

# EUV Dose Measurement System

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AXUV and SXUV series silicon photodiode detectors made by International Radiation Detectors Inc. have been widely used by the EUV lithography community to measure EUV radiation intensity. In this work, electronics developed to measure the EUV radiation intensity is described.



# PA13: Multi-channel System for Pulse Energy Measurement

The PA13 system measures the EUV pulse energy incident on several AXUV/SXUV photodiodes.

The PA13 system contains 10 identical channels which include :

- (1) a preamplifier which amplifies the charge produced from the incident pulse on the photodiode,
- (2) a driver board which provides the power to drive the signal over long cables and
- (3) a sampler board that samples the pulse produced by the preamplifier and provides an output voltage proportional to the photogenerated charge.

Proper operation of the PA13 system can be verified by the self test feature which does not need the detector illumination.



# PA13 SPECIFICATION (22°C)

Parameter	Conditions	Min	Typ	Max	Units
Detector Bias Voltage		0	10	12	V
Minimum Charge Detection Limit	High Gain	-	1	2	pC
Full Scale Charge Detection Limit	High Gain		100	110	pC
Full Scale Charge Detection Limit	Low Gain		1000	1100	pC
Maximum Pulse Width	Low gain/High Gain	30	50/150	75/200	μs
Acceptable Source Sample Rate	All Gain ranges	10	1K	2K	Hz
Noise Figure	All bands (unsampled)	>8	16	64	nV/(Hz) <sup>1/2</sup>
Test Capacitors	Integral to each channel	9	10	11	pF
Max Sampled Output	High Gain, 100 pC test charge		10	10.5	V
Max Sampled Output	Low Gain, 100 pC test charge		1.2	1.4	V
Power Supply Input Voltage	50 – 60 Hz	120	220		V
Total System Operating Current	Per Channel (sampler, buffer and pre-amp)		120		mA
Preamp power Supply Current	V = +/- 12 V		3.75		mA
Buffer Power Supply Current	V = +/- 12 V		3.0		mA
Preamp Power Dissipation			45		mW
Buffer Power Dissipation			36		mW
System Operating Current	All 10 channels		1.2		A



# PA13A: EUV Power Meter

The PA13A is a self-contained EUV meter capable of measuring EUV pulses with average power of 0.1W – 5.0W. SXUV100mj photodiode installed on the vacuum chamber wall or on a water cooled copper plate is used with this meter.

The PA13A measures EUV power by integrating the photogenerated charge collected continually on a shot-by-shot basis. Total power is then calculated from the time average of this charge.

Measurements are reported in Watts or Joules. The PA13A is designed for 0.1 Hz To 7 kHz EUV pulses with ability to trigger either internally or externally. This external trigger mode is helpful in extremely noisy environments where low power measurements need to be made.

The PA13A contains a self-test feature which does not need any illumination on the SXUV100mj diode.



# PA13A Options

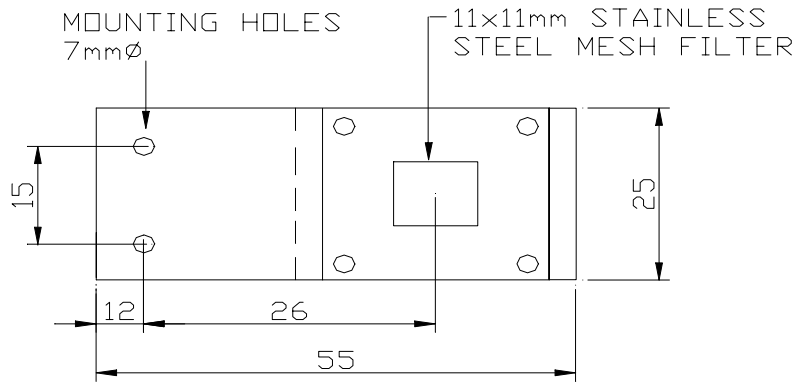
Model	Description	Notes
PA13A	Base model meter and readout	Readout is self-contained
PA13APP	Base model meter with additional Palm-Pilot based meter and graphics package	Meter readout is incorporated into palm pilot interface (Palm pilot is supplied)
PA13APC	Base model meter with additional windows-based PC meter and graphics package	Meter readout is incorporated into PC-based display (PC is user supplied)
(Base)-AO	Analog output option. Allows analog output to be supplied to chart equipment	Available with any base option

## PA13A Specifications (22°C)

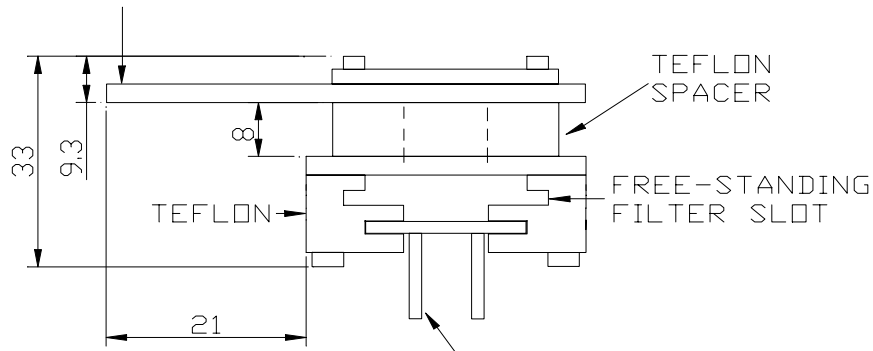
Parameter	Conditions	Minimum	Typical	Maximum	Units
Power Source	Supplied through an external adapter		+15/-15		VDC
Dynamic Range	Detector limits on a particular scale	1024:1	2048:1	4096:1	AU
Repetition rate	Any trigger, Int/ext Assume 100us data sample	0.1		7000	Hz
Power range	Assumes detector temperature is limited to 50 C	0.1		5	W
Charge detection range	Charge collected per shot	100		10000	pC
Detector Bias	Internal/external	10/10		12/150	V
Noise Figure	All bands (unsampled) Amplifier only	>8	16	64	nV/(Hz) <sup>1/2</sup>
Test Capacitors	Integral to each channel	95	100	105	pF



# SXUV100mj



Cu PLATE 3mm THICK, END USER TO MOUNT THIS PLATE ON A WATER COOLED PLATE OR ON THE VACUUM SYSTEM WALL



SXUV100 DETECTOR WITH DIRECTLY DEPOSITED FILTER

NOTE: ALL DIMENSIONS ARE IN mm

## SPECIFICATIONS (22°C)

Characteristics	
Sensitive Area (mm <sup>2</sup> )	100
Size (mm)	10 x 10
V <sub>b</sub> @1 $\mu$ A	>50 V
Capacitance @ 0V	<40 nF
Filter Transmission	>5 %
SS Grid Transmission	<1 %
Risetime ( 10-90 )	<10 $\mu$ Sec



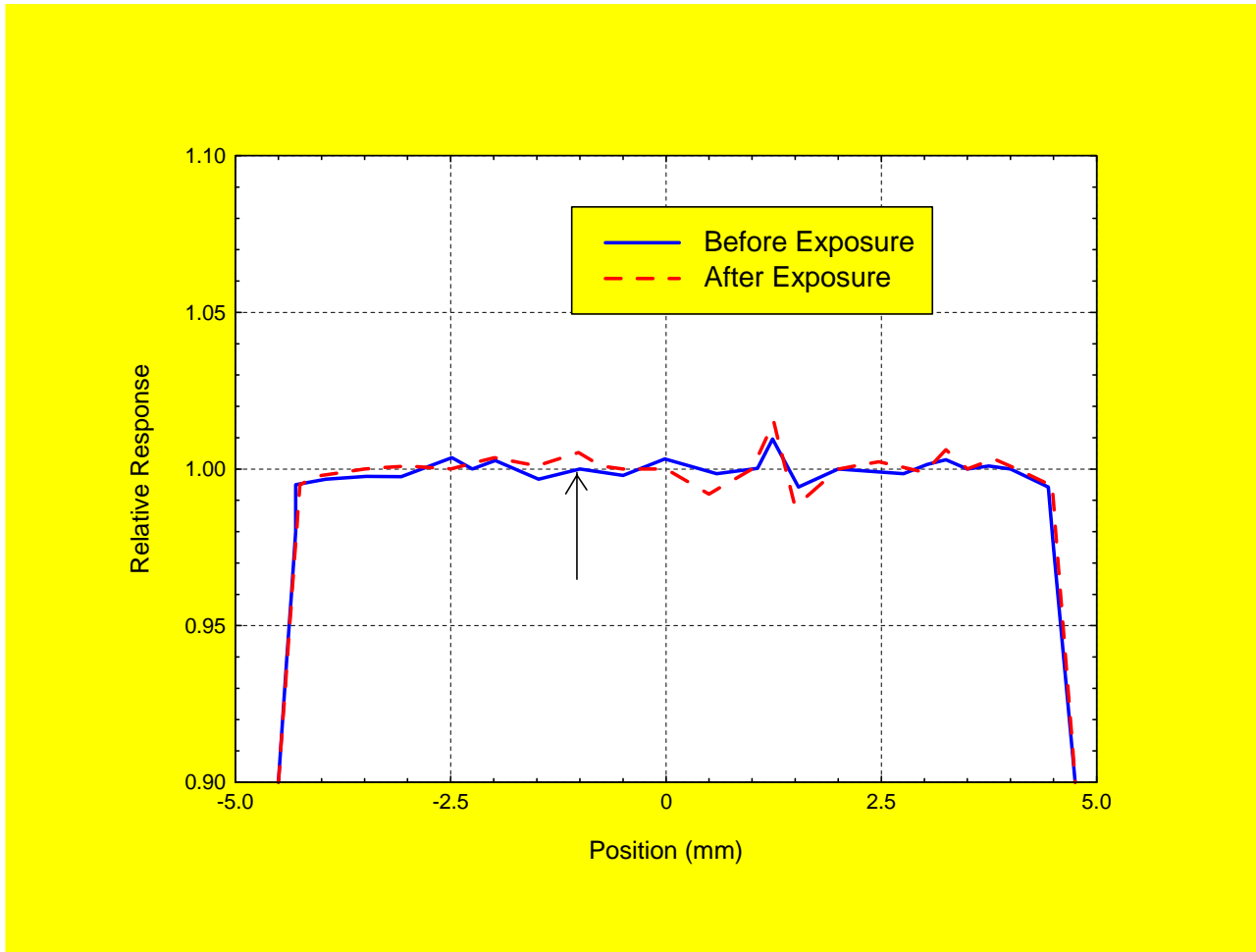


Figure: Line scan of the SXUV-100 diode with 12.4 nm beam before and after exposure to  $10^{22}$  photons/cm<sup>2</sup> 100eV photons



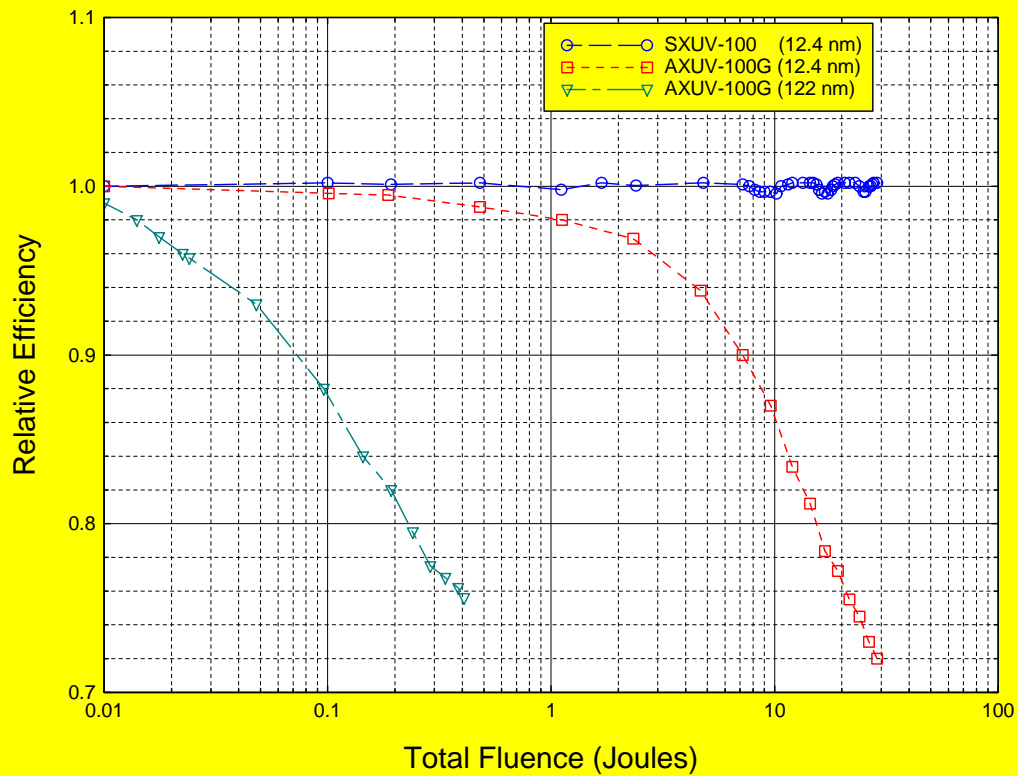


Figure: Relative responsivity of SXUV-100 and AXUV-100G photodiodes when exposed to 100eV and 10 eV photons



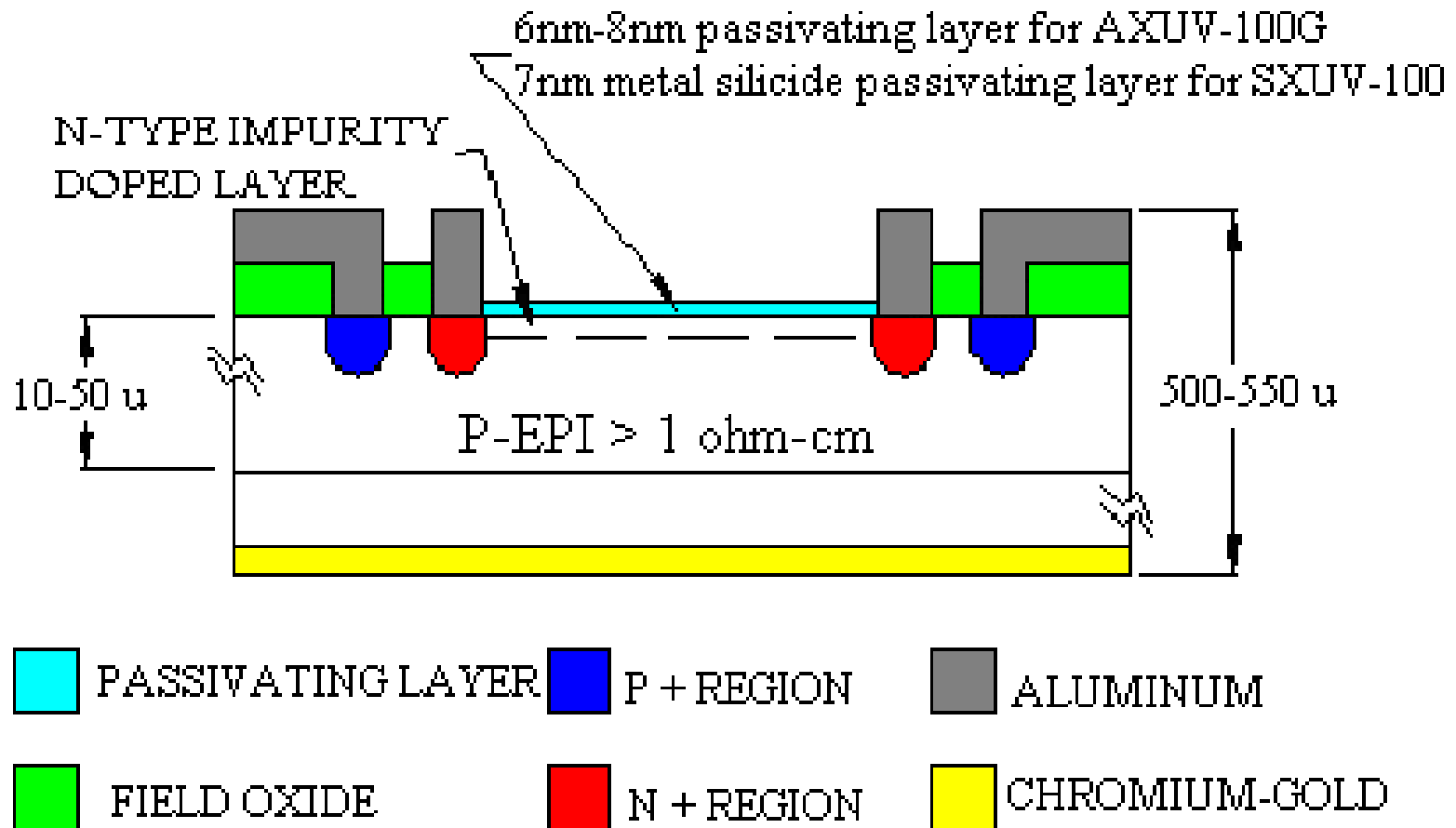


Figure: Structure of AXUV-100G and SXUV-100 photodiodes



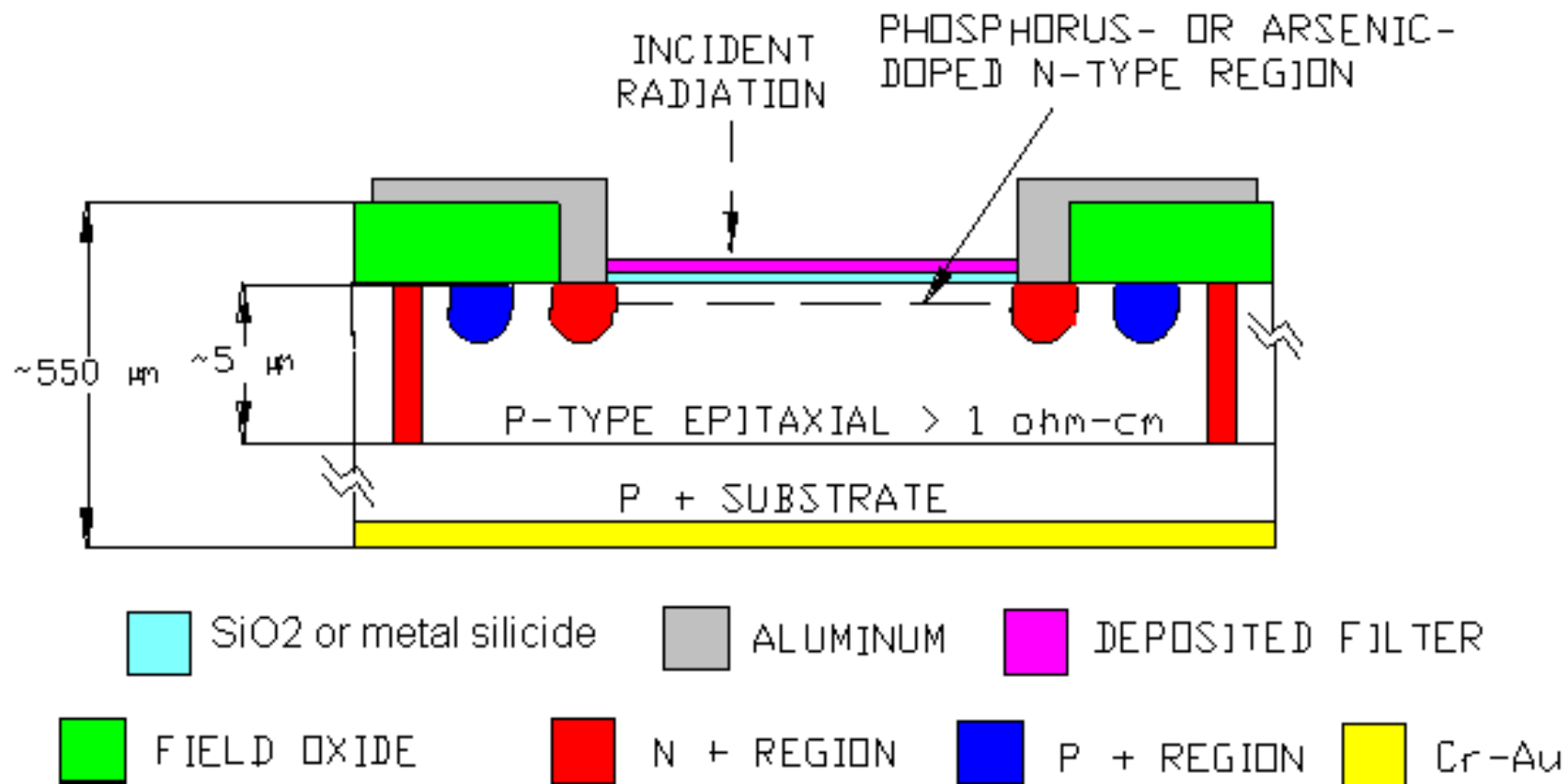


Figure: Structure of the AXUV/SXUV photodiode with directly deposited filter



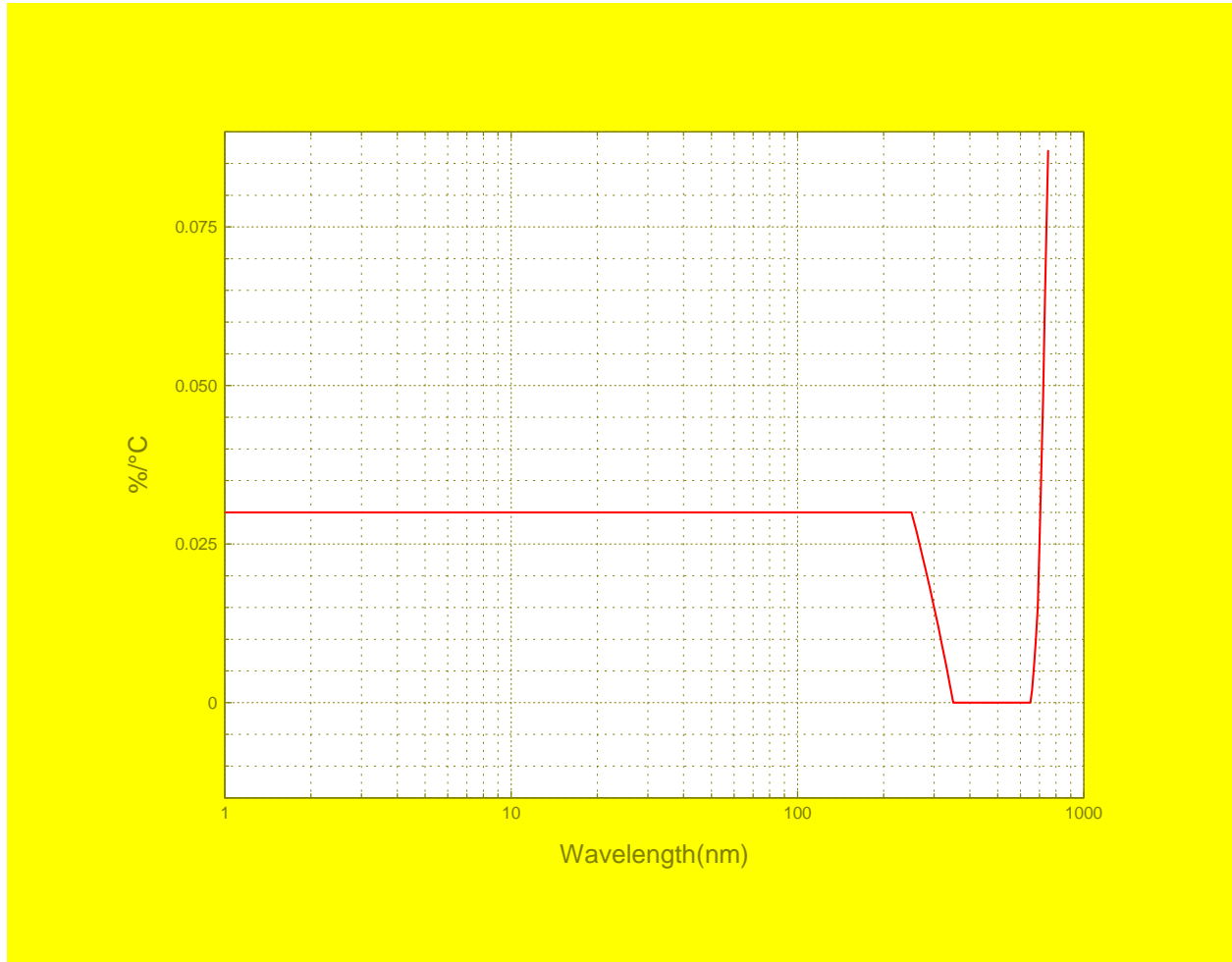


Figure: Change in the SXUV and AXUV photodiode responsivity with temperature

