Appendix 1

EDS Configurations

Ap.1.1 Introduction

This document describes the EDS configurations available to the guest observer. Each configuration can be specified by referencing its name.

If the configurations described here cannot adequately address the goals of a particular observation, the observer may request that other configurations be generated. Such requests will be honored within the limits of XTE project resources. For example, there are no pulsar fold configuration lists, since any use of the pulsar fold mode would have to be tailored to a specific pulsar. Thus, specific pulsar fold configurations will be generated for those observations which require the use of pulsar fold mode. Anyone wishing to specify new configurations should first read the appropriate section of the EDS Observers Manual and then contact the XTE GOF.

An up to date list of available configurations, including newly created configurations, will be available to all GOs via the GOF anonymous FTP account (`legacy.gsfc.nasa.gov`)

The reader should notice that each configuration described below generally requires one EA. Since 4 PCA EAs are available besides those running the standard configurations, the use of "cocktails" (i.e., using various EA's for different tasks), will be the rule rather than the exception. The user should keep in mind that regardless of how many EA's are used, the total telemetry must stay within the overall allocation for the observation.

Chapter 8 gives several examples of configuration choices.

Pulse height channel numbers are used to specify configurations. When X-ray photon energies are given below, we have assumed that the PCUs will operate with the nominal gain, for which pulse height channel 250 corresponds to 60 keV.

The various tables in the following sections give maximum count rates beyond which “rollovers” or data losses may occur. These maximum rates often exceed by orders of magnitude what is expected from the large majority of sources. For convenience of the user (and as a reference), we give in Table 1.1, “Count rate estimates for some bright sources.,” on page 176 the expected approximate TOTAL counting rates in the PCA of some of the very brightest sources in the range 1 - 60 keV. For sources with a counting rate greater than 100,000 cts/s, offset pointing may be required to prevent degradation of the detectors.

TABLE Ap.1.1. Count rate estimates for some bright sources.

Source	Total (cts/s)	<3.25 keV	<4.25 keV	<5.75 keV	<8.75 keV	<12.25keV
Sco X-1[a]	109,830[b]	25,850	47,280	76,240	96,630	106,030
Crab[c]	16,570	3,300	5,970	9,180	12,800	14,780
Cyg X-1[d]	8,380	1,290	2,450	3,990	5,930	7,120
A0620[e]	143,640[b]	80,550	112,190	132,060	141,280	143,090

a. Thermal Bremsstrahlung model T=5keV, normalization=32., wabs=3.5×10^{21}.

b. For instrument health, the PCA may require offset pointing to keep the count rate below 100,000.

c. Power law model: photon index=2.1, normalization=10.9, wabs=3.45×10^{21}.

d. Power law model: photon index=1.8, normalization=3.3, wabs=7.1×10^{21}.

e. 2 component power law model: photon index 1=4.7, normalization=3500., photon index 2=2.0, normalization=0.2, wabs=3.2×10^{21}.

Ap.1.2 Standard Configurations

Two of the EAs will always be running standard configurations to provide a common format for instrument monitoring, archival research and to make it easier to compare observations of different sources. The GO will be given the resulting standard data along with the rest of his/her data. Any information provided by the standard configurations does not need to be provided by the configurations selected for the 4 remaining PCA EAs. For many investigations the standard data is all that is needed.

Gain corrections are not applied to any of the standard data.

Ap.1.2.1 Standard 1

There are two unrelated parts to Standard 1, timing data and calibration data.

Every PCA event sent to the EDS is counted in exactly one of the Standard 1 bins.

The timing data consist of 8 time series, with 1/8 s time bins. Each readout of Standard 1 will contain 1024 time bins for each of the 8 time series. The 8 time series are defined in Table 1.2, "Time series in Standard 1," on page 177.

TABLE Ap.1.2. Time series in Standard 1

#	Description
1	Rate of good xenon events in PCU 1
2	Rate of good xenon events in PCU 2
3	Rate of good xenon events in PCU 3
4	Rate of good xenon events in PCU 4
5	Rate of good xenon events in PCU 5
6	Rate of all events not counted elsewhere
7	Rate of propane events in all PCUs
8	Rate of VLE events in all PCUs

The calibration data bins all events with a single xenon LLD and the alpha flag (see PCU instrument description for definition) set. These events are binned into 256 channel spectra separately for each xenon LLD and PCU. These spectra are readout once every 128 s.

Ap.1.2.2 Standard 2

Standard 2 provides full spectra separately for each anode and detector. The data provided in Standard 2 consists of xenon Spectra, propane Spectra and background rates. Normally Standard 2 data is read out every 16 s, however for very bright sources (> ~50,000 cts/s) faster readout times should be used to prevent bins from rolling over (e.g., more than 255 counts in a 8-bit bin).

Every event produced by the PCA will be counted in exactly one of the Standard 2 bins.

The xenon spectra comprise 129 channels for each of the six xenon anodes in each of the 5 PCUs.

The propane spectra comprise 33 channels for each of the 5 PCUs.

Background data comprise the rates of 29 types of events for each of the 5 PCUs. These events are monitored in Standard 2 to help with background modelling and deadtime corrections. The definitions of the 29 rates are given in Table 1.3, "," on page 178. In this table, V_X corresponds to the surrounding veto (or antico) layer of the PCU. Events on the veto layer are recorded with one of 3 energies, here labelled low, medium and high. L1-3 and R1-3 are the main xenon anodes. V_p denotes the propane layer. In the background rates numbered 13 through 18, the six xenon layers, the propane layer and the veto are all counted as discriminators. The VLE rate is the total rate of events with the VLE flag set. The calibration rate is the total rate of events with the calibration flag set and the VLE flag not set. Note that this is different from the calibration rates in Standard 1, where the calibration flag and a single xenon LLD flag must be set. For more information on the meaning of these flags, please refer to the PCA users manual. The "&" symbol in this table means that both specified flags must be set. For example, "V_p & L1" specified the rate of events where both the top "left" xenon layer and the propane layer, and no other anodes were simultaneously triggered. The "|" indicates a logical "or". For example, "Vp&(L2|L3|R2|R3)" specifies events that simultaneously triggered the propane layer and any one of the back 2 xenon layer anodes.

TABLE Ap.1.3.

#	Description
1	VLE rate
2	Vp & L1
3	Vp & R1
4	Vx & L1
5	Vx & R1
6	Vx & L2
7	Vx & R2
8	Vx & L3
9	Vx & R3
10	L1 & R1
11	L2 & R2
12	L3 & R3
13	Any 3 Discriminators
14	Any 4 Discriminators
15	Any 5 Discriminators
16	Any 6 Discriminators
17	Any 7 Discriminators
18	Any 8 Discriminators
19	Calibration
20	Low Energy Veto
21	Medium Energy Veto
22	High Energy Veto
23	Vp & (L2 | L3 | R2 | R3)
24	L1 & L2
25	R1 & R2

TABLE Ap.1.3.

#	Description
26	L2 & L3
27	R2 & R3
28	Other 2 LLD events
29	All flags 0.

Ap.1.3 Binned Mode Configurations with no Cutoff

In addition to the Standard configurations in Section Ap.1.2 on page 176, there are binned configurations that bin all events. These configurations are listed in Table 1.4, "Binned configurations with no high energy cutoff.," on page 179. The first two of these modes use a variable number of bits per channel, using more bits for lower energy channels where the count rate is higher. Gain corrections are applied to all of these configurations.

TABLE Ap.1.4. Binned configurations with no high energy cutoff.

Name	Time Bin Size	#bits/bin	# chan	PCU ID	Telem. (kbps)
B_250ms_128M_0_254	0.25 s	16,8,4[a]	128[b]	Yes	22.2
B_16ms_64M_0_249	16 ms	8,4[c]	64[d]	No	26.7
B_4ms_16X_0_249_H	4 ms	8	16[e]	No	32.9
B_4ms_16X_0_249_Q	4 ms	4	16[f]	No	16.5

a. 16 bit bins are used for the lowest 36 channels, 8-bit bins are used for the next 40 channels and 4-bit bins for the top 52 channels.

b. The 128 channels are: 0-4, 5-54:1, 56-135:2, 136-232:3, 236-239, 240-244, 245-249,250-254.

c. 8-bit bins are used for the lowest 20 channels and 4-bit bins are used for the top 44 channels.

d. The channels are: 0-4,5-6,7-15:1, 16-43:2, 44-46, 47-49,50-52, 53-55, 56-58,59-61, 62-64,65-67, 68-71, 72-75, 76-79, 80-83,84-87, 88-91, 92-96, 97-101, 102-106, 107-111. 112-116, 117-121, 122-126, 127-131, 132-137, 138-143, 144-149, 150-155, 156-161, 168-174, 175-181, 182-188, 189-195, 196-202, 203-209, 210-217, 218-225, 226-233, 234-243, 244-249.

e. There are 3 options for the energy channel boundaries:

A: 0-7,8-9,10,11,12,13,14,15,16-17,18-19,20-22,23-26,27-30, 31-35, 36-63, 64-249.
B: 0-9,10-11,12-13,14-16, 17-19, 20-22, 23-25, 26-28. 29-31, 32-35, 36-41, 42-49, 50-63, 64-91, 92-127, 128-249.
M: 0-8, 9-13, 14-20, 21-29, 30-39, 40-51, 52-65, 66-79, 80-95, 96-113, 114-133, 134-154, 155-177, 178-201, 202-227, 228-249.

f. There are 2 options for the energy channel boundaries:
A: 0-7,8-9,10,11,12,13,14,15,16-17,18-19,20-22,23-26,27-30, 31-35, 36-63, 64-249.
B: 0-9,10-11,12-13,14-16, 17-19, 20-22, 23-25, 26-28. 29-31, 32-35, 36-41, 42-49, 50-63, 64-91, 92-127, 128-249.

Ap.1.4 Low Energy Binned Mode Configurations

Binned mode configurations are appropriately used when the count rate is high and not all events can be telemetered via an event mode configuration. This section describes the available binned mode configurations designed to be used in conjunction with an event mode configuration with a low energy cutoff (Section Ap.1.7 on page 187). The upper energy cutoff of the binned mode should match the low energy cutoff of the event mode. Typically one would choose the cutoff such that 500 to 1000 events/s would have energies above the cutoff.

Table 1.5, "Binned mode configurations for 0-3.0 keV," on page 180 through Table 1.9, "Binned mode configurations for under 11.7 keV," on page 185 lists the binned mode configurations that will be available for binning events with a upper channel cutoff.

In these tables, column 1 specifies the name of the configuration. The naming convention for these configurations is B_ttt_ccX_0_hh_B, where ttt is the time bin size, cc is the number of energy channels, X selects the channel boundary option, hh specifies the upper channel boundary, an B is one of Q,H or F specifying that 4, 8 or 16 bit bins have been used. If there is more than one channel boundary option, an "X" has been left in the name in column 1, and the GO must choose one of the options listed in the table footnotes. The energy channel boundaries in binned mode are named with the same convention as in Event mode. If the configuration uses a variable number of bits per bin (typically more bits for lower energy channels), the "_B" is left off the name.

Column 2 lists the time resolution of the configuration. Column 3 lists the number of energy channels. Column 4 shows the number of bits used to telemeter each bin. Column 5 shows the telemetry rate that will be required to support this configuration. The telemetry rate does not depend on the count rate. The last column shows, approximately, the maximum rate of events below the cutoff energy that can be supported without risking rollover of counts.

TABLE Ap.1.5. Binned mode configurations for 0-3.0 keV

Name	Time	#Chan	#bits/bin	Telem (kbps)	Max Rate (cts/s)
B_500ms_10M_0_13	0.5 s	10[a,b]	16,4[c]	6.5	350,000
B_62ms_10M_0_13_H	62 ms	10[d,b]	8	6.5	103,000
B_16ms_10M_0_13_H	16 ms	10[b]	8	5.1	80,000
B_8ms_4A_0_13_H	8 ms	4[e]	8	4.1	64,000
B_4ms_4A_0_13_Q	4 ms	4[e]	4	4.1	3,000
B_2ms_4A_0_13_Q	2 ms	4[e]	4	8.2	6,000

TABLE Ap.1.5. Binned mode configurations for 0-3.0 keV

Name	Time	#Chan	#bits/bin	Telem (kbps)	Max Rate (cts/s)
B_2ms_2A_0_13_Q	2 ms	2[f]	4	4.1	3,000
B_1ms_2A_0_13_Q	1 ms	2[f]	4	8.2	6,000
B_1ms_4A_0_13_Q	1 ms	4[e]	4	16.5	12,000
B_500us_2A_0_13_Q	0.5 ms	2[f]	4	16.5	12,000
B_500us_4A_0_13_Q	0.5 ms	4[e]	4	33.0	24,000
B_250us_2A_0_13_Q	0.25 ms	2[f]	4	33.0	24,000

a. Ten channels are provided separately by PCU and for the 6 xenon and propane layers.

b. 10 channels: 0-4,5,6,7,8,9,10,11,12,13.

c. The front xenon layers and the propane layer use 16 bit bins, all others use 4 bit bins.

d. Ten channels are provided separately by PCU

e. 4 channels: 0-7, 8-9, 10-11, 12- 13.

f. 2 channels: 0-10, 11-13.

TABLE Ap.1.6. Binned mode configurations for 0-4.0keV

Name	Time	#Chan	#bits/bin	Telem Rate (kbps)	Max Rate (cts/s)
B_500ms_14M_0_17	0.5 s	14[a,b]	16, 4[c]	9	350,000
B_62ms_14M_0_17_H	62 ms	14[a,d]	8	9	143,000
B_16ms_14M_0_17_H	16 ms	14[a]	8	7	115,000
B_8ms_14M_0_17_H	8 ms	14[a]	8	14	230,000
B_8ms_8A_0_17_H	8 ms	8[e]	8	8	128,000
B_4ms_8A_0_17_H	4 ms	8[e]	8	16	256,000
B_4ms_4X_0_17_H	4 ms	4[f]	8	8	128,000
B_2ms_4X_0_17_H	2 ms	4[f]	8	16	256,000
B_2ms_2X_0_17_H	2 ms	2[g]	8	8	128,000
B_1ms_4X_0_17_H	1 ms	4[f]	8	33	350,000
B_1ms_4X_0_17_Q	1 ms	4[f]	4	16	12,000
B_1ms_2X_0_17_H	1 ms	2[g]	8	16	256,000
B_1ms_2X_0_17_Q	1 ms	2[g]	4	8	6,000
B_500us_4X_0_17_Q	0.5 ms	4[f]	4	33	24,000
B_500us_2X_0_17_Q	0.5 ms	2[g]	4	16	12,000
B_250us_4X_0_17_Q	0.25 ms	4[f]	4	66	48,000
B_250us_2X_0_17_Q	0.25 ms	2[g]	4	33	24,000

TABLE Ap.1.6. Binned mode configurations for 0-4.0keV

Name	Time	#Chan	#bits/bin	Telem Rate (kbps)	Max Rate (cts/s)
B_125us_4X_0_17_Q	0.125 ms	4[f]	4	132	96,000
B_125us_2X_0_17_Q	0.125 ms	2[g]	4	66	48,000

a. 14 Channels: 0- 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17.

b. The 14 channels are provided separately by PCU and for the 6 xenon and propane layers.

c. The front xenon layers and the propane layer use 16 bit bins, all others use 4 bit bins.

d. 14 channels are provided separately by PCU.

e. 8 Channels: 0-7, 8, 9, 10, 11, 12-13, 14-15, 16-17.

f. There are two options for the 4 energy channels:
Option A: 0-8, 9-10, 11-13, 14-17.
Option B: 0-10, 11-12, 13-14, 15-17.

g. There are two options for the 2 energy channels:
Option A: 0-11, 12-17.
Option B: 0-13, 14-17.

TABLE Ap.1.7. Binned mode configurations for 0-5.4 keV

Name	Time Bin	#chan	#bits/bin	Telem. (kbps)	Max Rate (< 5.4)
B_500ms_20M_0_23	0.5 s	20[a,b]	16,4[c]	13	350,000
B_62ms_20M_0_23_H	62 ms	20[a,d]	8	13	200,000
B_16ms_20M_0_23_H	16 ms	20[a]	8	10	160,000
B_16ms_16A_0_23_H	16 ms	16[e]	8	8	128,000
B_8ms_20M_0_23_H	8 ms	20[a]	8	21	300,000
B_4ms_16A_0_23_H	4 ms	16[e]	8	33	350,000
B_2ms_16A_0_23_Q	2 ms	16[e]	4	33	25,000
B_1ms_16A_0_23_Q	1 ms	16[e]	4	66	50,000
B_8ms_8X_0_23_H	8 ms	8[f]	8	8	128,000
B_4ms_8X_0_23_H	4 ms	8[f]	8	16	256,000
B_2ms_8X_0_23_H	2 ms	8[f]	8	33	350,000
B_2ms_8X_0_23_Q	2 ms	8[f]	4	16	12,000
B_1ms_8X_0_23_Q	1 ms	8[f]	4	33	25,000
B_500us_8X_0_23_Q	0.5 ms	8[f]	4	66	50,000
B_4ms_4X_0_23_H	4 ms	4[g]	8	8	128,000
B_2ms_4X_0_23_H	2 ms	4[g]	8	16	256,000
B_1ms_4X_0_23_H	1 ms	4[g]	8	33	350,000

TABLE Ap.1.7. Binned mode configurations for 0-5.4 keV

Name	Time Bin	#chan	#bits/bin	Telem. (kbps)	Max Rate (< 5.4)
B_1ms_4X_0_23_Q	1 ms	4[g]	4	16	12,000
B_500us_4X_0_23_Q	0.5 ms	4[g]	4	33	25,000
B_250us_4X_0_23_Q	0.25	4[g]	4	66	50,000
B_125us_4X_0_23_Q	0.125 ms	4[g]	4	132	100,000
B_2ms_2X_0_23_H	2 ms	2[h]	8	8	128,000
B_1ms_2X_0_23_H	1 ms	2[h]	8	16	256,000
B_1ms_2X_0_23_Q	1 ms	2[h]	4	8	6,000
B_500us_2X_0_23_Q	0.5 ms	2[h]	4	16	12,000
B_250us_2X_0_23_Q	0.25 ms	2[h]	4	33	25,000
B_125us_2X_0_23_Q	0.125 ms	2[h]	4	66	50,000

a. 20 Channels: 0-4, 5, 6, 7, 8, 9,10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23.

b. The 20 channels are provided separately by PCU and for the 6 xenon and propane layers.

c. The front xenon layers and the propane layer use 16 bit bins, all others use 4 bit bins.

d. 20 channels are provided separately by PCU.

e. 16 Channels: 0-6, 7-8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22-23.

f. There are two options for the 8 channels:
Option A: 0-7, 8-9, 10-11, 12-13, 14-15, 16-17, 18- 20, 21-23.
Option B: 0-9, 10-11, 12-13, 14-15, 16-17, 18-19, 20-21, 22-23.

g. There are two options for the 4 channels:
Option A: 0-8, 9-11, 12-15, 16-23.
Option B: 0-11, 12-15, 16-19, 20-23.

h. There are three options for the 2 channels:
Option A: 0-11, 12-23.
Option B: 0-13, 14-23.
Option C: 0-15, 16-23.

TABLE Ap.1.8. Binned mode configurations for 0-8.2 keV

Name	Time Bin	#chan	#bits/bin	Telem (kbps)	Max Rate (cts/s)
B_500ms_32M_0_35	0.5 s	32[a,b]	16,4[c]	21	350,000
B_62ms_32M_0_35_H	62 ms	32[d]	8	21	330,000
B_16ms_32M_0_35_H	16 ms	32[a]	8	16	256,000
B_8ms_32M_0_35_H	8 ms	32[a]	8	33	350,000
B_16ms_16A_0_35_H	16 ms	16[e]	8	8	128,000
B_8ms_16A_0_35_H	8 ms	16[e]	8	16	256,000
B_4ms_16A_0_35_H	4 ms	16[e]	8	33	350,000

TABLE Ap.1.8. Binned mode configurations for 0-8.2 keV

Name	Time Bin	#chan	#bits/bin	Telem (kbps)	Max Rate (cts/s)
B_2ms_16A_0_35_Q	2 ms	16[e]	4	33	24,000
B_1ms_16A_0_35_Q	1 ms	16[e]	4	66	50,000
B_8ms_8X_0_35_H	8 ms	8[f]	8	8	128,000
B_4ms_8X_0_35_H	4 ms	8[f]	8	16	256,000
B_2ms_8X_0_35_Q	2 ms	8[f]	4	16	12,000
B_1ms_8X_0_35_Q	1 ms	8[f]	4	33	24,000
B_500us_8X_0_35_Q	0.5 ms	8[f]	4	66	48,000
B_4ms_4X_0_35_H	4 ms	4[g]	8	8	128,000
B_2ms_4X_0_35_H	2 ms	4[g]	8	16	256,000
B_1ms_4X_0_35_Q	1 ms	4[g]	4	16	12,000
B_500us_4X_0_35_Q	0.5 ms	4[g]	4	33	24,000
B_250us_4X_0_35_Q	0.25 ms	4[g]	4	66	48,000
B_125us_4X_0_35_Q	0.125 ms	4[g]	4	132	96,000
B_62us_4X_0_35_Q	62 µs	4[g]	4	264	200,000
B_1ms_2X_0_35_H	1 ms	2[h]	8	16	256,000
B_1ms_2X_0_35_Q	1 ms	2[h]	4	8	6,000
B_500us_2X_0_35_Q	0.5 ms	2[h]	4	16	12,000
B_250us_2X_0_35_Q	0.25 ms	2[h]	4	33	25,000
B_125us_2X_0_35_Q	0.125 ms	2[h]	4	66	50,000
B_62us_2X_0_35_Q	62 µs	2[h]	4	132	100,000
B_31us_2X_0_35_Q	31 µs	2[h]	4	264	200,000

a. 32 Channels: 0-4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35.

b. The 32 channels are provided separately by PCU and for the 6 xenon and propane layers.

c. The front xenon layers and the propane layer use 16 bit bins, all others use 4 bit bins.

d. 32 channels are provided separately by PCU.

e. 16 Channels: 0-8, 9-10, 11, 12, 13, 14, 15, 16-17, 18-19, 20-21, 22- 23, 24-25, 26-27, 28-29,30-32,33-35.

f. There are two options for the 8 channels:

Option A: 0-7, 8-9, 10-11, 12-13, 14-15, 16-17, 18-21, 22-35.
Option B: 0-10, 11-13, 14-16, 17-19, 20-22, 23-26, 27-30, 31-35.

g. There are three options for the 4 channels:

Option A: 0-9, 10-13, 14-17, 18-35.
Option B: 0-13, 14-18, 19-25, 26-35.
Option M: 0-9, 10-15, 16-23, 24-35.

h. There are three options for the 2 channels:
Option A: 0-12, 13-35.
Option B: 0-15, 16-35.
Option C: 0-19, 20-35.

TABLE Ap.1.9. Binned mode configurations for under 11.7 keV

Name	Time	#Chan	#bits/bin	Telem (kbps)	Max Rate (cts/s)
B_500ms_46M_0_49	0.5 s	46[a,b]	16,4[c]	30	350,000
B_62ms_46M_0_49_H	62 ms	46[a]	8	30	350,000
B_16ms_46M_0_49_H	16 ms	46[a]	8	24	350,000
B_8ms_46M_0_49_H	8 ms	46[a]	8	47	350,000
B_16ms_16X_0_49_H	16 ms	16[d]	8	8	128,000
B_8ms_16X_0_49_H	8 ms	16[d]	8	16	250,000
B_4ms_16X_0_49_H	4 ms	16[d]	8	33	480,000
B_2ms_16X_0_49_Q	2 ms	16[d]	4	33	24,000
B_1ms_16X_0_49_Q	1 ms	16[d]	4	66	48,000
B_500us_16X_0_49_Q	0.5 ms	16[d]	4	132	96,000
B_8ms_8X_0_49_H	8 ms	8[e]	8	8	128,000
B_4ms_8X_0_49_H	4 ms	8[e]	8	16	256,000
B_2ms_8X_0_49_Q	2 ms	8[e]	4	16	12,000
B_1ms_8X_0_49_Q	1 ms	8[e]	4	33	24,000
B_500us_8X_0_49_Q	0.5 ms	8[e]	4	66	48,000
B_250us_8X_0_49_Q	0.25 ms	8[e]	4	132	96,000
B_125us_8X_0_49_Q	0.125 ms	8[e]	4	264	200,000
B_4ms_4X_0_49_H	4 ms	4[f]	8	8	128,000
B_2ms_4X_0_49_H	2 ms	4[f]	8	16	250,000
B_1ms_4X_0_49_H	1 ms	4[f]	8	33	480,000
B_1ms_4X_0_49_Q	1 ms	4[f]	4	16	12,000
B_500us_4X_0_49_Q	0.5 ms	4[f]	4	33	24,000
B_250us_4X_0_49_Q	0.25 ms	4[f]	4	66	48,000
B_125us_4X_0_49_Q	0.125 ms	4[f]	4	132	96,000
B_62us_4X_0_49_Q	61 µs	4[f]	4	264	192,000
B_2ms_2X_0_49_H	2 ms	2[g]	8	8	128,000
B_1ms_2X_0_49_H	1 ms	2[g]	8	16	256,000
B_1ms_2X_0_49_Q	1 ms	2[g]	4	8	6,000
B_500us_2X_0_49_Q	0.5 ms	2[g]	4	16	12,000
B_250us_2X_0_49_Q	0.25 ms	2[g]	4	33	24,000

TABLE Ap.1.9. Binned mode configurations for under 11.7 keV

Name	Time	#Chan	#bits/bin	Telem (kbps)	Max Rate (cts/s)
B_125us_2X_0_49_Q	0.125 ms	2[g]	4	66	48,000
B_62us_2X_0_49_Q	62 µs	2[g]	4	132	96,000
B_31us_2X_0_49_Q	31 µs	2[g]	4	264	192,000

a. 46 Channels: 0-4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49.

b. The 46 channels are provided separately by PCU and for the 6 xenon and propane layers.

c. The front xenon layers and the propane layer use 16 bit bins, all others use 4 bit bins.

d. There are 2 options for the 16 channels:

Option A: 0-7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17-18, 19-21, 22-25, 26-29, 30-35, 36-49.

Option B: 0-8, 9-11, 12-13, 14-15, 16-17, 18-19, 20-21, 22-23, 24-25, 26-27, 28-29, 30-32, 33-35, 36-39, 40-44, 45-49.

e. There are 2 options for the 8 channels:

Option A: 0-7, 8-9, 10-11, 12-13, 14-15, 16-17, 18-21, 22-49.
Option B: 0-11, 12-14, 15-17, 18-21, 22-26, 27-32, 33-39, 40-49.

f. There are 3 options for the 4 channels:

Option A: 0-9, 10-13, 14-17, 18-49.
Option B: 0-15, 16-22, 23-32, 33-49.
Option M: 0-10, 11-20, 21-33, 34-49.

g. There are 3 options for the 2 channels:

Option A: 0-13, 14-49.
Option B: 0-19, 20-49.
Option C: 0-23, 24-49.

Ap.1.5 Pulsar Fold Mode Configurations

There are no pulsar fold mode configurations. Pulsar fold configuration will be created and uploaded as needed. The operation of and parameters needed for pulsar fold mode are described in the EDS Observer's Manual.

Pulsar fold mode is most useful for X-ray pulsars with periods shorter than a few seconds, and count rates more than 1500 cts/s. For sources with lower count rates, one of the event modes in Section Ap.1.7 on page 187 will provide all the information needed to perform the folding on the ground. For bright sources with periods longer than a few seconds, one of the binned mode configuration will provide all the information needed to perform the folding on the ground. Of the presently known x-ray pulsars, the Crab is the only source where pulsar fold mode is unambiguously required. Pulsar fold may be useful for a few other known sources, especially in high intensity states.

When using the pulsar fold mode, the observer is responsible to determine the required accuracy of and value for the pulse period for each observation.

Ap.1.6 Delta-time Binned Mode Configurations

Delta binned mode provides a histogram of the time between selected events. Only a single energy band may be selected. In all these configurations, only good xenon events are selected. The delta-time binned mode can provide a good estimate of the autocorrelation function for very short delay times (less than mean time between events). This mode is also useful for providing a measure of the detector dead time (Zhang et. al. 1994) in parallel with other measurements.

The numbers of counts in the first few bins are, on the average, proportional to the square of the count rate, so care must be taken to prevent rollover of counts at high count rates.

For low count rates, there is a different concern. The times are calculated using a 14-bit number; thus a delay of 16,385 bins would be counted as a delay of 1 bin. If the bin size is 1 µs, 16,384 bins is 16 ms. If the event rate is 130 cts/s then 12.5% of the events will have a delay time greater than 16ms. For weak sources a longer time bin size should be chosen.

Table 1.10, “Delta-time bin configurations,” on page 187 lists the available delta-time binned configurations.

TABLE Ap.1.10. Delta-time bin configurations

Name	Time bin	Read out	Bits/bin	# Bins	Telem. (kbps)	Max Rate (cts/s)
D_4us_0_249_1024_64s_F	4 µs	64 s	16	1024	0.3	1,500
D_1us_0_249_1024_16s_H	1 µs	16 s	8	1024	0.6	3,000
D_1us_0_249_1024_16s_F	1 µs	16 s	16	1024	1.1	50,000
D_1us_0_249_1024_64s_F	1 µs	64 s	16	1024	0.3	25,000
D_1us_0_249_128_4s_F	1 µs	4 s	16	128	0.6	100,000
D_1us_0_249_128_1s_F	1 µs	1 s	16	128	2.4	200,000

Ap.1.7 Event Mode Configurations

For all sources it is advantageous to send some data in event mode. For sources with counting rates of <~ 1500 cts/s, or for brighter sources where a larger telemetry allocation has been obtained, it is possible to send all the “good X-ray” events to the ground in event mode. For sources where it is not possible to send all the photon data in event mode, it is still advantageous to send data for the higher energy photons in event mode. To facilitate this we provide 6 different low energy cutoff points as shown in Table 1.11, “Low energy cutoff values for event mode configurations,” on page 188. In this table we show the low energy boundary in column 1 in keV and the PCA raw pulse height in column 2.

TABLE Ap.1.11. Low energy cutoff values for event mode configurations

Energy	PH Chan
0 keV	0
3.0 keV	14
4.0	18
5.4	24
8.2	36
11.7	50

Event mode works by writing events and time markers into a buffer (16 bits per event). The buffer can hold up to 16384 events and time markers. The EDS configurations provide 2 options for reading out the buffer. The low rate option will read out the buffer every 8 seconds. This provides a maximum telemetry rate of 34 kbps. If the source counting rate exceeds 2000 cts/s events will be lost. There is also be a high rate readout time of 1 second. This provides a maximum telemetry rate of 265 kbps. Note that for a source with a counting rate below 2000 cts/s, the telemetry is almost the same for the high and low readout times. The difference is that if the counting rate increases above 2000 cts/s, the 8s readout time will lose events but keep the telemetry rate low, while the 1s readout will not lose events but the telemetry rate may get very high.

Table 1.12, “EDS event mode configurations,” on page 188lists the event mode configurations that are available. The guest observer has the option of trading energy resolution and anode/detector ID information for time resolution. Telemetry usage depends only on the counting rate of selected events and is independent of the trade-off between time resolution and energy resolution. Column 3 shows the information about the detector and/or anode that is contained in each event, so when PCU is listed it means the PCU ID is placed in each event. Where PCU,LLD is listed it means that both the PCU ID and anode code are available for each event. For the event mode configurations with very high time resolution, no information about the PCU ID is put in the events.

TABLE Ap.1.12. EDS event mode configurations

Time	# PH channels	Type	Time mark Interval
1 μs	1	PCU	4 ms
1 μs	4		8 ms
2 μs	2	PCU	4 ms
2 μs	8		8 ms
4 μs	4	PCU	4 ms
4 μs	16		8 ms
8 μs	8	PCU	4 ms

TABLE Ap.1.12. EDS event mode configurations

Time	# PH channels	Type	Time mark Interval
8 µs	32		8 ms
16 µs	16	PCU	4 ms
16 µs	64		8 ms
31 µs	16	PCU	8 ms
62 µs	32	PCU	8 ms
125 µs	64	PCU	8 ms
250 µs	128	PCU	8 ms
500 µs	64	PCU, LLD	8 ms
1 ms	128	PCU, LLD	8 ms

The Event mode configurations follow the following naming convention:

E_ttt_cco_ll_rr,

where ttt is the time bin size (column 1 of Table 1.12, "EDS event mode configurations," on page 188), cc is the number of energy channels, o is the channel boundary option, ll is the lower channel cutoff (column 2 of Table 1.11, "Low energy cutoff values for event mode configurations," on page 188) and rr is the readout time (either 8s or 1s). For example:

E_31us_16M_50_1s

is an event mode that selects all events with energy greater than 11.7 keV, labels every event with a time stamp accurate to 31 µs, a PCU id, a 4 bit energy that specifies one of 16 energy channels, uses option M for the energy boundaries and is read out once per second (high rate).

Four sets of energy channel boundaries have been defined and are labelled A,B,C, or M. Not all options are always available. The boundary options were chosen such that:

- A - The count rate for a source with a soft spectrum (A0620 in Table 1.1, "Count rate estimates for some bright sources.," on page 176) is roughly the same in all channels.
- B - The count rate for a source with a medium spectrum (Crab in Table 1.1, "Count rate estimates for some bright sources.," on page 176) is roughly the same in all channels.
- C - The count rate for a source with a hard spectrum (Cyg X-1 in Table 1.1, "Count rate estimates for some bright sources.," on page 176) is roughly the same in all channels.

- M - The channel width divided by the detector resolution is roughly the same for all channels.

TABLE Ap.1.13. Two Channel options

Name	Ch 1	Ch 2
2A_0	0-13	14-249
2B_0	0-23	24-249
2C_0	0-35	36-249
2M_0	0-49	50-249
2A_14	14-17	18-249
2B_14	14-23	24-249
2C_14	14-35	36-249
2M_14	14-99	100-249
2A_18	18-23	24-249
2B_18	18-29	30-249
2C_18	18-35	36-249
2M_18	18-103	104-249
2A_24	24-29	30-249
2B_24	24-35	36-249
2C_24	24-49	50-249
2M_24	24-109	110-249
2A_36	36-42	43-249
2B_36	36-49	50-249
2M_36	36-119	120-249
2A_50	50-63	64-249
2M_50	50-127	128-249

TABLE Ap.1.14. Four channel options

Name	Ch 1	Ch 2	Ch 3	Ch 4
4A_0	0-9	10-13	14-17	18-249
4B_0	0-13	14-23	24-35	36-249
4C_0	0-16	17-25	26-41	42-249
4M_0	0-35	36-79	80-159	160-249
4A_14	14-15	16-17	18-23	24-249
4B_14	14-20	21-29	30-45	46-249
4M_14	14-43	44-95	96-165	166-249
4A_18	18-19	20-23	24-29	30-249
4B_18	18-23	24-31	32-49	50-249
4M_18	18-47	48-99	100-171	172-249

TABLE Ap.1.14. Four channel options

Name	Ch 1	Ch 2	Ch 3	Ch 4
4A_24	24-26	27-31	32-49	50-249
4B_24	24-33	34-49	50-95	96-249
4M_24	24-59	60-109	110-174	175-249
4A_36	36-41	42-49	50-63	64-249
4M_36	36-71	72-119	120-179	180-249
4A_50	50-55	56-63	64-79	80-249
4M_50	50-85	86-131	132-187	188-249

TABLE Ap.1.15. Eight Channel Options

Name	1	2	3	4	5	6	7	8
8A_0	0-7	8-9	10-11	12-33	14-16	17-20	21-25	26-249
8B_0	0-11	12-14	15-17	18-21	22-27	28-35	36-49	50-249
8C_0	0-12	13-16	17-20	21-25	26-31	32-39	40-55	56-249
8M_0	0-9	10-19	20-35	36-59	60-95	96-139	140-191	192-249
8A_14	14	15	16	17-18	19-20	21-23	24-29	30-249
8B_14	14-17	18-20	21-24	25-29	30-36	37-45	46-61	62-249
8M_14	14-26	27-43	44-63	64-87	88-117	118-157	158-203	204-249
8A_18	18	19	20	21-22	23-24	25-27	28-33	34-249
8B_18	18-19	20-23	24-27	28-35	36-45	46-61	62-127	128-249
8M_18	18-30	31-47	48-67	68-91	92-123	124-159	160-204	205-249
8A_24	24-25	26-27	28-29	30-31	32-33	34-47	48-127	128-249
8B_24	24-28	29-33	34-39	40-45	46-61	62-99	100-139	140-249
8M_24	24-35	36-51	52-71	72-95	96-123	124-159	160-204	205-249
8B_36	36-39	40-44	45-49	50-57	58-69	70-99	100-139	140-249
8M_36	36-49	50-65	66-87	88-113	114-143	144-177	178-213	214-249
8B_50	50-52	53-56	57-61	62-67	68-77	78-89	90-127	128-249
8M_50	50-65	66-83	84-104	105-127	128-154	155-184	185-217	218-249

TABLE Ap.1.16. 16 channel options

Name	Lower bound of each channel[a]
16A_0	0, 8, 10, 11, 12, 13, 14, 15, 16, 18, 20, 23, 27, 31, 36, 64
16B_0	0, 10, 12, 14, 17, 20, 23, 26, 29, 32, 36, 42, 50, 64, 92, 128
16M_0	0, 9, 14, 21, 30, 40, 52, 66, 80, 96, 114, 134, 155, 178, 202, 228
16A_14	14, 15, 16, 17, 18, 19, 20, 21, 23, 25, 27, 29, 31, 36, 64, 128
16B_14	14, 16, 18, 20, 22, 24, 26, 29, 32, 36, 40, 45, 50, 64, 92, 128

TABLE Ap.1.16. 16 channel options

Name	Lower bound of each channel[a]
16M_14	14, 19, 25, 32, 40, 49, 59, 70, 82, 96, 114, 134, 155, 178, 202, 228
16B_18	18, 20, 22, 24, 26, 28, 30, 32, 34, 37, 40, 45, 50, 64, 92, 128
16M_18	18, 24, 31, 38, 46, 54, 64, 76, 89, 103, 118, 134, 155, 178, 202, 230
16B_24	24, 26, 28, 30, 32, 34, 37, 40, 44, 50, 57, 66, 78, 96, 128, 175
16M_24	24, 31, 38, 46, 54, 64, 76, 89, 103, 118, 134, 152, 171, 191, 212, 234
16B_36	36, 38, 40, 42, 44, 47, 50, 54, 59, 65, 72, 80, 90, 104, 128, 175
16M_36	36, 43, 50, 58, 66, 75, 85, 96, 108, 121, 135, 152, 171, 191, 212, 234
16M_50	50, 55, 61, 68, 76, 85, 95, 106, 118, 131, 145, 161, 178, 196, 215, 236

a. The upper bound of each channel is one less than the next channel's lower bound. The last channel has an upper bound of 249.

TABLE Ap.1.17. 32 channel options

Name	Lower bound of each channel[a]
32B_0	0, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 39, 43, 48, 55, 63, 72, 82, 94, 114, 150
32M_0	0, 8, 10, 13, 16, 19, 23, 27, 31, 36, 41, 46, 52, 59, 66, 73, 80, 88, 96, 105, 114, 124, 134, 144, 155, 166, 178, 189, 202, 215, 228, 241
32B_14	14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 34, 36, 39, 43, 48, 55, 63, 72, 82, 94, 114, 150, 196
32M_14	14, 16, 18, 20, 23, 26, 30, 34, 38, 42, 47, 52, 58, 64, 70, 76, 83, 91, 99, 108, 117, 126, 136, 146, 156, 166, 178, 189, 202, 215, 228, 241
32B_18	18, 20, 22, 24, 26, 29, 32, 35, 39, 44, 49, 54, 59, 64, 70, 76, 83, 91, 99, 108, 117, 126, 136, 146, 156, 166, 178, 189, 202, 215, 228, 241
32M_18	18, 21, 24, 27, 30, 34, 38, 42, 46, 50, 55, 60, 65, 70, 75, 81, 87, 93, 100, 108,117, 126, 136, 146, 156, 166, 178, 189, 202, 215, 228, 241
32M_24	24, 27, 30, 34, 38, 42, 46, 50, 55, 60, 65, 70, 75, 81, 87, 93, 100, 108, 116, 124, 133, 142, 151, 160, 170, 180, 190, 200, 210, 220, 230, 240
32M_36	36, 39, 42, 45, 48, 51, 55, 59, 63, 67, 71, 75, 80, 85, 91, 97, 104, 111, 118, 125,133, 142, 151, 160, 170, 180, 190, 200, 210, 220, 230, 240
32M_50	50, 53, 56, 59, 63, 67, 71, 75, 79, 84, 89, 94, 99, 104, 109, 114, 119, 124, 130, 136, 143, 150, 158, 166, 175, 184, 193, 203, 213, 223, 233, 244

a. The upper bound of each channel is one less than the next channel's lower bound. The last channel has an upper bound of 249.

TABLE Ap.1.18. 64 channel options

Name	Lower bound of each channel[a]
64M_0	0, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 47, 50, 53, 56, 59, 62, 65, 68, 72, 76, 80, 84, 88, 92, 97, 102, 107, 112, 117, 122, 127, 132, 138, 144, 150, 156, 162, 168, 175, 182, 189, 196, 203, 210, 218, 226, 234, 244[b]
64M_14	14, 15, 16, 17, 18, 19, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 49, 52, 55, 58, 61, 64, 67, 70, 73, 76, 79, 82, 85, 88, 92, 96, 100, 104, 108, 112, 116, 120, 124, 128, 132, 136, 141, 146, 151, 156, 161, 166, 171, 176, 181, 186, 192, 198, 204, 211, 218, 226, 234, 244[b]
64M_18	18, 19, 20, 21, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 49, 52, 55, 58, 61, 64, 67, 70, 73, 76, 79, 82, 85, 88, 92, 96, 100, 104, 108, 112, 116, 120, 124, 128, 132, 136, 140, 145, 150, 155, 160, 165, 170, 175, 180, 185, 190, 195, 200, 205, 210, 215, 220, 226, 232, 238, 244[b]
64M_24	24, 25, 26, 27, 28, 29, 30, 31, 32, 34, 36, 38, 40, 42, 44, 46, 49, 52, 55, 58, 61, 64, 67, 70, 73, 76, 79, 82, 85, 88, 92, 96, 100, 104, 108, 112, 116, 120, 124, 128, 132, 136, 140, 145, 150, 155, 160, 165, 170, 175, 180, 185, 190, 195, 200, 205, 210, 215, 220, 226, 232, 238, 244, 250[c]
64M_36	36, 37, 38, 39, 40, 41, 42, 43, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 73, 76, 79, 82, 85, 88, 91, 94, 97, 100, 103, 106, 109, 112, 116, 120, 124,128, 132, 136, 140, 145, 150, 155, 160, 165, 170, 175, 180, 185, 190, 195, 200, 205, 210, 215, 220, 226, 232, 238, 244, 250[c]
64M_50	50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74, 76, 78, 80, 82, 84, 86, 88, 91, 94, 97, 100, 103, 106, 109, 112, 115, 118, 121, 124, 127, 130, 133, 136, 139, 142, 145, 148, 152, 156, 160, 164, 168, 172, 176, 180, 184, 188, 192, 196, 200, 204, 208, 212, 216, 220, 225, 230, 235, 240, 245, 250[c]

a. The upper bound of each channel is one less than the next channel's lower bound.

b. The last channel has an upper bound of 249.

c. The last channel has an upper bound of 254.

TABLE Ap.1.19. 128 channel options

Name	Lower bound of each channel[a]
128M_0	0, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74, 76, 78, 80, 82, 84, 86, 88, 90, 92, 94, 96, 98, 100, 102, 104, 106, 108, 110, 112, 114, 116, 118, 120, 122, 124, 126, 128, 130, 132, 134, 136, 139, 142, 145, 148, 151, 154, 157, 160, 163, 166, 169, 172, 175, 178, 181, 184, 187, 190, 193, 196, 199, 202, 205, 208, 211, 214, 217, 220, 223, 226, 229, 232, 236, 240, 245, 250
128M_14	14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 70, 72, 74, 76, 78, 80, 82, 84, 86, 88, 90, 92, 94, 96, 98, 100, 102, 104, 106, 108, 110, 112, 114, 116, 118, 120, 122, 124, 126, 128, 130, 132, 134, 136, 138, 140, 142, 144, 146, 148, 150, 152, 155, 158, 161, 164, 167, 170, 173, 176, 179, 182, 185, 188, 191, 194, 197, 200, 203, 206, 209, 212, 215, 218, 221, 224, 227, 230, 234, 238, 242, 246, 250

TABLE Ap.1.19. 128 channel options

Name	Lower bound of each channel[a]
128M_18	18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62,63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 76, 78, 80, 82, 84, 86, 88, 90, 92, 94, 96, 98, 100, 102, 104, 106, 108, 110, 112, 114, 116, 118, 120, 122, 124, 126, 128, 130, 132, 134, 136, 138, 140, 142, 144, 146, 148, 150, 152, 154, 156, 158, 161, 164, 167, 170, 173, 176, 179, 182, 185, 188, 191, 194, 197, 200, 203, 206, 209, 212, 215, 218, 221, 224, 227, 230, 234, 238, 242, 246, 250
128M_24	24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 82, 84, 86, 88, 90, 92, 94, 96, 98, 100, 102, 104, 106, 108, 110, 112, 114, 116, 118, 120, 122, 124, 126, 128, 130, 132, 134, 136, 138, 140, 142, 144, 146, 148, 150, 152, 154, 156, 158, 160, 162, 164, 167, 170, 173, 176, 179, 182, 185, 188, 191, 194, 197, 200, 203, 206, 209, 212, 215, 218, 221, 224, 227, 230, 233, 236, 239, 242, 245, 248, 250
128M_36	36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 98, 100, 102, 104, 106, 108, 110, 112, 114, 116, 118, 120, 122, 124, 126, 128, 130, 132, 134, 136, 138, 140, 142, 144, 146, 148, 150, 152, 154, 156, 158, 160, 162, 164, 166, 168, 170, 172, 174, 176, 178, 180, 182, 184, 186, 188, 191, 194, 197, 200, 203, 206, 209, 212, 215, 218, 221, 224, 227, 230, 233, 236, 239, 242, 245, 248, 250
128M_50	50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 108, 110, 112, 114, 116, 118, 120, 122, 124, 126, 128, 130, 132, 134, 136, 138, 140, 142, 144, 146, 148, 150, 152, 154, 156, 158, 160, 162, 164, 166, 168, 170, 172, 174, 176, 178, 180, 182, 184, 186, 188, 190, 192, 194, 196, 198, 200, 202, 204, 206, 208, 210, 212, 214, 216, 218, 220, 222, 224, 226, 228, 230, 232, 234, 236, 238, 240, 242, 244, 247, 250

a. The upper bound of each channel is one less than the next channel's lower bound.
The last channel has an upper bound of 254.

Ap.1.8 2 Event Analyzer Event Mode configurations

By using 2 event analyzers, each in event mode, it is possible to collect every non-coincident xenon event, labeled with its PCU and LLD, time stamp it with 1 µs resolution. and keep all 256 energy channels. This is done by having the first EA telemeter the 8 bit energy, a 3 bit PCU ID, and a 3 bit LLD code. The second EA will telemeter the PCU id and the time stamp. Ground software uses the time stamps and PCU id to match up the two events and produce a single event list FITS file.

There will be 2 readout time options. With the fast readout time of 2 s, data on up to 8000 cts/s may be collected without loss. At this maximum count rate the 2 EAs will generate 265 kbps. With the slow readout time of 16 s, data on up to 1000 cts/s may be collected. At this maximum count rate the 2 EAs will generate 32 kbps. The selection of these configurations will require 2 names be selected on the proposal form.

TABLE Ap.1.20. EDS event mode configuration using 2 EAs

Name	Readout Time	Maximum Telemetry	Maximum Event Rate
Good_Xenon1_2s, Good_Xenon2_2s	2 s	263 kbps	8,000
Good_Xenon1_16s, Good_Xenon2_16s	16 s	33 kbps	1,000

Ap.1.9 Transparent configurations

The transparent configurations are a set of 3 event mode configurations designed to make the EDS look like a straight wire. When running the transparent configurations, no anti-coincidence rejection of events is applied, making these configurations largely unsuitable for science. However, they are very useful for verification testing and diagnosing problems in the EDS and PCA. There are 3 transparent configurations. They are designed to be run in parallel on separate Event Analyzers. The first 2 transparent configurations may be run together to get all the bits from every event and a time stamp with 1 ms resolution. All three transparent configurations may be run together to get all the bits from every event and a time stamp with 1 µs resolution. The transparent configurations will have a selection of 4 readout times listed in Table 1.21, “,” on page 195. The slower readout times (> 16 s) will be used in snapshot mode so that up to 32,000 events may be collected in each readout, whereas the faster readout times (16 s or less) will collect up to 16,000 events in each readout.

TABLE Ap.1.21.

Name	Readout time	Maximum telemetry	Maximum Event Rate
Transparent1_4s, Transparent2_4s, Transparent3_4s	4 s	197 kbps	4000 cts/s
Transparent1_16s, Transparent2_16s, Transparent3_16s	16 s	49 kbps	1000 cts/s
Transparent1_128s, Transparent2_128s, Transparent3_128s	128	12.5 kbps	256 cts/s
Transparent1_1024s, Transparent2_1024s, Transparent3_1024s	1024	1.5 kbps	32 cts/s

Ap.1.10 Event Burst Catcher Mode configurations

The Event Burst Catcher mode works by capturing 33,767 events plus time markers every time a trigger signal is received. If the trigger is high-priority the data will be immediately transferred to the S/C. If the trigger is low-priority, then the data is stored and only the data for the last trigger of each EA run is sent to the S/C.

TABLE Ap.1.22. EDS Burst Catcher Event Mode configurations

Name	Time	# PH channels	Type	Time mark Interval
CE_1us_1M_0	1 µs	1	PCU	4 ms
CE_1us_4X_0	1 µs	4[a]		8 ms
CE_2us_8X_0	2 µs	8[b]		8 ms
CE_4us_16X_0	4 µs	16[c]		8 ms
CE_8us_32X_0	8 µs	32[d]		8 ms
CE_16us_64M_0	16 µs	64[e]		8 ms
CE_31us_16X_0	31 µs	16[c]	PCU	8 ms
CE_16us_32M_0	62 µs	32[d]	PCU	8 ms
CE_125us_64M_0	125 µs	64[e]	PCU	8 ms
CE_250us_128M_0	250 µs	128[f]	PCU	8 ms
CE_500us_64M_0	500 µs	64[e]	PCU, LLD	8 ms
CE_1ms_128M_0	1 ms	128[f]	PCU, LLD	8 ms
CE_GoodXenon{1&2}[g]	1 µs	256	PCU, LLD	8 ms

a. The energy boundary options are the same as E_1us_4X_0_1s, (Table 1.14, “Four channel options,” on page 190)

b. The energy boundary options are the same as E_2us_8X_0_1s, (Table 1.15, “Eight Channel Options,” on page 191)

c. The energy boundary options are the same as E_4us_16X_0_1s, (Table 1.16, “16 channel options,” on page 191)

d. The energy boundary options are the same as E_8us_32X_0_1s, (Table 1.17, “32 channel options,” on page 192)

e. The energy boundaries are the same as E_16us_64M_0_1s, (Table 1.18, “64 channel options,” on page 193)

f. The energy boundaries are the same as E_250us_128M_0_1s, (Table 1.19, “128 channel options,” on page 193)

g. Requires 2 event analyzers for the catcher.

Ap.1.11 Binned Burst Catcher Mode Configurations

The following are examples of Binned Burst Catcher configurations. This mode is most useful for catch bursts that contain more than 32,000 events and for catching bursts of sources with significant persistent emission. For sources with little or no persistent emission and peak count rates in the burst of less than 16,000 counts/s, a continuous event mode configuration (see Section Ap.1.7) is the best way to catch bursts. The binned burst catcher must be run with a synchronous burst trigger configuration, which means the trigger and catcher configurations must both have the same interval duration. The binned burst catcher mode will provide 1 interval of data prior to the time of the initial high-priority trigger assertion, and 2 intervals of data following the final high-priority trigger assertion. If a low-priority trigger is received, 4 intervals of data will be saved on-board, overwriting any previously captured data. Upon receipt of a "terminate" command, this captured data is telemetered to the ground.

TABLE Ap.1.23. Binned Burst Catcher Configurations

Name	TimeBin	Interval Duration	Number channels	Bits/bin	Peak Telem.	Max Count rate
CB_2ms_64M_0_249	2 ms	0.25 s	64	8,4	200	350,000
CB_1ms_32X_0_249	1 ms	0.25 s	32	8,4	200	350,000
CB_500us_16X_0_249_Q	500 µs	0.25 s	16	4	133	100,000
CB_250us_8X_0_249_Q	250 µs	0.25 s	8	4	133	100,000
CB_125us_4X_0_249_Q	125 µs	0.25 s	4	4	133	100,000
CB_64us_2X_0_249_Q	64 µs	0.25 s	2	4	133	100,000
CB_32us_1M_0_249_Q	32 µs	0.25 s	1	4	133	100,000
CB_8ms_64M_0_249_H	8 ms	1 s	64	8	67	350,000
CB_4ms_32X_0_249_H	4 ms	1 s	32	8	67	350,000
CB_2ms_16x_0_249_H	2 ms	1 s	16	8	67	350,000
CB_1ms_8x_0_249_H	1 ms	1 s	8	8	67	350,000
CB_500us_4x_0_249_H	500 µs	1 s	4	8	67	350,000
CB_250us_2x_0_249_H	250 µs	1 s	2	8	67	350,000
CB_125us_1M_0_249_H	125 µs	1 s	1	8	67	350,000
CB_32ms_64M_0_249	32 ms	4 s	64	16,8	24	350,000
CB_16ms_32X_0_249	16 ms	4 s	32	16,8	24	350,000
CB_8ms_16x_0_249_H	8 ms	4 s	16	8	16	250,000
CB_4ms_8X_0_249_H	4 ms	4 s	8	8	16	250,000
CB_2ms_4X_0_249_H	2 ms	4 s	4	8	16	250,000
CB_1ms_2X_0_249_H	1 ms	4 s	2	8	16	250,000
CB_500us_1M_0_249_H	500 µs	4 s	1	8	16	250,000

TABLE Ap.1.23. Binned Burst Catcher Configurations

Name	TimeBin	Interval Duratio n	Number channels	Bits/bin	Peak Telem.	Max Count rate
CB_125ms_64M_0_249_F	125 ms	16 s	64	16	8	350,000
CB_64ms_32X_0_249_F	64 ms	16 s	32	16	8	350,000
CB_32ms_16X_0_249_F	32 ms	16 s	16	16	8	350,000
CB_16ms_8X_0_249_F	16 ms	16 s	8	16	8	350,000
CB_8ms_4X_0_249_F	8 ms	16 s	4	16	8	350,000
CB_4ms_2X_0_249_F	4 ms	16 s	2	16	8	350,000
CB_2ms_1X_0_249_F	2 ms	16 s	1	16	8	350,000

Ap.1.12 Burst Trigger configurations

Ap.1.12.1 High Priority Burst Triggers

The following high-priority trigger configurations are available for GO use. When using these triggers every triggered data set will be captured for each run, subject to the bandwidth limitations between the S/C and EDS. All of these configurations will trigger HEXTE. All of these configurations will use a single energy band covering channels 10-249.

TABLE Ap.1.24. High-priority burst trigger configurations.

Name	Trigger	Interval Duration	Time bin	Energy Channel.	Trigger Threshold
TLA_250ms_10_249_250ms_100_FN	Level	0.25 s	0.25 s	1	100 cts/bin
TLA_250ms_10_249_250ms_200_FN	Level	0.25 s	0.25 s	1	200 cts/bin
TLA_250ms_10_249_250ms_500_FN	Level	0.25 s	0.25 s	1	500 cts/bin
TLA_250ms_10_249_250ms_1000_FN	Level	0.25 s	0.25 s	1	1000cts/bin
TLA_250ms_10_249_250ms_2000_FN	Level	0.25 s	0.25 s	1	2000cts/bin
TLA_250ms_10_249_250ms_5000_FN	Level	0.25 s	0.25 s	1	5000cts/bin
TLA_1s_10_249_1s_500_F	Level	1 s	1 s	1	500 cts/bin
TLA_1s__10_249_1s_1000_F	Level	1 s	1 s	1	1000 cts/s
TLA_1s__10_249_1s_2000_F	Level	1 s	1 s	1	2000 cts/s
TLA_1s__10_249_1s_5000_F	Level	1 s	1 s	1	5000 cts/s
TLA_1s__10_249_1s_10000_F	Level	1 s	1 s	1	10000 cts/s
TLA_1s__10_249_1s_20000_F	Level	1 s	1 s	1	20000 cts/s
TLA_4s_10_249_4s_100_F	Level	4 s	0.25 s	1	100 cts/bin

TABLE Ap.1.24. High-priority burst trigger configurations.

Name	**Trigger**	Interval Duration	Time bin	Energy Channel.	Trigger Threshold
TLA_4s_10_249_4s_200_F	Level	4 s	0.25 s	1	200 cts/bin
TLA_4s_10_249_4s_500_F	Level	4 s	0.25 s	1	500 cts/bin
TLA_4s_10_249_4s_1000_F	Level	4 s	0.25 s	1	1000cts/bin
TLA_4s_10_249_4s_2000_F	Level	4 s	0.25 s	1	2000cts/bin
TLA_4s_10_249_4s_5000_F	Level	4 s	0.25 s	1	5000cts/bin
TLA_16s_10_249_4s_100_F	Level	16 s	0.25 s	1	100 cts/bin
TLA_16s_10_249_4s_200_F	Level	16 s	0.25 s	1	200 cts/bin
TLA_16s_10_249_4s_500_F	Level	16 s	0.25 s	1	500 cts/bin
TLA_16s_10_249_4s_1000_F	Level	16 s	0.25 s	1	1000cts/bin
TLA_16s_10_249_4s_2000_F	Level	16 s	0.25 s	1	2000cts/bin
TLA_16s_10_249_4s_5000_F	Level	16 s	0.25 s	1	5000cts/bin

Ap.1.12.2 Low Priority Burst Trigger configurations

The following low-priority trigger configurations are available for GO use. When using these triggers only one triggered data set will be captured for each EA run. None of these configurations will trigger HEXTE. Five of the configurations utilize level triggers (TL), 2 utilize hardness ratio triggers (TH), and two utilize edge triggers (TE).

TABLE Ap.1.25. Low-priority burst trigger configurations.

Name	**Trigger**	**Interval Duration**	**Time bin**	**Energy Channel.**	**Telemetry (bits/s)**
TLM_31us_0_249_500ms_QN	Level	0.5 s	31 µs	1	544
TLM_125us_0_249_2s_QN	Level	2 s	125 µs	1	136
TLM_1ms_0_249_2s_HN	Level	2 s	1 ms	1	136
TLM_4ms_0_249_1s_HN	Level	1 s	4 ms	1	272
TLM_31ms_0_249_8s_F	Level	8 s	31 ms	1	564
THM_4ms_0_14_249_1s_HN	Hardness	1 s	4 ms	2	272
THM_31ms_0_14_249_1s_F	Hardness	8 s	31 ms	2	564
TEM_4ms_0_249_1s_HN	Edge	1 s	4 ms	1	272
TEM_31ms_0_249_8s_F	Edge	8 s	31 ms	1	564

Ap.1.13 Single-Bit mode Configurations

The single-bit mode is used to provide a time series for 1 energy band per EA. To the guest observer single-bit mode data will look just like binned data. One advantage of single-bit mode is that the individual bins can not overflow.

Single-bit mode generates a 0 for every clock tick and a 1 for every event. The total telemetry rate is the sum of the clock tick rate and the event tick rate. So a source producing 3000 cts/s in the selected energy channel, when observed with a 0.25 ms single bit mode, would generate 7 kbps.

Single-bit mode operates with a buffer of 64k bits, which may be filled with either events or clock ticks. If a total of more than 64k events and clock ticks are seen within one readout time, data gaps will occur. If the buffer fills, a count of the number of events that were dropped is maintained.

The naming convention for single-bit mode configurations is SB_ttt_ll_hh_R, where ttt is the time bin size, ll and hh are the lower and upper boundaries of the selected energy band and R is the readout time.

Table 1.26, “Single-Bit configurations,” on page 200 lists the time bins available for single bit mode configurations. Table 1.27, “Lower and upper bounds (keV) for the energy channels for Single-bit configuration,,” on page 200list the available energy channels that may be selected. A single-bit mode configuration is specified by a time bin from Table 1.26, “Single-Bit configurations,” on page 200and an energy band from Table 1.27, “Lower and upper bounds (keV) for the energy channels for Single-bit configuration,,” on page 200. Pulse height corrections are applied to these channel boundaries.

TABLE Ap.1.26. Single-Bit configurations

Time Bin	Clock Rate	Readout Time	Maximum Rate (cts/s)
0.5 ms	2 kHz	2 s	30,000
0.25 ms	4 kHz	2 s	28,000
125 µs	8 kHz	1 s	54,000
62 µs	16 kHz	0.5 s	112,000
31 µs	32 kHz	0.5 s	96,000

TABLE Ap.1.27. Lower and upper bounds (keV) for the energy channels for Single-bit configuration,

Lower Energy (keV)	Upper Energy (keV)
0	3.0
0	4.0
0	5.4
0	8.2
0	11.7

TABLE Ap.1.27. Lower and upper bounds (keV) for the energy channels for Single-bit configuration,

Lower Energy (keV)	Upper Energy (keV)
0	58.4
3.0	4.0
3.0	5.4
3.0	8.2
3.0	11.7
3.0	58.4
4.0	5.4
4.0	8.2
4.0	11.7
4.0	58.4
5.4	8.2
5.4	11.7
5.4	58.4
8.2	11.7
8.2	58.4

Ap.1.14 FFT Mode configurations

The FFT mode works on two time series, each containing 256 points. Normally the two time series give counts as a function of time for two energy bands. The FFT mode works by first binning the data, with a prescale, into the two time series. Second, the mean of each time series is calculated, stored and subtracted from each time series. Third, the FFT is calculated with one time series in the real part and the other in the complex part. Fourth, the two Power Density Spectra (PDS) and Cross Spectra (CS) are calculated. The PDS and CS are summed up over a readout time. Dead time results since data is only collected during the first step. The data products produce by FFT mode are:

- summed PDS of band 1 (129 points)
- summed PDS of band 2 (129 points)
- summed CS between bands 1 and 2
- series of means for band 1
- series of means for band 2.

All the binning, mean subtraction, and FFT calculations are performed using 16-bit integers. There is no padding of the binned data, all 256 points are filled, and a 256 point FFT is performed. The minimum time interval for binning data (step 1 above) is 4ms, which results in extra dead time for time bins less than 15 us. The time needed for the other steps is 12ms.

The FFT requires at least 2 photons per time series to get a useful signal. Thus to effectively use the 1 μs time bins, one would like at least 2 photons per channel per 0.25 ms (256 x 1 μs time bins), which is ~16,000 cts/s, assuming the channels are chosen to split the counts equally. There is also a maximum count rate, due to the prescale, and 16-bit integer calculations.

In choosing an FFT mode the guest observer selects a time bin size (Table 1.28, “Time bin and readout time option for FFT configurations,” on page 202) and a set of channel boundaries (Table 1.29, “Energy channel boundaries for FFT configurations,” on page 202). The naming convention for FFT mode is:

F_ttt_l_m_h_r,

where ttt is the time bin size, l is lower bound of the lower energy channel, m is the upper bound of the lower channel and the lower bound of the upper channel, h is the upper bound of the upper channel, and r is the readout time. For example:

F_500us_0_12_249_64s

represents an FFT mode with 500 us time bins, which the 2 energy channels being 0 - 3.0 keV and 3.0 - 62.5 keV and a readout time of 64 s.

TABLE Ap.1.28. Time bin and readout time option for FFT configurations

Time Bin Size	Dead Time	Readout Time	Prescale	Telem. (kbps)	Max Rate (cts/s)
1 μs	98%	16s	8192	3.4	500,000
4 μs	93%	16s	8192	3.4	500,000
8 μs	86%	16 s	8192	3.4	500,000
16 μs	72%	16 s	8192	3.4	250,000
31 μs	56%	16 s	4096	2.9	250,000
62μs	38%	16 s	4096	2.3	125,000
125 μs	24%	16 s	4096	1.8	64,000
500 μs	7%	64 s	2048	0.5	32,000
4 ms	1%	64 s	1024	0.3	8,000

TABLE Ap.1.29. Energy channel boundaries for FFT configurations

Channel 1	Channel 2
0-11	12-249
0-13	14-249

TABLE Ap.1.29. Energy channel boundaries for FFT configurations

Channel 1	Channel 2
0-17	18-249
0-23	24-249