ENGINEERING CHANGE ORDER

Center for Astrophysics & Space Astronomy
University of Colorado, Boulder

ECO No. COS-074
Date 5/20/02
Sheet 1 of 9

Drawing/Document Title	Drwg/Doc No.	Revision Letter Current	Revision Letter New	Special Distribution
COS Calibration	COS-01-0003	A	B	
Requirements & Procedures				Stop Production Now ❑ Yes ❑ No

Description of Change:

See attached pages

Reason for Change:
Update to reflect current information and include additional calibration procedures based on improved knowledge of the FUV detector performance.

Disposition/Effectivity					
To Comply With ECO					
Use As Is					
Rework To ECO					
Scrap And Rebuild					
Record change Only					
Other (See Above)					

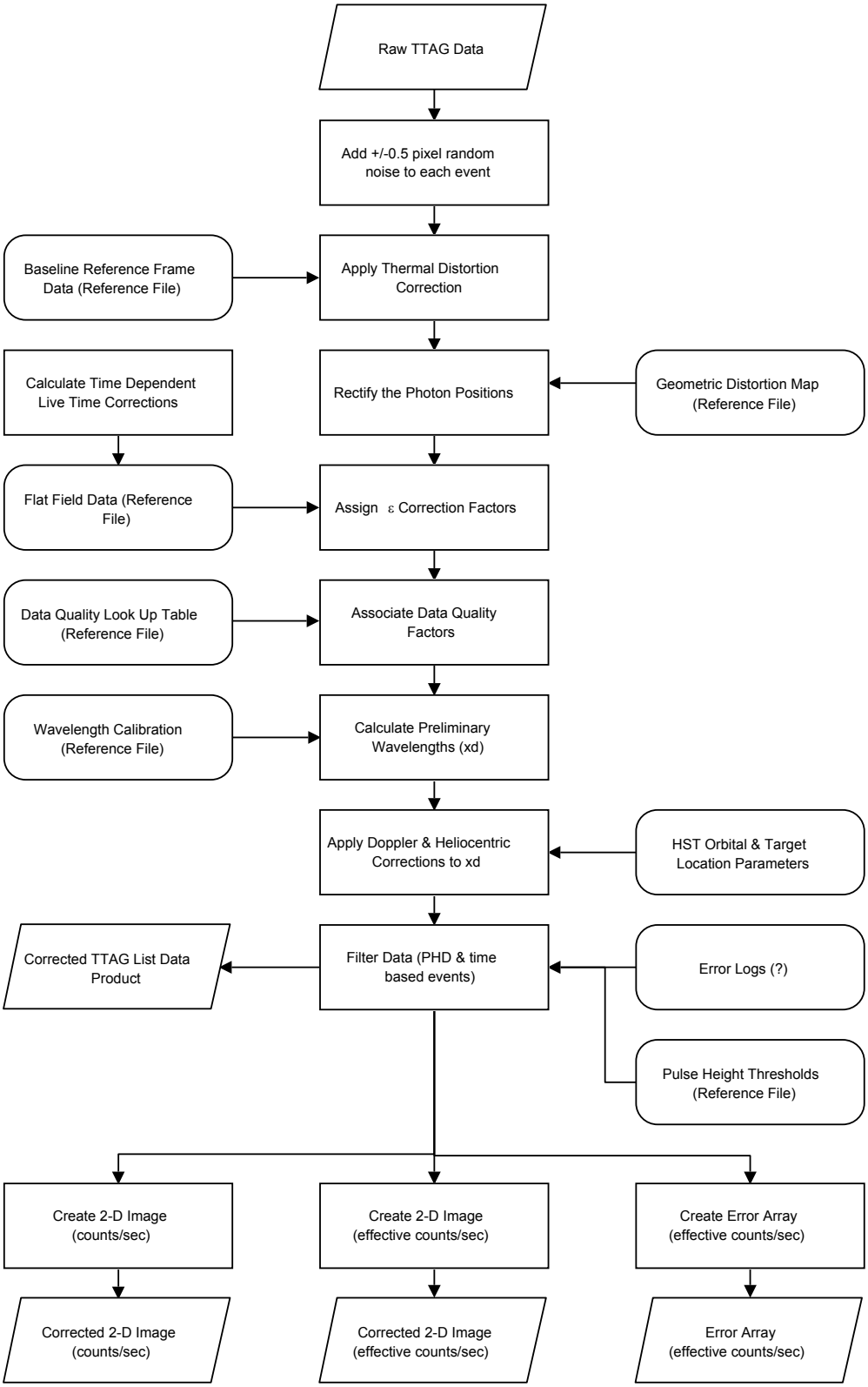
Prepared By:	E. Wilkinson	Date	5/20/02	CCB Required ❑Yes ❑No	❑Approved ❑NotApproved
Approved By:		Date			
Approved By:		Date			Immediate Incorporation
Approved By:		Date		❑Class I	
Approved By:		Date		❑Class II	❑Yes ❑No
Approved By:		Date		Completion	
Project Mgr:		Date		Date	

1. Page 13, Table 3.5, Insert new table as shown below.

Table 3.5
Binary Data Quality Flag Values

Flag	Condition
00000000	No anomalous condition noted
00000001	TBD
00000010	Grid shadow >TBD % variation above the flat field response
00000100	Live-time discrepancy – SDC1/DEC/FEC differ by more than 3σ from average count rate
00001000	Dead spot
00010000	Hot spot
00100000	Anomalous pulse height distribution
01000000	Time segment excluded in data
10000000	Data fill, Telemetry drop out

2. Page 16, Figure 4.1-2, Insert new figure below



3. Page 23, section 4.2, 1st paragraph, 4th sentence: Change the last word from "data" to "positional data".
4. Page 23, section 4.2, 2st paragraph, 2nd sentence: Change the last clause from "where a uniformly distributed random value ranging from –0.5 to +0.5 pixels is added…" to "where a uniformly distributed value Δx, where $-0.5 < \Delta x \leq +0.5$ pixels, is added…"
5. Page 24, section 4.2, 1st paragraph, 4th sentence: Change "…distributed random number ranging from –0.5 to +0.5." to "…distributed random numbers ranging from greater than –0.5 to less than or equal to +0.5.
6. Page 33, section 4.6.1; Insert the following new text in for section 4.6.1.

4.6.1 How Live Time is Determined

Live time is an important aspect of detector performance. This section outlines how live time is computed for each of the detectors onboard COS. In general terms, live time is the ratio of the number of events counted by the detector electronics compared to the number of events entering the detector electronics and thus is a measurement of the efficiency of a photon counting detector's electronics in processing data. Dead time, another common term for describing the efficiency of electronic system, is one minus the live time.

The FUV detector subassembly is really two entirely separate detectors up until the data streams are merged in the DEB. As such, the live time has two components; the live time associated with the segment specific electronics (dominated by the time to digital converters) and the live time associated with the electronics that merge the data stream (referred to as "round robin").

In the case of the FUV detector there are three places where live time is introduced into the system; the fast amplifiers, the time-to-digital converter, and finally the round robin, which is common to both detectors (See figure 4.6-1). This means that the live time between segments will likely be different based on the distribution of flux across the detector.

There are three counters that monitor the count rates throughout the processing and can be used to monitor and correct for the live time. The first are the fast event counters (LDCEFECA & LDCEFECB) that report output rate of the fast amplifiers. The digital event counters (LDCEDECA & LDCEDECB) report the output rate of the time-to-digital converters. Finally, the science data counters (LDCESDC1 and LDCESDC2) report the output rate of the round robin.

The dominant source of live time is the time-to-digital converters. At count rates less than 50 kHz the fast amplifiers and round robin circuitry introduce ~ 98% live time, which is still dominated by the fast amplifiers. On the other hand, the time-to-digital converters introduce ~75% live time at 50 kHz.

Based on this understanding, the following assumptions shall be used in determining the live time for the FUV detector:

1. The round robin does not introduce significant live time at count rates below 50 kHz, a rate 25% greater than the maximum global rate for the detector.
2. The FEC rates are dominated by full gain photon events and not low gain noise events.

With respect to item 2, the FEC shall be thought of as reporting the input photon rate with a small correction for live time. However, the FEC reports *all* events that trigger the fast amplifiers. The inputs to the FEC have very low thresholds, thus they report low gain events as well as photon events with higher gain. This is done to provide insight into the performance of the microchannel plates, such as reporting low gain hot spots. In instances where significant noise from the microchannel plates is introduced into the fast amplifiers, the derived photon rate computed entering the fast amplifiers will be incorrect. This can lead to inaccuracy in the photometric calibration of the data. Comparing the FEC rate computed using the DEC rate with the FEC rate reported in the flight telemetry identifies this condition. The accuracy of the photometry may be recovered through analysis and reprocessing of the data, albeit outside of the pipeline processing and depends upon the nature of the noise component.

The NUV detector has a single data pipeline, thus the live time can be effectively characterized by the output count rate and an associated calibration curve which relates live time to output count rate.

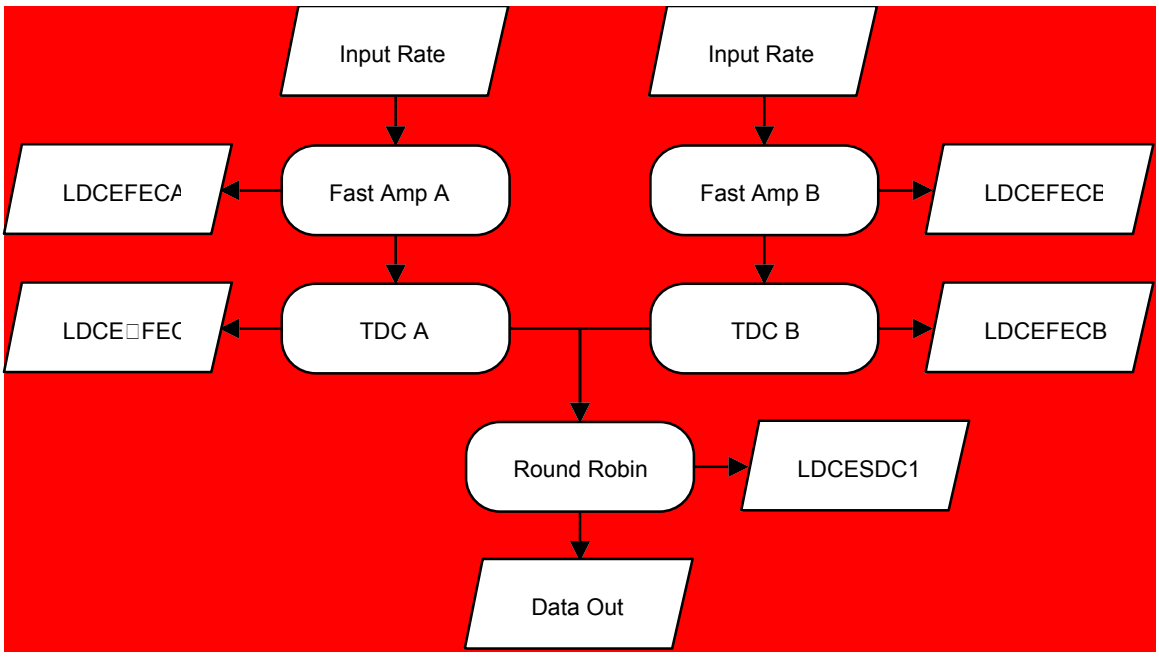
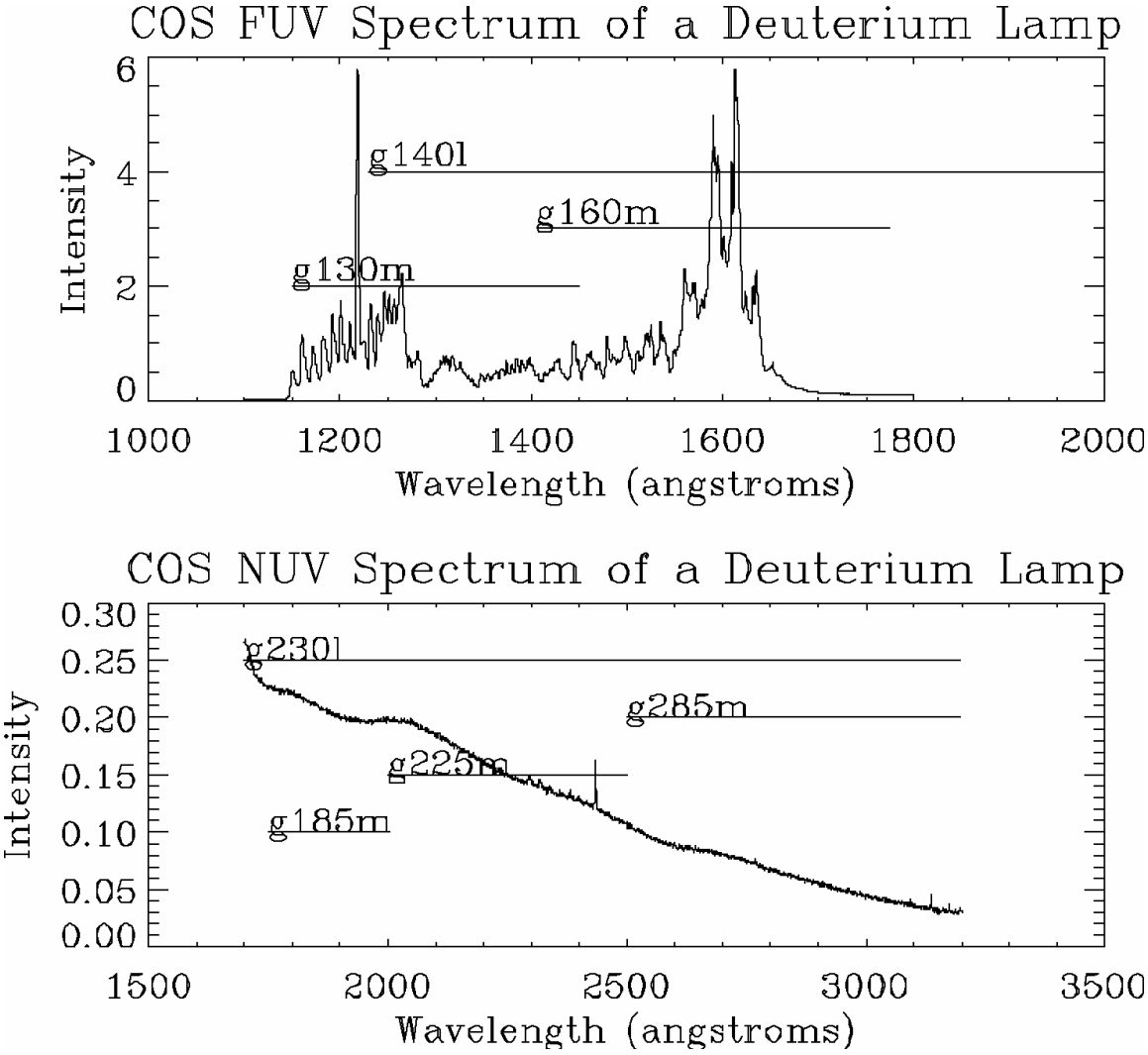


Figure 4.6-1: Flowchart representation of the counters in the FUV detector that are used to calculate the live time.

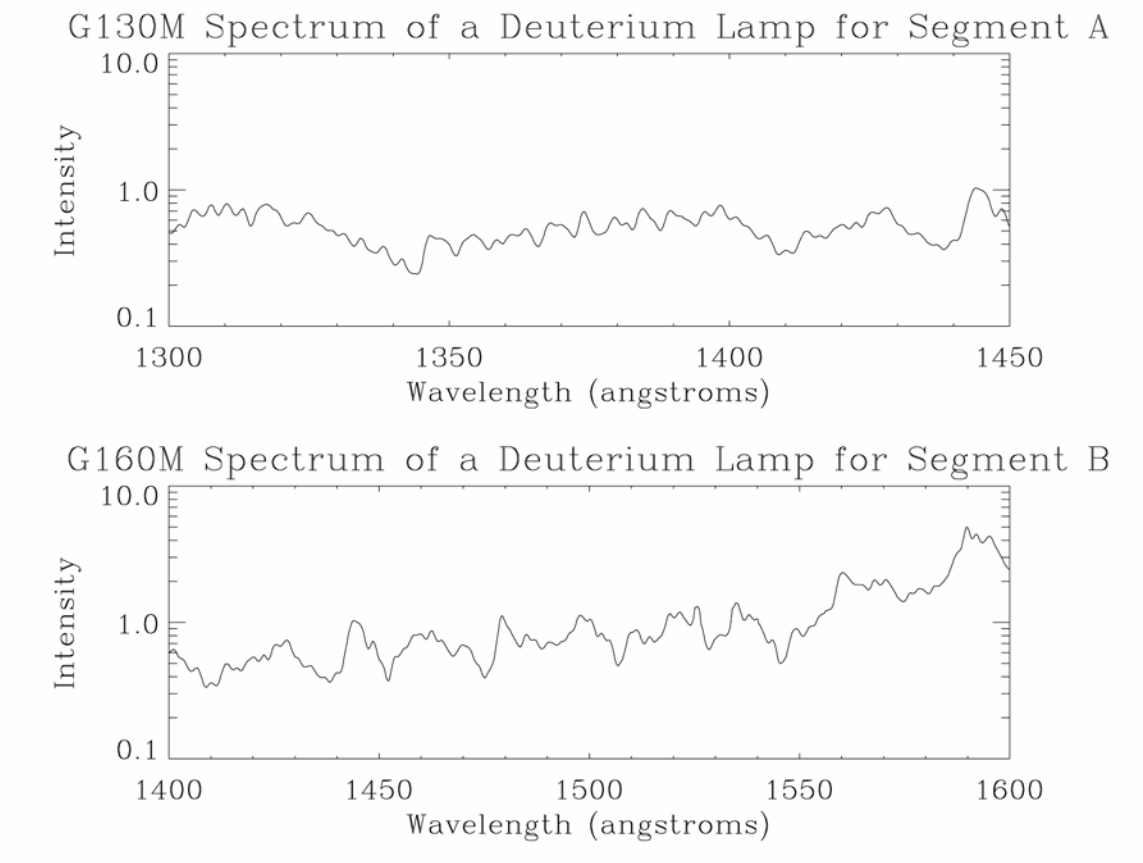
7. Global substitution: Throughout the entire document change
    - LFCDECA to LDCEDECA
    - LFCDECB to LDCEDECB
    - LFCFECA to LDCEFECA
    - LFCFECB to LDCEFECB
    - LFCSDC1 to LDCESDC1
    - LFCSDC2 to LDCESDC2
8. Page 37, section 4.6.5, LMEVEVTS should be LMEVENTS.
9. Page 40, equation 4.9-5 should be $v_0 = -|\dot{v}|\sin(Le)$.
10. Page 55, section 4.16, 3rd paragraph: Replace the third paragraph with the following paragraph…" There may remain in the spectra differences in the wavelength scales that might degrade the resolution if the spectra were simply co-added. Therefore, prior to co-adding the wavelength scales of each spectrum shall be adjusted slightly so that all the spectra will lie on the same wavelength scale. The wavelength offsets shall be determined using a cross-correlation technique applied to the individual wavelength calibration spectra and then applied to the individual science spectra."
11. Page 58, section 5.3, append at the end of the section the following text: "Ground testing of the FUV detector has shown that the geometric distortion depends upon high voltage of the detector (see CU document COS-11-0039). The geometric distortion cannot be directly measured in flight, however, it should be possible to correct the geometric distortion for variations due to changes in the high voltage using wavelength calibration spectra acquired at various high voltage levels. To that end, wavelength spectra shall be acquired in each configuration at±100 volt increments about the nominal high voltage. The number of increments, and thus range in high voltage, shall be sufficient to cover the expected operational range of high voltage, nominally the ±500 volts.
12. Page 62, section 5.7, 2nd paragraph, append at the end of the 2nd paragraph the following sentences: "In addition, the efficiency of the FUV channel shall be at 3 widely separated wavelengths in each configuration with the detector quantum efficiency enhancement grid OFF.
13. Page 64, section 5.8, 5th sentence: Change "G140L" to "G130M"

14. Page 65, figure 5.8-1, replace the figure with the one below



15. Page 65, figure 5.8-2, replace the figure with the one below. Also, in the figure caption replace “G140L” with “G130M”

This figure is new



Page 67, section 5.10, Table 5.10-1, add the following text to the sentence describing the italics notation: "…exists. At these levels bright emission lines may exceed the maximum local count rates. Only test these levels if they are not expected to exceed the maximum local rates.