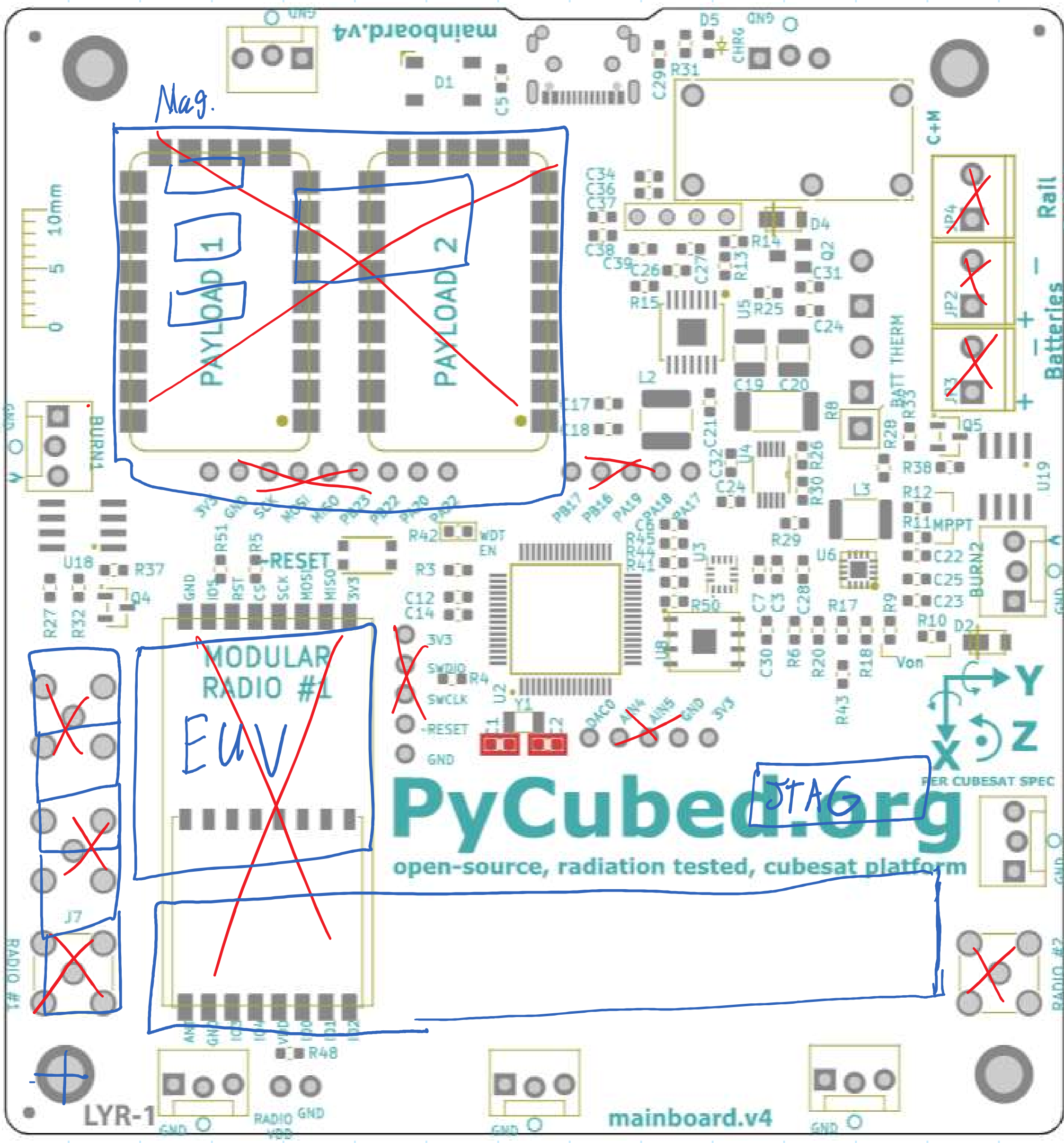
OWLSAT Flight Board Planning

Sunday, May 29, 2022 4:02 PM



KiCAD:

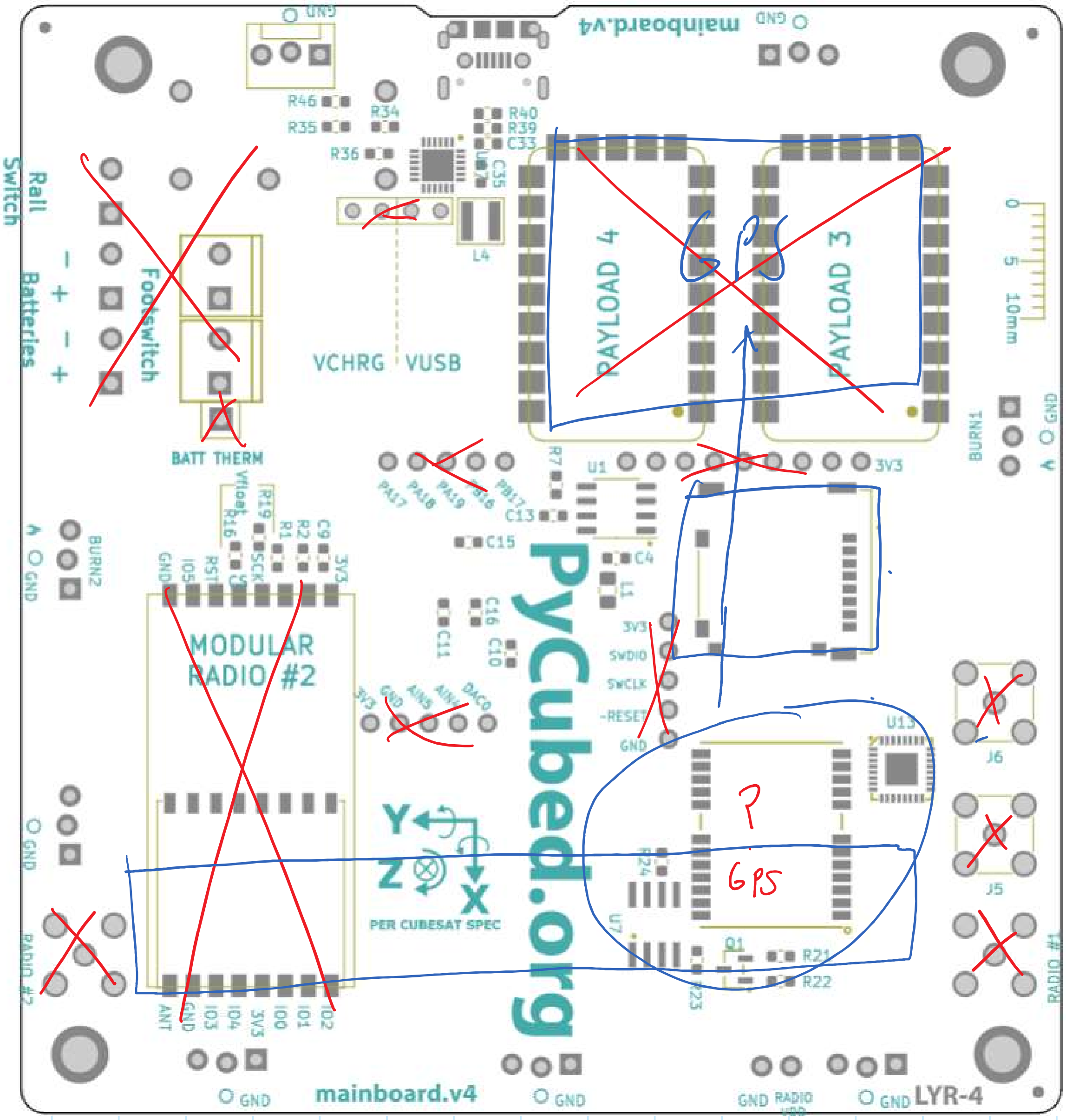
Pros:
- Already exists
- Most MPN in
- Design flow easy
- Davis familiar

Cons:
- difficult re-route
- Poor DRC
- BOM 100% manual
- Lack experience

Altium:*

Pros:
- easy re-route
- Robust DRC
- BOM automated

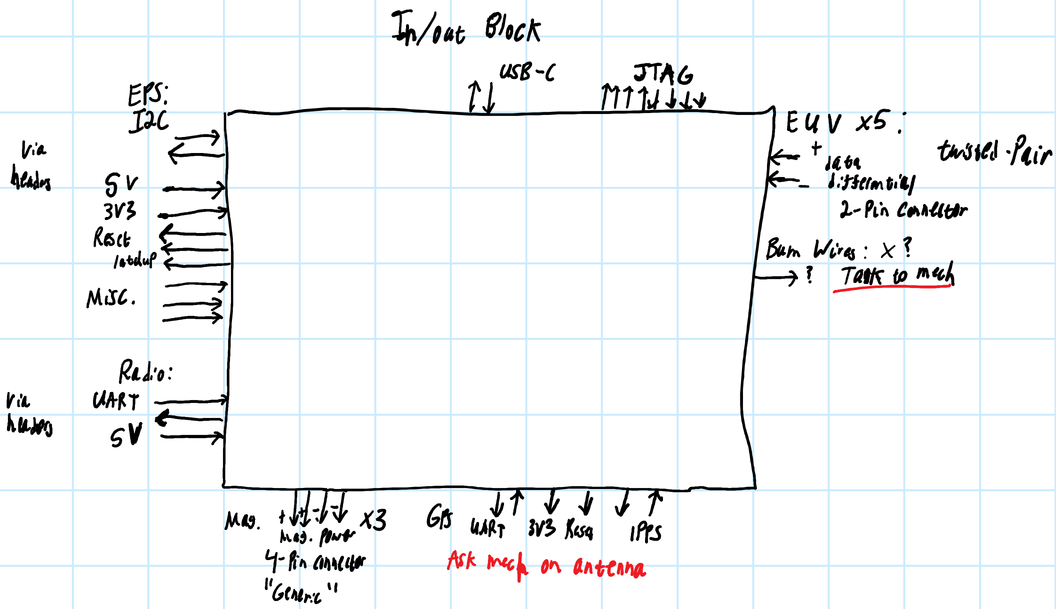
Cons:
- Manual BOM entry
- Learning curve


mainboard.v4
PAYLOAD 4
PAYLOAD 3
GPS
?
GPS
MODULAR RADIO #2
PyCubed.org
VCHRG VUSB
BATT THERM
Rail Switch
Batteries
Footswitch
PER CUBESAT SPEC
LYR-4

Block Diagram

Sunday, May 29, 2022 4:08 PM

- Solar ✓
- Mag. ✓
- EUV ✓
- Radio ✓
- EPS ✓



Pin width: 0.63mm

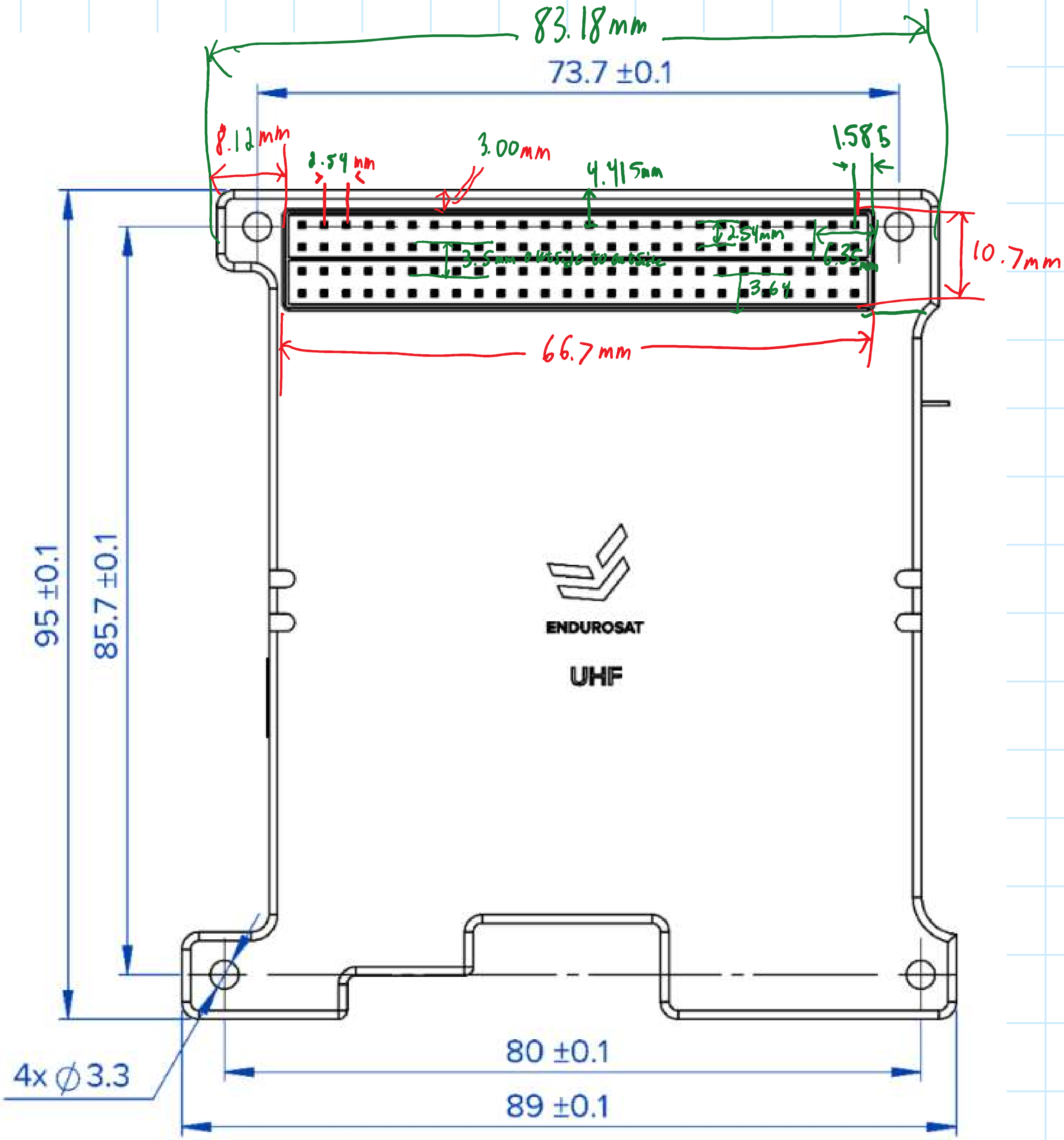


Figure 22: UHF Transceiver Type II - Top and S

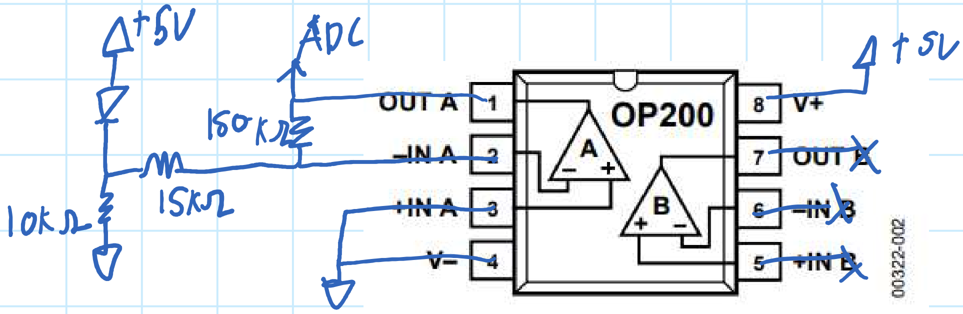


Figure 2. 8-Lead PDIP (P-Suffix)
8-Lead CERDIP (Z-Suffix)

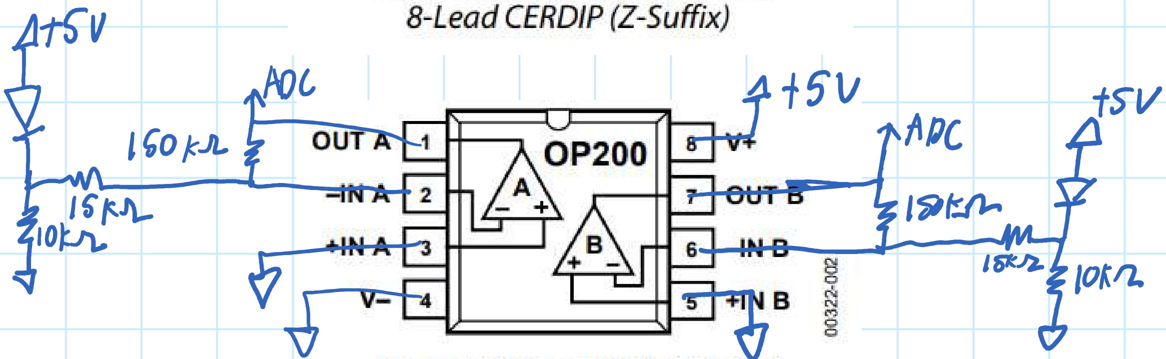
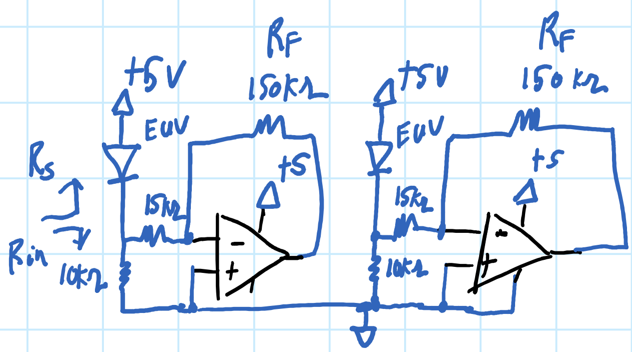


Figure 2. 8-Lead PDIP (P-Suffix)
8-Lead CERDIP (Z-Suffix)



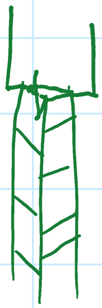
Input-Refered Gain Control

Probably not good.

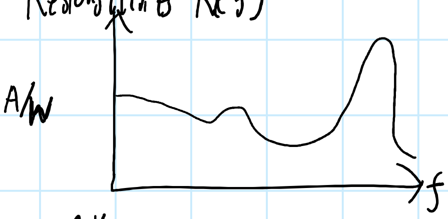
$A_v(R_F, R_{in}, R_s)$ is normal,

but here

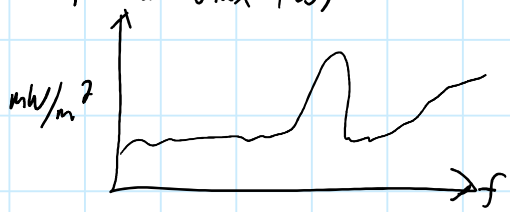
R_s(EUV), not constant!!



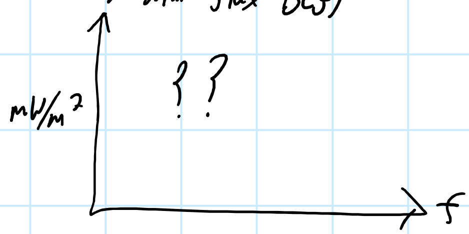
Responsivity R(f)

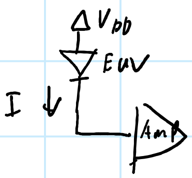


min solar flux F(f)

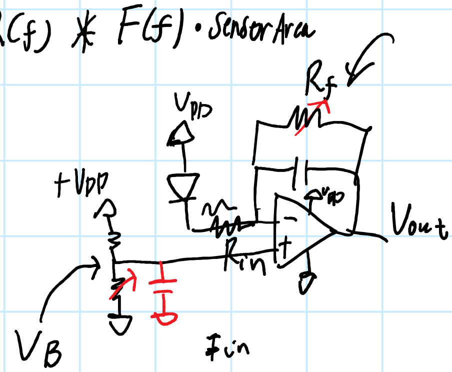


max solar flux B(f)

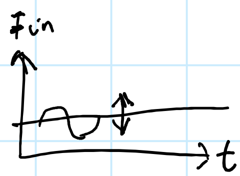


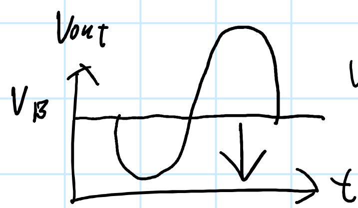


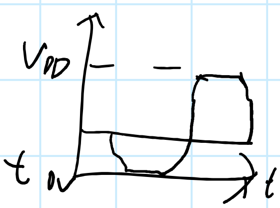
$I = R(f) * F(f) \cdot \text{SensorArea}$



$$A_v = -\frac{R_f}{R_{in}}$$

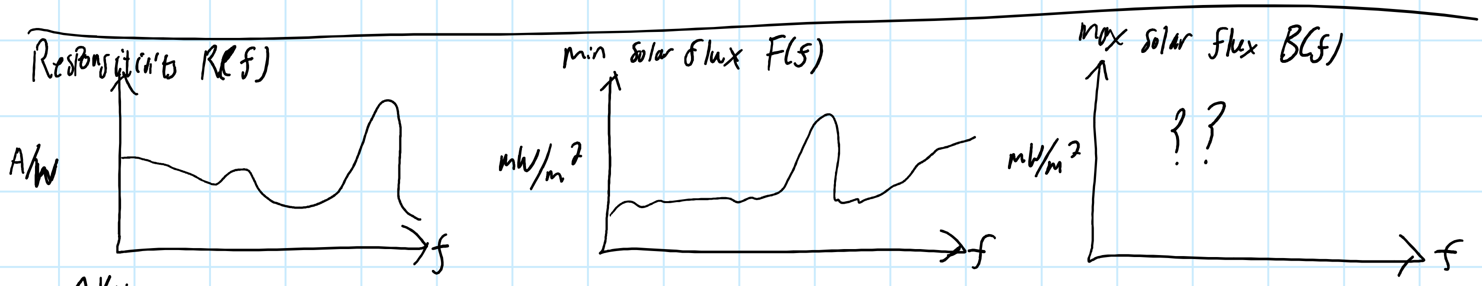


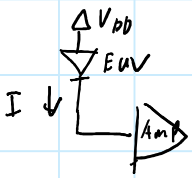




EUV Current Estimation

Sunday, October 2, 2022 7:48 PM





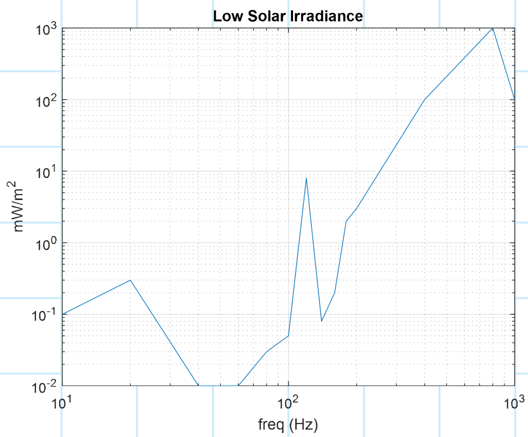
$I = R(f) * F(f) \cdot \text{SensorArea}$

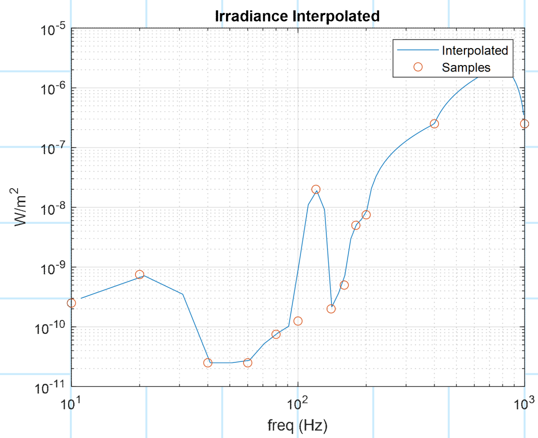
The EUV sensors are diodes that require a DC voltage supply at the cathode, which then modulates the through current in direct proportion to the spectrum incident to the sensor face. The responsivity graph provided in the datasheet describes the relationship between incident spectrum in watts to amperes of through current.

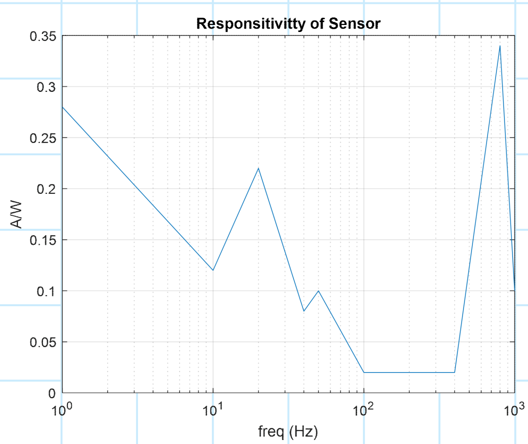
We have a plot of low solar flux conditions near LEO that shows the spectrum of the measured flux in milliwatts per area (m^2).

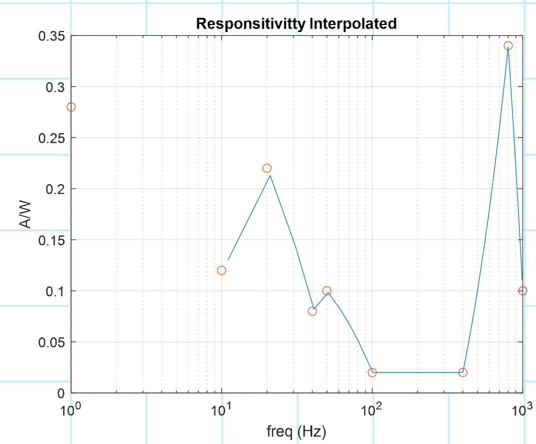
To find the through current of the sensor, convolved the solar flux spectrum, $F(f)$, multipled by the area of the sensor, A, with the responsitivitty spectrum, $R(f)$.

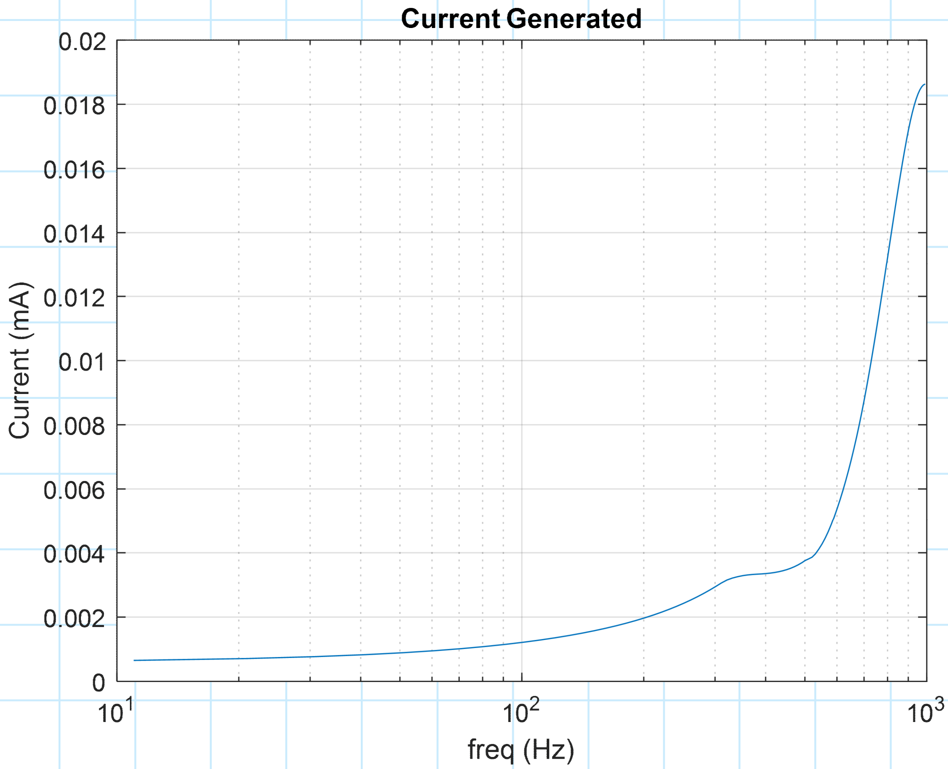
$I = R(f) * (A \cdot F(f))$











Total Current is the integral across the applied frequency band
Total Current = 6.56 mA
This represents the expected current without filters in low irradiance.

Investigating the SXUV5 Sensors

Sunday, October 2, 2022 11:47 PM

Lianne suggested I look at a research paper utilizing the SXUV5 sensor. She found one of the original tests of the device that was done at the Naval Research Laboratory. It showed that conditions have to be very controlled to get decent readings. https://ieeexplore-ieee-org.ezproxy.rice.edu/document/1580857
"
For the 3–88-nm wavelength measurements, the test silicon photodiodes were mounted in a vacuum chamber at the Naval Research Laboratory beamline X24C at the National Synchrotron Light Source. The photodiode under study was custom packaged to include an integrated temperature sensor to measure the photodiode temperature during the EUV measurements. The photodiode package was mounted on a support fixture that included a temperature controller consisting of a 50-W heater and a separate temperature sensor. Cooling was achieved by flowing liquid nitrogen through a vacuum feedthrough coupled by a flexible copper strap to the photodiode support fixture. This arrangement made it possible to cool the photodiode to approximately −100 °C. The photodiode temperature was adjusted to a selected higher temperature using the heater associated with the temperature controller. All the reported measurements were performed with no bias on the photodiode."

Next, I found a description of the Diodes from the original posting about them and found they also make them with integrated filters. See tables on next page.
https://confluence.aps.anl.gov/download/attachments/6226377/IRD2011.pdf

Some Applications:
[2] G. Eppeldauer and J. E. Hardis
"Fourteen-decade Photocurrent Measurement with large - area Silicon Photodiodes at Room Temperature"
Appl. Optics, Vol. 30, 3091-3099 (1991)

Diodes with Integrated Bandpass Filters

To avoid use of fragile freestanding thin film filters during XUV experiments and also in space missions, visible blind AXUV and SXUV photodiodes with integrated thin film filters have been developed. The following table lists available AXUV and SXUV diodes with different filter materials and their passbands. Typical visible light transmission of these filtered diodes is less than 10^{-4}. Diodes with higher visible light blocking can be specially selected if required. Opto Diode is continuously making diodes with many different filters. Users are requested to contact us for their special filter requirements.

The advantages of these integrated detector-filter devices over presently used separate freestanding thin foil filters and detectors are compactness, higher reliability, ease in manufacturing and handling, more stable bandpass and flexibility in design as the filter thicknesses are determined by optical constants and not by the mechanical strength requirement.

Owing to these advantages filtered AXUV diodes have been successfully used in several rocket experiments and satellites to measure the solar EUV radiation. The SXUV filtered diodes are being used to characterize the EUV lithography sources and also are being used in the EUV steppers.

We anticipate that the filtered diodes will be extremely useful in future space missions and other applications like soft x-ray radiometry, x-ray and EUV lithography, x-ray microscopy and XUV spectroscopy and plasma diagnostics.

Product Name	Filter Thickness (nm)	Pass Band (nm)	Product Name	Filter Thickness (nm)	Pass Band (nm)
AXUV100Cr/W/Au	8/100/400	< 1	AXUV100In/SiC	200/20	76-105
AXUV100Al/Fe	400/450	1.7-3.5	AXUV100LA	200	117-131
AXUV100Al/Mn2	500/500	1.9-3.5	AXUVSP2Al	150	17-80
AXUV100Al/V	400/600	2.4-3.5	AXUV96Ti/Mo/C	70/200/50	5-13
AXUV100Ti/Zr/Al	250/100/100	2.8-5	AXUV96Al	300	17-80
AXUV100Al/CaF$_2$/Ag	200/1000/250	3.6-5.2	AXUV96Sn	200	53-74
AXUV100Ti/Mo/Au	40/200/100	5-12	AXUV96In/SiC	200/10	76-105
AXUV100Ti/Mo/C	50/200/70	5-13	AXUV20Ti/Mo/C	70/200/50	5-13
AXUV100Ti/Mo/Si/C	40/200/100/50	5-15	AXUV20Zr/C	200/50	6-16
AXUV100Zr/C	200/50	6-16	AXUV20Si/Zr	100/200	11-18
AXUV100Ti/Zr/Au	20/200/100	6-12	AXUV20Mo/Si	350/500	12.2-15.8
AXUV100Ti/C	500/50	<7	AXUV20Al	300	17-80
AXUV100Ti/Pd	200/100	<11	AXUV20Ti/C	200/50	<7
AXUV100Si/Zr	100/200	11-18	AXUV20HS1Si/Zr	100/200	11-18
AXUV100Mo/Si	350/500	12.2-15.8	AXUV20HS1Mo/Si	350/500	12.2-15.8
AXUV100Ti/C2	200/50	< 12	AXUV20HS1Al5	300	17-18
AXUV100Al/Zr	125/125	17-21	AXUV20ASi/Zr	100/200	11-18
AXUV100Al	150	17-80	AXUVHS5Si/Zr	100/200	11-18
AXUV100Al2	40	17-80	AXUV20AMo/Si	350/500	12.2-15.8
AXUV100GAl2	50	17-80	AXUV20BNC-Si/Zr	100/200	11-18
AXUV100Al3	100	17-80	SXUV100Mo/Si/SiC	250/200/50	11-16
AXUV100Al4	1000	17-80	SXUV100Si/Zr	100/200	11-18
AXUV100Al5	300	17-80	SXUV100Mo/Si	350/500	12.2-15.8
AXUV100Al/C	200/50	17-36	SXUV20HS1Si/Zr	100/200	11-18
AXUV100Al/Nb/C	250/50/50	17-21	SXUV20HS1Mo/Si	350/500	12.2-15.8
AXUV100Al/Mn3	270/100	25-40	SXUV20HS1Mo/Si/SiC	500/500/50	12.5-14.5
AXUV100Al/Mn	200/100	25-40	SXUV20AMo/Si	350/500	12.2-15.8
AXUV100Cr/Al	60/150	27-40	SXUVHS5Mo/Si	350/500	12.2-15.8
AXUV100Cr/Al3	100/270	27-37	SXUVHS5Si/Zr	50/480	11-18
AXUV100Cr/Al2	100/200	27-37	SXUV300C-Mo/Si/SiC	500/500/50	12.5-14.5
AXUV100Sn (2% Ge)	200/10	53-74	SXUV20AMo/Si/SiC	250/200/50	11-16

Ref. N.E. Lanier et. al. "Low-cost, robust, filtered spectrometer for absolute intensity measurements in the soft x-ray region", Review of Scientific Instruments, Vol 72, No. 1, 1188-1191 (2001).

EUV Circuit

Friday, October 7, 2022 4:30 PM

AD512xx

$V_A = 5V,\ V_B = 0V$

$$V_W(D) = \frac{R_{WB}(D)}{R_{AB}} \times V_A + \frac{R_{AW}(D)}{R_{AB}} \times V_B \Rightarrow \boxed{V_W(D) = \frac{R_{WB}(D)}{R_{AB}} \cdot 5}$$

Bias Voltage

$10k\Omega$ or $100k\Omega$

AD5122A:

$$R_{WB}(D) = \frac{D}{128} \times R_{AB} + R_W \quad \text{From 0x00 to 0x7F} \quad (1)$$

AD5142A:

$$R_{WB}(D) = \frac{D}{256} \times R_{AB} + R_W \quad \text{From 0x00 to 0xFF} \quad (2)$$

where:
D is the decimal equivalent of the binary code in the 7-bit/8-bit RDAC register.
R_{AB} is the end-to-end resistance.
R_W is the wiper resistance.

AD5122A:

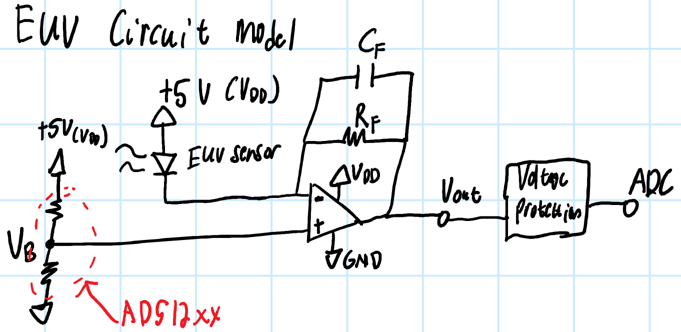
$$R_{AW}(D) = \frac{128 - D}{128} \times R_{AB} + R_W \quad \text{From 0x00 to 0x7F} \quad (3)$$

AD5142A:

$$R_{AW}(D) = \frac{256 - D}{256} \times R_{AB} + R_W \quad \text{From 0x00 to 0xFF} \quad (4)$$

where:
D is the decimal equivalent of the binary code in the 7-bit/8-bit RDAC register.
R_{AB} is the end-to-end resistance.
R_W is the wiper resistance.

EUV Circuit model



To amplify the current that is produced by the EUV sensor through its transfer function relating intensity of EUV to a low-frequency current, we need to feed it to a transconductance amplifier which converts current to voltage. Since the signal range and frequency are unknown, we need a robust set of settings available for both bias and gain that can be programmed in-flight. These are provided by the AD512xx series digital potentiometers.

EUV Sensor Amplifier Requirements

Friday, November 18, 2022 4:34 PM

Aldolfo on Friday October 28th:
Right, no problem! In Watts/m^2, the stats for the data are the following:
mean: 2521
median: 0.058
max: 1.1e7
min: 0.054
stdev: 1.36e5For the most part, variations are on the 5-10% level around the mean, due to the sun's rotation(!). So the minimum is 0.05 W/m^2, and we want to make sure we're sensitive to factors of 10-20 increases in this. I don't know how great a dynamic range you can span, but if we could make sure we catch some larger events, that would be ideal. But we probably don't need to worry about catching things with contrast levels of 10^7, those would be big enough that we can note when they happen with other observatories and compare to the GPS data after the fact

See Payloads folder in Google Drive for spectrum plot pictures