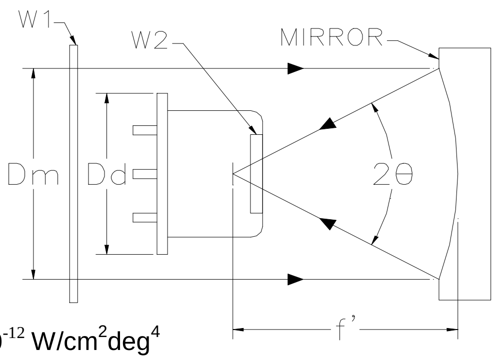
2. Differential blackbody radiance for three spectral regions*

$$\frac{\partial L}{\partial T} = \int_{\lambda_1}^{\lambda_2} \frac{C_1 C_2}{\pi\lambda^6 T^2} \bullet e^{(C_2/\lambda T)} \bullet [e^{(C_2/\lambda T)} - 1]^{-2} d\lambda \quad W/cm^2 sr\ ^oC$$

∂L/∂T	-30	-20	-10	0	10	20	30	37	40	50	^oC
8-13µm	36.9	42.9	49.1	55.6	62.4	69.3	76.3	81.3	83.5	90.7	$\frac{\mu W}{cm^2 sr\ ^oC}$
7-15.5µm	57	66	75	85	95	106	117	124	128	139	
1.8-25µm	90	103	116	131	148	165	184	198	204	226	

*$C_1 = 37{,}413\ W\mu m^4/cm^2$; $C_2 = 14{,}388\ \mu mK$; $T = 273 + {}^oC$

Detector Signal Calculation



Power On Detector: $\Delta\Phi = \tau_0\tau_1\tau_2\rho(\Delta L)\pi SIN^2\theta Ad$ Watts

$\theta \approx TAN^{-1}\left(\frac{Dm}{2f'}\right)$; $\quad \Delta L = \frac{4\sigma T^3 \Delta T}{\pi}$

Where:

$\tau_1\tau_2$ = Transmission of Windows W_1 & W_2 $\quad \sigma = 5.6686 \times 10^{-12}\ W/cm^2 deg^4$

$\tau_0 = 1 - \left(\frac{Dd}{Dm}\right)^2$ $\quad T = 273 + {}^oC$ (T in Kelvin)

ρ = Mirror Reflectance $\quad$ Ad = Detector Area in cm^2 $\quad \Re$ = Responsivity

Voltage from Detector: $\Delta V = \Re\ \Delta\Phi$ Volts

Signal to Noise Ratio: $(S/N) = \Re\ \Delta\Phi/N$; Where N = Amplifier & Detector Noise

Sensitivity:

$$\Delta T = \frac{N(S/N)}{\tau_0\tau_1\tau_2\rho(4\sigma T^3)(\Re\ Ad)SIN^2\theta}\ {}^oC$$

Dexter Research Center • 7300 Huron River Drive • Dexter, MI 48130 • www.DexterResearch.com • +1 734 426 3921