PCA Housekeeping - Text and Graphics Display Screens Design

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PCA-HK-DES-V4.5

This document illustrates the design of text and graphics display screens for the PCA Housekeeping.

1.0 Introduction

PCA Text and Graphics screens display the spacecraft housekeeping information. Text display screen is the most basic form of display for the incoming telemetry values. It is a table of ascii legends with their associated parameters which are decoded to physical values. Graphics screen is the dynamic display of real time data or data from an update period in the past.

2.0 Requirements

Design of these screens is based on the document "PCA Housekeeping - Status, Use, Screen Functions, Recall Modes, SOC Interface" Barry Giles.

2.1 Text Mode Requirements

HealthnSafety.1 *Show a text "detector screen" display for each PCU that presents ALL its housekeeping parameters in a structured layout (very little diagnostic information included).*

Response Individual detector information screens are provided for each PCU. The screens provide a complete summary snapshot of the state of the detectors and they all have identical screen appearance. See Section 6.1.1 on page 6.

HealthnSafety.2 *Show several types of the text "Combined Screens" that list groups of information from all five detectors at the same time for ease of comparison.*

Response Several types of possible combined text screens are provided. These screens allow easy comparison of selected groups of parameters between all 5 PCU's at the same time. See Section 6.1.2 on page 7.

HealthnSafety.3 *Show a single "Combined Screen" that presents only RIF diagnostic sub frame information.*

Response A combined RIF diagnostic text screen is provided displaying the diagnostic information of all the 5 PCU's.

HealthnSafety.4 *Be able to do printouts (screen dumps) of a selected table. - "snapshot records".*

Response A selected text screen can be sent to the printer or to a file.

2.2 Graphics Mode Requirements

HealthnSafety.5 *Be able to select any parameter for graphical display.*

Response Single parameter graphs can be plotted against time.

HealthnSafety.6 *Suitable axes legend to be provided in a table. Scale factors on X & Y (X is normally time) to be calculated from the span selected or from the parameter conversion table.*

Response

HealthnSafety.7 *Be able to select any combination of parameters for graphical display.*

Response There will be no upper limit but normally only a few (<6) parameters at one time will be plotted on the same graph.

HealthnSafety.8 *Provide multiple graphs on screen*

Response

HealthnSafety.9 *Be able to do printouts (screen dumps) of selected graphs.*

Response A selected graphical screen can be sent to the printer or to a file.

3.0 Build Deliveries

- A Design Document that describes the detail architecture of the software component.
- A User's Guide that describes normal operation of the software.
- A Test Plan describing the procedures to follow for testing the software.

4.0 Operating Scenarios

During the mission, certain housekeeping data, crucial to health and safety of instruments and spacecraft, will be constantly monitored with limit checking. Real-time telemetry data will be displayed in text format and also as a strip chart. The format of the housekeeping and status information returned from each detector in the PCA looks identical. The detector the packet refers to can be identified by the application ID (APid) number contained within the CCSDS packet header. The Spacecraft will sample a group of 5 housekeeping packets (one for each detector) every 8 seconds. Since there are no multiplexed or sub-multiplexed channels all data values will be updated at the same time on the ground every 8 seconds ignoring data gaps or downlink bursts following breaks in reception.

Each detector in the PCA has a remote Interface (RIF) box that controls the execution of received commands and also outputs housekeeping information to the spacecraft (SC).

The SC builds up a full picture of the PCA status by interrogating a string of sub addresses in the RIF and storing the returned data words. All this information is then converted to the CCSDS packets and returned to Earth by the spacecraft telemetry system

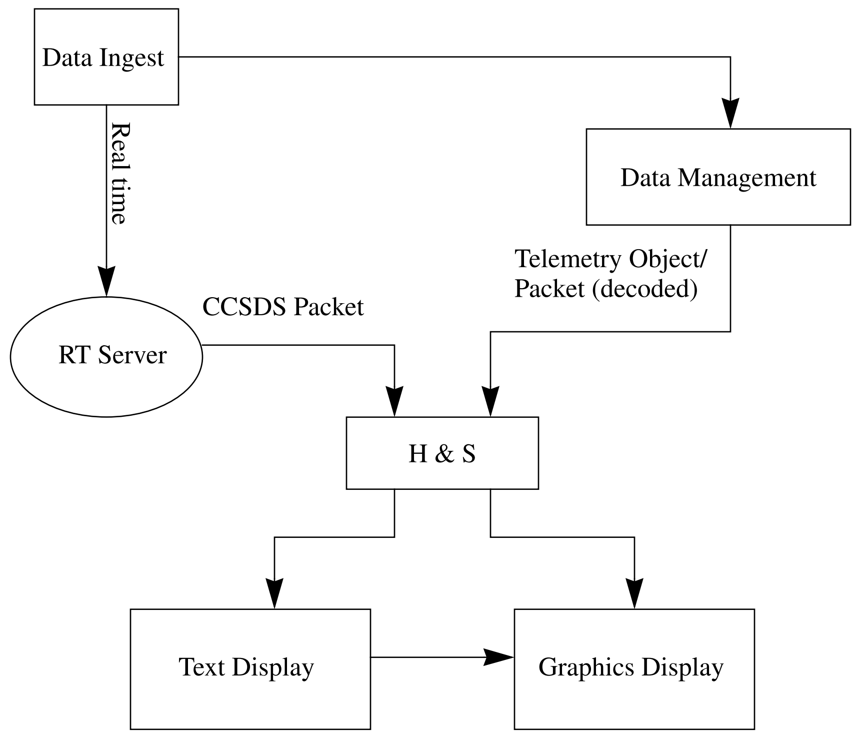
- The eight count rates returned in the housekeeping which are used by the High Rate Monitor (HRM) are obtained from the RIF using sub address 16.
- The six additional count rates returned in the housekeeping which are not used by the High Rate Monitor (HRM) are obtained from the RIF using sub address 17.
- The status of commands received by each RIF/PCU are available through sub address 18.
- Each detector has a number of analog channels that monitor various parameters using sub address 19.
- Each detector has some diagnostic information available on sub address 29.
- The exterior of each detector body has 4 thermistors mounted on it that are measured by the spacecraft system and not by the RIF box. The thermistors are termed A1, A2 & B1, B2 for each detector.

5.0 Open issues

- Do we need to be able to plot one parameter against another in H&S?
- What kind of plots should we need? histograms or point to point plots?

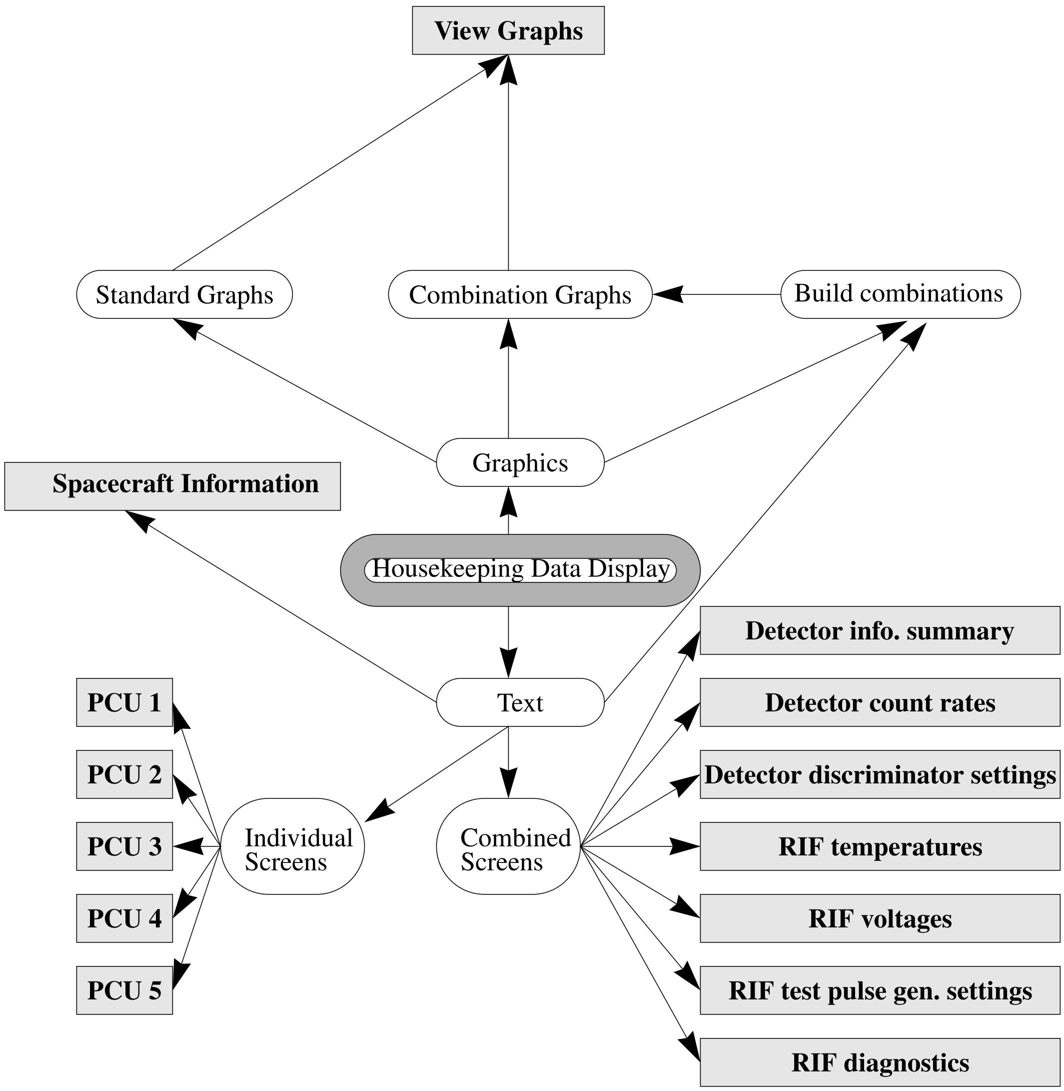
6.0 Design Architecture

Only *Data Ingest* subsystem may access the real-time telemetry stream and all other subsystems will get the data from DBMS, which will deliver MDOs to the analysis. Original design of the H&S honored this agreement, and true real-time monitoring was omitted. Since then, design of this subsystem has been evolved to monitor two phases of the data stream, real-time and stored production data, where real-time is mainly for monitoring, and production data for the trend calculation. Main portion of the functionality for the two streams of data is identical except input data communication from the server. Telemetry data will be displayed in two modes; Text and Graphics. Both data streams are used for the display in each of these two modes. Default time sample displayed in Text and Graphics mode is the latest incoming data from the real-time server.



The Health and Safety Monitoring subsystem constantly monitors housekeeping of all the instruments in the spacecraft including PCA instrument. PCA housekeeping displays information in Text and Graphics modes. Text mode contains a list of standard screens defined later in this document. All these screens display the information in physical engineering units obtained from the conversion tables and the raw data. An option is available to see the raw data also. The display time sample will be either the latest data (default setting) or the data obtained from an update moment in the past.

Graphics display is a plot of values of a parameter vs. time. Parameters that are available for plotting are given later in this document. Items to be plotted can consist of combination of parameters or individual parameters. User can build his own combinations containing several parameters (combination graph). These combinations can be named and can be shown on selection menu. All the graphs can be set to active or dormant mode. Active graphs can either display incoming data as a strip chart or show a defined time span from the local history. There are number of graphs that can be considered to be standard features that will always be active. These are defined at the end of this document.


View Graphs
Standard Graphs
Combination Graphs
Build combinations
Graphics
Spacecraft Information
Housekeeping Data Display
Detector info. summary
Text
Detector count rates
PCU 1
PCU 2
Detector discriminator settings
Individual Screens
Combined Screens
PCU 3
RIF temperatures
PCU 4
RIF voltages
PCU 5
RIF test pulse gen. settings
RIF diagnostics

6.1 Text Display Screens

The most basic form of display for incoming telemetry values is to produce a table that combines ascii legends with their associated parameters which are decoded to physical values. A series of “standard screens” can be displayed for the PCA experiment. Mainly there are two groups of screens. 1) Main individual detector information screens, 2) Combined text screens for detectors 1 to 5

6.1.1 Full Detector Information Screens:

There are five of identical screens, each will provide a complete summary “snap shot” of the state of an individual detector. Menu options will select which of the 5 PCU’s is displayed.

DETECTOR INFO	RATES (HRM)	DISCRIMINATORS	TEMPERATURES
Pr HV cmd	L1	L1	RIF
Pr expected HV (V)	R2	R1	ADC
Pr measured HV (V)	L2	L2	CSA
Pr pressure torr	R2	R2	SA
Pr HV relay on/off	L3	L3	TPG
Pr HV on/off	R3	R3	LVPS
Xe HV cmd	VP	VP	HVPS
Xe expected HV (V)	VX	VX	Det A1
Xe measured HV (V)		Alpha	Det A2
Xe pressure torr	HRM	VLE window	Det B1
Xe HV relay on/off			Det B2
Xe HV on/off			
LVPS relay on/off	RATES	TPG	VOLTS
Select A/B	VP vle	L1	+12V LVPS
ADC dither on/off	XE vle	R1	-12V LVPS
Override rate veto	VX vle	L2	+6V LVPS
HV inhibit - rate veto	Alpha	R2	-6V LVPS
Override 1 pps veto	2 or more	L3	+12V RIF
HV inhibit - 1 pps veto	XE good	R3	-12V RIF
Override HRM veto		VP	+5V RIF
HV inhibit - HRM veto		VX	
HRM Flag		Alpha	
HRM for last 2 intervals		TPG Mode	
HRM for last interval		TPG Enable	

6.1.2 Combined Text Screens

There are several types of possible combined text screens which allow easy comparison of selected groups of parameters between all 5 PCU's at the same time. It is possible that the MET time stamp in each PCU packet may be different if data has been lost, arrives out of sequence or arrives late.

Detector Information Summary Screen: These parameters are obtained from several sub addresses and summarize the specific detector setup except for the discriminator settings.

DETECTORS	PCU 1	PCU 2	PCU 3	PCU 4	PCU 5
Pr HV cmd	1100	1100	1100	1100	1100
Pr expected HV (V)	2800	2800	2800	2800	2800
Pr measured HV (V)	2795	2795	2795	2795	2795
Pr pressure torr	798	798	798	798	798
Pr HV relay on/off	ON	ON	ON	ON	ON
Pr HV on/off	ON	ON	ON	ON	ON
Xe HV cmd	1000	1000	1000	1000	1000
Xe expected HV (V)	2050	2050	2050	2050	2050
Xe measured HV (V)	2048	2048	2048	2048	2048
Xe pressure torr	845	845	845	845	845
Xe HV relay on/off	ON	ON	ON	ON	ON
Xe HV on/off	ON	ON	ON	ON	ON
LVPS relay on/off	ON	ON	ON	ON	ON
Select A/B	A	A	A	A	A
ADC dither on/off	ON	ON	ON	ON	ON
Override rate veto	Active	Active	Active	Active	Active
HV inhibit - rate veto	Triggered	Triggered	Triggered	Triggered	Triggered
Override 1 pps veto	Active	Active	Active	Active	Active
HV inhibit - 1 pps veto	-	-	-	-	-
Override HRM veto	Inactive	Inactive	Inactive	Inactive	Inactive
HV inhibit - HRM veto	-	-	-	-	-
HRM Flag	ON	ON	ON	ON	ON
HRM for last 2 intervals	YES	YES	YES	YES	YES
HRM for last interval	YES	YES	YES	YES	YES

<u>Detector Count Rates</u>: These will be shown as integers in counts per second so the returned telemetry rates must be divided by 8. The rates shown below are typical background rates.

RATES C/SEC	PCU 1	PCU 2	PCU 3	PCU 4	PCU 5
L1	10.0	10.0	10.0	10.0	10.0
R1	10.0	10.0	10.0	10.0	10.0
L2	5.0	5.0	5.0	5.0	5.0
R2	5.0	5.0	5.0	5.0	5.0
L3	5.0	5.0	5.0	5.0	5.0
R3	5.0	5.0	5.0	5.0	5.0
VP	200.0	200.0	200.0	200.0	200.0
VX	200.0	200.0	200.0	200.0	200.0
HRM value	8192.0	8192.0	8192.0	8192.0	8192.0
VP vle	15.0	15.0	15.0	15.0	15.0
XE vle	15.0	15.0	15.0	15.0	15.0
VX vle	20.0	20.0	20.0	20.0	20.0
Alpha	150.0	150.0	150.0	150.0	150.0
2 or more	20.0	20.0	20.0	20.0	20.0
XE good	50.0	50.0	50.0	50.0	50.0

<u>Detector Discriminator Settings</u>: These are shown in two bit binary form.

DISCR.	PCU 1	PCU 2	PCU 3	PCU 4	PCU 5
L1	11	11	11	11	11
R1	11	11	11	11	11
L2	10	10	10	10	10
R2	10	10	10	10	10
L3	01	01	01	01	01
R3	01	01	01	01	01
VP	11	11	11	11	11
VX	10	10	10	10	10
Alpha	10	10	10	10	10
VLE window	01	01	01	01	01

RIF & Detector Temperatures: These will be shown to a resolution of 0.1 degrees C.

Temperature C	PCU 1	PCU 2	PCU 3	PCU 4	PCU 5
RIF box	20.0	20.0	20.0	20.0	20.0
ADC box	15.3	15.3	15.3	15.3	15.3
CSA box	-4.3	-4.3	-4.3	-4.3	-4.3
SA box	5.5	5.5	5.5	5.5	5.5
TPG box	2.3	2.3	2.3	2.3	2.3
LVPS box	19.9	19.9	19.9	19.9	19.9
HVPS box	21.5	21.5	21.5	21.5	21.5
Detector A1	20.6	20.6	20.6	20.6	20.6
Detector A2	19.9	19.9	19.9	19.9	19.9
Detector B1	21.5	21.5	21.5	21.5	21.5
Detector B2	21.1	21.1	21.1	21.1	21.1

RIF voltages: These will be shown in Volts to a resolution of 0.01V.

Voltages V	PCU 1	PCU 2	PCU 3	PCU 4	PCU 5
+12V LVPS	12.04	12.04	12.04	12.04	12.04
-12V LVPS	-12.03	-12.03	-12.03	-12.03	-12.03
+6 LVPS	5.96	5.96	5.96	5.96	5.96
-6 LVPS	-6.01	-6.01	-6.01	-6.01	-6.01
+12V RIF	12.04	12.04	12.04	12.04	12.04
-12V RIF	-11.97	-11.97	-11.97	-11.97	-11.97
+5V RIF	5.01	5.01	5.01	5.01	5.01
spare	-	-	-	-	-

RIF Test Pulse Generator Settings: These are simply as ON or OFF.

TPG	PCU 1	PCU 2	PCU 3	PCU 4	PCU 5
L1	OFF	OFF	OFF	OFF	OFF
R1	ON	ON	ON	ON	ON
L2	OFF	OFF	OFF	OFF	OFF
R2	OFF	OFF	OFF	OFF	OFF

TPG	PCU 1	PCU 2	PCU 3	PCU 4	PCU 5
L3	OFF	OFF	OFF	OFF	OFF
R3	OFF	OFF	OFF	OFF	OFF
VP	OFF	OFF	OFF	OFF	OFF
VX	OFF	OFF	OFF	OFF	OFF
Alpha	OFF	OFF	OFF	OFF	OFF
TPG Mode	MONO	MONO	MONO	MONO	MONO
TPG Enable	YES	YES	YES	YES	YES

RIF Diagnostics: This screen will only be used for monitoring tests on the RIF boxes if a problem is suspected.

Diagnostics	PCU 1	PCU 2	PCU 3	PCU 4	PCU 5
rate chip # 1	2334	2334	2334	2334	2334
selected N chip # 1	Xe L1 *	Xe L1	Xe L1	Xe L1	Xe L1
chip # 1 test bit	1	1	1	1	1
chip # 1 status	Enabled	Enabled	Enabled	Enabled	Enabled
rate chip # 2	1021	1021	1021	1021	1021
selected N chip # 2	Xe vle *	Xe vle	Xe vle	Xe vle	Xe vle
chip # 2 test bit	1	1	1	1	1
chip # 2 status	Enabled	Enabled	Enabled	Enabled	Enabled
clock speed	125 KHz	125 KHz	125 KHz	125 KHz	125 KHz
gate control chip # 1	1	1	1	1	1
gate control chip # 2	1	1	1	1	1
status select N	5	5	5	5	5
last cmd LS byte	A7	A7	A7	A7	A7
1 pps timeout det.	NO	NO	NO	NO	NO
rate r/o timeout det.	NO	NO	NO	NO	NO
waiting for 1 pps	YES	YES	YES	YES	YES
HRM last 2 rates	NO	NO	NO	NO	NO
HRM last rate	NO	NO	NO	NO	NO

6.2 Graphics Display Screens

The following tables provide summaries of the parameters available for plotting (main & diagnostic) for a single PCU.

Main Parameter Type	Type of information	No. of parameters
detector count rates + HRM setting	24 bit	15
temperatures	12 bit	8
voltages	12 bit *	8
detector HV & pressure for Xe & Pr	12 bit *	4
detector HV command for Xe & Pr	4 bit *	2
detector disc. levels	2 bit	10
detector state monitors + dither	1 bit	20
TPG options	1 bit	11
RIF diagnostics	various items see below	18
spacecraft detector temperatures	8 bit	4

* denotes conversion parameters to be applied

The diagnostic parameters also need to be accessible in the same way. Since they will seldom if ever be needed they are detailed in a separate table.

RIF Diagnostics Parameter Type	Type of information	No. of parameters
chip #1 & #2 count rates	24 bit	2
select chip #1 & #2 counter reg. N	4 bit	2
last command	8 bit	1
select N	3 bit	1
status / mode bits	1 bit	12

6.2.1 Standard Graphics Screens

There are a number of graphs that can be considered to be standard features that will always be active.

- The 5 evXEgood (xenon good events) count rates - one for each PCU
- The sum of the 5 Xegood rates
- The 5 evVX (xenon veto layer) count rates - one for each PCU
- The sum of the 5 evVX rates

These could be shown conceptually in the following way where each block represents a complete graph.

Xe good PCU 1	VX PCU 1
Xe good PCU 2	VX PCU 2
Xe good PCU 3	VX PCU 3
Xe good PCU 4	VX PCU 4
Xe good PCU 5	VX PCU 5
Xe good PCU 1+2+3+4+5	VX PCU 1+2+3+4+5