

Display and Graphics Commonality Standard

International Space Station Program

January 30, 2001 Baseline



*Russian
Space
Agency*



Canadian Space
Agency

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National Aeronautics and Space Administration
Space Station Program
Johnson Space Center
Houston, Texas



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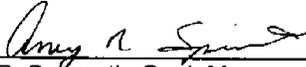
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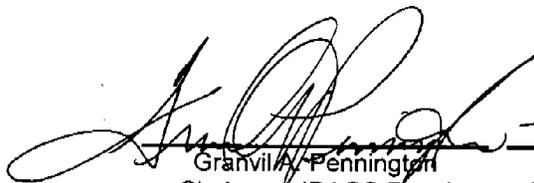
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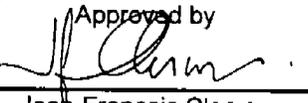
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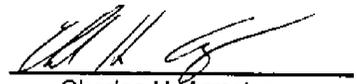
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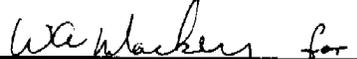

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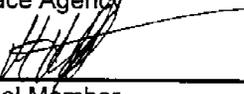

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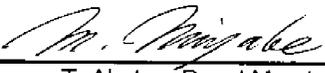

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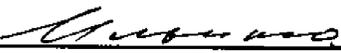

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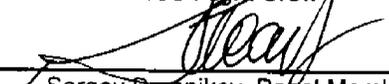

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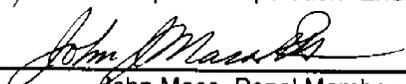

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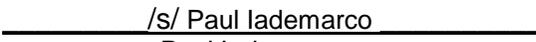

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REVISION AND HISTORY PAGE

REV.	DESCRIPTION	PUB. DATE
Version A	Initial draft.	
Version B	Initial IDAGS Panel Release. Sections 1-4 approved by all IPs.	23 March 1998
Version C	Extensive reformatting with a view toward more clearly stating the intended standard and including the identified differences of the IPs.	Jan 1999
Version D	Major editorial change to Section 4.	30 April 1999
Version E	Editorial changes to all Sections.	25 Aug 1999
Version F	Incorporates baselined sections changes agreed to at Jan 2000 IDAGS Multilateral Panel meeting.	28 Jan 2000
-	Initial Release (Reference per SSCD 004248 R1, EFF. 08/03/01) Incorporates completed Action Items from Jan 2000 IDAGS Multilateral Panel meeting and changes agreed to at the Jan 2001 IDAGS Multilateral Panel meeting. January 31, 2001 document signatures are supplemented by SSCD 004248R1 approval signatures.	12-06-01

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DGCS Status

Following is a summary of the major changes made to the DGCS since January 2000 and the latest technical change date. Sections of the DGCS are either: approved and baselined, proposal submitted for review, or in work.

Section	Status	Date
Section 1, Introduction	Baselined and agreed to by all IPs.	28 Jan 00
Section 2, Applicable Documents	Baselined and agreed to by all IPs. Format updated to SSP Standard for web access to the most recent versions.	22 Nov 00
Section 3, Display and Graphic Development Operational Concept	Baselined and agreed to by all IPs.	28 Jan 00
Section 4, Layout	Baselined and agreed to by all IPs.	11 Apr 00
Section 5, Display Organization and Hierarchy	Baselined and agreed to by all IPs.	11 Apr 00
Section 6, Operations Nomenclature, ODF Procedures and Displays	Actions still in work.	30 Apr 99
Section 7, Use of Symbols, Graphics, and Icons	Baselined and agreed to by all IPs. New proposal submitted.	28 Jan 00
Section 8, Command Window	Baselined and agreed to by all IPs.	28 Jan 00
Section 9, Station Moding	Baselined and agreed to by all IPs..	28 Jan 00
Section 10, Telemetry	Baselined and agreed to by all IPs.	28 Jan 00
Section 11, Caution and Warning	Baselined and agreed to by all IPs.	28 Jan 00
Section 12, Onboard Plan and Procedures Viewers	Actions still in work.	5 Jan 00
Section 13, Laptop Operating System configuration and Features	Baselined and agreed to by all IPs.	28 Jan 00
Appendix A, Definition and Use of Standard Terminology	Under review. Proposal submitted.	28 Jan 00
Appendix B, Colors	Under review. New proposal submitted.	28 Jan 00
Appendix C, Graphic Symbols	Baselined and agreed to by all IPs. Line items under review. Proposed changes submitted.	18 Sept 00
Appendix D, Robotics	Under review.	28 Jan 00
Appendix E, Acronyms	Baselined and agreed to by all IPs.	15 Aug 00
Appendix F, ISS Graphics Training Products Development	Baselined by the ITCB as a separate document. Baselined document submitted in the DGCS.	19 Sept 00
Appendix G, ISS DGCS Deviations From Standards Request Form	Baselined and agreed to by all IPs.	30 Apr 99
Appendix H, Payload Display Design Standards and Guidelines	Baselined as a NASA deviation. Baselined document submitted in the DGCS.	8 Sept 00

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SECTION 1

INTRODUCTION

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SECTION 1.0 INTRODUCTION

This document specifies standards and guidelines to be used in the development of displays for International Space Station (ISS) (Ref. Section 6). This document serves to coordinate the efforts of procedure, graphic, and display development to generate cohesive and integrated products for use in real-time operations and training. Commonality shall be achieved through common display look and feel.

This standard also can be used as reference material during the development of control center displays.

1.1 PURPOSE

The purpose of the ISS Display and Graphics Commonality Standards (DGCS) is to document the standards utilized in design and implementation of displays and graphical products used by International Space Station crew members and ground control centers.

1.1.1 This document contains standards written as either “shalls” or “shoulds.” Statements written as “shalls” represent standards to which all display designers must adhere, if applicable. If the standards are not applicable to a display, simply ignore the standard. Waivers are not necessary in this case. Some standards are necessary for good design, but may be too restrictive in some situations. These standards are stated as “shoulds.” Even though a standard has been stated as a “should,” the designer is expected to follow the “should” standard under most circumstances.

1.2 SCOPE

This document shall apply to all onboard displays being produced for ISS operations or produced by other organizations in support of ISS operations. If there is a conflict with other ISS program-level documentation, SSP 50313 shall take priority for standards or guidelines which pertain to onboard displays directly used by the flight crew, the flight control team, or the training personnel supporting the ISS Program. In addition, reference drawings and graphics reference materials, which are used for crew, including products developed by partners, shall be developed in compliance with the standards and guidelines contained in this document. All configuration control boards managed by ISS Operations are required to implement these guidelines in the execution of their configuration management responsibilities of these materials. Products currently developed are exempt from compliance to these standards. However, all new products and major revisions to the user interface shall adhere to these standards. Commercial Off-the-Shelf (COTS) software products are also exempt.

1.2.1 This document establishes the single source of top level, graphical, and nomenclature related standards on displays to be used in all phases of development for onboard crew displays, reference drawings, and other graphical reference material. The Integrated Display and Graphics Standards (IDAGS) Panel shall provide for configuration management of this document. Any proposed changes in or deviations from this document or to the standards presented must be submitted to the IDAGS Panel for review and approval as defined in Section 3.3, Change Control Process for Standards.

1.2.2 The core of each section of the document contains the proposed standard and, if the International Partners' standard differed from the proposed common standard, a sub-section for each partner is provided. This sub-section contains the partner's current implementation. The

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final version of the document will consist of a core document containing the internationally agreed standards.

1.3 INTERNATIONAL PARTNERS ROLES AND RESPONSIBILITIES

Each ISS partner is responsible for the display development of his segment or module. The displays should be developed according to the standards of the developer and within the framework of the agreements contained in the Display and Graphics Commonality Standard, SSP 50313. The developer is responsible for all changes, including the quality, completeness, and timeliness of any changes.

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SECTION 2

APPLICABLE DOCUMENTS

- 2.1 APPLICABLE DOCUMENTS.....2-Error! Bookmark not defined.
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SECTION 2.0 APPLICABLE DOCUMENTS

2.1 APPLICABLE DOCUMENTS

The following documents include specifications, models, standards, guidelines, handbooks and other special publications. The current issue of the following documents is identified in the Program Automated Library System (PALS) (<http://issa-www.jsc.nasa.gov/cgi-bin/dsdl+/ORAP?h+palshome>) or Payload Integrated Library System (PILS) (<http://sspweb.jsc.nasa.gov/pils/payload.cfm>). The documents listed in this paragraph are applicable to the extent specified herein. Inclusion of the applicable documents herein does not in any way supersede the order of precedence identified in Paragraph 1.2 of this document.

<u>DOCUMENT NO.</u>	<u>DOCUMENT TITLE</u>	<u>TYPE</u>
SSP 30219	Space Station Reference Coordinate Systems	NASA Internal
SSP 30540	Human Computer Interface Guide	NASA Internal
SSP 30570	SSFP Flight Human-Computer Interface Standards	NASA Internal
SSP 30575	Space Station Interior and Exterior Operational Location Coding System	Multilateral
SSP 50005	SS Flight Crew Integration Standard (NASA-STD-3000/T)	Multilateral
SSP 50014	ISS Utility Coding Specification	Multilateral (3)
SSP 50253	Operations Data File Standards	Multilateral
SSP 50254	Operations Nomenclature	Multilateral

Documents below are not available at the above listed website:

<u>DOCUMENT NO.</u>	<u>DOCUMENT TITLE</u>
ASTME 380	Standard Practices for Use of the Industrial System of Units
FED-STD-595B	Colors Used in Government Procurement
IEC Standard 417	International Electrotechnical Commission, Graphical Symbols
ISA-dTR 77.60.04	Human-Machine Interface-CRT Displays
ISA-S5.1, S5.3, S5.5	Instrument Society of America, Graphic Symbols for Graphic Display OSF/Motif User's Guide, Open Software Foundation, Cambridge, MA, Version 1.2
JSC 10506	The Drafting Standards for System Handbook Drawings Mission Operations Directorate
JSC 13570	CCC HCI Style Guide and Standards
JSC 17952	Orbiter Crash and Rescue Information
MIL-STD-1472D	Human Engineering Design Criteria for Military Systems, Equipment, and Facilities

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For NASA Payloads only:

<u>DOCUMENT NO</u>	<u>DOCUMENT TITLE</u>
SSP 58700-ANX5	United States Payload Operations Data File Management Plan, Annex 5: Payload Display Review Plan
SSP 58700-ANX6	United States Payload Operations Data File Management Plan, Annex 6: Payload Developers Review Guide

2.2 REFERENCE DOCUMENTS

<u>DOCUMENT NO</u>	<u>DOCUMENT TITLE</u>
Std-005-00	APM Flight Human Computer Interface Standard (DASA) Doc Col-RIBRE-Std-005-00 Concepts, Guidelines, and Standards for Crew Interface ISS Automated Preliminary Crew Procedure Execution White Paper Human Computer Interface (HCI) White Paper
JCX-97180	JEM System Laptop Terminal Display Style Guide
DS006424110	JEMRMS Laptop Workstation HCI Display Design Specification (Toshiba)
NASA-STD-3000	Volume 1, Integrated Training Facility HCI Style Guide and Standards (SST-204)

SECTION 3

DISPLAY AND GRAPHIC DEVELOPMENT OPERATIONAL CONCEPT

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3.2.1.1	Development of Graphical Products and Procedures.	3-Error!	Bookmark not defined.
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SECTION 3.0

DISPLAY AND GRAPHIC DEVELOPMENT OPERATIONAL CONCEPT

3.1 GENERAL PRINCIPLES AND RATIONALE

Crew members and Flight Controllers will utilize a common display style for all segments and all systems of the vehicle. In addition to this common set of displays, flight controllers will have additional tools to allow for viewing and processing of data. Refer to Section 6.

- a) Ops concept for procedure access from displays and vice versa.
- b) Ops concept for interoperability between laptops.

3.1.1 Displays and Procedures

Displays and procedures are closely related products and must be developed together. Procedures will follow the layout of the onboard payload and system displays, but maintain compliance with the procedure standards. Nomenclature used in these products must match and the organization of one product must complement that of the other.

Procedure and display nomenclature should be consistent not only across a discipline but also across all the displays. Operations nomenclature is used on displays to assure that labels match terms used in flight procedures. Operations nomenclature, rules and definitions shall be in accordance with SSP 50254, Operations Nomenclature. A list of agreed-upon abbreviations and acronyms is in the Operations Nomenclature document.

3.1.2 ISS Computer Displays

ISS computer displays must then be reviewed and approved by the IDAGS Panel prior to being integrated onto a platform. This can be achieved during partners project reviews. The IDAGS Panel will check the display for consistency with other similar displays, a look and feel consistent with other displays, and assurances by the Integrated Display and Graphical Standards Development Team (IDAGSDT) or the International Partner that the proper integration has been performed and the process for developing the display has been followed.

3.2 PARTNER SPECIFIC IMPLEMENTATION

3.2.1 NASA Deviation

The PCS and MCC-H shall utilize the same "top level" graphical displays for ISS operations. Displays below this level of detail may be different, where necessary. Some displays provided in the MCC-H may not be provided on the PCS.

3.2.1.1 Development of Graphical Products and Procedures

Development of graphical products and procedures for the ISS should utilize a team consisting of all of the users of the graphical product including, but not limited to, the procedures developer, flight crew, flight controllers for the affected system(s), training personnel, and other system experts. This team then creates a preliminary graphical product based on the integrated experience of the group. It is important that the graphical product be prototyped and evaluated several times in order to converge on the best product.

3.2.2 RASA Deviation

The basic set of displays is to be designed and tested on the ground (formats reference library). This supports in-flight display design capability. The display has to reflect the system operation and functioning, its structure, and location (interior or exterior of the module, on which plane, and behind which panels). Both the intersystem and intermodule interface should be accounted for. Depending on the system's complexity, one or several formats are being designed (for

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each system's function). If more than one display is available from the system button, a menu window appears giving the user a choice of which display to launch. Displays should not be overloaded with information. If there is no possibility to fit all the information within one display, the display is to be split in two levels. The upper level contains the basic data on monitoring and control. The lower level includes a set of detailed displays which are called by selecting on the object buttons or <<Details>> of the upper level display. The general philosophy for detailed displays is to use graphical schematic formats. On request from the ground control, the crew may either correct the existing display or create their own display, whichever is the most appropriate in the current situation.

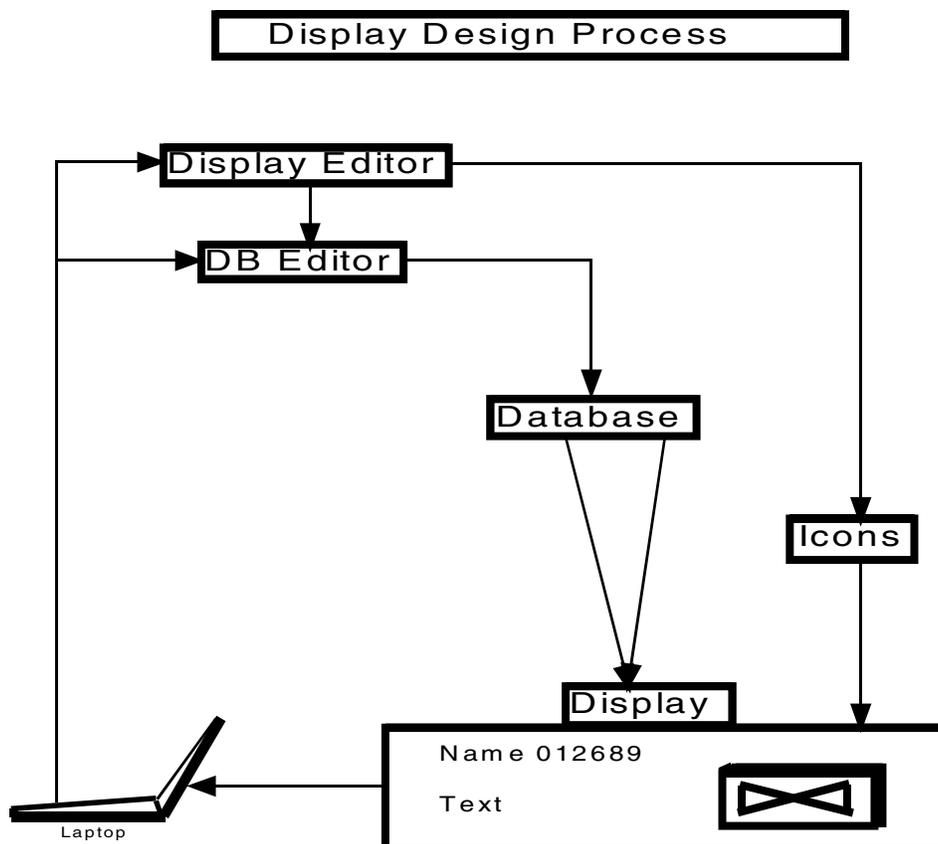


Figure 3-1 Russian Display Design Process

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3.2.2.1 RASA Capabilities

This capability supports the following functions:

1. Moving objects within the display.
2. Duplicating objects.
3. Relocation of information to another display.
4. Deletion of objects.
5. Block functions (selection, relocation, copying, resizing, and reorienting of blocks).
6. Filtering of information inside the display.

Multi-window interface support consists of the following:

1. Selection of display's fragments (scrolling).
2. Resizing of the window.
3. Scaling of the window.

These enable the user to monitor several parameters from different formats simultaneously.

3.2.3 ESA-Columbus Approach Deviation

ESA-Columbus has up to three Portable Work-Station (PWS) laptops, which can be used inside ESA-Columbus, one hook-up point is also provided ESA-Columbus-external in the Node2. Interfaces during parallel use of PWSs are procedural by the crew.

ESA-Columbus Flight Monitoring and Control Displays (MCDs) on the PWS provide the monitoring and control capabilities for the nominal ESA-Columbus systems. They are based on the COTS tool SAMMI. Other displays, like the Master Time Line (MTL) and Automated Crew Procedures (ACP) viewers, Message Panel and Time Display Panel are also part of the ESA-Columbus display set.

The development of ESA-Columbus MCD nominal system displays and procedures is performed at system level by the ESA-Columbus prime contractor. Verification is by review and utilization/dedicated tests during ESA-Columbus ground testing, with participation of ESA operations, flight crew, and training representatives at dedicated events.

ESA-Columbus displays and procedures for monitoring and control of the vital ESA-Columbus systems (used during activation/deactivation and for critical/vital ESA-Columbus) are provided by NASA on the ISS PCS laptops (one hook-up point is inside ESA-Columbus), based on requirements from the ESA-Columbus developer, and implemented according to the NASA approach.

3.2.4 NASDA Deviation

JEM has three laptop Computers: System Laptop Terminal (SLT), Payload Laptop Terminal (PLT), and RMS Laptop Terminal (RLT). Each terminal provides crew interface for only JEM system, payloads, or RMS. Basically, NASDA displays are built on a GUI tool, SAMMI. The displays are to be designed and tested on the ground. The display has to reflect the system functioning, its structure, and physical location. Depending on the segment's or system's complexity, one or several hierarchical displays are provided.

Space Station Integration and Promotion Center (SSIPC) will have dedicated displays apart from the JEM flight displays.

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Displays related to payloads and training is TBS.

3.2.5 CSA Deviation

The MSS Operations Center (MOC) shall utilize the same “top level” graphical displays for the MSS operations. Displays below this level of detail may be different, where necessary. Some displays provided in the MOC may not be provided on the PCS.

3.3 CHANGE CONTROL PROCESS FOR STANDARDS

All display products developed for ISS Operations must comply with the standards defined in this document to be approved for use in the training and execution of ISS flight operations. All configuration control boards managed by MO&UCB shall use these standards as the overall, top level requirements for the presentation, interaction, and layout of displays. Any proposed deviations to this standard which may be due to either single, unique requirement, or a generic modification, shall be jointly approved by MO&UCB through the following processes.

3.3.1 Requests for Deviations

Requests for deviations from ISS DGCS should be submitted using the form found in Appendix G of this document.

3.3.2 Flight Specific and/or Single, Unique Deviations

If a proposed deviation is for a single flight or a single, unique application, the change request should be submitted to the appropriate configuration management control board responsible for management of the products affected. The change request should clearly identify the specific standard which is related to the deviation. . Explanation and rationale for why this is not a generic change to the standards shall also be included. The managing control board is responsible for reviewing and deciding on the technical merit of the proposed deviation. The board's decision is to be included as part of the documentation for the proposed deviation. This documentation is then forwarded to IDAGS Panel for review and final disposition.

3.3.3 Generic Deviations or Changes to the Standards

If a proposed deviation is applicable to multiple flights or is generic in nature, the change request should be submitted to the appropriate configuration management control board responsible for management of the products affected. The change request should clearly identify the specific standard which is related to the deviation and technical rationale explaining why the deviation is required. The managing control board is responsible for reviewing and deciding on the technical merit for the proposed deviation. The board's decision is to be included as part of the documentation for the proposed deviation. This documentation is then forwarded to the IDAGS Panel for review and final disposition. All approved multi-flight deviations will be added to the references to the applicable flights.

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SECTION 4.0 LAYOUT

4.1 GENERAL PRINCIPLES AND RATIONALE

All displays shall conform to a common, general layout convention to allow ease of navigation and to clarify functional and physical relationships between displayed items.

4.2 GENERAL WINDOW CHARACTERISTICS

Unix/Solaris based windows are designed with general Motif characteristics. All user interface software (displays, environment configuration, and interaction methodologies) developed must follow a number of human-computer interface guideline documents. At the highest level, all user interface software must attempt to be compliant with the accepted industry standard in X-Window user interface style, the Open Software Foundation (OSF) Motif Style Guide. All X-Window based non-Commercial Off-the-Shelf (COTS) user interfaces will follow the conventions defined in the OSF/Motif Style Guide unless other overriding standards are defined in this document. COTS building toolkits can be used if the end product adheres to the general guidelines in this document (Ex. Labview, web-based interface). Sections of this document are not intended to violate the conventions defined in the Motif Style Guide, rather, they are intended to provide more guidance for the display designer and builder when working on display designs. All Microsoft based non-COTS user interfaces shall follow the conventions defined in Microsoft unless other overriding standards are defined in this document.

Display designers shall strive to build aesthetically pleasing displays that are more conducive to long hours of use. Displays shall be balanced with symmetrical, easy to read layouts. Subsections of displays shall be equally spaced and not jammed together when space is available. Lines and components shall have equal distance between them so there is no misinterpretation as to what title or label applies.

4.2.1 NASA General Window Characteristics Deviation

4.2.2 RASA General Window Characteristics Deviation

X-Window Library.

4.2.3 ESA-Columbus General Window Characteristics Deviation

4.2.4 NASDA General Window Characteristics Deviation

4.2.5 CSA General Window Characteristics Deviation

4.3 WINDOW SIZE

The maximum physical window size is platform dependent; 800 x 600 for the IBM 760ED (Early PCS) and 1024 x 768 for the IBM 760XD (PCS).

The maximum allowable window size is implementation dependent and may be less than the maximum physical size if there are persistent windows that consume display space. Persistent windows are defined as windows that are always on the display in a fixed location (cannot be moved) and are forced to be on top of all other displays (cannot be covered up). An example of

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a persistent window is a dedicated Caution and Warning window which is always at the top of the display and always on the top of other displays.

The default size of a display window should be determined by the content to be displayed and may not be larger than the maximum allowable window size. For example, a display window depicting part of a system or block may only require a window space of 100 x 200 pixels. The actual space available within the window for display objects will be less due to window manager overhead (borders and title bar).

4.3.1 Window Resize

Nominally, all windows may be resized except for persistent windows and dialog windows. Windows with resize capability will conform to one of the following behaviors.

- | | |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Integrated | The display contents (objects contained in the display) automatically scales proportionately with the display window frame size. The display window frame height-to-width ratio will be retained during resize operations. |
| Independent | The display contents and window frame may be resized independent of each other. The display contents height and width may be resized independently of each other or may be resized such that the height-to-width ratio is maintained. The display window frame height and width are independent of each other. If the window size is smaller than the display content size, a mechanism must be available to scroll or pan within the window. |
| Window only | The display contents size remains fixed and the display window frame is resized. The display window frame height-to-width ratio may be either independent or proportional. If the window size is smaller than the display content size, a mechanism must be available to scroll or pan within the window. |

Any display window that allows display content to be resized will have a uniquely defined minimum height and minimum width required to maintain legibility.

4.3.1.1 NASA Window Resize Deviation

4.3.1.2 RASA Window Resize Deviation

4.3.1.3 ESA-Columbus Window Resize Deviation

ESA-Columbus follows general Window Resize, using exclusively the "Window only" behavior.

4.3.1.4 NASDA Window Resize Deviation

JEM PCS's provide "Window only" resize capability only due to SAMMI restriction.

4.3.1.5 CSA Window Resize Deviation

4.4 OBJECT SIZE

An object must be sized so that it is easily discernible.

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4.5 WINDOW PLACEMENT

A default location on the display screen can be specified for each window. If a default location is not specified, then the location will be decided by the operating system window manager. The default window arrangement (for windows without a default location) should cascade rather than tile.

The general philosophy for window placement is that, where applicable and possible, a pop-up or detailed window shall default to a location that does not obscure associated data on the referencing display. In general, there should be no loss of information if a window does cover the associated data on the parent display (e.g., the obscured data will appear on the detailed window). Realization of this philosophy may be dependent on the implementation and constraints imposed by the display software architecture.

4.6 WINDOW CONTROL/DECORATION

All display windows shall include standard decorations to allow closing, resizing, iconification, and movement of the display. This is the standard method any user will invoke to manage a display window without requiring additional controls. If any window closure may result in closing the base software application, then an acknowledgment to the window is necessary.

4.6.1 NASA Window Control/Decoration Deviation

4.6.2 RASA Window Control/Decoration Deviation

The RASA displays follows the same control means except close (quit). They use the escape key to quit/close a window versus the window manager menu.

4.6.3 ESA-Columbus Window Control/Decoration Deviation

This is applicable for viewing only, for some ESA-Columbus/DASA displays. For non-critical displays, windows acknowledgment is not implemented for window closure.

4.6.4 NASDA Window Control/Decoration Deviation

Dialog windows (ex. confirm window) of JEM displays do not have decorations. JEM RLT does not have decorations for window resize.

4.6.5 CSA Window Control/Decoration Deviation

4.7 WINDOW TITLES

Window titles, shown in the title bar area, reflect the appropriate operations nomenclature for a block, subsystem, module, location, or other functional unit of the vehicle. Window titles shall correspond to associated navigation buttons that call the display (i.e., the name of the button that calls a display must have the same name as the called display). Where necessary, abbreviations consistent with Operations Nomenclature standards may be applied to window titles and/or navigation button labels.

A display's window title bar shows the following:

RPCM_NIRS1_A

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Window size and title length should be coordinated such that, at the default window size, the entire window name may be read.

The **Home Page** Title bar shall include a label indicating the appropriate version of the **Home Page**. See Figure 4-1.



Figure 4-1 Home Page Title Bar (typical)

4.7.1 NASA Window Titles Deviation

4.7.2 RASA Window Titles Deviation

4.7.3 ESA-Columbus Window Titles Deviation

The ESA MCD title bar area is divided in two sections. The first part is generated automatically by the development tool. This part contains the MCD-MDB (Mission Database) name incl. short identifier. In the second part ESA follows general window titles. Where window size and title length can not be coordinated such that the second part can be read (Command and Data Window), the window title is in the upper left corner of the MCD.

The MCD version number is not part of each MCD title. It is defined by the MDB version included in the title of the MCD home page only. Even if a single MCD is revised, the generation process on ground requires a new MDB version, such that the version of each MCD is uniquely identified by this MDB version.

4.7.4 NASDA Window Titles Deviation

NASDA basically follows general window titles. Flight numbers are not applied for JEM because JEM PCS displays are not replaced in flight by flight. Window titles of the JEM RLT are not always the same as the names of buttons which call the window.

4.7.5 CSA Window Titles Deviation

4.8 HOME FUNCTION

The Home Page shall be functionally accessible with a single action at any time.

4.8.1 NASA Home Button Deviation

This requirement does not apply to detailed windows that are automatically called up or to command windows.



This button shall change color to correspond to the highest class event that is in alarm. When there are no active Emergency, Warning, or Caution events, the Home button color is gray (the standard navigation button color).

4.8.2 RASA Home Button Deviation.

The RASA Home button is on the Events window and is always accessible.

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4.8.3 ESA-Columbus Home Button Deviation

4.8.4 NASDA Home Button Deviation

JEM SLT has a Home function which leads to the JEM home page. It is possible to navigate among JEM module displays without going back to Homepage on JEM SLT. JEM RLT does not have this button because JEM RMS Home Page is always in the bottom of the displays.

4.8.5 CSA Home Button Deviation

4.9 TOOLBARS

Toolbars provide multiple buttons to the user in order to accomplish a given set of tasks. The tasks available are dependent on the toolbar they are associated with. Generic categories of functions include caution and warning, systems interfaces, user tools, or a combination of these.

The internationally agreed standard of the time shown on the tool bar is:

GMT: ddMmmyy hh:mm:ss
for example GMT: 13Nov01 23:03:28

4.9.1 NASA Toolbars Deviation

At present, three such toolbars have been identified for use in display windows - the alarm toolbar (used to handle Caution & Warning), the user toolbar (used to access applications beyond the scope of "pure displays"), and the system toolbar (used to view more details regarding a specific system). See Figure 4-2.

The alarm toolbar is discussed in detail in the Caution & Warning section of this document. On the **Home Page**, this toolbar includes a single message line to indicate the oldest unacknowledged alarm message.

On the tool bar message line and C&W summary, hh:mm:ss only will be shown on each message line. But the C&W log time format for each item will retain the whole time information.

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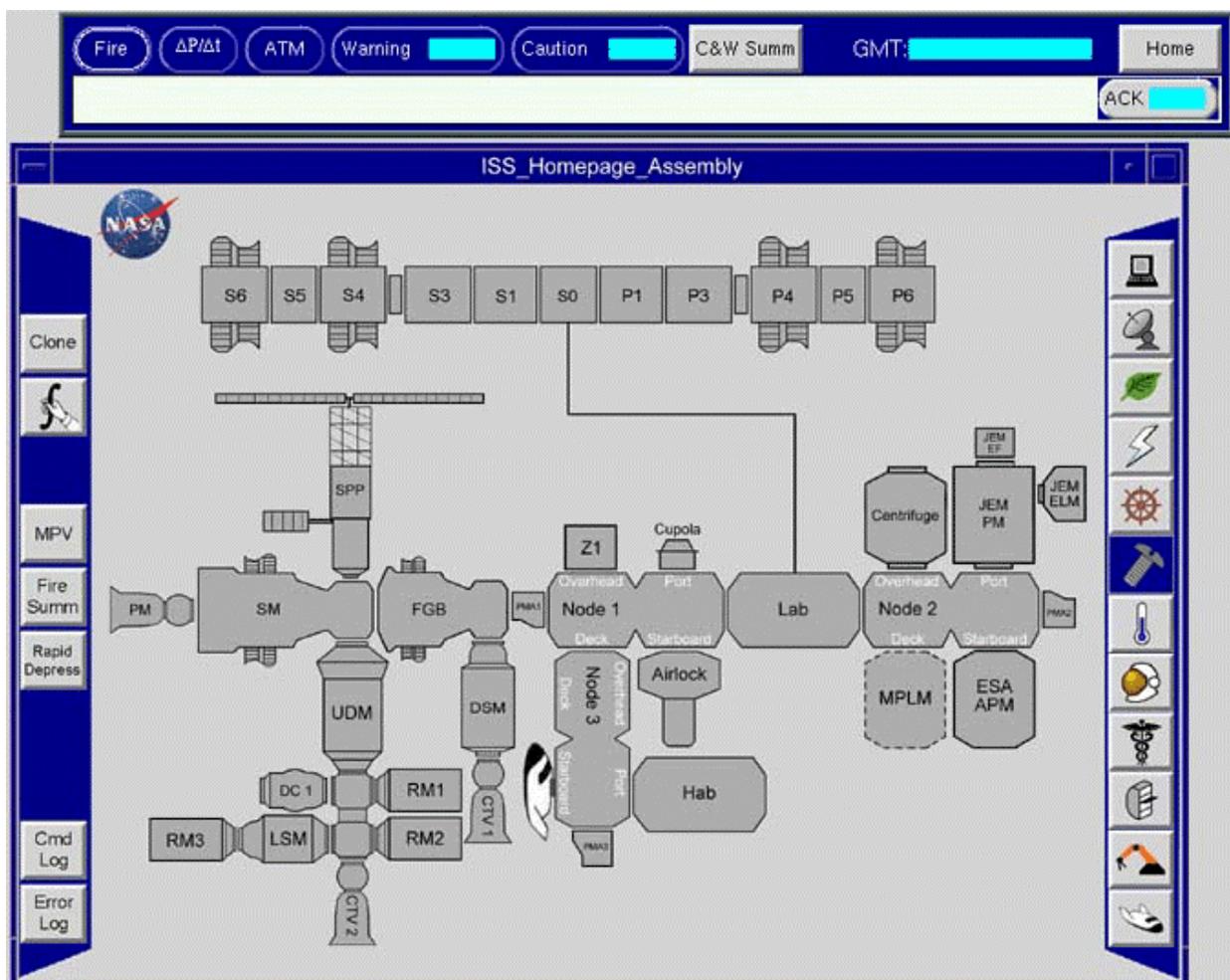
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Figure 4-2 Home Page

The Greenwich Mean Time (GMT) associated with a Caution & Warning message shall appear directly beneath and aligned vertically with the current GMT shown near the upper right corner of the alarm toolbar.

The user toolbar is shown on the left side of the **Home Page** (Figure 4-2). This toolbar has a “Cmd Log” button to view the log of sent commands and an “Error Log” button to view the log of past errors.

Other displays also provide a “Clone” button to duplicate the current display (Figure 4-2a). The “Clone” button allows the user to open a second copy of a display. This button shall only be provided on displays that have more than one accessible overlay (e.g., Node 1:C&DH and Node1:ECLSS). Once a display is opened, it can be brought to the front of layered displays that are covering it when the user selects the navigation button for that display. The only way to invoke a copy of the display is by use of the “Clone” button.

A given display can only show one system layer at a time. If a user wishes to view both the Node1: ECLSS layer and the Node1:C&DH layer at once, then he or she must open the Node1 display, select either the ECLSS or C&DH layer, clone the Node 1 display, and then select the other system layer on the clone.

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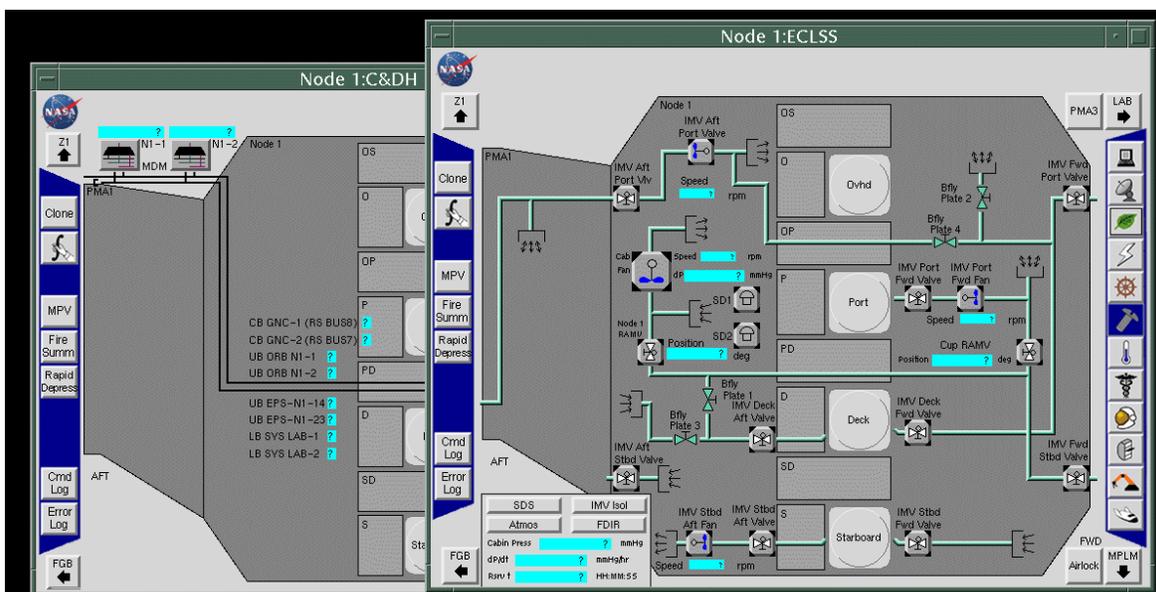
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Figure 4-2a Node 1

The system toolbar is shown on the right side of the **Home Page** (Figure 4-2). On the **Home Page**, this bar allows the user to access summary displays for each system. On the module level displays, the toolbar provides access to system overlays for that module. These overlays are shown within the same window.

4.9.2 RASA Toolbars Deviation

RASA currently uses a GMT format of ddmmyy hh:mm:ss with mm being numeric. RASA will continue to use this format until the next major update.

RASA does not need a clone button because a new window appears when a button is selected.



Figure 4-3 RASA Tool Bar

4.9.2.1 The alarm toolbar is a separate event display. The events display is covered in the C&W section of the DGCS.

4.9.2.2 System toolbar - available on homepage

4.9.2.3 User toolbar - available on homepage.

4.9.3 ESA-Columbus Tool Bars Deviation

ESA-Columbus has no tool bars. The main applications are activated by buttons and/or menus. The APM Caution and Warning functions will be available on the PCS (see Section 11).

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4.9.4 NASDA Tool Bars Deviation

JEM SLT tool bars are shown in Figure 4-4.

4.9.4.1 Alarm Tool Bar. JEM PCS does not have Alarm toolbar. The JEM Caution and Warning functions will be available on the NASA PCS; but there is JEM Local C&W Summary button on user toolbar on JEM SLT.

4.9.4.2 Module Tool Bar. JEM module tool bar is provided on upper side of subsystem tool bar.

4.9.4.3 Subsystem Tool Bar. JEM subsystem tool bar is provided on the right side.

4.9.4.4 User Tool Bar. APV, MPV, and miscellaneous button exists on the user tool bar.

4.9.4.5 NASDA has implemented a standard of using hundreds of days (Julian date) for GMT. NASDA will continue to use this format until the next major update per the exclusion clause.

The format of SLT and RLT is DDD/HH:MM:SS.

Current GMT. JEM SLT shows the current GMT at the lower left corner, and RLT at the upper right corner.

4.9.4.6 Clone Button. JEM PCS's do not have the Clone button, because NASDA PCS's do not provide two windows at the same time.

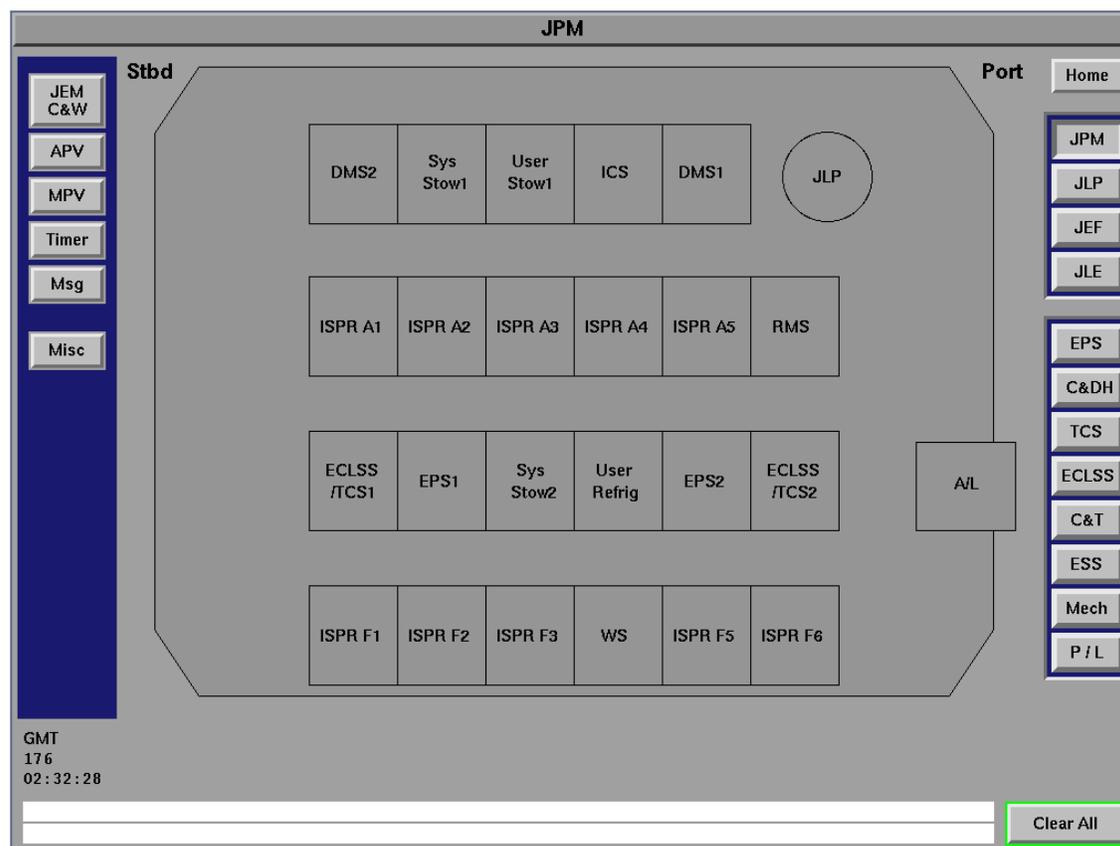


Figure 4-4 JEM SLT Toolbar

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4.9.5 CSA Tool Bars Deviation

CSA tool bar is consistent with the NASA tool bar.

4.10 GRAPHICAL LAYOUT

Across multiple systems and across different knowledge levels, there can be developed a visually consistent set of graphical products. Guidelines for producing visually consistent graphical products include a common layout, flow directions, and common icons. This section provides guidelines on flow directions and a common layout. Appendix C of this document provides a list of common icons.

Items of high criticality, such as Caution & Warning lights, shall be placed near the top of the display to indicate their relative importance. Items that control the appearance of the display, such as buttons providing navigation to accessible system overlays, shall be placed near the edge of the display.

4.10.1.1 4.10.1 International Partner Deviation

4.10.1.1 NASA Graphical Layout Deviation

4.10.1.2 RASA Graphical Layout Deviation

4.10.1.3 ESA-Columbus Graphical Layout Deviation

ESA-Columbus is using MOD drafting standards as a guideline. Symbols, icons, and text will be used as appropriate.

4.10.1.4 NASDA Graphical Layout Deviation

NASDA is using MOD drafting standards as a guideline. Symbols, icons, and text will be used as appropriate.

4.10.1.5 CSA Graphical Layout Deviation

CSA is using MOD drafting standards as a guideline. Symbols, icons, and text will be used as appropriate. Robotic arm physical representation does not reflect true arm position due to its reconfigurable nature.

4.10.2 Guidelines for Common Layout

At each step in the process of creating graphics for drawings, schematics, displays, etc., the developer must determine how much information can be presented within the physical constraints of each product. For example, how big a piece of paper is available for a drawing or how big is the monitor for a display. The following hierarchy provides a graphics developer with a set of choices for presenting information in a graphical form. The organization hierarchy does not describe a sequential process for creating training graphics or displays. When developing a graphic product, the developer needs to decide which of the following conventions to use at each step in the process of creating training graphics, displays, etc.

4.10.3 Display Organization Hierarchy

- a. Physical Template Convention. Information is presented in a spatial orientation according to the **preferred view convention** as defined section 4.10.4. All blocks and parts are placed in their actual physical location within the modules.

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- b. Partially Physical Template and Partially Functional Flow Convention. Display of modules still follows the preferred view. The blocks and parts that perform functions within the modules are not in their respective physical locations. The blocks and parts are oriented in the module in order to show system functions. The guidelines for producing functional drawing should be followed (i.e., information flow top to bottom, left to right, etc.) when possible.
- c. Functional Flow Convention. The outline and orientation of the modules is not shown. The blocks and parts are oriented in order to show system functions. The guidelines for producing functional drawing must be followed (i.e., information flow top to bottom, left to right, etc.).
- d. No Convention. The outline and orientation of the modules is not shown. The blocks and parts are oriented on the display in order to show system functions. The guidelines for producing functional drawings are not followed (i.e., information flow top to bottom, left to right, etc.). Organization of blocks and parts is driven solely by visual simplicity.

4.10.4 Hierarchy of ISS Functional and Physical Divisions

Graphical products such as displays and schematics can be developed using varying levels of detail. In order to establish guidelines to standardizing the level of detail contained in a particular graphical product, a hierarchy from more general to more specific must be used. The terminology used to describe these levels is contained below. This terminology is not intended to alter the nomenclature of any hardware.

HIERARCHY OF ISS FUNCTIONAL AND PHYSICAL DIVISIONS

- Super-system
- Station
- Segment
- Module
- System
- Subsystem
- Block
- Part

Super-System - An organization which includes the orbital station, other space vehicles, and ground facilities.

Station - A group of segments (or modules) that are combined to form a complete orbital complex.

Segment - A number of modules that can be logically grouped together by form, function, or program responsibility. Examples include the Russian Segment (RS) and the United States On-orbit Segment (USOS).

Module - A single structural element that provides significant additional functionality to the station. Usually contains multiple systems and may be pressurized or unpressurized. Examples include FGB, SM, Node 1, Node 2, and SO Truss.

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System - A collection of components that perform unique functions supporting activities in a module, segment, or in the entire station. Some systems may interface across the larger super-system. Examples include the Electrical Power System (EPS), the Thermal Control System (TCS), etc. (was "subsystem" in previous designations).

Subsystem - A collection of blocks that work together to perform a function within a system. One example is the fire detection and suppression components of ECLSS. A part of a system, for example part of a system limited by a given module, is also called a subsystem.

Block - Sometimes referred to for manufacturing purposes as an assembly. A grouping of parts to perform a function for a subsystem. A block is generally connected to control signals, electrical supply, thermal support, or other environmental support services to perform its job.

Part - Sometimes referred to for manufacturing purposes as equipment. The individual pieces that are assembled together to form a block. Examples include a single valve, a controller card, a pump, latch, etc.

4.10.5 Physical Representation - Preferred View Convention

A guideline to develop a common layout for physical representation and ensure spatial consistency is a preferred viewing convention from which isometric or orthographic projections can be derived.

In order to provide visual consistency when representing the view of the ISS modules, it is necessary to provide an orientation of the ISS on the figures that follow these four principals (see Figure 4-5 and 4-6):

- a) Zenith or port or aft at the top.
- b) Aft or starboard on the left.
- c) Nadir or starboard or forward at the bottom.
- d) Port or forward on the right.

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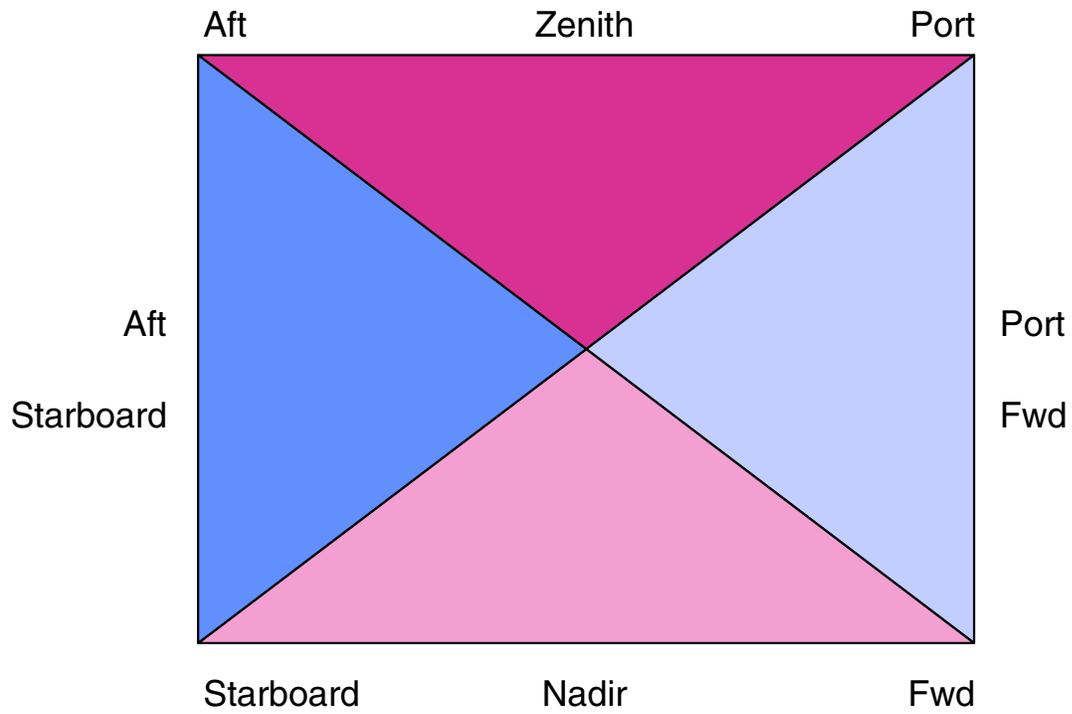


Figure 4-5 Zenith or Port or Aft at the top,
Nadir or Starboard or Forward at the bottom,

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The previous graph can also be interpreted this way:

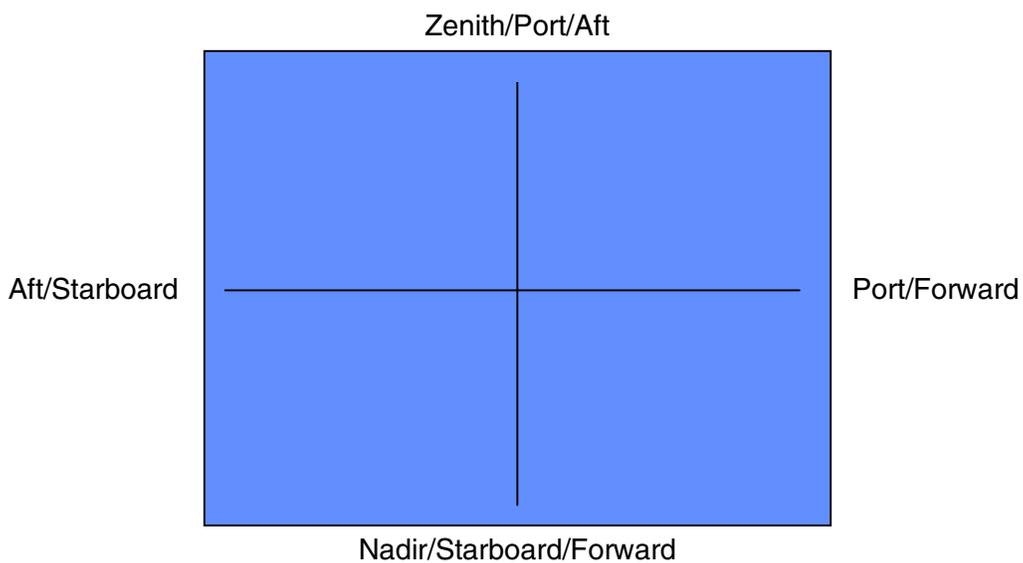


Figure 4-6 Aft or Starboard on the left,
Port or Forward on the right

Preferred View convention applied to Figure 4-7:

1. Isometric

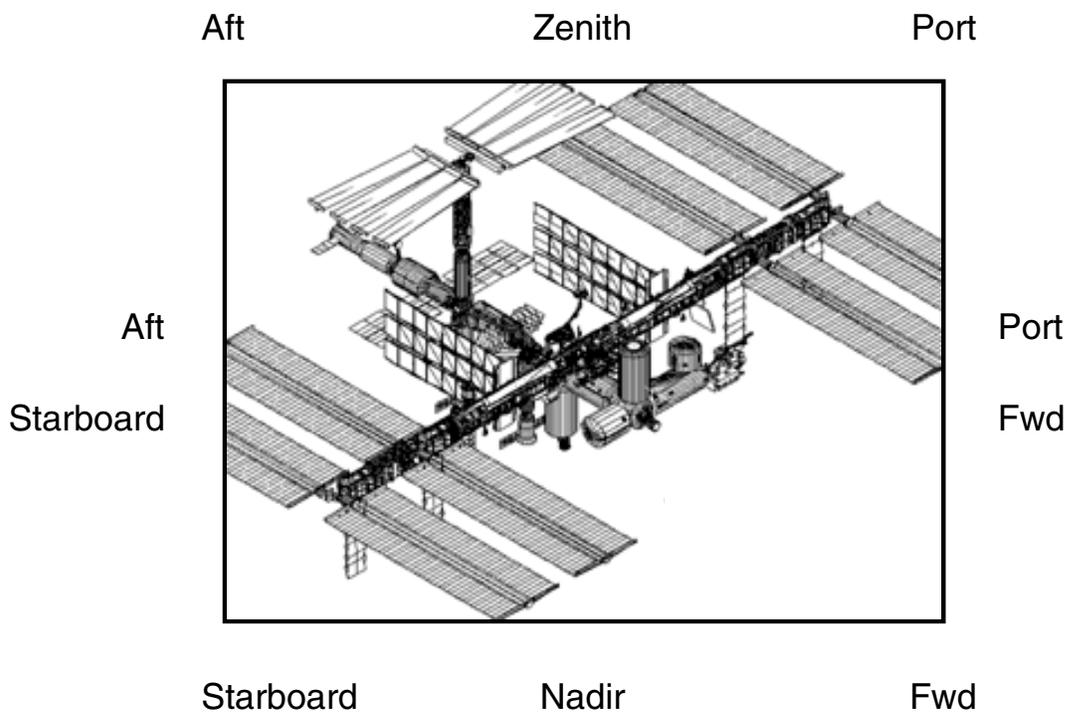
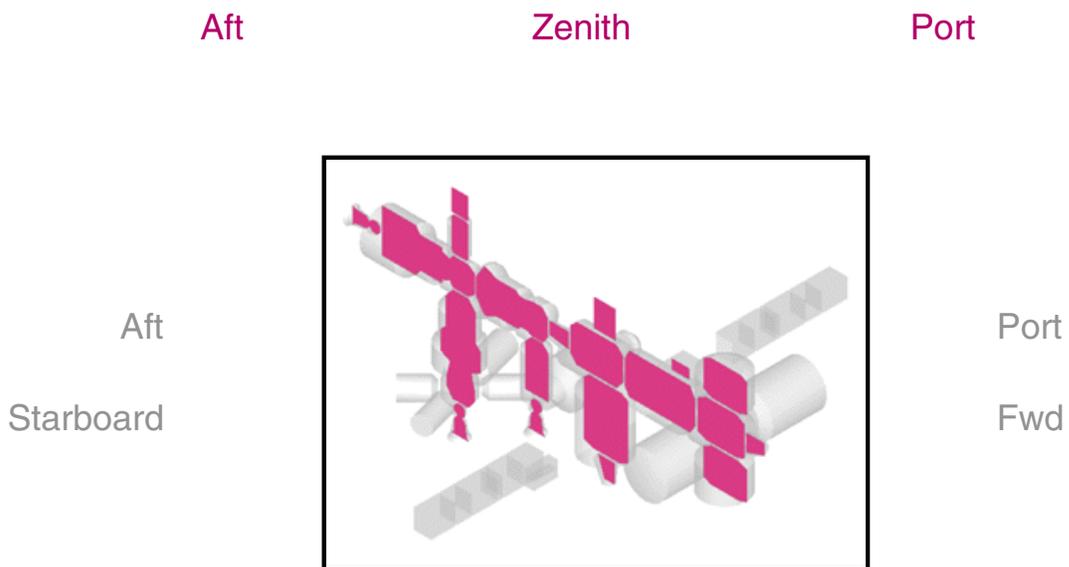


Figure 4-7 Isometric

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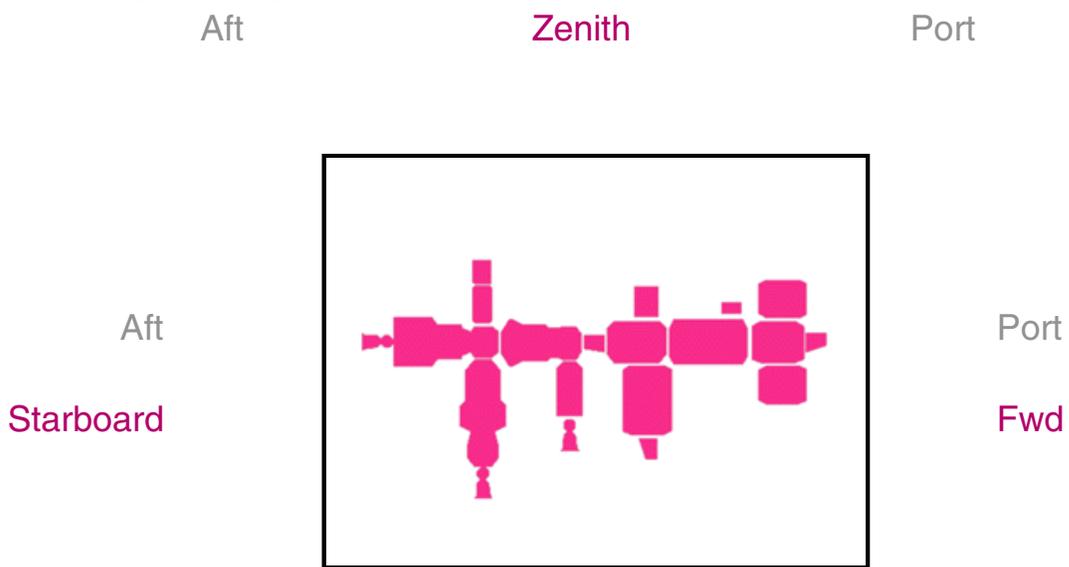
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2. Isometric with cutaway plane, Figure 4-8



Starboard Nadir Fwd
Figure 4-8 Isometric Cutaway

3. Orthographic, Figure 4-9



Starboard Nadir Fwd
Figure 4-9 Orthographic

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From Figure 4-9, a template was derived from the preferred view convention (orthographic map) to produce Figure 4-10:

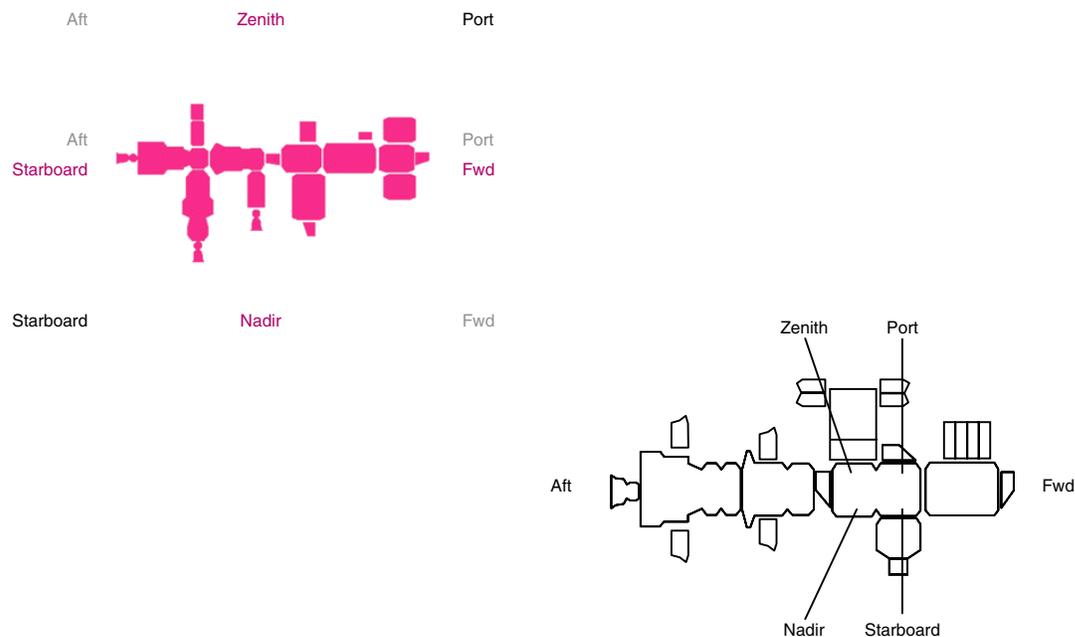


Figure 4-10 Derived Template

4.10.6 Conventions for Two-Dimensional Representations

All products shall comply with the following conventions regarding spatial references, orientations, and means of depicting various views.

4.10.7 ISS Vehicle Coordinate System and Reference Orientation

The coordinate system to be used shall be the ISS vehicle coordinate defined as a right-handed Cartesian, body-fixed coordinate system, in accordance with SSP-30219. The origin of the coordinate reference frame is located at the geometric center of the mid-ship truss section, Integrated Truss Segment (ITS), S0. The positive directions of the coordinate system are based on an ISS flight orientation of 0, 0, 0 LVLH, where LVLH is defined here:

Local Vertical-Local Horizontal (LVLH) coordinate system (see Figure 4-11). The positive Z-axis is pointing toward the nadir. The positive Y-axis points perpendicular to the orbital plane as the vector cross product of the radius and the velocity vector. The positive X-axis is the horizontal projection of the velocity vector which is a vector product of the y and z unit vectors which define the local horizontal axis.

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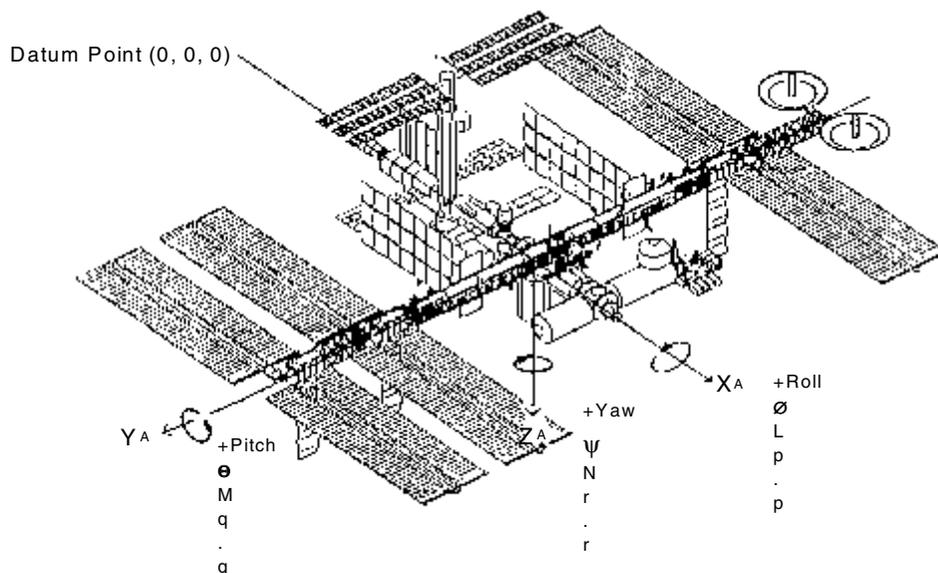
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Figure 4-11 Space Station Analysis Coordinate System Based on Reference Coordinate System

Displays shall identify which Euler angle sequence is being used.

4.10.8 Mapping of Three-Dimensional Surfaces

Three conventions have been selected to map internal and external surfaces. These conventions are defined as follows (see Figure 4-13):

- a. Cylindrical – Provides continuity along the surface. Useful to illustrate wiring connections or piping along surfaces.
- b. Combined Orthographic – Provides simultaneous views of external surfaces on both vertical (Nadir/Zenith) and horizontal (Port/Starboard) planes. Useful to create a layout with the greatest number of modules and their proper connectivity in a single view.
- c. Stabilization Planes – Provide orthographic views of the four lateral surfaces of a module shown with the same orientation as seen by an internal observer standing on the deck, facing forward. See Figure 4-12.

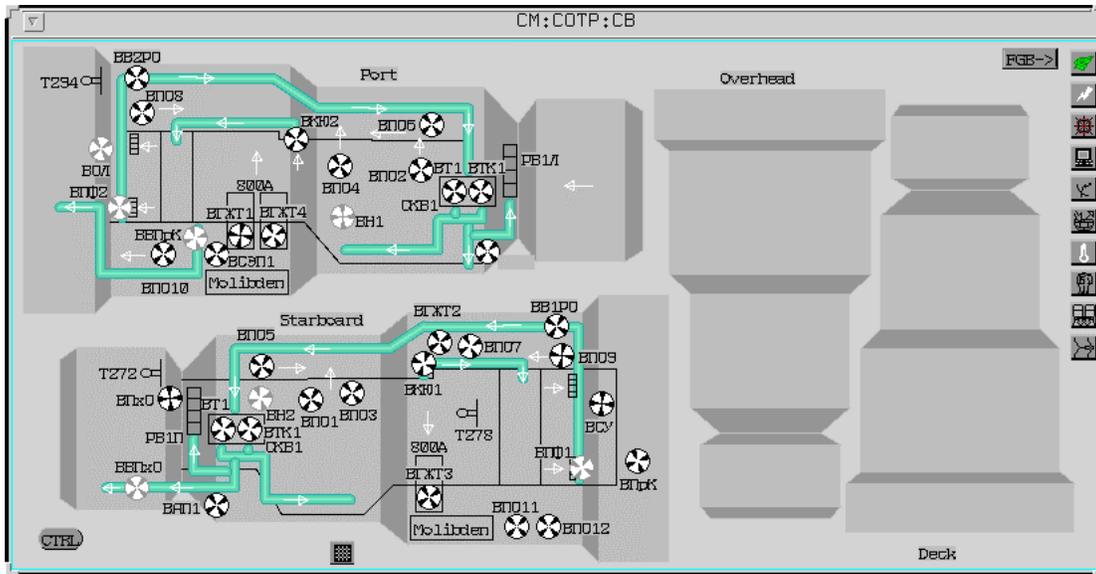


Figure 4-12 Stabilization Planes

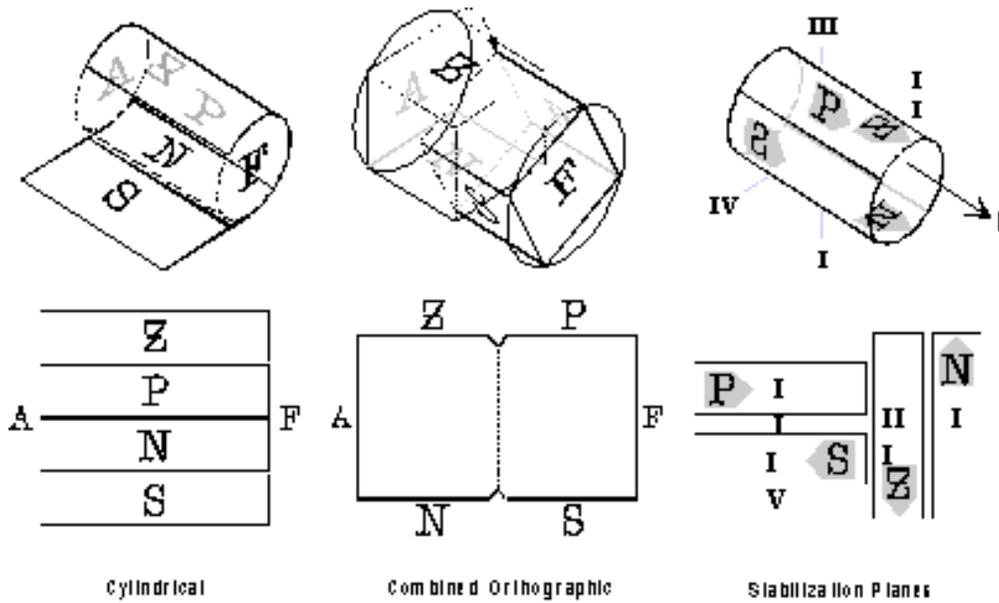


Figure 4-13 Mapping of Three Dimensional Surfaces

The reference position for the station deployable structures shall be defined by paragraphs 4.10.9 through 4.10.12.

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4.10.9 Articulated Structures

Articulated structures – such as parts of the truss, solar arrays, etc., change position as the ISS orbits the Earth. This makes it necessary to establish a fixed point for depicting these structures in graphic materials. The following conventions shall be applied:

- a) The US Electrical Power System shall be oriented such that the plane of the solar arrays are perpendicular to the direction of the zenith.
- b) The US Thermal Control System radiators shall be oriented vertically in relation to the Station truss segment.
- c) All Russian segment power systems shall be oriented such that the plane of the solar arrays are perpendicular to the direction of the zenith with the modules' active side toward zenith.

4.10.10 Modules Not in a Perpendicular Plane

When representing out-of-plane modules, the following priorities should be followed:

- a) Forward/Aft should be mapped to Preferred View convention (i.e., Forward/Right and Aft/Left).
- b) Port/Starboard should be mapped to the Preferred View convention (i.e., Port/Top and Starboard/Bottom).

4.10.11 Applied Examples of the Mapping Conventions

Pressurized modules are split and flattened to provide a two-dimensional representation (Figure 4-14).

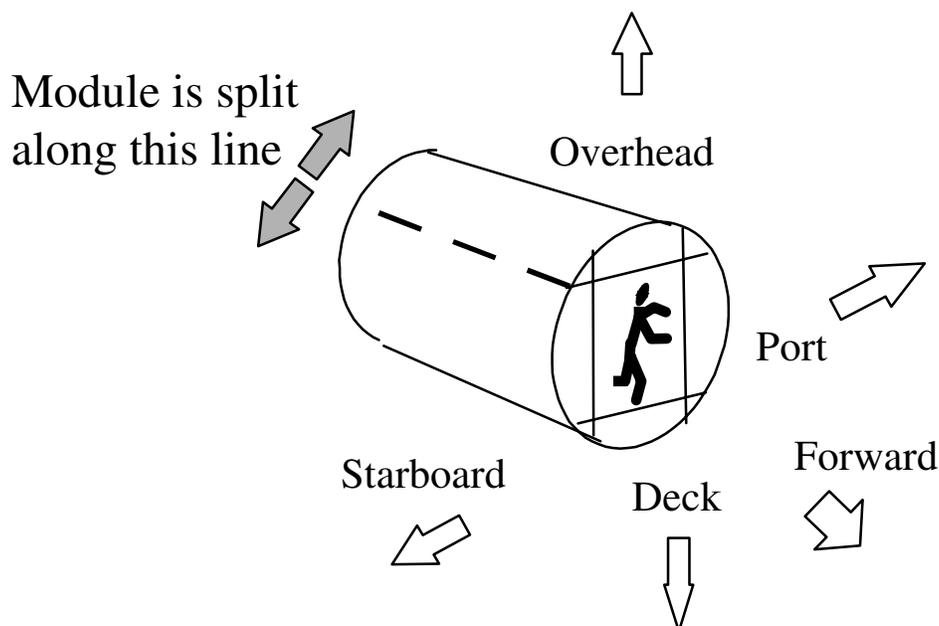


Figure 4-14 Module Split

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4.10.11.1 Cylindrical Mapping Convention

Regions of the module, such as the overhead area and the forward endcone, may be labeled as necessary. Racks and standoffs may be depicted as rectangles. Hatches may be shown as well. Each of these items, if shown, should be labeled per the interior location coding standards. In addition, module endcones may be represented as angled sections at each end of the module outline. An example of proper labeling for Node 1 is shown in Figure 4-15.

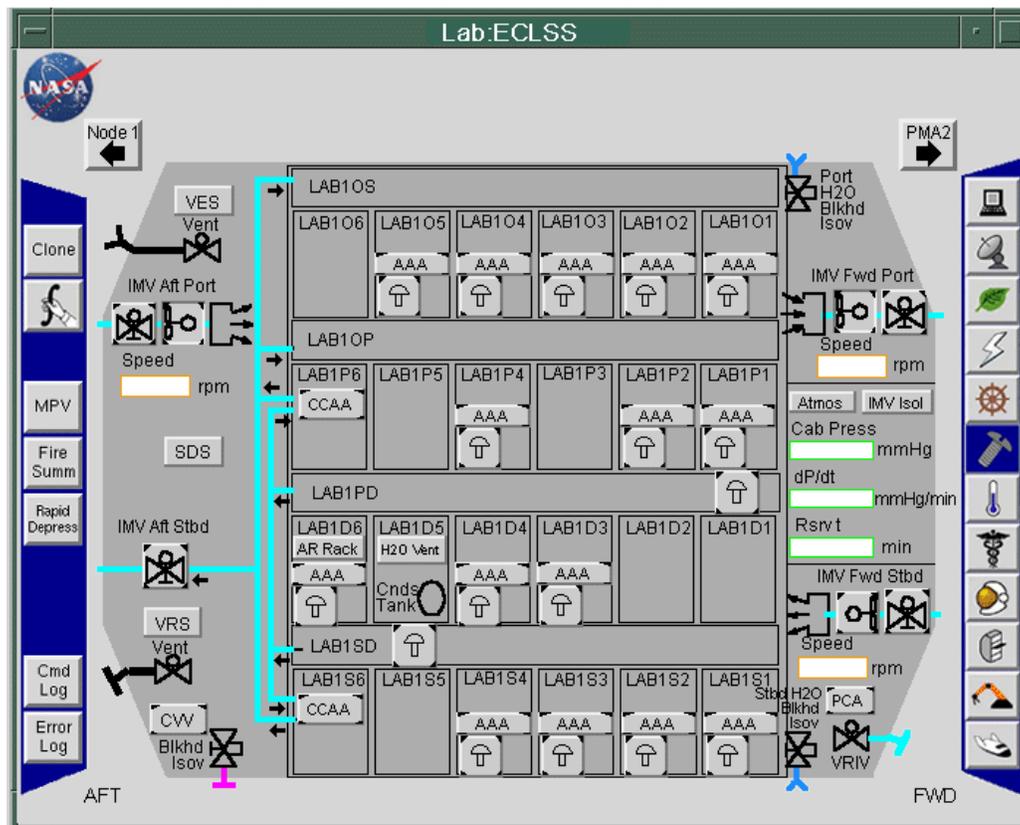
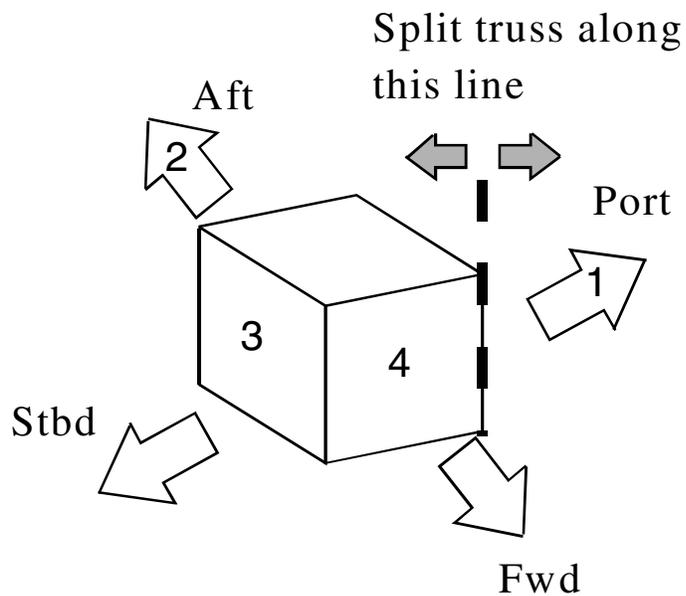


Figure 4-15 Labeling

4.10.11.2 Additional Conventions for Cylindrical Mapping

In some cases, it may be preferable to slightly distort the module's shape to indicate interfaces to adjoining modules. This may be particularly useful when more than one pressurized module is shown on a single display (or other graphical product). A node module outline may then be shown in either of the below configurations:

Vertically-aligned truss segments, such as Z1, shall be similarly flattened as shown in Figure 4-16 which shows that forward locations shall be shown to the right.



Port	Aft	Stbd	Fwd
1	2	3	4

Figure 4-16 Vertical Truss Alignment

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Horizontally-aligned truss segments, such as S0, shall be split and flattened as shown in Figure 4-17.

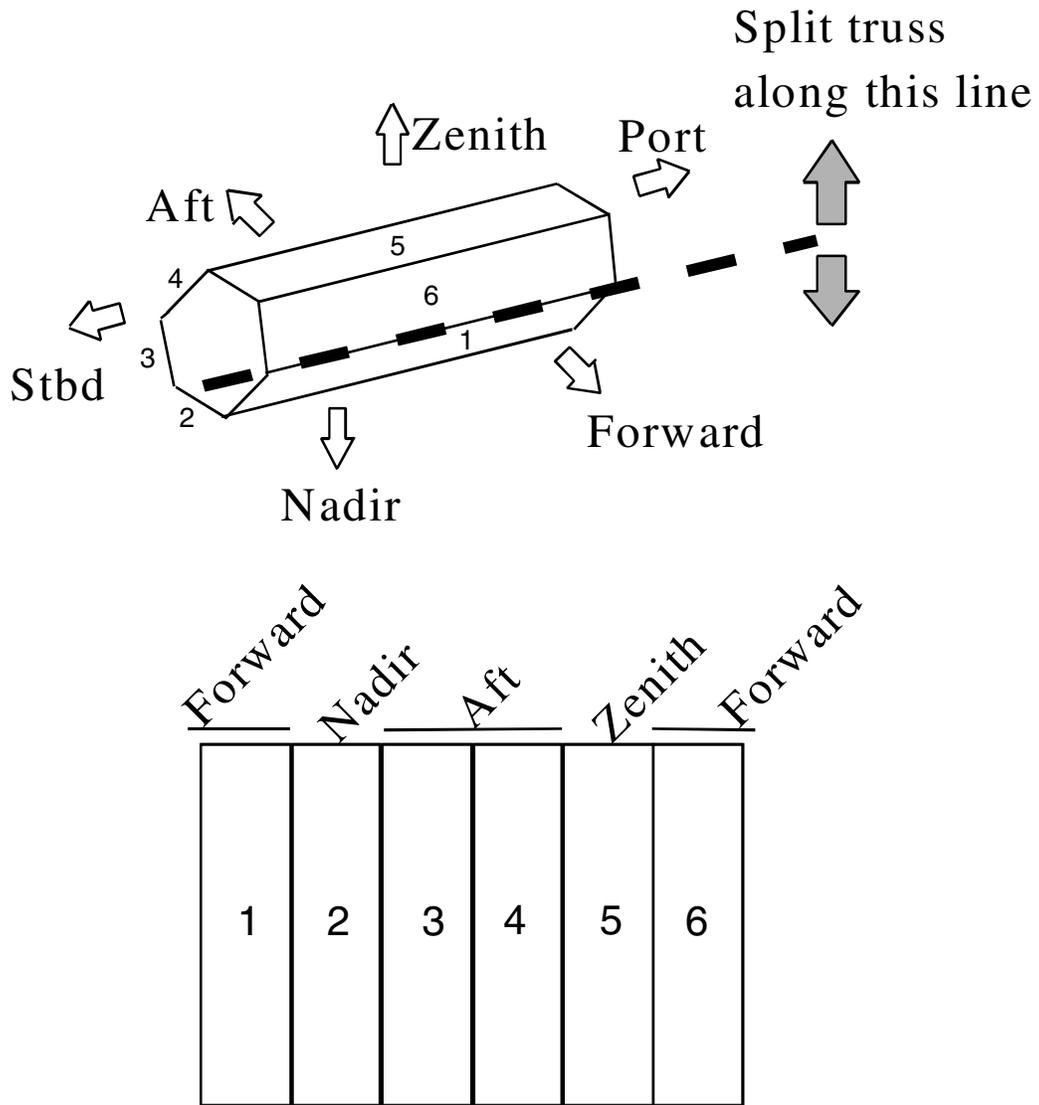


Figure 4-17 Horizontal Truss Alignment

Again, the forward face is shown to the far right.

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4.10.11.3 Combined Orthographic Mapping Convention

The shape shown to the right indicates all six faces of the node. In this case, the upper left face corresponds to the Zenith direction, the upper right corresponds to the Port direction, the lower left corresponds to the Nadir direction, and the lower right corresponds to the Starboard direction.

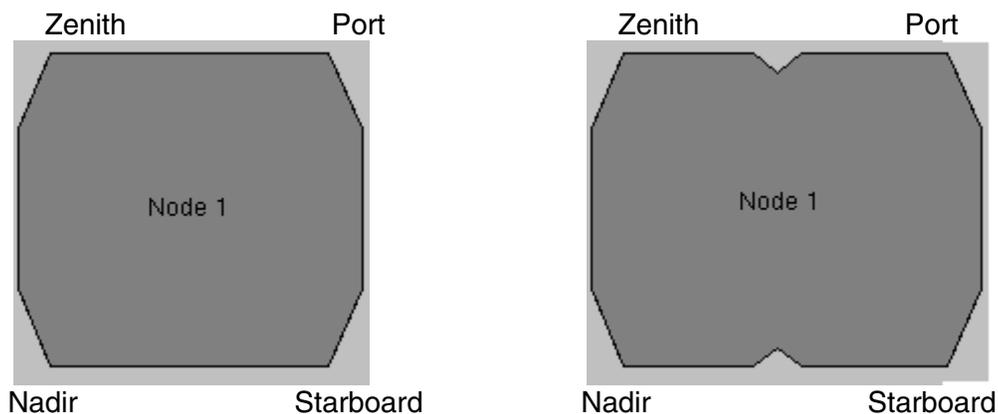


Figure 4-18 Orthographic Mapping

4.10.11.4 Example of Preferred View Convention applied to Exterior Views

Exterior views are defined as those graphics depicting the Station – or some of its segments – as seen from outside their bounding volume (Figure 4-19). This is sometimes called a "bird's-eye-view." It is a visual eye point depicting the current Station configuration enabling the display viewer to assess the exterior configuration and attitude from a global or external viewpoint. (Also see Figure 4-7.)

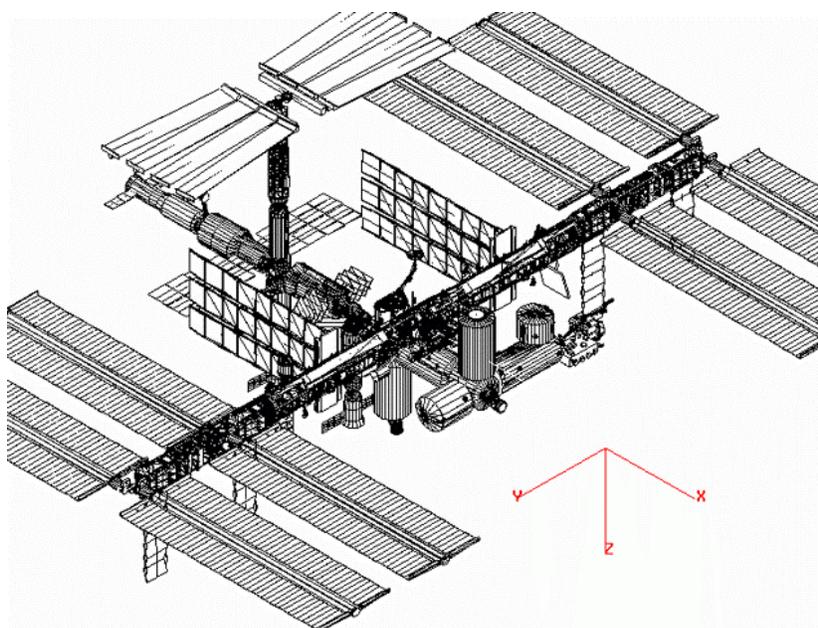


Figure 4-19 Exterior Point of View

4.10.12 Examples of Multiple Conventions Applied

Using the Preferred View convention, the Combined Orthographic mapping convention and the Articulated Structures convention results in the following Figures 4-20a & b:

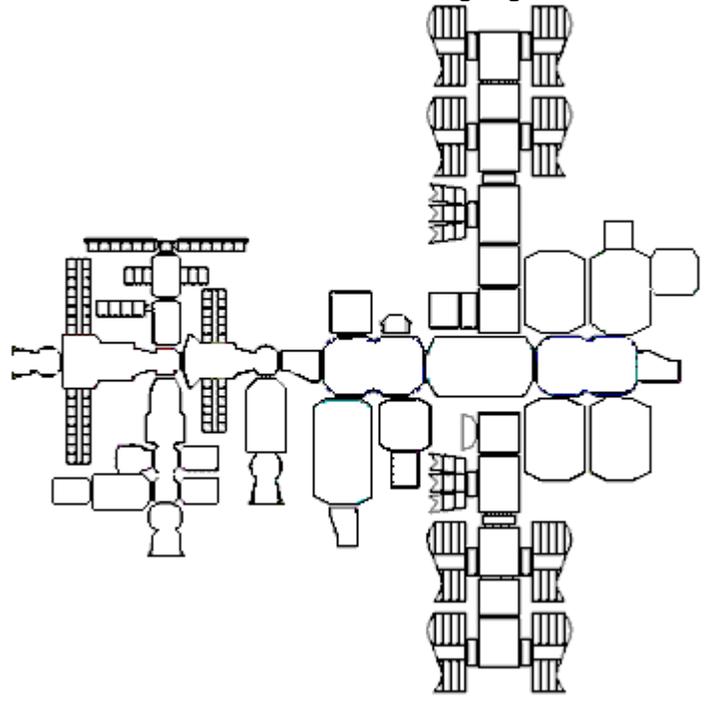


Figure 4-20a Port Side Pointing Up

The following shows the flexibility in the rules:

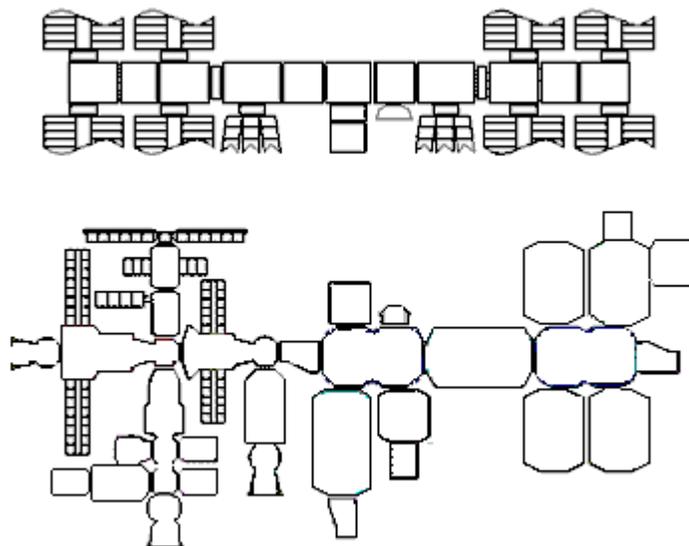


Figure 4-20b Port Side Pointing to Left

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4.11 FUNCTIONAL REPRESENTATION - FLOW DIRECTION

Functional display layouts are most often seen in system (vs. topological) displays. A functional layout may show the flow of information, heat, power, fluid, logic, or any other media within one or more systems. For example, a Summary display describing the status of the Command and Data Handler system will utilize a functional layout to show the relationship between the system's many parts.

Displays shall not provide misleading or incorrect information regarding location of equipment. Items on the display shall correctly reflect whether components and resource routing (pipes and wires) are internal or external to pressurized modules. Any exceptions to this must be clearly noted on the display.

Where not physically misleading, the flow of data, power, fluids, logic, etc., shall be from left to right and top to bottom.

When looking at diagrams that illustrate functions, the logic flow needs to be consistent across all graphics products. The following set of guidelines are provided to ensure this consistency (Figures 4-21a, 21b, 21c, and 21d).

- Potential Flow – left to right, top to bottom

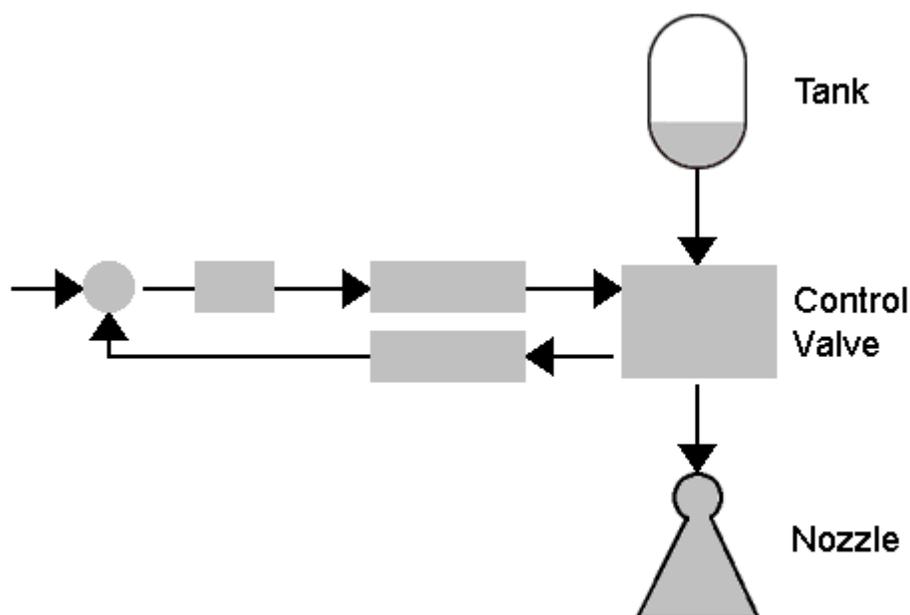


Figure 4-21a Potential Flow

- Power Distribution - power sources on left and loads on the right.

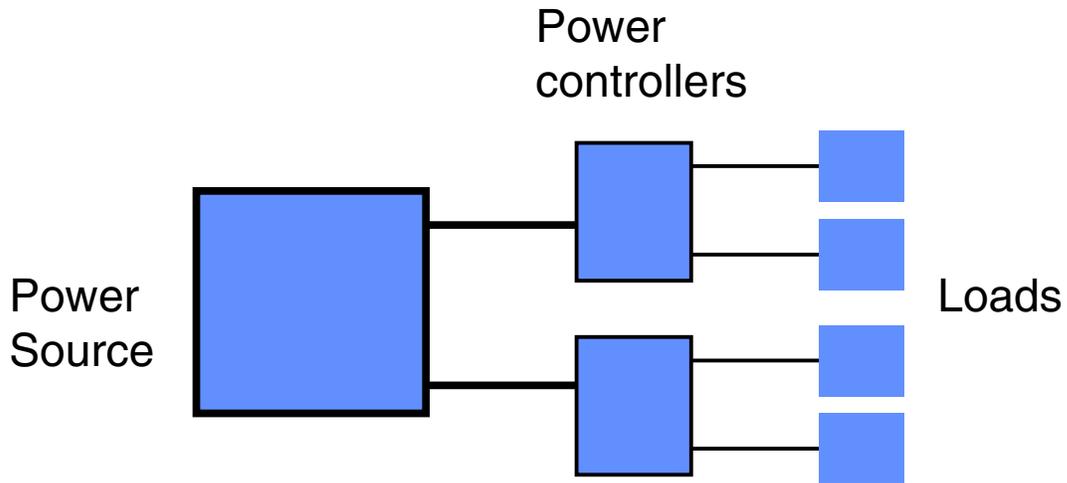


Figure 4-21b Power Distribution

- Control Hierarchy - left to right and top to bottom

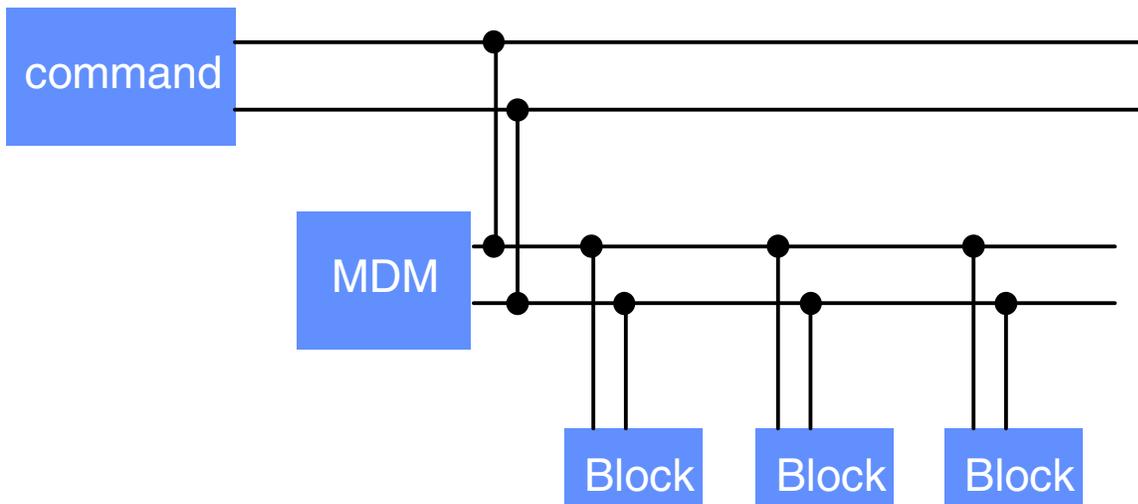


Figure 4-21c Control Hierarchy

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- Signal Flow
 - Left to Right
 - Clockwise loop
 - Feedback below forward path

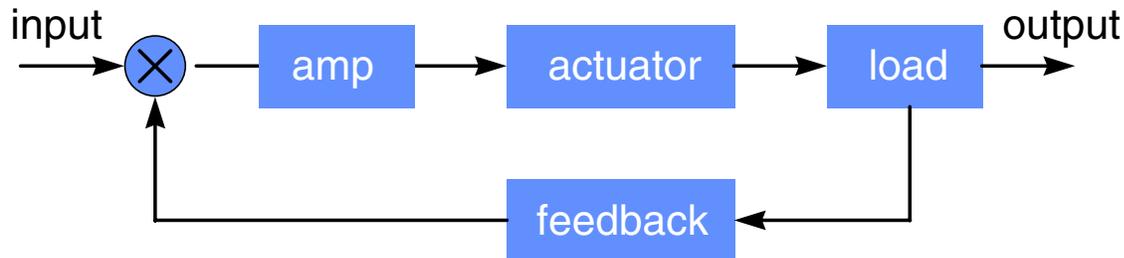


Figure 4-21d Signal Flow

4.11.1 NASA Functional Representation - Flow Direction Deviation

4.11.2 RASA Functional Representation - Flow Direction Deviation

4.11.3 ESA-Columbus Functional Representation - Flow Direction Deviation

Topological ESA-Columbus displays are flattened following the mapping conventions in section 4.10.10. See also example in section 5.2.3.

4.11.4 NASDA Functional Representation - Flow Direction Deviation

NASDA follows the general requirements except currently deviated displays.

4.11.5 CSA Functional Representation - Flow Direction Deviation

Application of flow direction guidelines subject to space constraints on the display window.

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4.12 FLOW BETWEEN DISPLAYS

When two or more (typically topological) displays address the flow of data, power, fluids, logic, etc., within a system or location, the two displays shall show a natural flow of these interfaces.

For example, the C&DH overlays for the FGB and Node 1 displays are organized as shown in Figure 4-22.

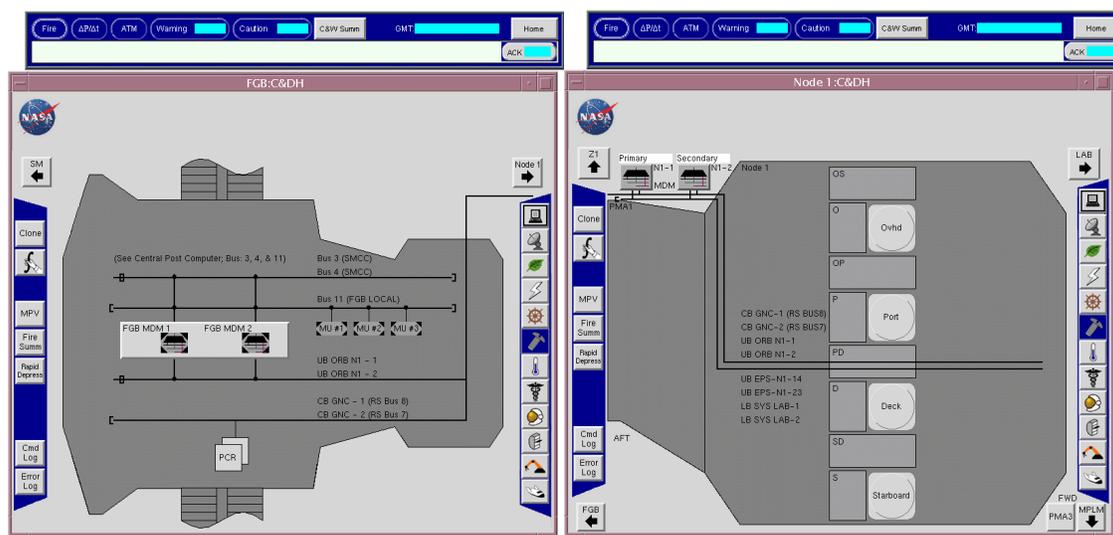


Figure 4-22 C&DH for FGB and Node 1

Data bus interfaces between the two modules are shown such that they flow from one to the other when the two displays are shown side-by-side. Note that the data buses meet at a point outside the gray-filled outlines of the modules, indicating that this is an external connection. Internal connections would be shown as within the module outlines.

4.12.1 NASA Flow Between Displays Deviation

4.12.2 RASA Flow Between Displays Deviation

4.12.3 ESA-Columbus Flow Between Displays Deviation

4.12.4 NASDA Flow Between Displays Deviation

Two or more topological displays cannot be shown on the SLT at one time.

4.12.5 CSA Flow Between Displays Deviation

MSS displays depict flow of a single functional string of a subsystem only. MSS displays do not depict flow between subsystems.

4.13 DISPLAY REGIONS

Separate functional regions of the display shall be labeled appropriately with a “Graphical Location Identifier” (GLI) so that the user may find a region within the display. GLIs should be

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left justified. For example, regions of a display may be labeled “PMCU 1 State Transitions,” “PMCU 2 State Transitions,” etc. See Figure 4-23, Functional Regions.

Functional regions of a display may be indicated by placing a gray filled rectangle behind all of the relevant graphics, parameters, and labels as indicated in the example below. See Figure 4-23 .

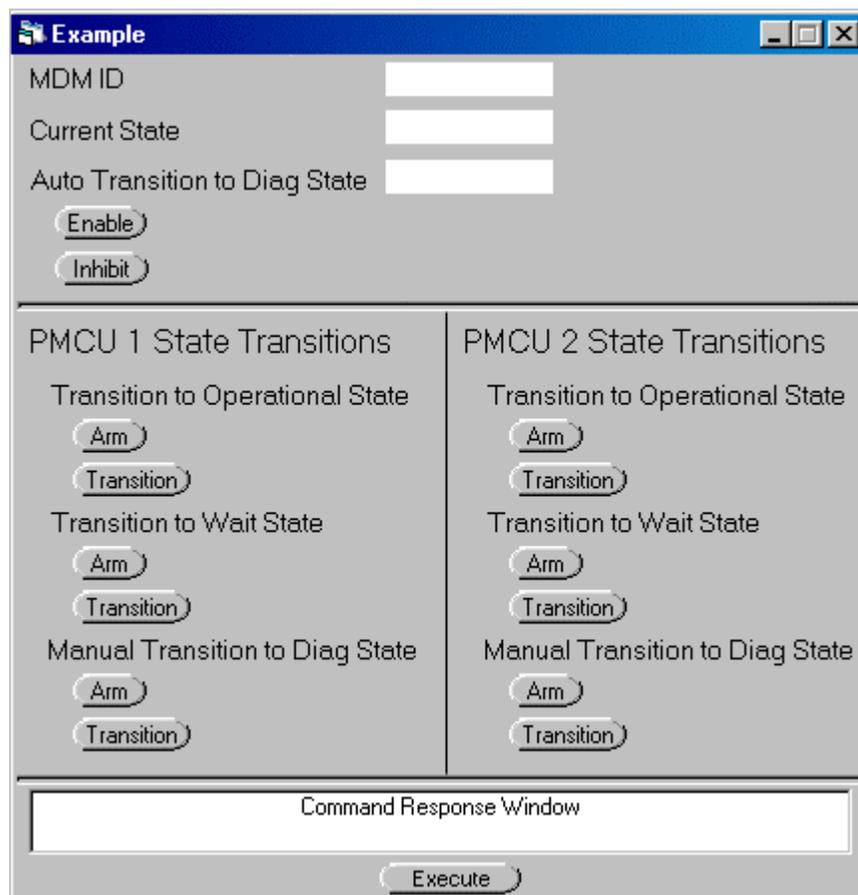


Figure 4-23 Functional Regions

Where appropriate, interfaces between functional blocks may be depicted using lines and arrows.

Grouping, bordering, or boxing of data refers to placing a rectangle around an object or group of objects. Bordering can be used to:

- Group a set of related text input or text data fields;
- Group a set of related graphic images or icons;
- Emphasize a single graphic image or icon in a group of images or icons.

Techniques for grouping data include:

- Separation of groups of information in an area using blanks, spacing, lines, color coding.
- The default color for thin line borders shall be black;

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- The default color for solid fill boxes shall be a subtly contrasting shade of gray;
- Single line borders should be used for text and low density display areas. Solid fill boxes should be used for complex graphical areas and/or dense display areas.

If it is desirable to indicate a logical group of functional components within a schematic, this logical grouping shall be indicated using either a dashed line or a solid fill gray box.

4.13.1 NASA Display Regions Deviation

4.13.2 RASA Display Regions Deviation

4.13.3 ESA-Columbus Display Regions Deviation

4.13.4 NASDA Display Regions Deviation

NASDA follows general display regions except that color is used to indicate the corresponding medium which is being measured.

4.13.5 CSA Display Regions Deviation

4.14 UNINSTALLED EQUIPMENT AND FUNCTIONS

Some displays may contain data or other references to hardware or software that is not yet installed for a particular ISS stage. If the hardware or software, although not present, must be shown on the display, then it shall be associated in a region that clearly indicates the items are not yet installed.

Parameter fields that, if shown, are not active for a given version should be filled with light gray. The user shall be presented with annotations which allow him to tell when an option is unavailable (i.e., "grayed out"). Unavailable objects on a display which are currently not implemented may be statically drawn, but should be obviously disabled by either "graying out" the graphic object, or enclosing static text between two asterisks.

Only those display regions that are selectable shall be shown with a three-dimensional button appearance. If a region will not be selectable until a future version, then the region shall not appear as a button until the applicable later version.

4.14.1 NASA Uninstalled Equipment Functions Deviation

4.14.2 RASA Uninstalled Equipment Functions Deviation

4.14.3 ESA-Columbus Uninstalled Equipment Functions Deviation

4.14.4 NASDA Uninstalled Equipment and Functions Deviation

JEM SLT displays all JEM segments and components regardless of JEM real configuration. But data areas in uninstalled components are always displayed as un-updated data. JEM RLT grays out the data of uninstalled components.

4.14.5 CSA Uninstalled Equipment Functions Deviation

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4.15 TEXT

Mixed case (upper and lowercase) letters shall be used for all labels. A similar style font and font size shall be used on each display when depicting terms or labels with similar levels of importance. This rule also applies to similar items or components on the display.

Operations Nomenclature standards apply to all text. Words in labels and titles should be spelled out (not abbreviated) when at all possible, unless the abbreviation is more commonly used than the word(s). If a word cannot be spelled out, use the standard acronym or abbreviation found in SSP-50254, Operation Nomenclature document. Use mixed (upper and lower) case letters with text and sentences.

Only acronyms should use all upper case letters.

If necessary, text may be shown vertically to fit in constrained regions. See Figure 4-24.

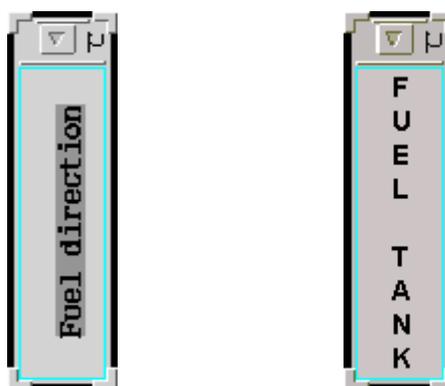


Figure 4-24 Examples of Vertical Text.

Cyrillic font may be used to provide Russian acronyms where a transliterated acronym is not feasible.

4.15.1 Schematic Text

This standard may be revised as improvements in software are realized. This standard is for schematic text.

Programs and fonts may be used to support a schematic drawing to ensure compatibility of processes so all International Partners can view the files. If using MicroStation, use 'Font 1' for English text and 'Font 143' for Cyrillic text. If using AutoCAD, use 'Romans' for English and 'Cyrillic' for Russian.

'Romans' is a sans serif font and is a single-strong font. 'Cyrillic' is a serif font similar to Times New Roman. Text height shall be 0.1 inch on all drawings (minimum). Text width shall be 1 for level 1a drawings. Text width shall be .75 for all other drawings.

4.15.2 International Partner Deviation

4.15.2.1 NASA Text Deviation

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To maximize readability when at full size and reduced size, all text must be shown in san serif font. For most applications, a minimum of Helvetica 12 point shall be used with 14 point preferred. Helvetica 16 may be used for special emphasis of labels that designate regions of the display, major system components, physical locations, etc. Exceptions may be made for font point sizes to be 10 point, but only when used for non-critical, static labels, like dimensional units of footnotes/legends.

The spacing between lines of related text should be 0.5 of upper case letter height. Spacing between headings and text should be 0.6 to 1.0 of upper case letter height. For optimal legibility, characters on a line should be separated by a minimum of one pixel or 20 percent of character width (whichever is greater). See NASA-STD-3000, Vol. IV. The space between the tallest character of a lower line should not be less than one stroke width from a character above it that projects below the line. Interline Spacing refers to the amount of spacing reserved between the baseline of one line of text and the top of the next line of text. The default Interline Spacing shall be single space.

4.15.2.2 RASA Text Deviation

RASA uses the Alt8x13 font. This font supports English and Russian.

4.15.2.3 ESA-Columbus Text Deviation

ESA uses Helvetica Bold (sans serif) for all text/numbers on MCDs, Courier Bold for dynamic data in data fields (SAMMI constraint). The Size 12 or Size 10 is used (Size 8 used in exceptional cases to avoid undue abbreviations; this size is still good readable on the high resolution laptop screen).

The Ops Nomenclature as defined in the ISS Operational Nomenclature NASA JSC - SSP 50254 (with Appendix TBD - ESA-COLUMBUS Operations Nomenclature) will be used on the MCDs. Parsing is applied in the MCD layout such that the full Ops Nomenclature name can be unambiguously deduced top-down for each item and function on an MCD.

4.15.2.4 NASDA Text Deviation

NASDA text font and spacing are restricted with SAMMI. For most displays of JEM SLT, Helvetica Bold 14 point shall be used. In some JEM SLT displays, 10 point is used. For JEM RLT displays, Helvetica and courier Bold more 12 point shall be used. Applicability of the Operations Nomenclature Standard is TBD. NASDA does not follow schematic text standard.

4.15.2.5 CSA Text Deviation

CSA text standards are consistent with NASA deviations.

4.16 **BUTTONS**

Buttons are controls used to navigate between displays, control display behavior, and select or send commands to the vehicle.

Buttons are usually shown as rectangles with shading to provide a three-dimensional appearance (see Figure 4-25). Bottom and right edges of buttons are shown darker than the button fill color, while top and left edges are shown lighter than the button fill color. However, it may be desirable to produce buttons that have unique shapes.

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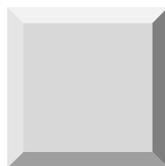
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Figure 4-25 Button (typical)

Buttons shall be clearly labeled, either on the button surface or just outside the button edge, to indicate the display to which the button navigates or the command issued by selecting that button.

4.16.1 Command Buttons

In order to easily differentiate the buttons used to send commands from the buttons used to navigate from display to display, the following convention will be used: Command buttons will have rounded corners. See Figure 4-26.

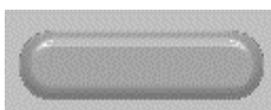


Figure 4-26 Command Button (typical)

Other buttons will have square corners except when some unique shapes (different from the above) are desired in some special cases.

Command buttons are defined according to one of the following criteria:

1. A single action on the button results in a signal sent out from the operator workstation to a station system.
2. When, for safety reasons, 2 button actions by the operator are required before an actual command is sent out as described above, the first button to be selected will be considered to be a command button.
3. When a command requires 2 actions - selection and confirmation - to be sent, the first action button used for the selection is considered to be a command button. This rule includes the case where several commands can be selected in sequence before they are sent together with one unique confirmation button action. However, this rule doesn't apply to the buttons used to select a set of parameters defining a configuration message. In which case they act more like a telemetry input field rather than a command button.

4.16.1.1 NASA Command Button Deviation

NASA Training uses rectangular buttons only (tool limitation) with static text or symbol.

4.16.1.2 RASA Command Button Deviation

RASA also uses an oval button for control related navigation.

4.16.1.3 ESA-Columbus Command Button Deviation

ESA-Columbus uses rectangular buttons only (tool limitation) with static text or symbol. Different background colors are used for different button types.

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4.16.1.4 NASDA Command Button Deviation

Due to SAMMI restrictions, JEM RLT will use parentheses to differentiate between command and navigation buttons. Command buttons will have parentheses. Navigation buttons will not. JEM SLT uses rectangular buttons only due to SAMMI restriction.

4.16.1.5 CSA Command Button Deviation

4.16.2 Navigation Buttons

Navigation buttons are defined according to the following criteria:
Navigation buttons are rectangular in shape. Navigation button will include an appropriate label to indicate the display to which the button navigates. This label shall match the title of the display. Due to the restrictive size of buttons versus display title area availability, destination displays may add a more definitive title than what appears on the selecting button. This allows a button to show abbreviations or acronyms and the requested display to be enhanced with the total title spelling out the abbreviation or acronym. An example navigation button is shown below in Figure 4-27. This button navigates to the "DDCU 4B" display. The display navigated to could be titled "DDCU 4B" or "DDCU 4B, Direct Current-to-Direct Current Converter Unit 4B." Buttons can contain either graphic icons or text. If graphics/icons are used, they must be labeled with enough information to identify what it is or does.



Figure 4-27 Navigation Button (typical)

Buttons may contain icons (preferred) and/or labels and data fields to group related data and to clarify the function of the button. All buttons shall be clearly labeled to indicate the effect of selecting the button. There may be slight differences depending on the display building tool kits used.

4.16.2.1 NASA Navigation Button Deviation

4.16.2.2 RASA Navigation Button Deviation

RASA also uses an oval button for control related navigation.

4.16.2.3 ESA-Columbus Navigation Button Deviation

ESA-Columbus uses rectangular buttons only (tool limitation) with static text or symbol. Different background colors are used for different button types.

4.16.2.4 NASDA Navigation Button Deviation

4.16.2.5 CSA Navigation Button Deviation

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4.16.3 Radio Button

Note that the following covers standards to be applied to all radio buttons, in general. (Figure 4-28)

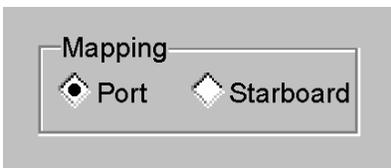


Figure 4-28 Radio Buttons

Radio buttons should be used to:

1. Present a group of, from two to eight, mutually exclusive options to the user for changing the state of an object. This change of state is not processed until an associated button is selected.
2. Less frequently, to allow the user to control the initiation of a dialog that is not task-sequence dependent, but is mutually exclusive of other task dialogs.
 - a. Unavailability of options should be shown by graying out the radio button label text.
 - b. A unique radio button shall be presented for every option; each should be presented on a single line.
 - c. Radio buttons shall be listed in some logical order, such as expected frequency of use.
 - d. If no logical basis for ordering exists, an alphabetical listing shall be used.
 - e. A single radio button should be set by the application, at all times.

4.16.3.1 Appearance

The display designer can specify the number of buttons and the corresponding text labels and title, size, location, and arrangement.

- a. Individual radio buttons shall be recognizable by the presence of a diamond shaped indicator, to the left of the radio button label.
- b. Only one indicator in the set of buttons is illuminated at a time.
- c. The indicator color, when inactive, shall match the background color of the button. The indicator color, when active, shall be a highly contrasting color (from the button background) and may be representative of some meaningful color coding scheme.

4.16.3.2 Size

The size of a radio button grouping depends on the number of options within the grouping.

- a. A radio button grouping should include from two to eight displayed options.

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- b. Either a horizontal format or a vertical format should be used for displaying two buttons.
- c. A vertical format should be used for displaying more than two buttons.

4.16.3.3 Location

Radio buttons can be located anywhere within a display.

4.16.3.4 Labels and Titles

- a. Radio button grouping titles shall be located in a consistent fashion above the groups they describe.
- b. The relationship of the title to the group should be clearly discernible.
- c. Each title should be separate and distinguishable from the body of the information beneath it.

4.16.4 Radio Button Deviations

4.16.4.1 NASA Radio Button Deviation

4.16.4.2 RASA Radio Button Deviation

4.16.4.3 ESA-Columbus Radio Button Deviation

ESA-Columbus uses rectangular buttons only (tool limitation) with static text or symbol. Different background colors are used for different button types.

4.16.4.4 NASDA Radio Button Deviation

The maximum number of radio buttons for JEM RLT is four.

4.16.4.5 CSA Radio Button Deviation

4.17 POWER ON/OFF STATE INDICATIONS

Power state is defined as the state of a device providing or not providing power to the unit represented by the icon. The corners of the icon will display the power state. When the device is closed (powered), the corners of the icon will be displayed in green. When the device is open (unpowered), the corners of the icon will be black.

Operational status is defined as the indication whether the unit represented by the icon is in normal operation or whether it is under a caution or warning. When in a nominal operational status, (power state provided by the unit and no caution and warning indication) the inner field of the icon will be dodger blue. When the unit is under a warning, the inner field will be red. Under a caution, the field will be yellow. When the unit is powered, but not operating, the inner field will be gray. For example, if two pumps get power at the same time, but only one is actually operating, the pump that is operating will have green corners and an inner field of dodger blue. The pump that is not operating will have green corners and an inner field of gray. When the unit is not powered, the inner field will be gray. If communication with a device providing the power state and operational status is lost, the inner field will be cyan.

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Buttons and indicators (not raised boxes) may be used to represent power state and operational status. See Figure 4-29.

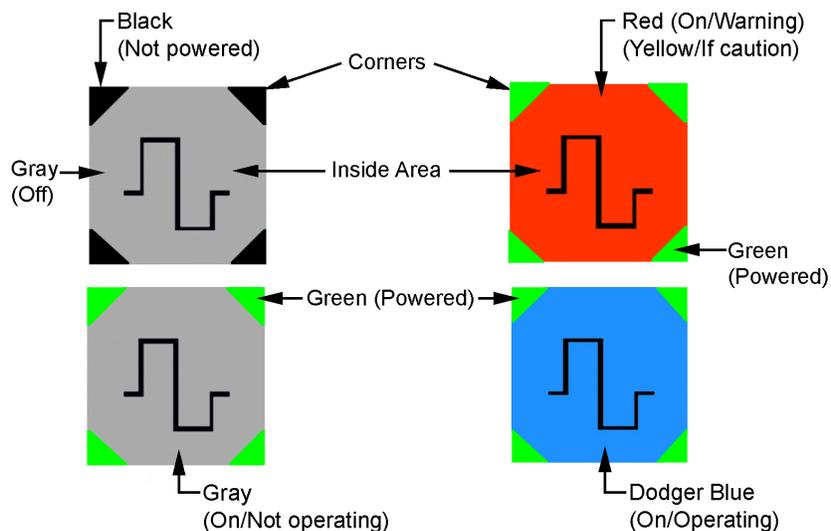


Figure 4-29 Power State and Operational Status Indications

The color of the triangular corners represents the power state of the RPC (or unavailability of this information due to the lack of communication).

RPC Corners	
Power State	Color
On	Green
Off	Black
Unknown	Cyan

The color of the inside area represents the power state and/or operational status (health) of the hardware/equipment (or unavailability of this information due to the lack of communication).

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Hardware/Equipment (inside area)		
RPC Power State	Operational Status	Color
On	Nominal (operating)	Dodger Blue
On	Off Nominal: Caution or Warning	Yellow or Red
On	Equipment not operating	Gray #67
Off	(not applicable)	Gray #67

Where there is no independent telemetry provided to indicate the power state of the hardware, the power state of the RPC will be used for both RPC and hardware.

4.17.2 RASA Power On/Off State Indications Deviation

RASA will have icons without corners, but will put a frame or line outside the button. Borders around the icon are used to indicate power on/off, icon colors indicate device status.

4.17.3 ESA- Columbus Power ON/Off State Indications Deviation

No dynamic status indication on buttons (tool limitation). Dynamic status data fields are placed next to buttons.

4.17.4 NASDA Power On/Off State Indications Deviation

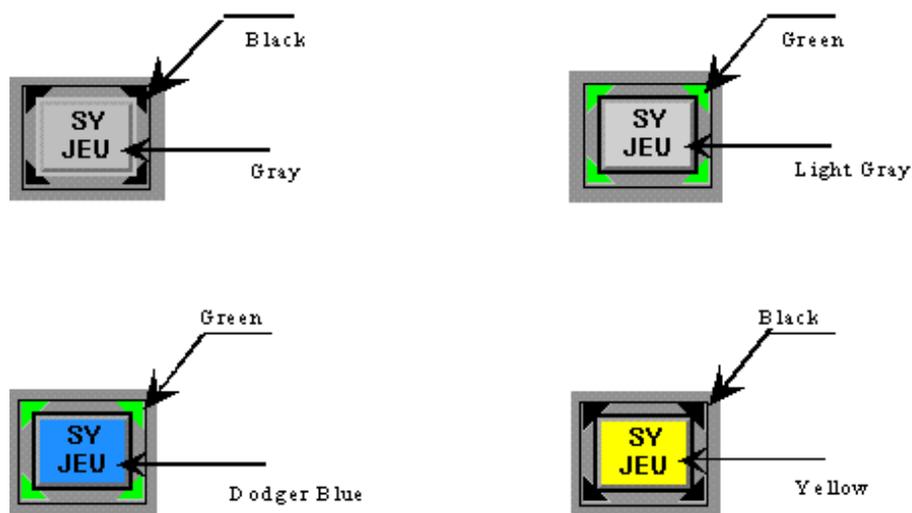
JEM SLT buttons will not have corners and the button color is reflected power state (On: Dodger blue, Off: Gray). When C&W happened, the color of buttons change to Yellow (Caution) or Red (Emergency & Warning) which are shown in Figure 4-30.



Figure 4-30 JEM SLT Power On/Off State Indication

JEM RLT buttons look similar to NASA indications but have a three dimensional appearance as shown in figure 4-31.

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Triangle corner	RPC Status (Black: OFF, Green: ON)
Button	Hardware Status
	(Gray No Power Supplied,
	Light Gray Communication Disable with Power Supplied,
	Dodger Blue Nominal
	Yellow Off Nominal)

Figure 4-31 JEM RLT Power ON/OFF State Indications on "Power"

4.17.5 CSA Power ON/OFF State Indications Deviation

CSA Power ON/OFF State Indications follow NASA Power ON/OFF State Indications.

4.18 TOOL TIPS

Utilization of tool tips is permissible.

4.18.1 NASA Tool Tips Deviation

Currently, NASA is not developing a tool tip capability.

4.18.2 RASA Tool Tips Deviation

RASA has a status/help window at the bottom of the screen. To get brief Help about an icon or a button, the user is required to select the icon or the button. There are two ways to select an object:

- To make cursor jump to the object using the arrow keys.
- To click left mouse button just near to the button, or the icon, or on the icon if it is not a button.

Context information window comes at the program start up. User can iconify that window. To get it back, the user is required to double-click on the icon. User cannot quit Context info window.

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4.18.3 ESA-Columbus Tool Tips Deviation

There will be context-sensitive help on display level, but no tool tips.

4.18.4 NASDA Tool Tips Deviation

NASDA does not have Tool Tip function.

4.18.5 CSA Tool Tips Deviation

4.19 DYNAMIC CURSOR

The utilization of dynamic cursor is permissible.

4.19.1 NASA Dynamic Cursor Deviation

NASA PCS Displays currently does not have this capability.

4.19.2 RASA Dynamic Cursor Deviation

RASA currently does not have this capability.

4.19.3 ESA-Columbus Dynamic Cursor Deviation

Not provided by tool.

4.19.4 NASDA Dynamic Cursor Deviation

NASDA does not change cursor due to SAMMI restrictions.

4.19.5 CSA Dynamic Cursor Deviation

4.20 COLORS

Use of color should be limited to a set of well chosen colors. The identified colors should be used repetitively to maintain consistency across content areas and across displays. The color standards and definitions have been extracted from several industry and government standards documents as listed in Section 2.0.

An important factor to consider when selecting colors is the contrast among colors. This is needed to ensure that each color is easily discriminated from the others. Although contrast is an important consideration, it should not be used without regard to other important factors such as convention or standard, inherent meaning and consistency across displays. The color selections also need to be evaluated for shades of gray discrimination for black and white printouts. In the case of gases and fluids, color will also be accompanied when possible with an alphanumeric character inside or adjacent to the tank or pipe containing the fluid to indicate the material or substance.

All displays shall conform to color usage specifications outlined in this section and Appendix B. Red and yellow are reserved for use with emergency, warning, and caution notification. Red is reserved for indicating an alarm message or parameter limit violation indicative of an emergency or warning condition. Yellow is reserved for indicating an alarm message or parameter limit violation indicative of a caution condition.

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Digital and textual data values may reflect caution and warning limit status using the following color coding.

Status	Foreground Color	Background Color
Nominal	Black	White
Caution	Black	Yellow
Warning	White	Red
Emergency	White	Red

Table 4-1 Caution & Warning Status Colors

Graphical elements also shall utilize the color codes included in the appendices of this document.

Training graphical products which deviate from the colors prescribed in Appendix B must include a legend which documents the color usage.

4.20.1 NASA Colors Deviation

Off scale high and low are indicated by turning the data field red.

4.20.2 RASA Colors Deviation

4.20.3 ESA-Columbus Colors Deviation

ESA-Columbus MCD's follow general colors, in few cases using the "best match" of available tool-colors. Other displays as per APM FHCI standard.

4.20.4 NASDA Colors Deviation

Some displays of SLT and RLT have more than nine colors. On SLT, the same label of fluid and gases are displayed outside of the pipe and some are not displayed.

4.20.5 CSA Colors Deviation

4.21 ATTENTION SYMBOL

The attention symbol, an exclamation mark inside a yellow triangle (See Figure 4-32a), is used anytime it is desired to attract the user's attention based on some operational criteria. In particular, there are four cases:

- Denoting an out of configuration state or change in configuration
- Denoting an out of operational limits condition
- Providing additional troubleshooting information for C&W enunciated failures (i.e. ancillary cues)
- As an indication for the user to navigate to a more detailed level display for more information.

In the first three cases, the attention symbol will be positioned next to a telemetry data field. In the fourth case, the attention symbol will be positioned near a navigation button indicating to the user that information that should be looked at can be found by navigating to the next display.

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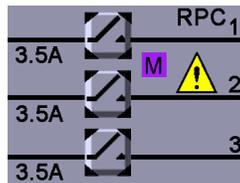
If the attention symbol is used to indicate that the user should navigate to a lower level display, the display should avoid sending the user to a page full of parameters on which there is no obvious indication of what drove the attention symbol.



Figure 4-32 Attention Symbol

This symbol is used for many items, including (but not limited to) switches, valves, data buses, power feeds, and health status indicators.

For example, the attention symbol is used to indicate that a Remote Power Controller (RPC), or switch, has tripped open. Rather than continuously showing the trip flag for all RPCs on any display, the attention symbol is used to indicate that the switch has tripped.



By selecting the RPC button, the user may view the RPCs detailed parameters to further investigate the trip (Figure 4-33).

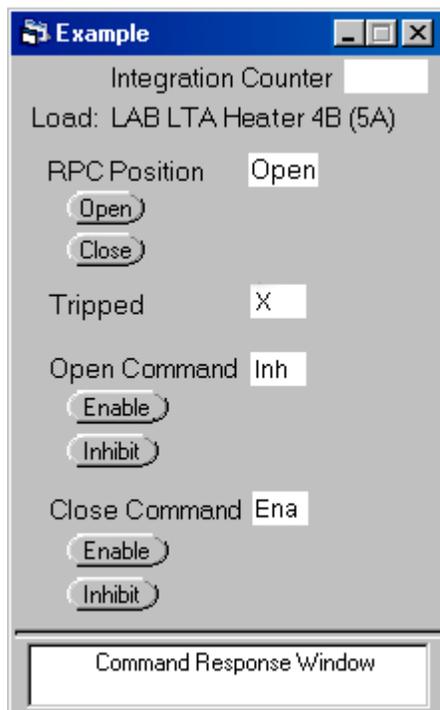


Figure 4-33 RPC Detailed Parameters

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The attention symbol will be shown as long as the parameter to which it refers is in the off-nominal state.

4.21.1 NASA Attention Symbol Deviation

NASA follows general Attention Symbol. For the NASA PCS implementation any parameters driving an attention symbol must be included in the same DDCT (Display Data Control Table) as the display on which the attention symbol will appear. This is especially true in the navigation case as unless the parameter is in the DDCT, there will be no way for the PCS to detect the condition.

4.21.2 RASA Attention Symbol Deviation

RASA does not use the attention symbol.

4.21.3 ESA-Columbus Attention Symbol Deviation

Attention symbol is not supported. Replaced by data quality indication, see Section 10.3.3.

4.21.4 NASDA Attention Symbol Deviation

JEM SLT uses the attention symbol to indicate event occurrence (include C&W) and RPC trip. There are no functions of showing detail information by clicking region of attention symbol. When clicking the RPC button, the commanding window (RPC Open/Close) is displayed. JEM RLT does not have an attention symbol.

JEM RLT does not use button type RPCs.

4.21.5 CSA Attention Symbol Deviation

CSA uses Attention Symbols for RPCs and Colored Icons and Advisory Messages in lieu of Attention Symbol, otherwise consistent with NASA Attention Symbol Deviation.

4.22 LIMITS

TBD.

4.22.1 NASA Limits Deviation

The limit manager application is a utility that interfaces with the ISP data server. The purpose of the application is to indicate data values that are approaching or exceeding limits as defined in a user defined input file. The limit manager includes an interface that allows the operator to change the predefined ranges as the program is executing. Changes made are resident only on the local ISP data server. Therefore, changes made to ground display limits will not be reflected on PCS displays and changes made to PCS display limits will not be reflected on the ground display limits.

The user may access the limit manager by left-selecting on the parameter field of interest. A menu appears giving options to plot the value or to view the limit manager. Selecting the "Limits" option opens the Limit Manager application with the parameter limits of interest shown.

When the limit manager is first started, the application uses a predefined input file that is loaded at program startup. Once the limit manager starts, the values defined in the data file can be changed or deleted, and undefined values can be added. The user interface to the limit manager is available via the popup menu that appears when the left mouse button is pressed

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over a data field. When the Limit option is selected, the window appears as shown in Figure 4-34.

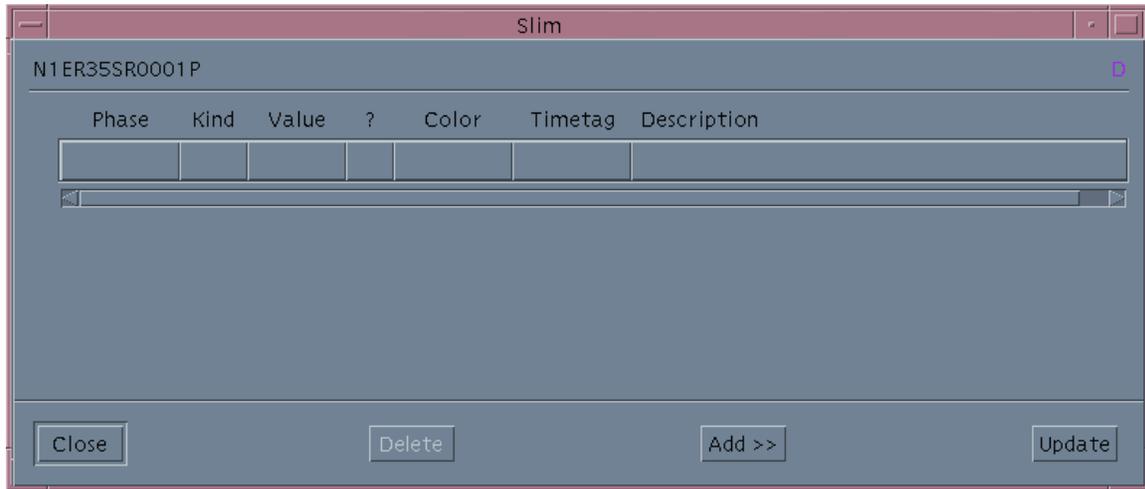


Figure 4-34 Limit Manager

The name of the PUI is shown at the top of the window, and the current limits defined for the PUI are shown in the text area. By selecting the Add, Replace, or Delete buttons, these current limits can be changed. When the Add button is selected, the following window appears (Figure 4-35). A similar window appears for the Replace button.

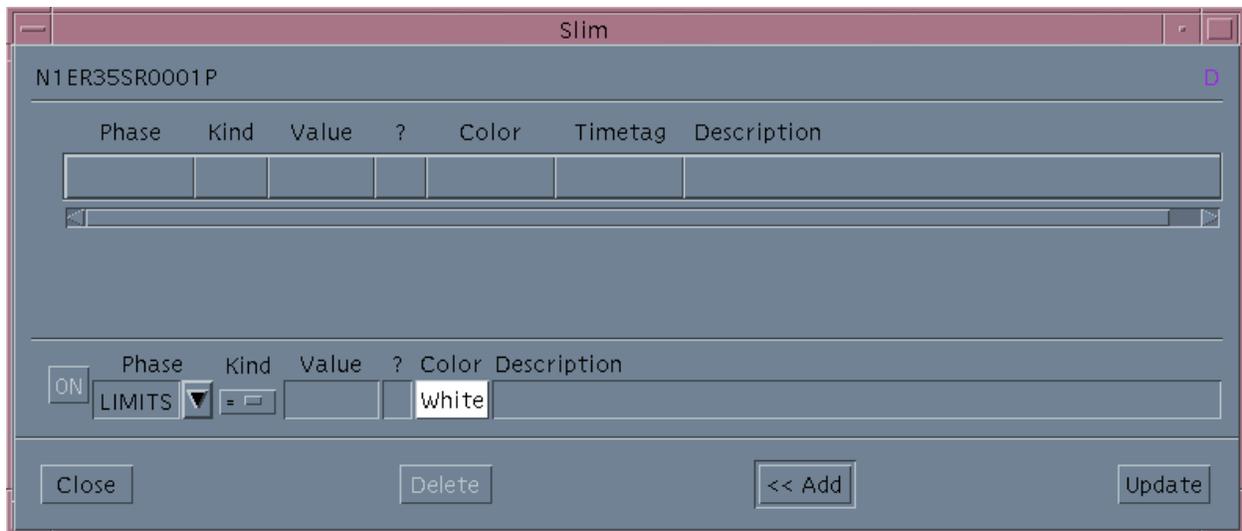


Figure 4-35 Add Limit

The operator can define the kind of limit, the indicator associated with the range, and the color to be shown when the PUI value falls into the defined range. The value used as a limit threshold and a description of the limit is entered at the bottom of the window. The OK button will enter this range into the text area of the limit manager window, and the Cancel button will ignore any inputs in the window before closing the window.

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4.22.2 RASA Limits Deviation

RASA is not using this functionality for the crew. It is technically possible using unique technical interfaces but this capability is usually done by ground control.

4.22.3 ESA-Columbus Limits Deviation

The PWS Monitoring Limits application provides a tabular display of limit sensed HK-data with the monitoring parameters. The crew can enable/inhibit the limit sensing and select between two predefined (soft-high) limit sets. Actual changes of limits are controlled from ground.

4.22.4 NASDA Limits Deviation

JEM SLT limit manger window shown in Figure 4-36 is opened by clicking the data label (button) of limit check data of Figure 8-1 in paragraph 8.1.4. There is no PUI on limit manager window. The event inhibit flag, current limit set (only for analog value), and current limit value (only for analog value) are displayed. NASDA SLT provides crew the capabilities to enable/inhibit the event detection and to change the limit set and limit value. JEM RLT is TBS.

JPM CDH HRMS Temp Hi CW

Event Detection:

Limit Set:

Set No.	Lower	Upper
1	*****	70.0
2	*****	70.0
3	<input type="text" value="0.0"/>	<input type="text" value="0.0"/>

Limit Set3

Lower

- No Change
- Change to deg C
- No Limit

Upper

- No Change
- Change to deg C
- No Limit

The following FAS auto proc is provided for this event
C&DH FAS0010 (HRMS_Temp_FDIR)

Figure 4-36 SLT Limit Manager

4.22.5 CSA Limits Deviation

CSA us using the standards Limits Manager provided by PCS.

4.23 MENUS

The word "menu" implies a list of choices, normally presented in the graphic form. The flexibility of an X-Window type system allows options to be presented using other graphics, like selection lists, or rows of pushbuttons. The intent of these guidelines shall be applicable to most graphic presentations providing lists of options.

Menu selection systems require careful task analysis to ensure that all functions are supported conveniently and that terminology is chosen carefully and used consistently.

Accept only one selection from each menu at a time. Multiple selections should generally not be allowed within each menu tree. Also, keep the selections in a single column and make the pointing area for selection as large as reasonably possible.

Provide a way to exit the menu without making a choice. This guideline is important in designing any menu, regardless of its complexity, but a "quick escape" method is particularly important. Frequently, the designer may want to give the user more than one exit option on a menu, such as one to go to another menu or screen, and one to leave the application completely. Example:

- Moving the cursor out of the menu.
- Providing options to quit or return to a previous screen.

Put a meaningful title on top of all lists and as pull-down menu categories. Menu navigation can be facilitated by providing a name that categorizes the options in the menu in a meaningful way. Strip and horizontal menu bars that stay on the screen throughout the life of an application will not need a title. A menu title may also describe the level of the menu in a menu hierarchy. For example, the title "Main Electronic Mail Menu" describes both the level of the menu and its contents.

Choose an organizing principle for the menu options. If there is no obvious organizing principle, choose to list items in alphabetic or numeric order. Organizing principles include:

- Expected frequency of use.
- Logical sequence of operations (task chronological order).
- Alphabetic or numeric order.

Usually, there will be a logical frequency of use or order to the list, and, when using icons, one of these two methods should always be used. If there is no logical order, list them vertically and alphabetically to make them easier to scan. This is especially important when there are a large number of menu options, such as more than eight.

To facilitate scanning, divide menu items into logical groups. If necessary, visually divide long lists after every fifth option. As a rule, organize a menu hierarchy according to the tasks users will perform, and organize the options in a way to minimize user search time. If the menu options consist of more than single words, attempt to limit the number of options to between five and eight. If a menu contains more than eight to ten options, there is probably more than one category of information contained in it, and it should be broken up into two or more menus.

Use words for menu options that clearly and specifically describe what the user is selecting. Use simple, active verbs to describe menu options. Sometimes, the active verb on a menu

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choice is "implied." For example, listing the available fonts the user can pick from actually names things rather than actions on those things. The implied action verb in this case is "choose one" or "pick one." Top-level menus, used for application navigation, may also be used. The implied verb in this case would be "go to." The selection of words for a menu screen should follow these principles:

- Use words that clearly describe the options and are distinct from one another.
- Use common English words rather than computer jargon. Spell out words completely.
- Use simple, active verbs to tell users what actions will result from their choice. Users are selecting from a menu because they want to do something. In English, only verbs can be used to describe actions. Do not try to mix the use of nouns and verbs.
- Be sure that the option to leave the menu describes the consequences of its selection completely. Reserve such words such as "quit" for cases in which the user will be transferred completely out of the application.
- Describe the options using parallel construction. For example, if single words are used to describe each option, use the same part of speech for all the options. Action verbs are preferable.

If icons are used, ensure that they unambiguously identify the meaning of the user's options.

Display the menu options in mixed (upper and lower) case letters to provide more information at a faster rate. Text should only be displayed in upper case when it is an acronym.

Menus should be interactive and require a positive action on the part of the user. Mouseovers should be avoided.

4.23.1 NASA Menu Deviation

4.23.2 RASA Menu Deviation

4.23.3 ESA-Columbus Menu Deviation

4.23.4 NASDA Menu Deviation

JEM RLT has up to 17 menu options.

4.23.5 CSA Menu Deviation.

SECTION 5

DISPLAY ORGANIZATION AND HIERARCHY

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SECTION 5.0 DISPLAY ORGANIZATION AND HIERARCHY

5.1 GENERAL PRINCIPLES AND RATIONALE

There are three major types of displays: topological/structure, system, and task. Some displays may be accessed via topological or system displays. These system displays are organized in a hierarchy to define increasing levels of detail (Figure 5-1). Task displays may also be accessed from a pull-down menu on the user tool bar.

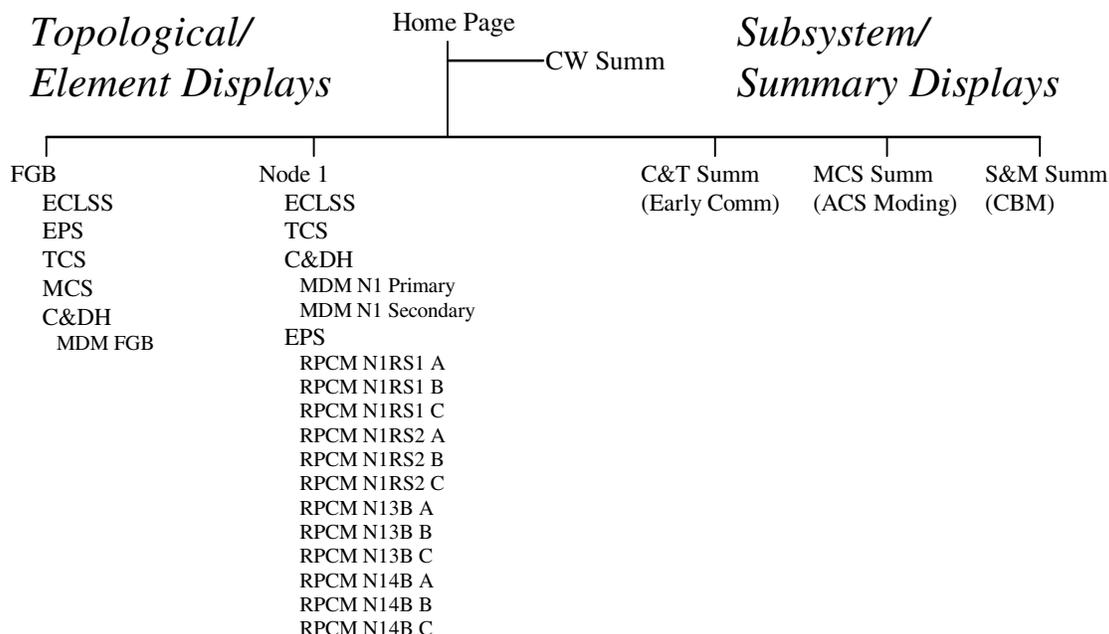


Figure 5-1 Topological Element Displays (typical)

5.2 TOPOLOGICAL/STRUCTURE DISPLAYS

Topological displays (Figure 5-2) provide information grouped by location - US Lab, Node 1, P6, etc. A topological display shows the shape of the segment (P6, FGB, etc.) as a gray outline filling the majority of the display window. These are "module" displays. The proportion shape for the module should not change when navigating to other displays of the same module. The size may change, but not the proportion.

It is possible that other topological displays may portray more than one segment. For example, a single display may show data for the entire starboard truss in a topological format.

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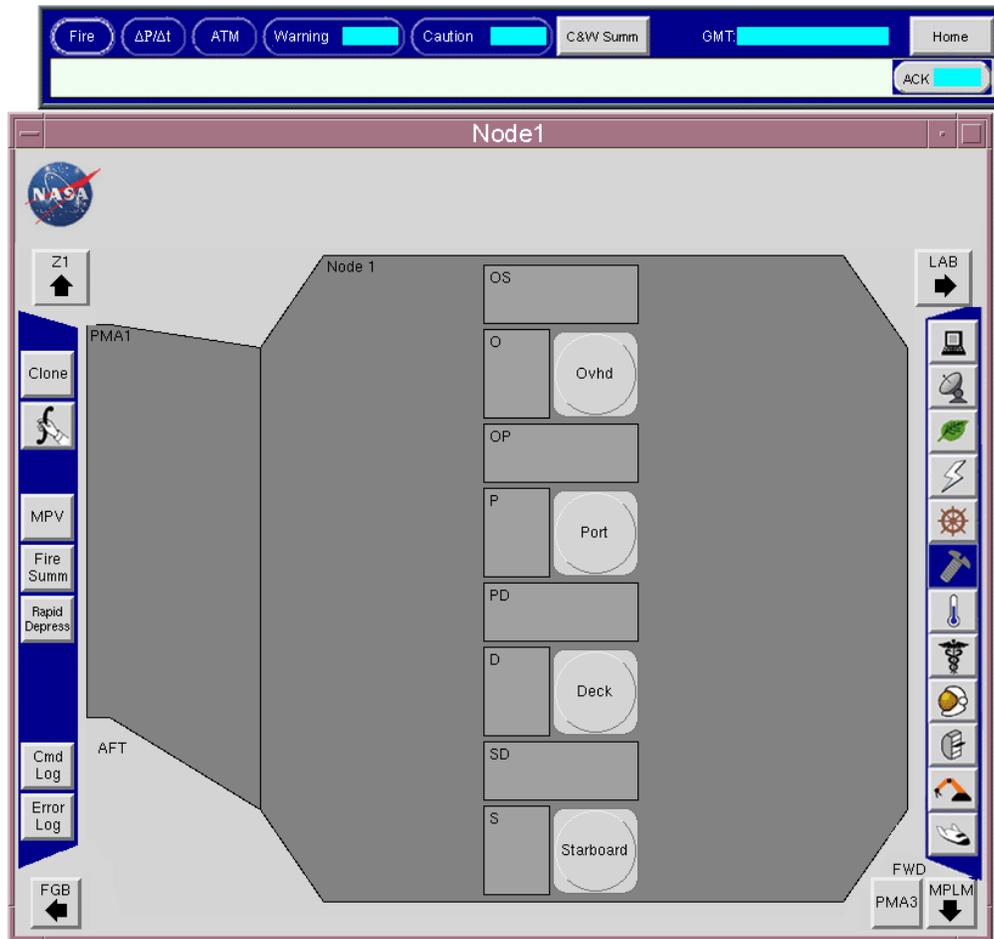
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Figure 5-2 Topological Display (typical)

Module displays provide system overlays to allow the user to view details of a particular system's blocks in that location (Figure 5-3). These overlays are accessible via system buttons on the right side of the display.

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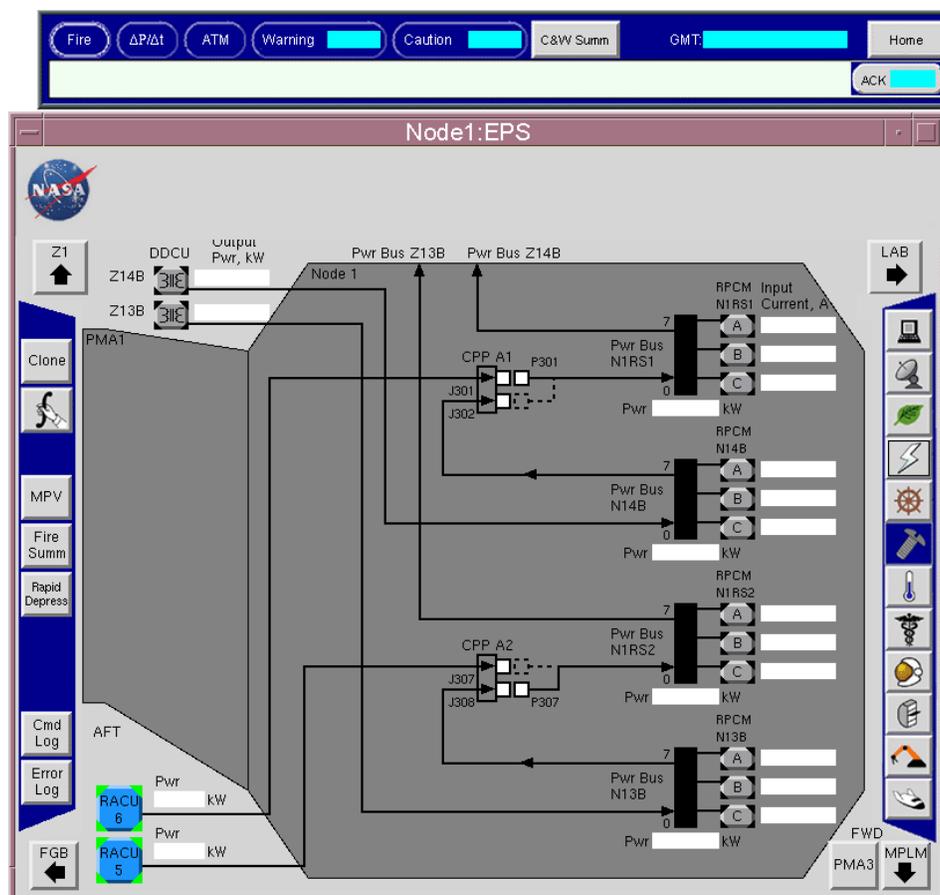
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Figure 5-3 EPS Subsystem Location Display

Module displays should contain navigation buttons for adjacent module displays. For example, a button near the left (aft) side of the Node 1 display provides navigation to the FGB display.

5.2.1 NASA Topological/Structure Displays Deviation

5.2.2 RASA Topological/Structure Displays Deviation

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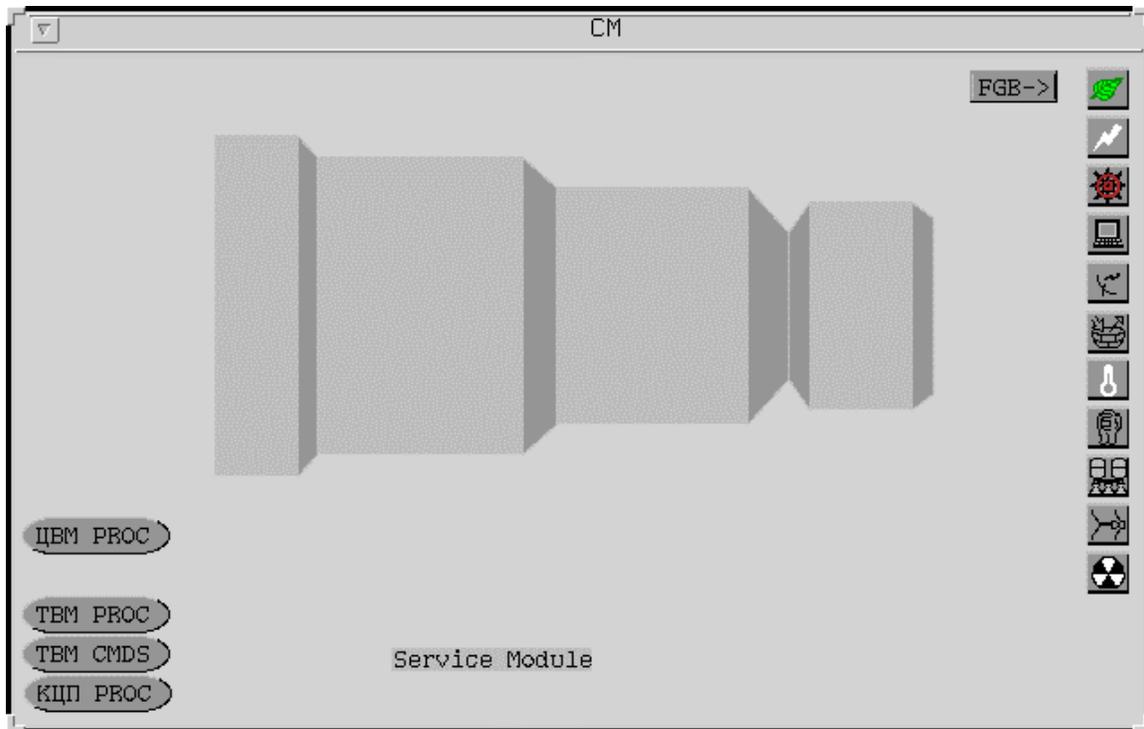
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Figure 5-4 RASA SM Display

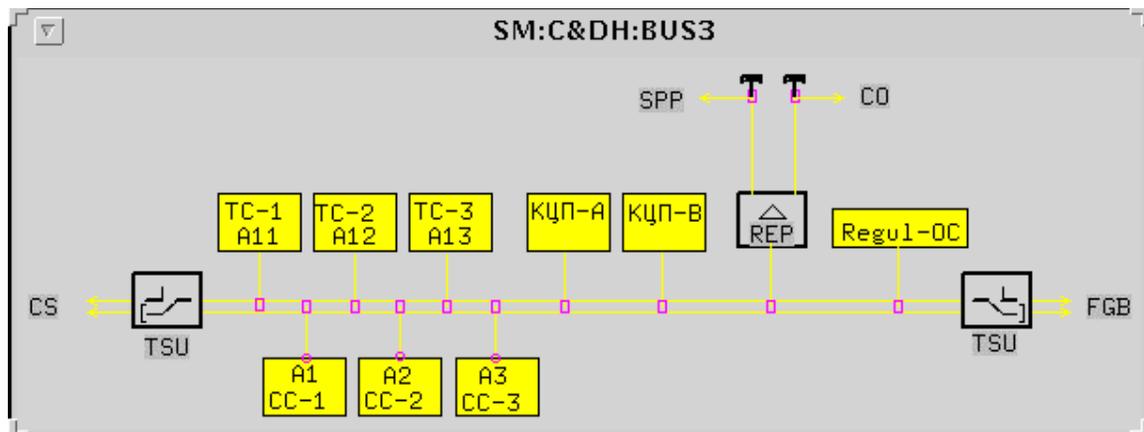


Figure 5-5 RASA C&DH Subwindow

5.2.3 ESA-Columbus Topological/Structure Displays Deviation

ESA-Columbus topological displays will show the shape of the ESA-Columbus element as a gray outline filling the majority of the display window. The module display provide subsystem overlays, which is actually a new display but with the same background, to allow the user to view details of a particular subsystem components in the module. These overlays will be accessible via subsystem buttons on the right side of the display. An example of an ESA-Columbus related topological display is shown in Figure 5-6a. The display shows the main components of the ECLSS and their location in the module.

In specific cases deviating topological views are used. E.g. most DMSS equipment is accommodated in the Starboard Cone. To provide a good overview, the starboard end-cone is

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tilted into the display plane and provides a front view on the cone with the DMS equipment, shown in Figure 5-6b.

Topological MCDs serve primarily for a topological system overview and include generally only selected overview status data that are representative for the overall system status.

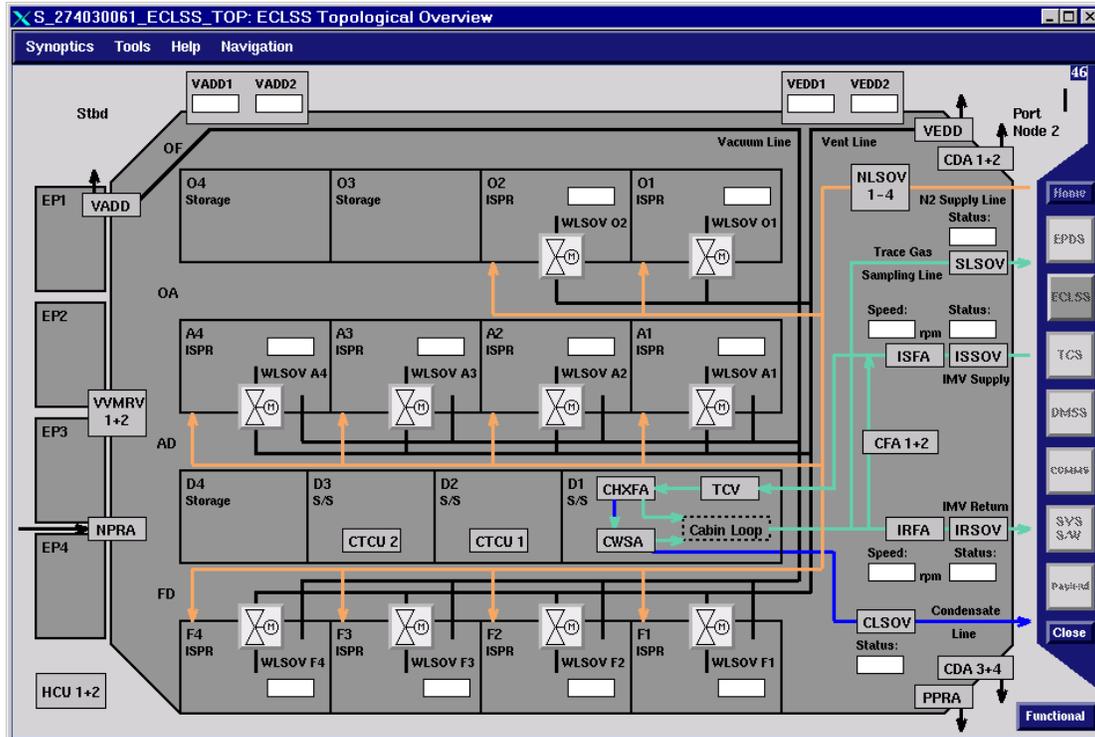


Figure 5-6a Example of Topological ECLSS Display for ESA-Columbus (typical)

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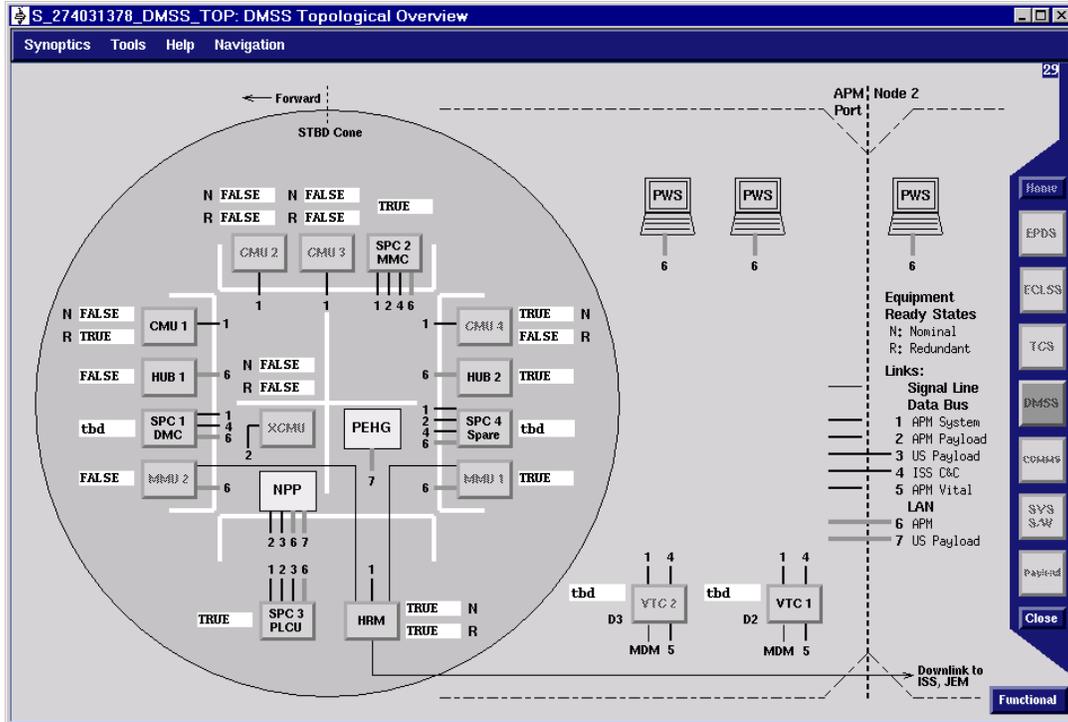
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Figure 5-6b Topological DMSS Display for ESA-Columbus

5.2.4 NASDA Topological/Structure Displays Deviation

JEM RLT is TBS.

5.2.5 CSA Topological/Structure Displays Deviation

Displays may be reflective of the actual position of those elements that move.

5.3 HOME PAGE

The **Home Page** is defined as the top most or initial display used in beginning from and navigating to other displays. In most cases, the **Home Page** is always displayed and available on-screen to users.

The **Home Page** display should indicate status of the module (or modules) and provide navigation to other displays.

The **Home Page** should provide a graphical depiction of the module's (or modules') physical layout.

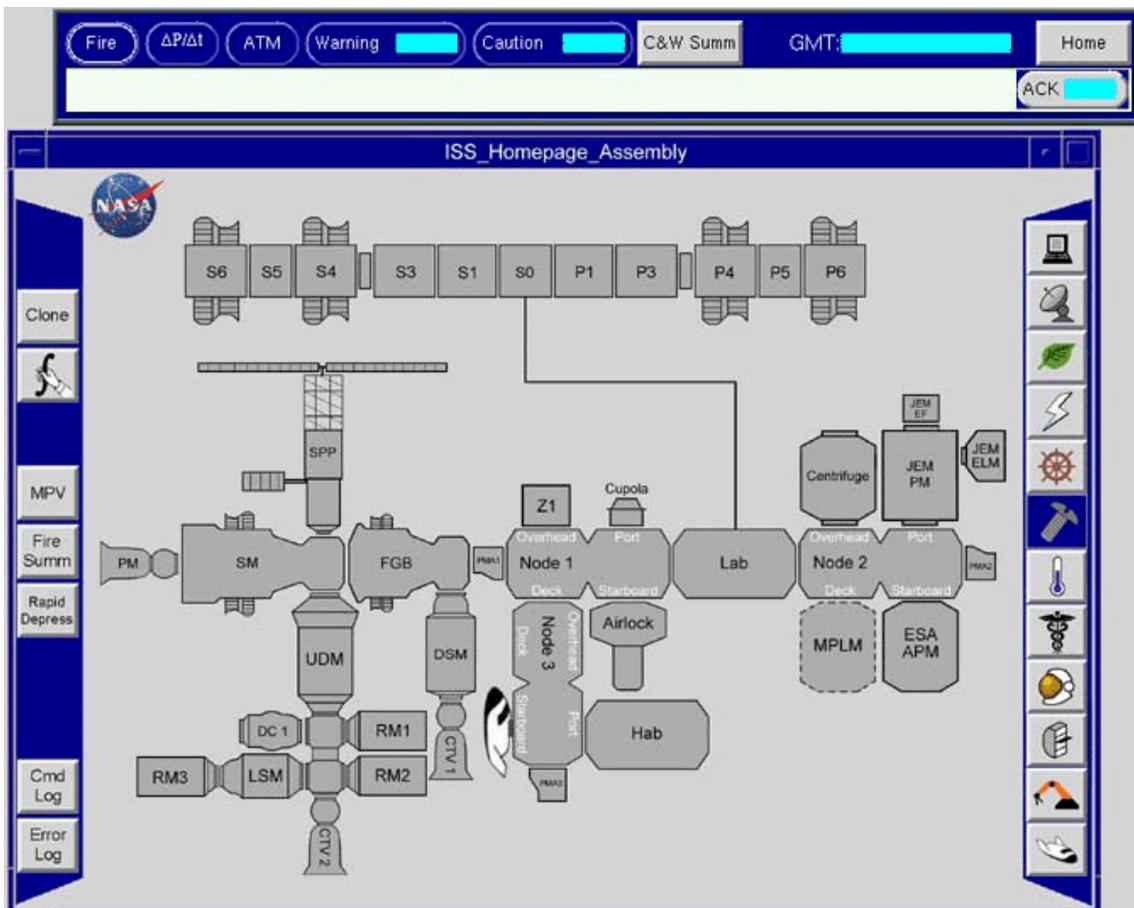


Figure 5-7 NASA Home Page

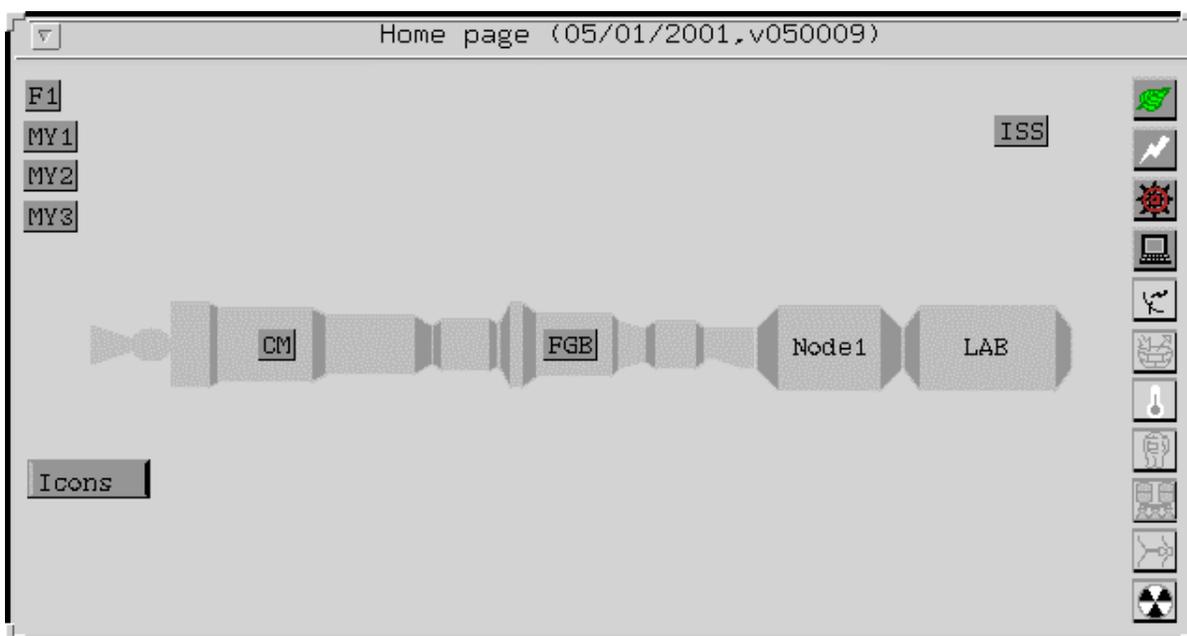


Figure 5-8 RASA Home Page

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TBS
Figure 5-9 APM Home Page

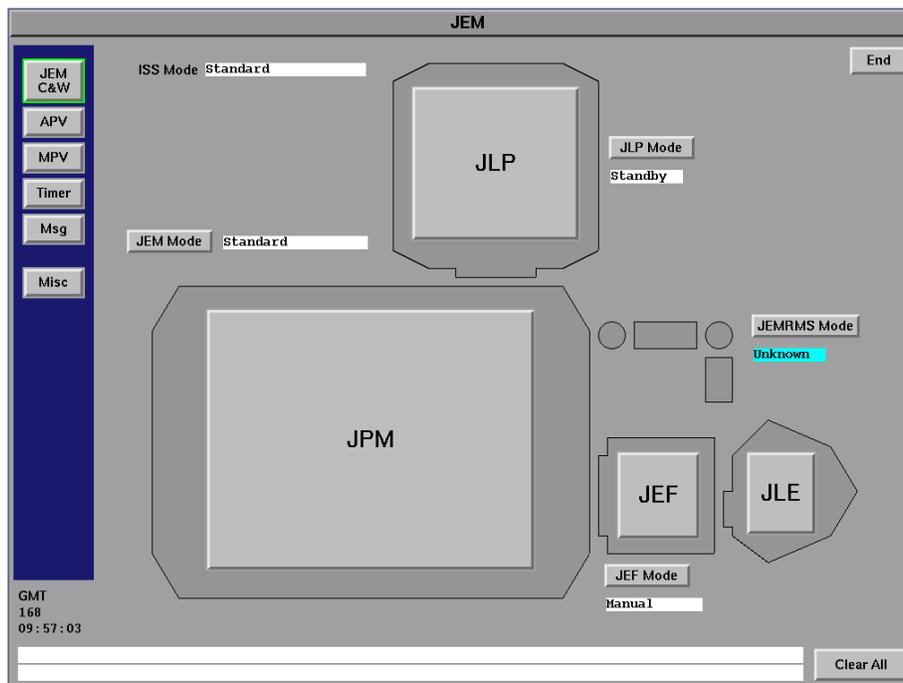


Figure 5-10 JEM Home Page

5.3.1 NASA Home Page Deviation

5.3.2 RASA Home Page Deviation

5.3.3 ESA-Columbus Home Page Deviation

The ESA-Columbus system home page, which is equivalent to other partners' home pages, is the topmost synoptic display which is displayed when the Monitoring and Control Display (MCD) application is started or de-iconized, respectively. Navigation from one synoptic display to another is performed via navigation buttons or the MCD navigation menu. These features are described in more detail in Section 5.7.3.

5.3.4 NASDA Home Page Deviation

JEM SLT home page as shown in Figure 5-10 is the top of the JEM display hierarchy. JEM RLT is TBS.

5.3.5 CSA Home Page Deviation

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5.4 SYSTEM DISPLAYS

5.4.1 NASA System Displays Deviation

System display (Figure 5-11) provide data organized by the functional vehicle system and often include many physical regions of the vehicle. Each system shall have a summary display available from the **Home Page**. This summary shall provide general vehicle-wide (i.e., including IP segments) system status information and the ability to navigate to related displays.

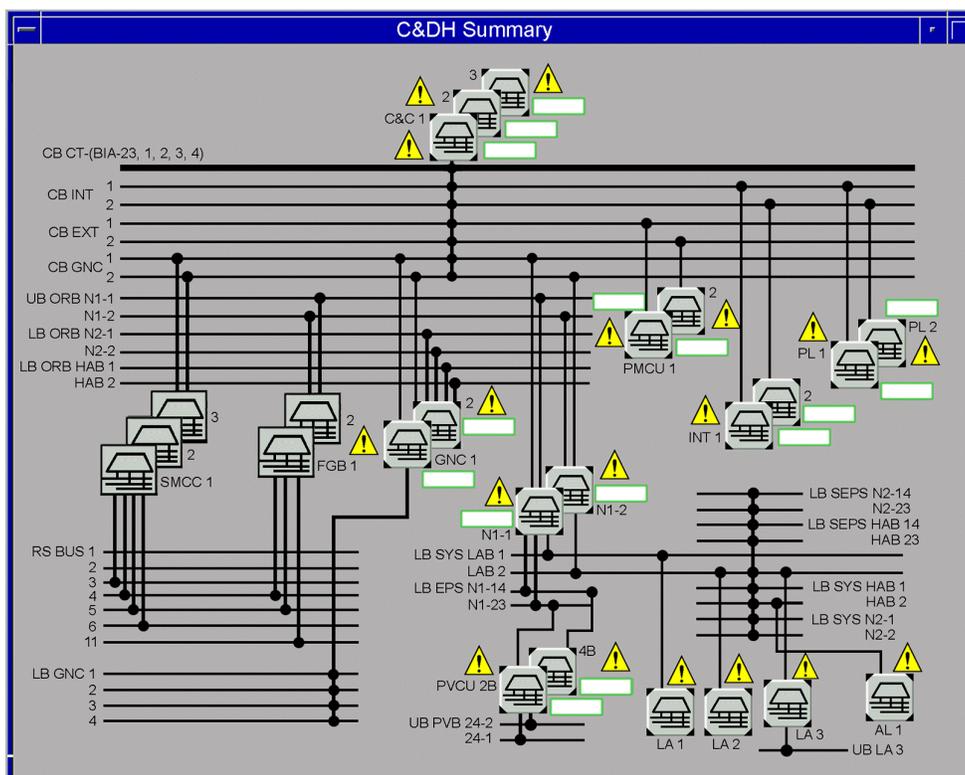


Figure 5-11 C&DH System Display (typical)

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5.4.2 RASA System Displays Deviation

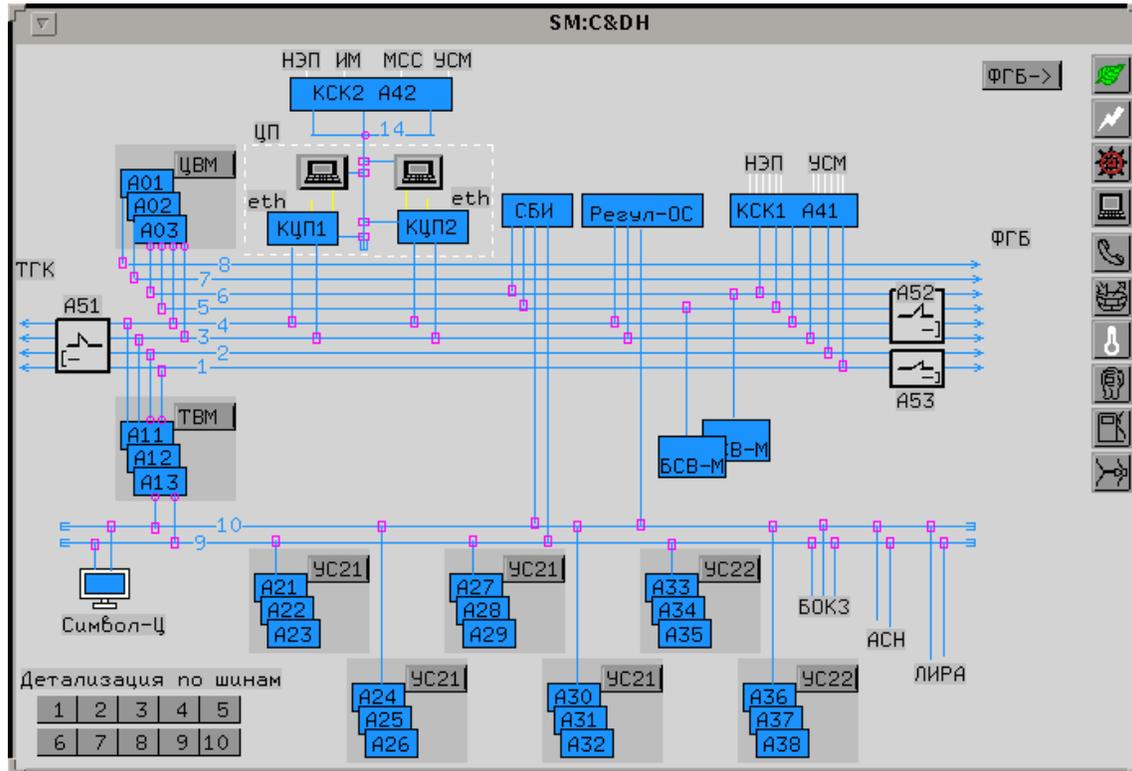


Figure 5-12 RASA System Display (typical)

5.4.3 ESA-Columbus System Displays Deviation

ESA provides ESA-Columbus system displays as both topological and functional overview displays for all ESA-Columbus Systems. From these overview displays, navigation is provided to lower level functional displays as described in section 5.7.3.

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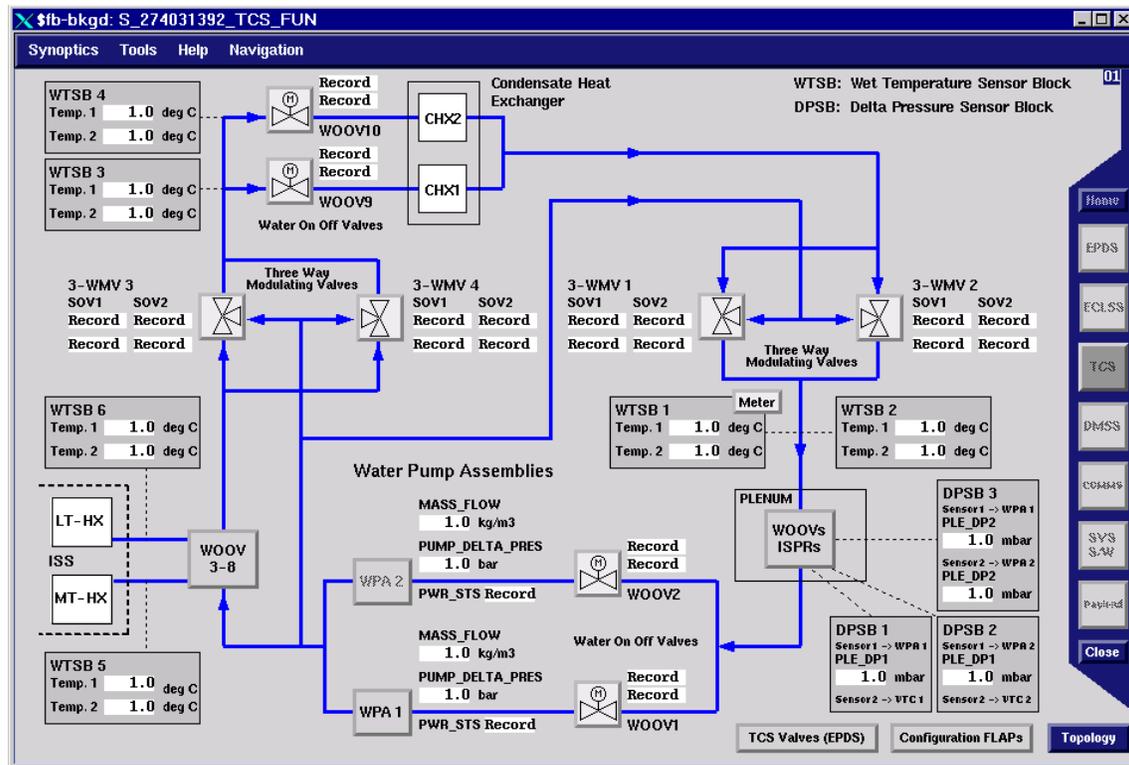
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Figure 5-13 Functional TCS Display for ESA-Columbus (typical)

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5.4.4 NASDA System Display Deviation

JEM SLT systems displays as shown in Figure 5-14 provide data organized by the functional JEM system and often include many physical regions of the JEM. JEM RLT is TBS.

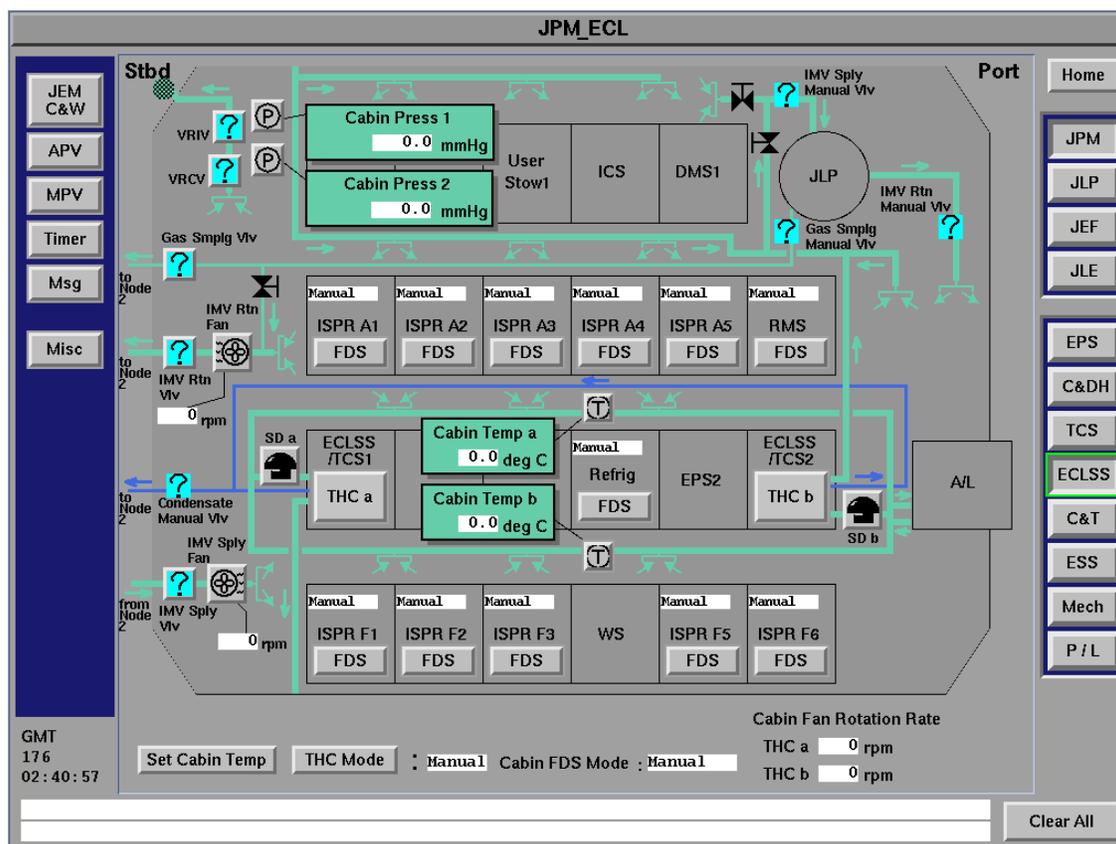


Figure 5-14 JEM ECL System Display (typical)

5.4.5 CSA System Displays Deviation

CSA provides MSS Systems Home Displays. E.g., SSRMS, MBS, and SPDM.

5.5 TASK DISPLAYS

Task displays are uniquely configured to assist the user in performing particular actions. Task oriented displays may be used when a particular task is repetitious (performed frequently) or is complex and time critical involving several systems or disciplines. A task display may be useful in simplifying the procedure to be used by reducing the number of displays and the amount of searching required to execute a complex procedure.

To determine whether a task-oriented display is necessary or redundant to existing system or discipline displays, a procedure using existing displays should be drafted and discussed with the various system or discipline experts and display/procedure users. If this team finds that there is a clear advantage to the development of a task-oriented display in addition to the displays present for system monitoring and commanding, then a task-oriented display may be developed. See Figure 5-15.

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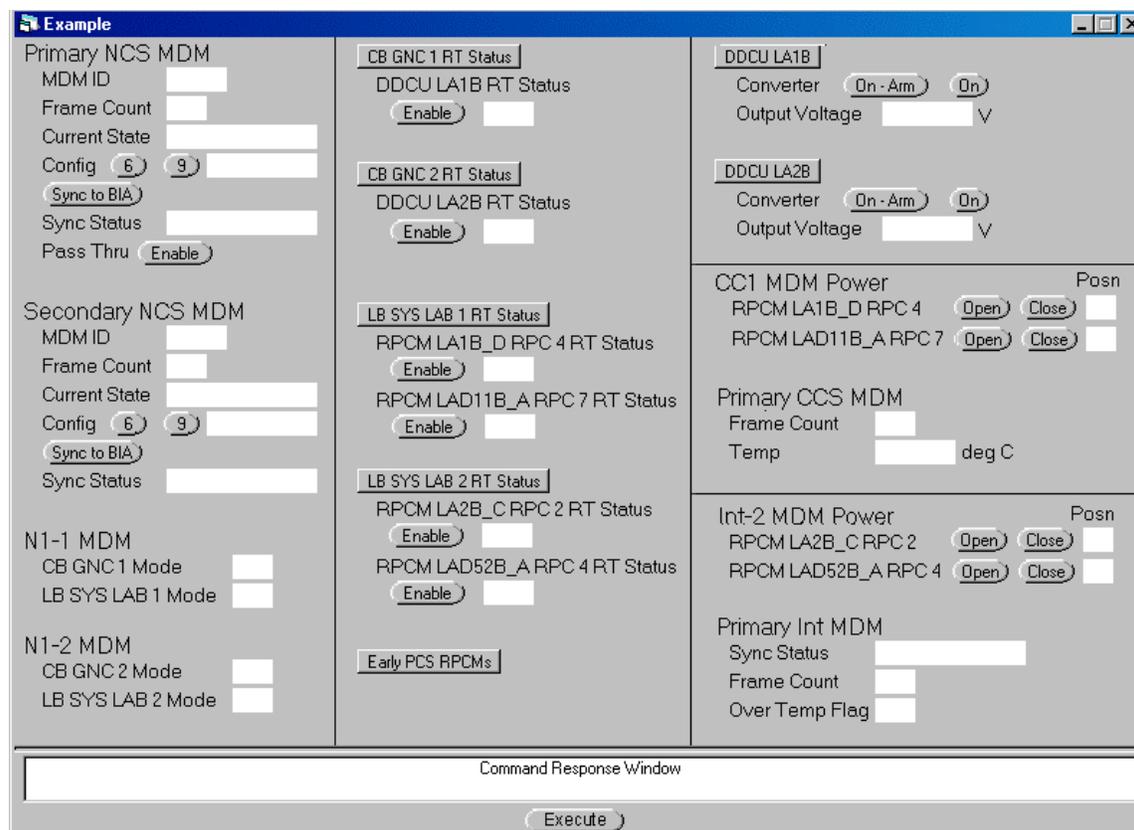
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Figure 5-15 Task-Oriented Display

5.5.1 NASA Task Displays Deviation

Integrated task displays are accessed via a “task” button on the user toolbar. System specific task displays may be associated with, and accessible from, both topological and system displays. For example, a Lab Activation display may be accessible from the Lab display, and a Power Load Shed display may be accessible from the EPS Summary.

5.5.2 RASA Task Displays Deviation

5.5.3 ESA-Columbus Task Displays Deviation

ESA-Columbus task displays are not provided as synoptic displays.

5.5.4 NASDA Task Displays Deviation

JEM SLT does not provide Task Display. JEM RLT is TBS.

5.5.5 CSA Task Displays Deviation

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5.6 DETAIL DISPLAYS

These segment and summary displays provide further navigation to more detailed displays for individual functions, blocks, and other components. It is possible to navigate to a single display via multiple unique paths. Figure 5-16 shows an example hierarchy. Note that the user may navigate to the "MDM N1 Primary" display in two ways - once via the C&DH Summary display and again through the Node 1: C&DH overlay.

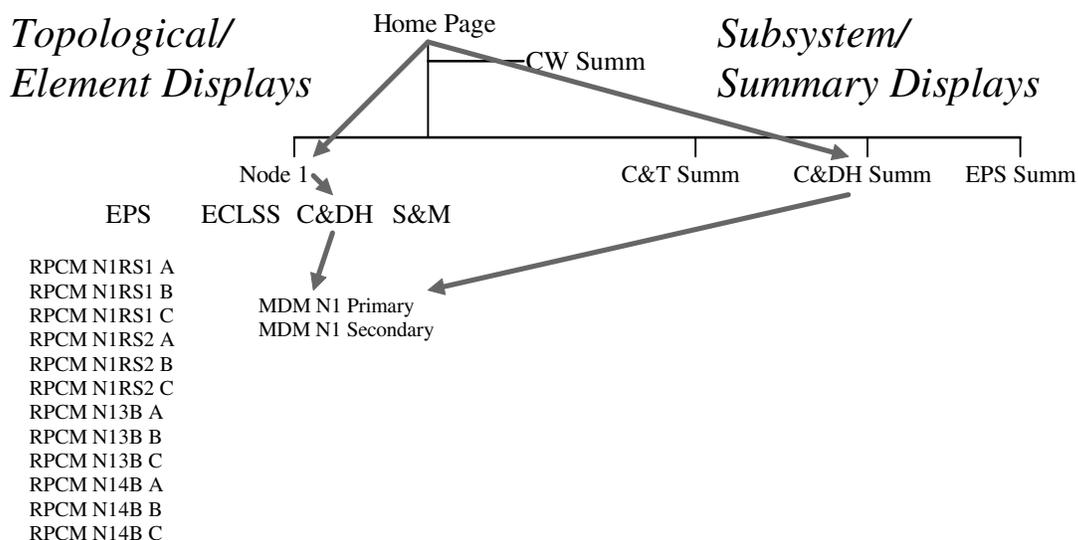


Figure 5-16 Example Display Hierarchy

The user navigates from one display to another by means of navigation buttons, gray raised buttons included on other displays.



5.6.1 NASA Detailed Display Deviation

5.6.2 RASA Detailed Display Deviation

5.6.3 ESA-Columbus Detailed Display Deviation

The level of detail on the MCDs is adequate to provide the commands and status information required to perform crew procedures related to the operations of the nominal ESA-COLUMBUS system, irrespective whether these are implemented as manual procedures, ACPs, or executed by the crew in online communication with ground control or autonomously according to predefined flight rules. Each remote command needed for nominal ESA-COLUMBUS system operations as well as for failure recovery by the crew is provided on MCDs.

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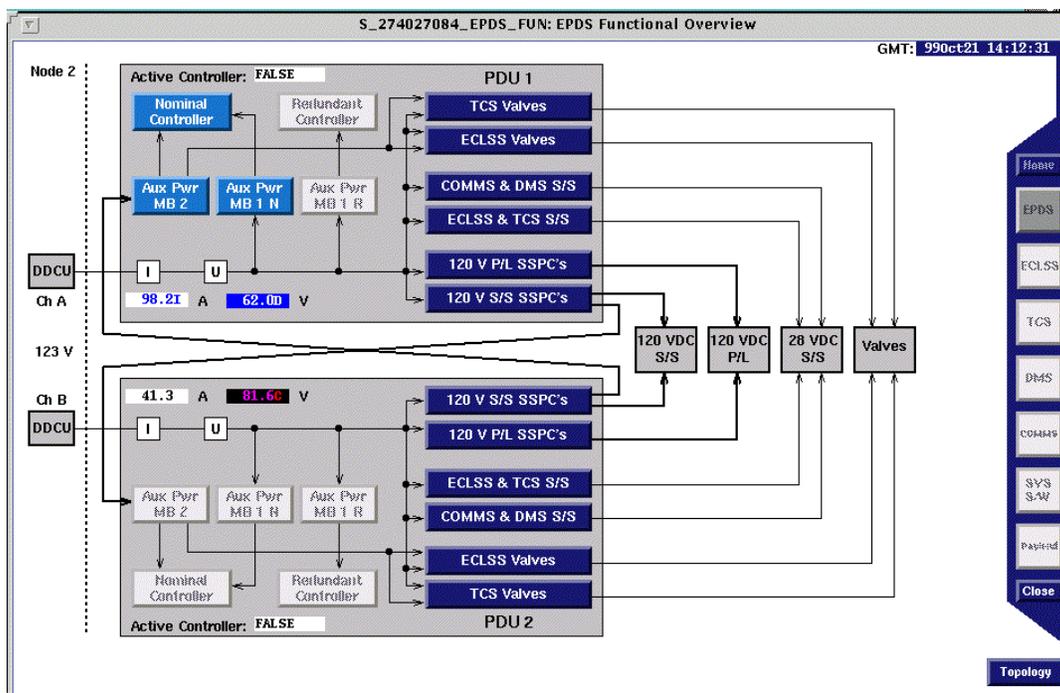
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Figure 5-17 EPDS Functional Overview Display

The user can also navigate to this level and any other APM display through the pull-down navigation menu from the MCD main panel.

5.6.4 NASDA Detailed Display Deviation

JEM SLT does not have subsystem summary displays, so there is one path to navigate details windows. JEM RLT is TBS.

5.6.5 CSA Detailed Displays Deviation

5.7 DISPLAY NAVIGATION

Navigation from one display to another can be performed via navigation buttons, command buttons (when such a button allows commanding and navigation), or menu items.

- A. From the **Home Page**, the user may single click on a navigation button in the system toolbar to call a summary display for that system. Alternatively, clicking on a module or truss icon calls a summary topological display for that segment.
- B. Navigation buttons will be provided on each tier of the display hierarchy to link related displays together.
- C. All navigation buttons shall be appropriately labeled to indicate the display destination. This button may be textual or graphical.
- D. Navigation buttons shall function unconditionally to the system status.
- E. A method should be provided to access a hierarchical menu of all displays.
- F. A method should be provided to list windows currently open.
- G. Navigation buttons or graphical elements can be used to navigate to adjacent modules.
- H. Navigation from a higher level to a lower level graphical display shall maintain orientation unless there is proper rationale for doing otherwise.
- I. For a series of equal level displays which can call each other, the group of navigation buttons that are located on each display shall be in the same order.

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- J. A navigation button should be indicated to be inactive if it will not provide an action.
- K. The display should be consistent when grouping/ordering items and buttons. If items are presented in specific manner, then this convention should be continued through the display tree of similar displays.
- L. The inactive and active status of navigation button should not normally be determined by telemetry. Deviations must be specifically approved.

5.7.1 NASA Display Navigation Deviation

NASA does not provide the following capabilities:

A method should be provided to access a hierarchical menu of all displays.

A method should be provided to list windows currently open.

5.7.2 RASA Display Navigation Deviation

5.7.3 ESA-Columbus Display Navigation Deviation

On ESA-Columbus provided laptops, or so called Portable Work Stations (PWS), display navigation starts on the Root Display. The Root Display as shown in Figure 5-18 will be displayed on the laptop after successful execution of the boot-up sequence and start of the Date and Time Group (DTG) and the Crew Notification. The function related DTG Panel and System Message Panel will be displayed in reserved areas and fixed positions on the screen. They will not be overlaid by other application windows.

From the Root Display, other applications, e.g., Procedure Viewer, Monitoring and Control Displays, can be started via the ESA-Columbus Segment Menu. This menu can be activated by clicking with the right mouse button on the Root Display window. Alternatively, the applications can be started automatically (can be specified in a dedicated start-up file), but will be iconized.

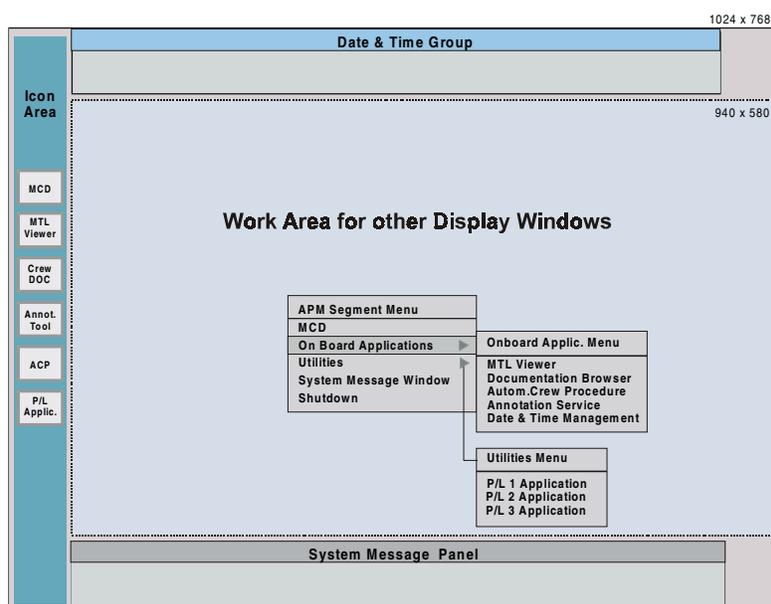


Figure 5-18 ESA-Columbus Portable Work Station Root Display

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The MCDs are structured in a top-down hierarchy tree following the ESA-Columbus System breakdown. Figure 5-19 provides an overview of the generic hierarchy and structure of ESA-Columbus MCDs. Top level is the ESA-Columbus Home Page, from which appropriate paths lead to the S/S Overview MCDs and from there to more detailed displays.

The further breakdown of functional MCDs on Assembly/Unit level is to the detail of automated or manual crew procedures. The actual number of levels and individual MCDs will vary for the different systems.

Navigation to a desired MCD is provided in the following basic ways:

- using the "Synoptics" menu on the main panel of the home page and of overview MCDs, which allows to pre-select and call the selected MCDs directly.
- using the "Navigation" menu on the main panel of the home page and overview MCDs, which cascades down the lowest MCD level.
- using the system bar on the right side of the home page and overview MCDs to call MCDs of a different ESA-Columbus system
- using internal navigation buttons on the MCDs which directly call a predefined MCD.

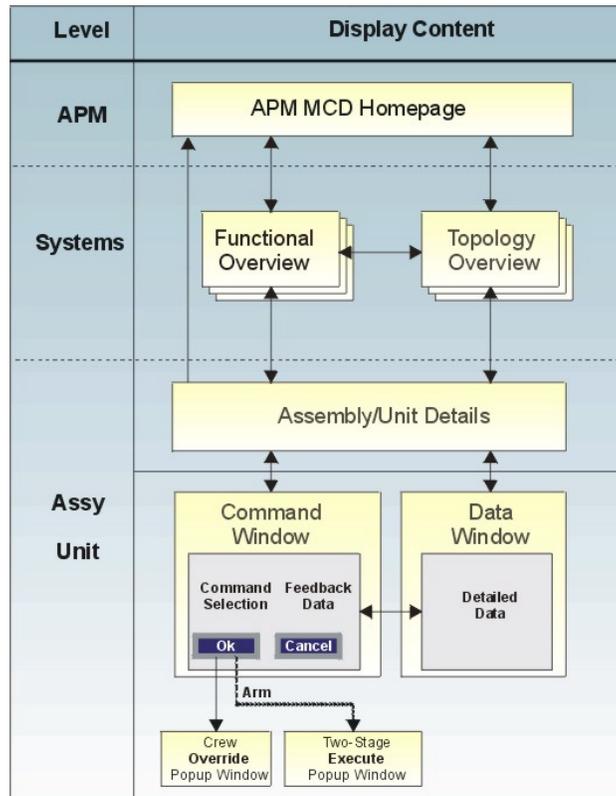


Figure 5-19 ESA-Columbus Display Hierarchy

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5.7.4 NASDA Display Navigation Deviation

JEM SLT has no subsystem summary display. The element button is always displayed, so it is able to move one element display to another without going back to the Home Page. JEM RLT is TBS.

NASDA does not provide the following capabilities:

A method should be provided to access a hierarchical menu of all displays.

A method should be provided to list windows currently open.

5.7.5 CSA Display Navigation Deviation

Consistent with NASA deviations.

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SECTION 6

OPERATIONS NOMENCLATURE, ODF PROCEDURES AND DISPLAYS

Actions in work. Not included in CR4248.

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SECTION 7

Section Baselined for CR4248. Proposal submitted for next CR. USE of SYMBOLS, GRAPHICS, and ICONS

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7.2.1 Graphical Symbols.....	7-Error!	Bookmark not defined.
7.2.1.1 NASA Graphical Symbols Deviation.....	7-Error!	Bookmark not defined.
7.2.1.2 RASA Graphical Symbols Deviation.....	7-Error!	Bookmark not defined.
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7.2.1.4 NASDA Graphical Symbols Deviation.....	7-Error!	Bookmark not defined.
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7.3 PROCEDURE FOR INCORPORATING CHANGES AND ADDITIONS TO GRAPHIC SYMBOLS AND ICONS.....	7-Error!	Bookmark not defined.
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7.4.1.1 NASA Meters Deviation.....	7-Error!	Bookmark not defined.
7.4.1.3 ESA-Columbus Meters Deviation.....	7-Error!	Bookmark not defined.
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7.4.2 Fixed Scale Linear Meters.....	7-Error!	Bookmark not defined.
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SECTION 7.0 USE OF SYMBOLS, GRAPHICS, AND ICONS

7.1 GENERAL PRINCIPLES AND RATIONALE

Various graphic designations are used in the flight and training documentation to display different diagrams and operational procedures. The basic principles of their display and usage should be applied when using the conventional graphic designations.

Conventional graphic designations are the means of conveying information about a system's function and structure. Electrical, hydraulic and other system elements, as well as the connections between them, are conventionally displayed by graphic designations. Conventional graphic designations should be clear in understanding or without double meaning, they should not be identical to other designations with already assigned meaning.

7.2 SYMBOLS

Conventional graphic designations used in training documentation should be called graphic symbols.

Conventional graphic designations used in onboard displays should be called icons.

Icons may be an exact copy of a graphic symbol or its simplified image.

In any case, the following rule should be followed:

If an icon exists, then this image should be used in all other ISS documentation. E.g., in the flight and training documentation.

7.2.1 Graphical Symbols

Graphic symbols are drawn like schematic signs whose form does not necessarily correspond to the real configuration of the displayed elements (or parts). Geometric elements which make up the graphic symbols (such as squares, circles, triangles and etc.), should be connected to one another not only geometrically, but also in the proper proportion. It is accepted to proportionally and simultaneously enlarge or reduce the size of all graphic symbols. It is accepted to display graphic symbols of elements which are integral parts of the designations of other elements, reduced in size in comparison with other elements. Graphic symbols are displayed in the position in which they are displayed in the present standard (Appendix C) but can be used in any orientation.

7.2.1.1 NASA Graphical Symbols Deviation

7.2.1.2 RASA Graphical Symbols Deviation

7.2.1.3 ESA-Columbus Graphical Symbols Deviation

Some icons appearing in Columbus documentation will have a different appearance than the corresponding display icon. (This is due to application of other standards for documentation preparation previously performed.)

7.2.1.4 NASDA Graphical Symbols Deviation

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NASDA SLT and RLT provide no indication for disconnected equipment. Backup components are identified by the label of the icon on NASDA SLT.

7.2.1.5 CSA Graphical Symbols Deviation

7.2.2 Icons

Icons will be simple, clear, and easy to understand symbols. Icons can be used simply as a symbol of an object or function that cannot be manipulated, or as a symbol on which the user can directly act (e.g., selecting the icon to open or move applications or files). An icon can change in shape and color over time if that change adds useful information to the user in an intuitive manner. The object or action that the icon represents should be visible in the icon. This guideline has two implications:

- (1) The size of the icon should be large enough for the user to perceive the representation and discriminate it from other icons and no smaller than 20 x 20 pixels, and
- (2) The representation should be pictographic whenever possible. To the greatest extent possible, icons should be accompanied by a text label, especially when the icons do not closely resemble the symbolized object or action. A dashed line forming the outline of an icon means it is a secondary item or component.

The "system tool bar" shall contain only the systems icons as shown in C2.12 of Appendix C.

Interaction with an icon shall be accomplished by selecting the icon itself, not by selecting any additional label associated with the icon. See Section 4.16 for button guidelines.

7.2.2.1 NASA Icons Deviation

An "X" placed over an icon or symbol means the equipment has been identified as being failed.

7.2.2.2 RASA Icons Deviation

7.2.2.3 ESA-Columbus Icons Deviation

Restrictions due to already selected commercial display building toolkit will apply.

7.2.2.4 NASDA Icons Deviation

SLT has some restrictions for using colored icons because of SAMMI restrictions. The SLT subsystem tool bar provides only a text label instead of icon, label, and tool tip. SLT does not use a dashed line for secondary components. JEM RLT is TBS.

7.2.2.5 CSA Icons Deviation

7.3 PROCEDURE FOR INCORPORATING CHANGES AND ADDITIONS TO GRAPHIC SYMBOLS AND ICONS

Graphic symbols and icons may be changed and supplemented during onboard system development, ground tests and flight operations. Graphic symbols and icons are updated via change requests which are submitted by the international partners, the IDAGS Board members. Only the graphical material in the Change Request that needs updating is updated. The Change Request, which includes only those pages of Appendix C requiring changes, should be issued

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together with the accompanying list of graphical symbols or icons which replace those in the original version, or which should be incorporated in the updated version. This Change Request should contain a brief description of the incorporated changes and their rationale.

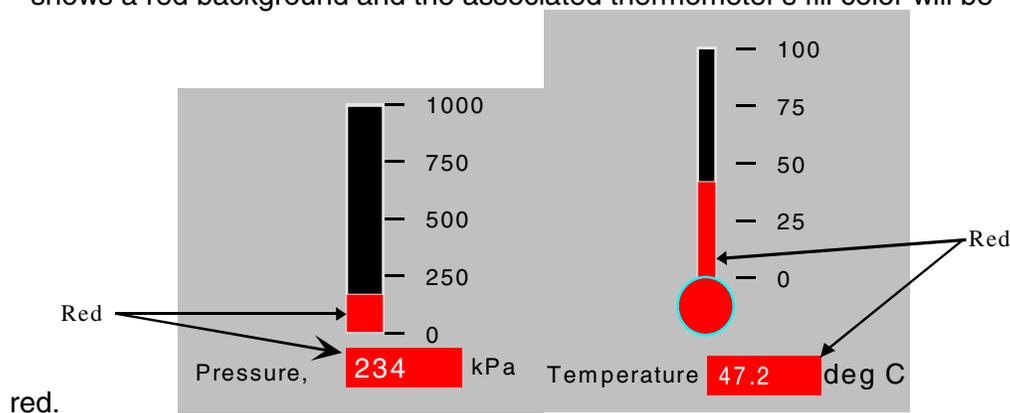
Partners should try to develop diagrams based on the conventional graphic designations and icons, listed in this standard (Appendix C). When partners need a more detailed level of training diagrams than those covered by the standards, the use of graphic symbols of their own countries' standards is approved. However, training documentation that defines the meaning of these graphic symbols should accompany any such diagram.

7.4 METERS

Meter symbols, such as bar graphs, filling tank symbols, and thermometers, must include appropriate labels (typically above, below, or to the left) to indicate the parameter depicted. In most cases, a digital value will be shown near the meter (typically below or to the left).

Minimum and maximum values for the meter should be labeled. Color standards apply to all meters.

Color standards apply to all meters. When a parameter's background color indicates an off-nominal status, the associated bar meter changes its fill color in the same way. For example, in Figure 7-1, if a fluid's temperature exceeds a warning limit, the temperature parameter field shows a red background and the associated thermometer's fill color will be



7.4.1.1 NASA Meters Deviation

7.4.1.2 RASA Meters Deviation

7.4.1.3 ESA-Columbus Meters Deviation

7.4.1.4 NASDA Meters Deviation

The color of meters in NASDA SLT is not changed because of SAMMI restrictions. JEM RLT is TBS.

7.4.1.5 CSA Meters Deviation

7.4.2 Fixed Scale Linear Meters

7.4.2.1 Application

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Fixed-scale linear meters are used as an on-screen graphical representation of hardware devices that depict data along a scale in which the pointer moves along the scale and the scale remains stationary. Fixed-scale linear meters are designed to present quantitative data where the magnitude of the end-points and the scale increment permit the full scale to be displayed within the maximum size allowed. Unlike bar charts and line plots, only a single dynamic data value is tied to this graphic. See Figure 7-1.

7.4.2.2 Appearance

The display can specify the text labels associated with the meter, the length of the meter, and the increment of the scale, as well as its orientation (horizontal or vertical). Fixed-scale linear meters can optionally contain a data output field, displaying the current scale value. Fixed-scale linear meters can optionally show a fill color associated with the current scale value within the meter.

- a. If threshold limits are shown, the color change associated with exceeding a threshold shall apply to the entire meter, up to the value displayed.
- b. Threshold indicators shall be displayed if limits are shown.

7.4.2.3 Size

The length of the meter is dependent on the range of values depicted and the increment between individual values.

- a. The minimum length of a fixed-scale linear meter should be 2 inches.
- b. The maximum length of a fixed-scale linear meter should be 6 inches.

7.4.2.4 Location

A fixed-scale linear meter can be used anywhere within a display.

7.4.2.5 Labels and Titles

In addition to each fixed-scale linear meter having a label, each group of fixed-scale linear meters can have a title that describes the function of the grouping.

- a. The titles shall be located in a consistent fashion below the data groups they describe.
- b. The relationship of the title of the group should be clearly discernible.
- c. Each title should be separate and distinguishable from the body of information above it.

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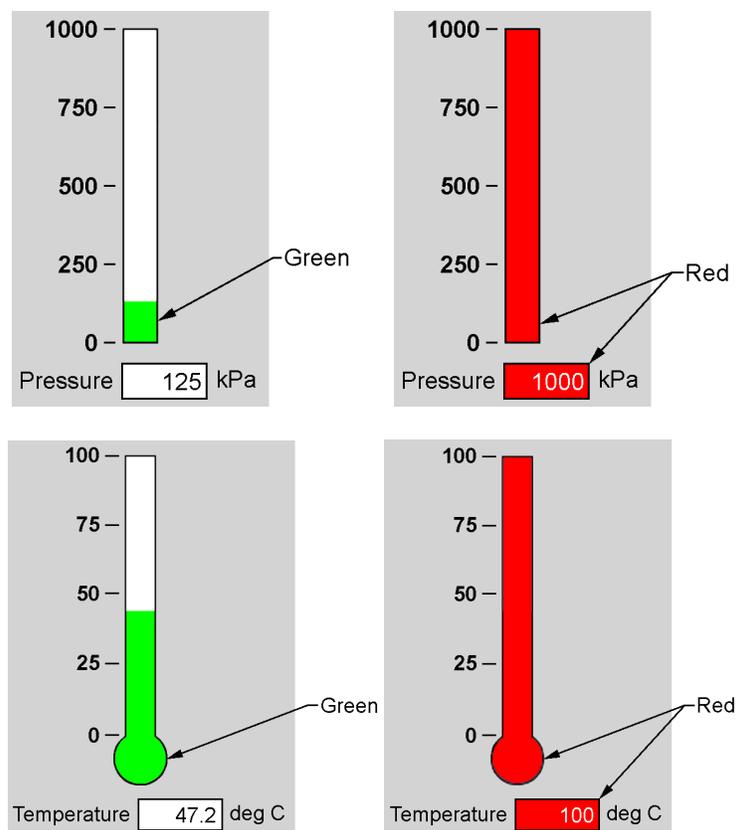
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Figure 7-1 Fixed Scale Linear Meters

7.4.3.1 NASA Fixed Scale Linear Meters Deviation

7.4.3.2 RASA Fixed Scale Linear Meters Deviation

7.4.3.3 ESA-Columbus Fixed Scale Linear Meters Deviation

7.4.3.4 NASDA Fixed Scale Linear Meters Deviation

Fixed Scale Linear Meters cannot change the threshold limits (they are displayed by color coding) reflecting current limits due to SAMMI restrictions.

7.4.3.5 CSA Fixed Scale Linear Meters Deviation

7.5 STATUS LIGHTS

For some enumerated parameters, such as mode indicators, it may be desirable to emulate the appearance of hardware panel lights in a separate window. Given an appropriate parameter label to the left, a series of rectangles may be used to indicate different possible states. A labeled rectangle will change its appearance to indicate the value of the parameter.

7.5.1 NASA Status Lights Deviation

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7.5.2 RASA Status Lights Deviation

7.5.3 ESA-Columbus Status Lights Deviation

ESA-Columbus does not use status lights on symbols or icons (tool restriction).

7.5.4 NASDA Status Lights Deviation

JEM SLT does not have status lights.

7.5.5 CSA Status Lights Deviation

7.6 LINE TYPE CODING

Line types are defined to distinguish between: power lines, fiber optic lines, MIL-Bus lines, LANs, etc. When it is important to note the type of data bus, be it a twisted-shielded pair or optical-coupled, an icon representing that function will be associated somewhere with the transmission line.

Line type is a graphic code and appears as shown in Figure 7-2. Thick, solid lines (2 pixels) represent data transmissions. Thin, solid lines (1 pixel) show power distribution. Dashed lines (1 pixel) are for video connections. When using the line type convention, the display designer shall be consistent within a subsystem. Whenever a meaning has been associated with a line type, the meaning shall be obvious either by explicitly drawing a legend on the display, or providing a legend on a help pop-up.

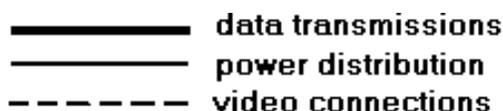


Figure 7-2 Line Types
(figure will be altered. Description of dashed line will be changed to "Backup sets.")

7.6.1 NASA Line Type Coding Deviation.

7.6.2 RASA Line Type Coding Deviation.

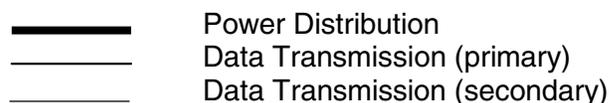
RASA Uses dashed lines to show backup sets (pipes, data links, buses, devices, etc.)

7.6.3 ESA-Columbus Line Type Coding Deviation.

ESA-Columbus Ops schematics will following drawing tool conventions. For displays, ESA follows general Line Type Coding.

7.6.4 NASDA Line Type Coding Deviation.

JEM SLT Line Type coding is as follows in Figure 7-3.



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Figure 7-3 JEM SLT Line Types

7.6.5 CSA Line Type Coding Deviation.**7.7 LINES AND PIPES**

Within a schematic, electrical and data resource pathways shall be represented by lines. These lines shall be made visually distinct by use of the appropriate coding method. See Figure 7-3.

- Schematics that display lines or pipes that cross shall be shown as line or pipe images that overlap.
- Schematics that display lines that cross and connect, shall be shown with a circle at the intersection which is four pixels larger (two on each side) than the line, and has a black fill color.
- Schematics that display pipes that cross and connect, shall be shown with a circle at the intersection which is four pixels larger (two on each side) than the pipe, and has the same fill color as the pipe.

Pipes shall be labeled with their contents per Appendix B.

Direction of Flow Indication

Arrows used with lines to show direction of flow shall be placed on the line to prevent overcrowding of displays. When several arrows are used in groups of parallel lines or lines in close proximity to each other, the arrows shall be aligned in a symmetrical manner. If the display is too detailed to allow the aligning of arrows, the arrows shall be staggered or offset enough to prevent them touching or running together and confusing the user. Figure 7-4 shows the arrangements.

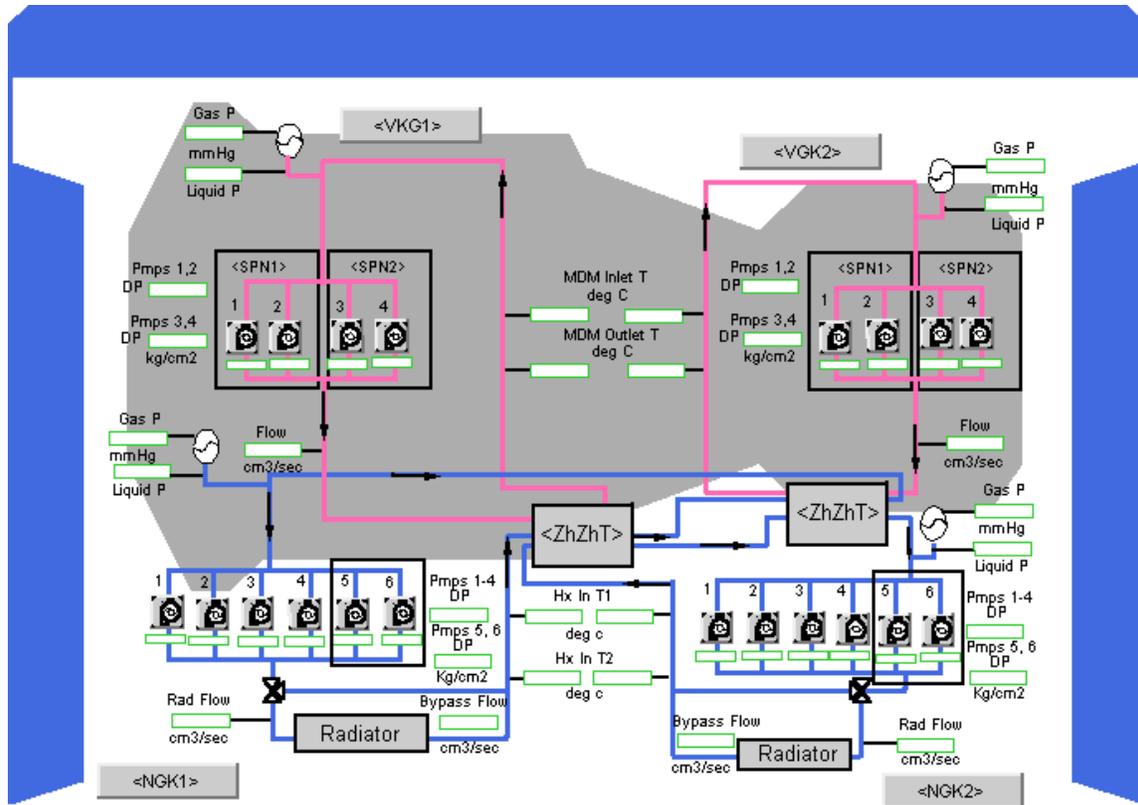


Figure 7-4 Lines and Pipes

7.7.1 Line Specific

- A. Lines that cross and do not connect shall be shown as lines images that overlap. See Figure 7-5.

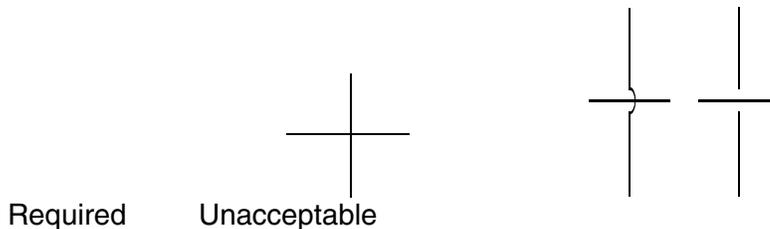
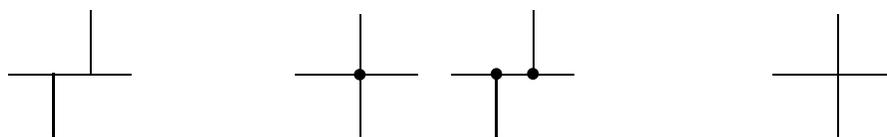


Figure 7-5 Lines Crossing and Not Connecting

- B. Lines that are perpendicular and non-crossing should not use a black filled circle. Lines that cross and connect, shall be shown with a circle at the intersection. The circle shall be four pixels larger (two on each side) than the line and filled with the color black. See Figure 7-6.



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Preferred

Acceptable

Unacceptable

Figure 7-6 Lines Crossing and Connecting

- D. Lines that intersect to form T-junction or Y-junction do not require use of a circle. See Figure 7-7.

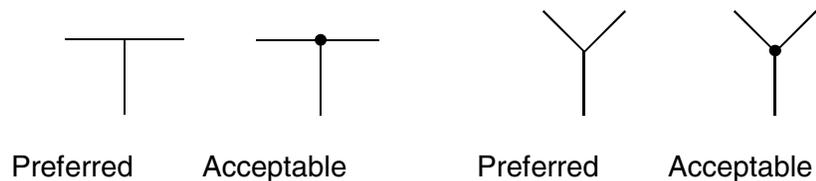


Figure 7-7 Intersecting T-Junction and Y-Junction Lines

7.7.1.1 NASA Lines and Pipes Deviation

7.7.1.2 RASA Lines and Pipes Deviation

7.7.1.3 ESA-Columbus Lines and Pipes Deviation

ESA-Columbus Ops schematics will following drawing tool conventions. For displays, ESA follows general Line Type Coding.

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7.7.1.4 NASDA Lines and Pipes Deviation

JEM SLT displays have no circle at line or pipe intersections.

NASDA uses the following method to indicate lines that cross and do not connect. See Figure 7-8

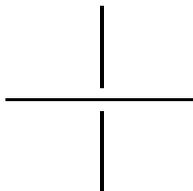


Figure 7-8 NASDA Lines deviation

7.7.1.5 CSA Lines and Pipes Deviation

7.8 ACTIVE LINE CONVENTIONS

When a line is used as an indicator, then

- a) If there is no active parameter associated with a line, then it will be always present with a normal line width and will be black in color.
- b) When information indicating the active status of a line is present, the color of that line shall follow the normal color convention.

7.8.1 NASA Active Line Conventions Deviation

7.8.2 RASA Active Line Conventions Deviation

7.8.3 ESA-Columbus Active Line Conventions Deviation

ESA-Columbus does not use active lines. ESA uses lines as static background only. The colors of the lines follow the normal color conventions.

7.8.4 NASDA Active Line Conventions Deviation

7.8.5 CSA Active Line Conventions Deviation

7.9 VALVES

Valves are represented by two or more triangles sharing a common point. A two-way valve (allowing forward or reverse direction flow) is depicted as a “bow tie” combination of two triangles. A three-way valve, controlling fluid flow through a T intersection is shown as three triangles. See Figure 7-9.

The valve icon may be placed on top of a button to allow access to a more detailed popup window.

All valves must be clearly labeled with appropriate operations nomenclature.

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Figure 7-9 Two- and Three-Way Generic Valves

Modifiers may be placed on the top of this symbol to indicate the method by which the valve is actuated. Certain symbols can be additive to represent multi-controls. E.g., a 'manual T-cross' could be placed on top of the solenoid symbol to represent a manual override capability of a solenoid valve. See Figure 7-10. Valve modifiers can be found in Appendix C.

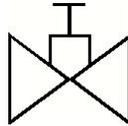


Figure 7-10 Valve with Modifier

The triangular portions of the valve are filled white when flow is not allowed by the valve. If the valve allows fluid to flow along a path, that path is shown by filling the applicable triangular sections with the color code for the associated fluid. See Figure 7-11.

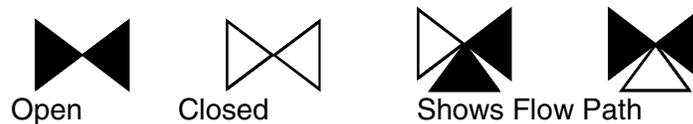


Figure 7-11 Valve Position depiction

A modulating valve is valve which can be nominally between the open and closed state to allow active control of the flow rate.

For three-way modulating valves, i.e. valves that nominally vary their position between Flowthru and Bypass, the three-way mix valve icon will be used to display the Flowthru, Bypass, Indeterminate, and Modulating positions. The term "Modulating" or "Mod" will replace "InTrans" in the telemetry field; the three-way mix valve icon will display all valve legs highlighted with the appropriate fluid color to indicate flow in all directions. See Figure 7-12.



Figure 7-12 Modulating Valve

A valve in transition between open and closed positions shall be indicated using barberpole fill, as shown below. See Figure 7-13.



Figure 7-13 Valve in Transition

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If a valve's position is indeterminate, the valve shall be filled with white, and a question mark shall be shown over the valve icon. See Figure 7-14.



Figure 7-14 Indeterminate Valve

The valve icon should be placed next to associated pipes such that the edge of the valve is flush with the connected pipe. When the valve allows flow, the valve icon will be filled with the same color used to fill the pipe. See Figure 7-15.

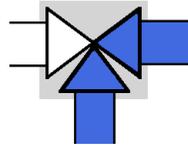


Figure 7-15 Valve Placement

If a valve can be set to variable positions, a data field may be placed near the valve to indicate the measured valve position. See Figure 7-16.

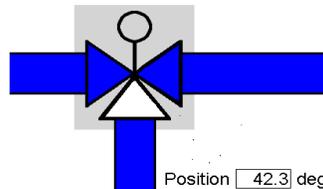


Figure 7-16 Measured Valve Position

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7.9.1 NASA Valves Deviation

7.9.2 RASA Valves Deviation

7.9.3 ESA-Columbus Valves Deviation

Valve status in ESA-Columbus displays cannot be animated with fill pattern. The status is shown in a text field next to the valve (typically below or to the left). The valve symbols are shown as per Appendix C.

7.9.4 NASDA Valves Deviation

Because of SAMMI restrictions, in JEM SLT, the triangular positions of the valve are filled with the icon background color when flow is not allowed by the valve. The valve fill color is black regardless of fluid type. The valve icon does not change in transition between open and close positions. If a valve position is indeterminate, a question mark is shown without the valve icon.

7.9.5 CSA Valves Deviation

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SECTION 8.0 COMMAND WINDOW

8.1 GENERAL PRINCIPLES AND RATIONALE

Sending commands to the ISS is one of the fundamental purposes of the ISS displays. Most, if not all, commands sent by the ISS flight crew or ground controllers will be through a command window. The basic philosophy behind each command window is that it contains enough telemetry information to safely send a command and monitor its response.

Generic telemetry display arrangements should follow the order of top to bottom, left to right.

8.1.1 NASA General Principles and Rationale Deviation

8.1.2 RASA General Principles and Rationale Deviation

8.1.3 ESA-Columbus General Principles and Rationale Deviation

8.1.4 NASDA General Principles and Rationale Deviation

JEM SLT status windows as shown in Figure 8-1 contain buttons located at right side of status data area to open a command window which includes command buttons related with the status data. JEM RLT is TBS.

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JPM_CDH_PDH_a Stat:		
PDB RPC Posn	Open	<input type="button" value="Cmd"/>
Pwr On BIT Stat	Invalid	
Pwr On BIT Result	Normal	
<hr/>		
JCP/PDH Comm Stat	OK	
<hr/>		
PDH Mode	Normal	
<hr/>		
Temperature	0 deg C	
<hr/>		
PLBus1A Comm Stat	OK	
PLBus1B Comm Stat	OK	
PLBus2 Comm Stat	OK	
PLBus3 Comm Stat	OK	
PLBusE Comm Stat	OK	
<hr/>		
PDH Comm Overflow	Normal	
<hr/>		
All P/L Pwr Off Req	Normal	<input type="button" value="Cmd"/>

Figure 8-1 NASDA Status Window

8.1.5 CSA General Principles and Rationale Deviation

8.2 COMMAND DISPLAY STRUCTURE AND LABELING

Within the ISS C&DH architecture there are “One Step” and “Two Step” commands. A one step command means that the user only needs to send a single command (sometimes in conjunction with using an “Execute” button) in order for the intended action to be performed.

A two step command requires that two separate commands be executed (each of which may also require the use of an “Execute” button) prior to the intended action being performed. The two step commands are designed to prevent an operator from accidentally executing an action, however, there are different terms for describing the two steps which should be used depending on the nature of the action. Generally the use of the terms is decided by the time criticality of the action. These should be used as display labels for the commands.

Rules for naming commands:

The term “Fire” shall not be used in the context of executing commands and shall be reserved only for a physical fire onboard the Space Station or for the “firing” of thrusters. This is to

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prevent confusion on the displays and within the procedures. The label on the command button shall be the name of the action being performed.

When used for commanding, the term “Arm” shall only be used when an *immediate* action is enabled or an action is to be performed within a specified time from the moment of arming. If the hardware design permits, each “Arm” command should have an associated “Disarm” command if there is not an automatic disarming function associated with the action after a specified period of time.

Generally, the term “Arm” is used in a 2 step command when an action is being performed which is time critical with respect to the “Arm” and the operator is expected to only have the action available for a short period of time. It is the kind of action where the action command is expected to be sent immediately after the arm command. “Disarm” is obviously necessary so that the action command cannot be sent if it is no longer required. Most systems of this nature have been designed such that the action command can only be “Armed” for a short period of time before automatically returning to a safe state.

The term “Enabled” shall be used when allowing automatic processes (such as software routines) to operate or when allowing the specified action to occur whenever commanded.

The term “Inhibit” shall be used when preventing a command from being executed or an action from being performed.

“Enable” will be used for all the other cases. In some cases, commands may usually be in an “enabled” state and the action command may be sent at will only to be “inhibited” as required for special circumstances such as maintenance. Therefore there may be no time criticality associated with this terminology.

Use on Displays:

Labels such as “Ena Off” or “Arm Inh” for commands can be confusing as the object and action can be misinterpreted and should be avoided. Therefore the standard for labeling commands is as follows (with a couple of examples):

In the display region near the command, use a display label to identify the function of the commands when parsed appropriately such as “Flux Capacitor” then “Charge”. Then next to that label include the appropriate command buttons for arming and disarming labeled as “Arm” and “Disarm,” etc. as required. These buttons are then followed by the button labeled with the name of the action which actually sends the command which has been “armed.”

In the example below, the command to enable the Departure Response Software is armed, then the actual command to “Enable” the software is sent with the “Enable” button. (Although the “Inhibit” command does not need to be “armed” prior to sending, the format of the commands above it is retained for symmetry of the display. This display could have also had an “Execute” button which would need to be used with all the command buttons on this display.)

Please note the placement of the telemetry feedback at the top of the display. It is placed such that the confirming cue for the action to be taken on this page is the first item the operator sees when opening this window. The operator can then immediately assess the state of the system to be commanded and can therefore easily verify that the system is in the required configuration.

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Whenever using feedback telemetry which is an enumerated state, such as “Arm”, “Disarm,” “Ena,” “Inh,” etc. it is preferable to use the appropriate word or abbreviation rather than an “X” or blank showing in the field next to a label.

In Figure 8-2, we can see that we are commanding either the primary or secondary departure response software. The operator will arm or disarm and enable and inhibit the software as required in the procedure. Note the status of the command being armed or not is situated immediately next to the commands for immediate feedback.

Primary NCS		Secondary NCS	
Departure Response SW <input type="checkbox"/>		Departure Response SW <input type="checkbox"/>	
Enable	State	Enable	State
<input type="button" value="Arm"/>	<input type="checkbox"/>	<input type="button" value="Arm"/>	<input type="checkbox"/>
<input type="button" value="Disarm"/>		<input type="button" value="Disarm"/>	
<input type="button" value="Enable"/>		<input type="button" value="Enable"/>	
Inhibit		Inhibit	
<input type="button" value="Inhibit"/>		<input type="button" value="Inhibit"/>	
Command Response Window			

Figure 8-2 Example of Good Layout and Labeling

Procedural Example:

```
PCS sel PMA2 Departure Response SW
PMA2 Departure Response SW
'Secondary NCS'
```

√Departure Response SW - Inh

'Enable'

cmd Arm

√Arm State - Arm

cmd Enable

√Departure Response SW - Ena

Anything which can be done to clarify the relationship between the arm/disarm buttons and their associated action button is encouraged. See Figure 8-3.

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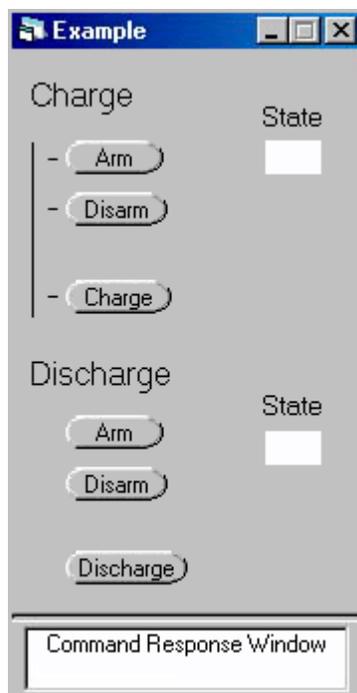
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Figure 8-3 Example of a line used to group commands

There are other terms in addition to "Arm," "Disarm," "Enable," and "Inhibit" which must be used according to the rules as defined in the Appendix A - "Definition and Use of Standard Terminology" in order to prevent confusion and minimize the number of similar terms being used for identical functions.

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An Execute button is used to add an additional level of protection to a command. Any command details page on which an Execute button appears requires its use for all commands on the display. An Execute button may be used at the discretion of the display designer; however, in the following case it is required:

- For Criticality 2 or 3 commands on displays that are not protected with a laptop-provided “Are you sure?” or similar prompt.

The cases where an Execute button is recommended to be used are:

- Any command page that has on it a set of commands that are intended to be accessed randomly in procedures (the display is not a task-oriented display with buttons laid out in a unique sequence to support the task), may use an “execute” button to allow the user to verify the selection of a command prior to sending it.
- If a command is loaded into a buffer for verification prior to sending or “incorporating.”

Command Talkback

If information is available relative to the condition or state of a system being commanded, then a field should be provided near the command button to display that information.

8.2.1 NASA Command Windows Deviation

A typical NASA command window is shown below in Figure 8-4. NASA Command windows are accessed by selecting an icon or button.

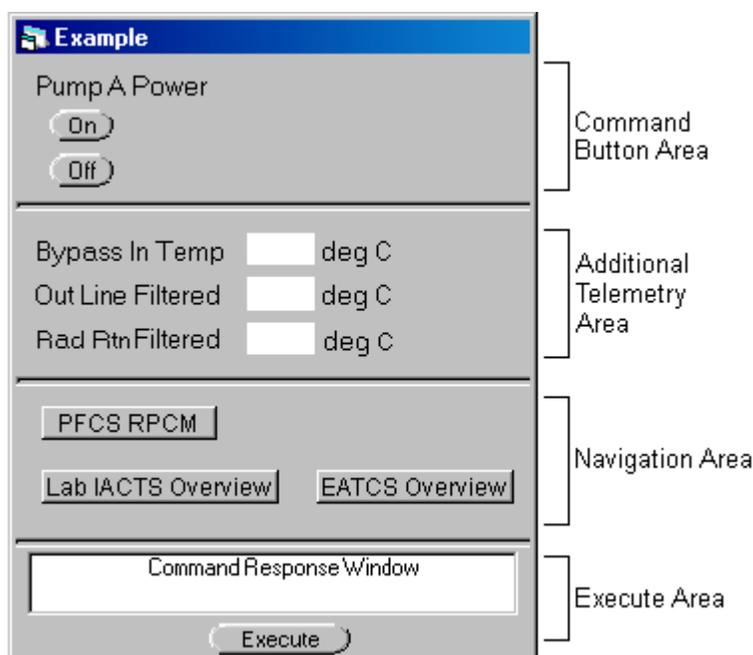


Figure 8-4 Sample Command Window

8.2.1.1 Command Window Format

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Each command window will have the standard windows control features (minimize, close, etc.) located at the usual location at the top of the window. Command windows labeling will be 'parsed' or broken down into parts to provide unambiguous but easy to read labels.

8.2.1.2 Command Window Areas

Each command window can be separated into four general areas:

Area 1: Control Button Area. Control buttons are to be grouped logically and should have, at the least, a command and its 'opposite.' For example, if there is an 'on,' there should be an 'off,' and if there is an 'open', a 'close' is necessary. The 'positive' command should come first (i.e., 'on', 'open'). Command buttons should be grouped in columns to enhance procedure flow operations. However, to allow efficient use of window space, the display may be designed with several columns. This design still allows a sequential flow of action down each column without the necessity of scrollbars.

Talkbacks. Associated, near the command buttons, in logical order, should be a field to provide feedback as to the condition or state of the block, so that the resulting actions of a command are easily visible and understood. For example, next to the fan 'On' and 'Off' buttons, there should be a telemetry field able to show, at a minimum, 'ON' and 'OFF.' This is so that the operator can see the state of the fan before commanding (e.g., the fan is 'OFF') and after commanding (e.g., the fan is 'ON'). It is preferred that when able, words such as 'ON', 'OFF', 'OPEN', and 'CLOSED' should be used in these talkbacks. When necessary to use a binary condition, such as an RPC tripped status, the capital letter 'X' shall be used. (See Section 10.6, Boolean.)

Area 2: Additional Telemetry Area. Additional telemetry to provide information necessary for system monitoring and for situational awareness during commanding can be placed in this area. For example, fluid pressures might be needed before making the decision to open a valve. Careful selection of parameters should be made to ensure that only the minimum, essential telemetry is presented.

Area 3: Navigation Area. Navigation buttons provide the capability to quickly access related systems' telemetry and commanding (e.g., navigation to Pump B commanding can be available from the Pump A commanding page). Additionally, commands and telemetry for 'utility functions' related to an ORU (e.g., electrical power or data buses) can be easily accessed.

Area 4: Execute Area. This area of the command window contains the Execute button (if one is necessary) and a window showing commanding message traffic (if possible).

8.2.2 RASA Command Windows Deviation

A typical Russian Command Window is shown below in Figure 8-5. Commands using the Russian Segment Laptop may be issued from any hierarchical level: module, system, functional display, or detailed display. For example, a generic command window with all available module commands is accessible from the module-level display by selecting a button labeled "Commands." Also, when a particular system's commands are needed, the user can navigate to the particular system-level display and select a commands button, which produces a command window with all available system commands. Finally, each block-level icon can also be used to navigate to a command window listing commands for that subsystem/block.

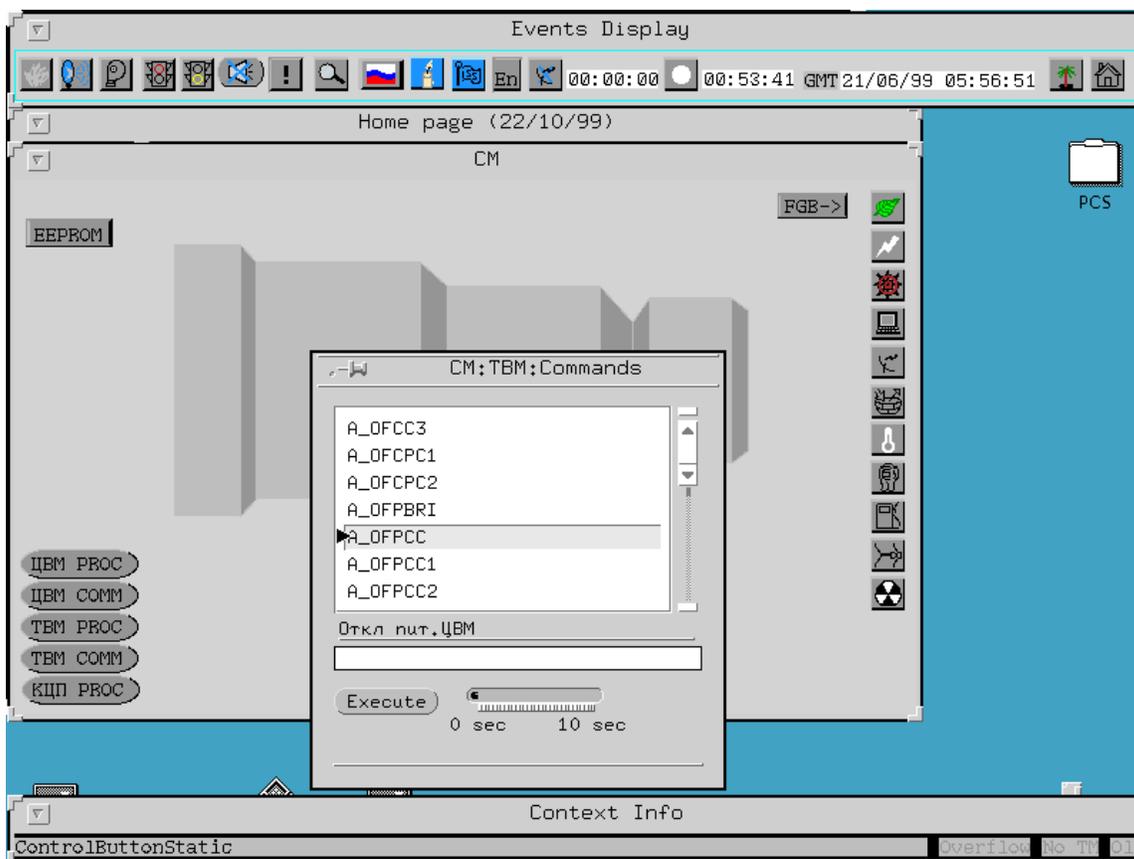


Figure 8-5a CM Command

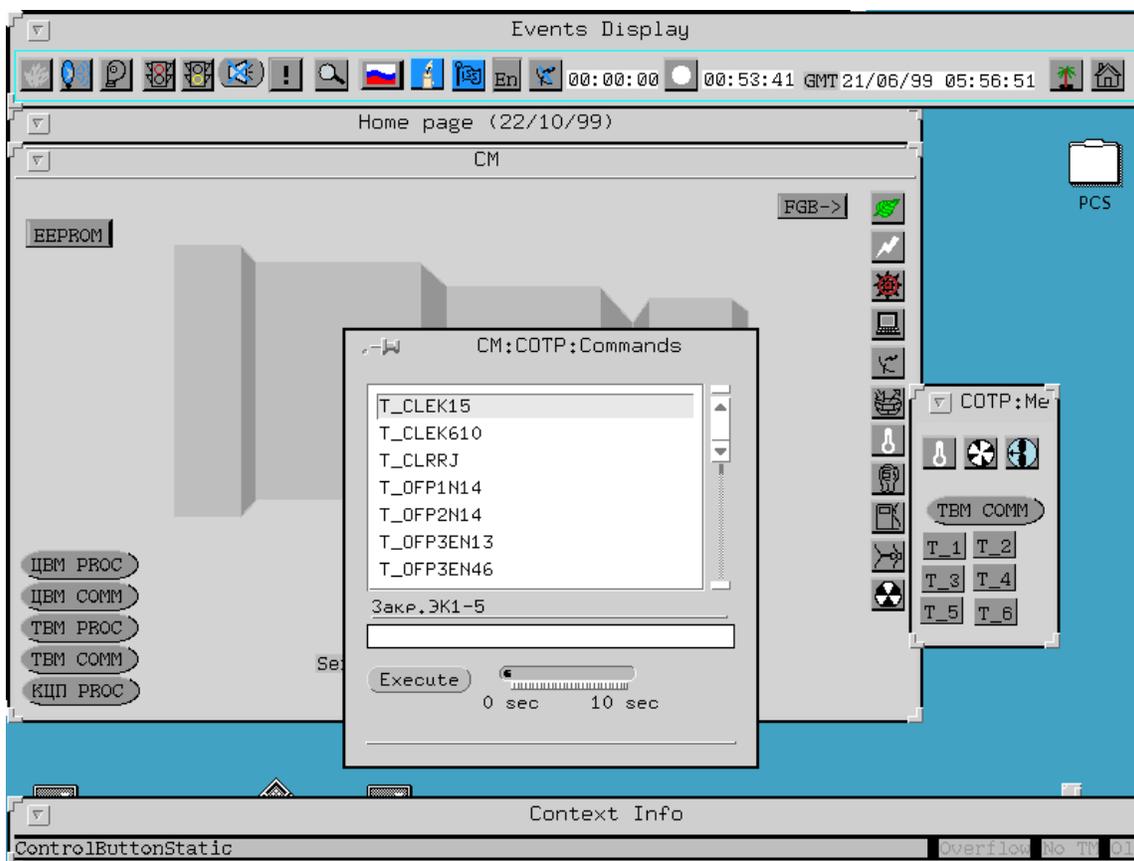


Figure 8-5b CM COTP Command

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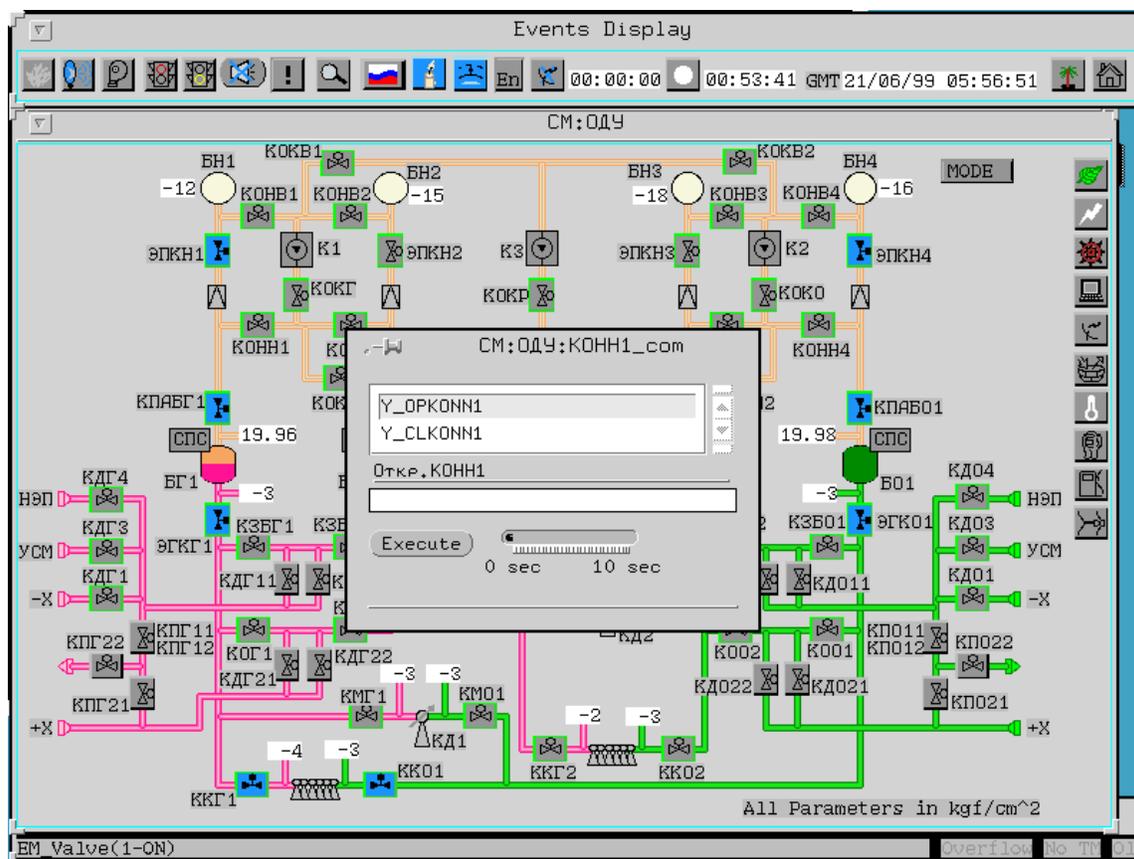
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Figure 8-5c Detailed Pop-Up

8.2.2.1 RASA Command Window Areas

Each command window can be separated into four general areas:

Area 1: Command List Area. This gives a list of all available commands for the level of commanding selected (i.e., all module commands are displayed when the command window was accessed from the module-level display). Additionally, the user can type the first letters command name to quickly get to the desired command.

Area 2: Parameter Name and ID Area. After a command in the command list is highlighted, its name and engineering description of the command (ID) is displayed.

Area 3: Execute Area. This area of the command window contains the Execute button to execute the desired command and timer line for displaying of waiting time for command check message.

Area 4: The Status line provides command feedback as a check to the issue command.

8.2.3 ESA-Columbus Command Windows Deviation

ESA-Columbus follows the general commanding principles. Commands to ESA-Columbus nominal systems will be “One Step” commands. “Two step” ESA-Columbus commands are in principle possible from ESA-Columbus displays, but typically provided for critical ESA-Columbus vital system controls from ESA-Columbus displays on the PCS laptop.

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ESA-Columbus uses combined command-data windows with separate fields for commands and relate data. A typical example is shown in Figure 8-7 below. The command Data window is divided in three areas:

- Top - Left: Command Selection Box
- Top - Right: Positive Feedback Data
- Middle: Detailed Data
- Bottom - Right: Close Button
- Bottom - Left: optional button which opens extra MCD with more detailed data

Commands are implemented as “Selection List” with one or multiple commands options. The selection lists are exclusive, only one command can be selected. Button for command confirmation and cancel are provided below the selection list: Confirmation is always required for the execution unless the command is canceled. The confirmation button is always labeled “OK” (tool restriction).

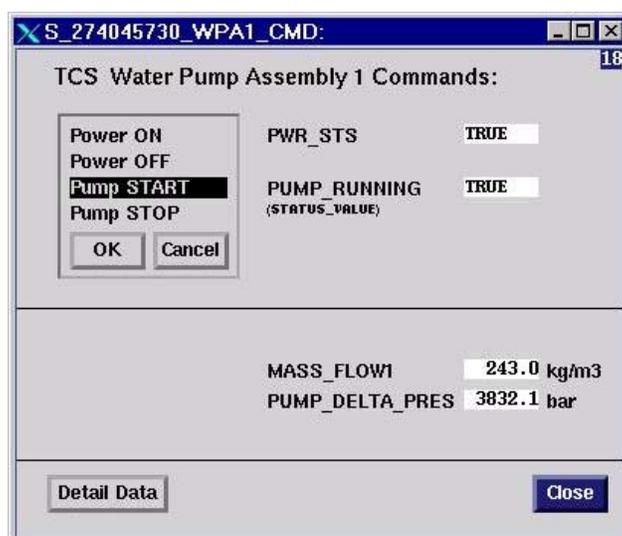


Figure 8-6 Example of ESA-Columbus Data and Command Window (data are from a random preview simulation and are not meaningful)

8.2.4 NASDA Command Windows Deviation

A typical NASDA Command Window is shown below in Figure 8-7. Basically, commands using the JEM Laptop are issued from any hierarchical level: module, subsystem, or detailed display. When a particular subsystem’s commands, e.g., mode transition, are needed, the user can navigate to the particular subsystem-level display and select a command button. When a particular assembly/ORU command is needed, the user can navigate to the particular assembly/ORU-level status display and select a command button labeled “Cmd.”

JEM SLT command window includes an “Execute” button. Basically, all commands will be issued when the user pushes the execute button. Some windows include a “Restriction” button, which provides a window listing condition that the commands are rejected by JCP software. The “Ovrd” (Override) button provides a capability for crew to force to execute the command by overriding the software inhibit.

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In case a command is hazardous, a command confirmation window, as shown in Figure 8-8, appears, when the crew selects the command.



Figure 8-7 JEM SLT select type Command Window

The feedback telemetry data is displayed at the left side of the parent “Cmd” button.

If the command is failed, e.g. a communications error, the command response is shown in a Command Response window.

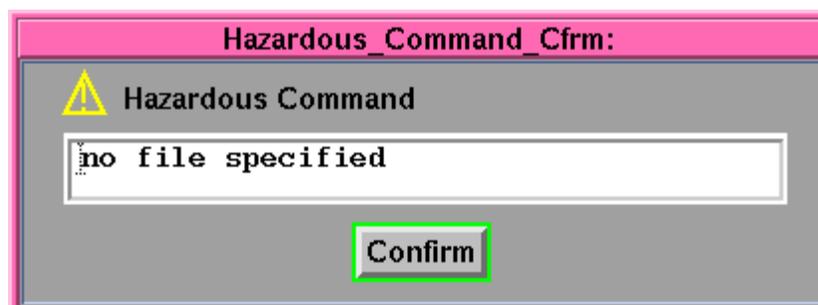


Figure 8-8 JEM SLT Hazardous Command Confirmation Window

JEM RLT is TBS.

8.2.5 CSA Command Window Deviation

MSS sub-system or unit commands or command windows may be separated from the functional state, status or condition fields for that sub-system or unit.

The MSS uses 3 step commands for executing actions that result in robotics manipulator motion or end effector payload release, in compliance with the hazard analysis's approved by the ISS Safety Review Panel. Other commands for executing actions that result in end effector motion are also implemented as 3 step commands for commonality in end effector operation.

The MSS uses 'Confirm' or 'Cancel' as the valid choices for the 2nd step of its 3 step commands.

There is no 'Disable' or 'Disarm' type specific commands beyond the 2nd step of a 3 step command. Applying the brakes or Safing, whichever appropriate, via a hardware display and

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control panel, renders this capability. If this capability were available via a specific command, it would be named using a different label than 'Disable' or 'Disarm'.

For the MSS, the use of 'Ena' and 'Inh' for the terms Enabled and Inhibit respectively, is reserved for indicating that a sub-system is operating as a result of a third step of a 3 step command.

8.3 TEMPLATE COMMANDS

Many commands to be sent are templates. This means that some portion of a command structure is not instantiated and is left for the operator to provide in real time. In general, the format of a template command should follow a logical flow from top to bottom of the display. By ordering the display in this manner, it will be intuitive to the operator what actions are necessary before commands are executed.

Each portion of the display should have a distinct graphical location identifier (GLI) if more than one template command exists on the display. For each template command, the first field following the GLI will be the feedback data that indicates the current status of the item being commanded, if it is required to be evaluated prior to executing the template command. Otherwise, the feedback value should follow the command button. Exceptions would include command pages called from an overview type display that already contains the status information and would be redundant to have that information repeated at the top of the new display. An example of a display where this would be true would be a task oriented (integrated or system specific) display which is called from an overview display on the recognition of a particular condition. Then it may be determined that it would be redundant to repeat the data at the top and the display would begin with the first item according to the written procedure and end with the appropriate feedback for the task.

The list of data input fields where the operator will enter the required values are positioned vertically under the telemetry feedback in procedural order. Each data input field shall be clearly labeled such that an operator can understand what values may be entered. If more than one data field is required, subsequent data fields will be left justified with respect to the first data input field. A command button will be directly below the data input field(s) and will be labeled "Set." It is assumed that the GLI will clearly define the template command such that additional labeling on the command button will not be required. (However, it is expected that in some cases other verbs may be used if clearly more descriptive of the action to be taken.) In the case that a data input field uses a quick-pick list or pull down menu, it is important that the list does not partially cover the "Set" button to avoid inadvertent selection of the button when choosing an entry. An example of multiple template commands on a page is shown in Figure 8-9a.

In cases where there exists a buffer for the data, a command button labeled "Load" will be included between the data input fields and the "Set" button. If feedback for the buffered value is provided to the laptop, this buffered value should be displayed directly beneath the "Load" button. An example of the template command window with a buffer is shown in Figure 8-9b.

Data input fields may be input by either manual entry or as a choice from a "quick-pick" list or pull down menu. When procedures refer to data to be input, the word "pick" is used with respect to a quick-pick list and "input" is used for data to be manually typed into the data input field.

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Data input fields will be rendered as 3-D recessed fields to be distinguished from telemetry. The command button(s), data input fields, and associated labeling shall all be placed together or otherwise delimited to unambiguously indicate that they are grouped together.

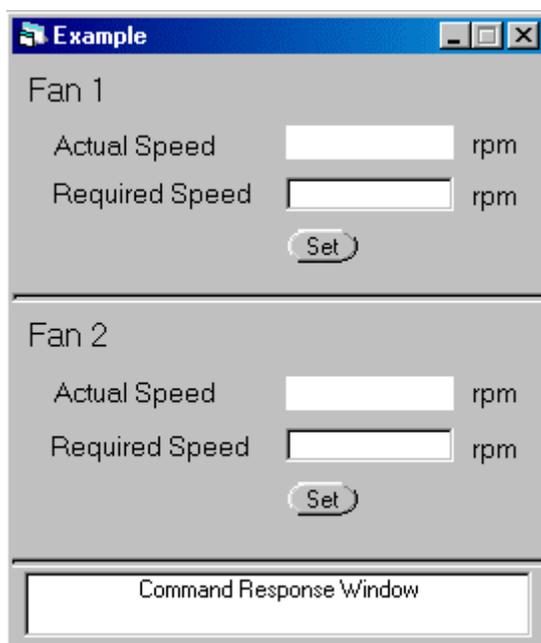


Figure 8-9a Example of Fan Speed

Procedural example:

PCS sel Fan_Speed

Fan_Speed
'Fan 1'

input Required Speed - 700

cmd Set

√Actual Speed - 700

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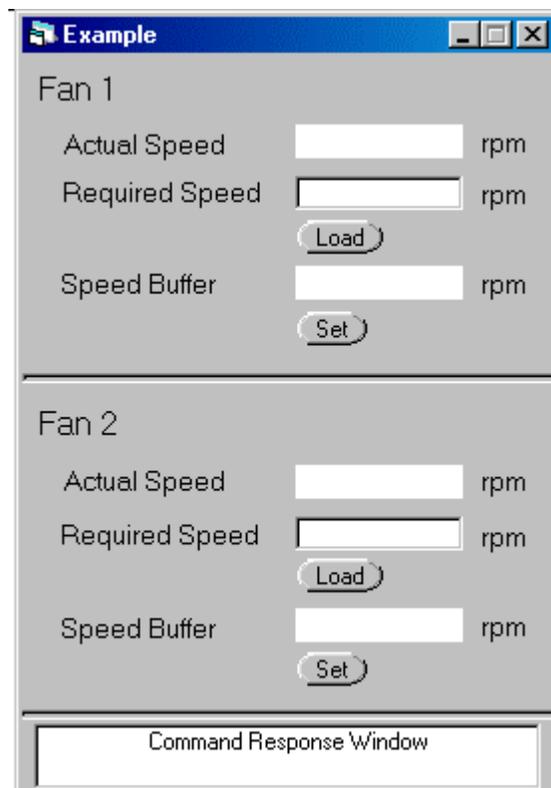
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Figure 8-9b Example of Fan Speed with Buffer

Procedural example:

PCS sel Fan_Speed

Fan_Speed

'Fan 1'

input Required Speed - 700

cmd Load

√Speed Buffer- 700

cmd Set

√Actual Speed - 700

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ESA-Columbus will not use template commands for ESA-Columbus nominal system displays.

8.3.4 NASDA Template Commands Deviation

SLT Template command window example is shown in Figure 8-10. The command is executed with the 'Execute' button, instead of 'set'.

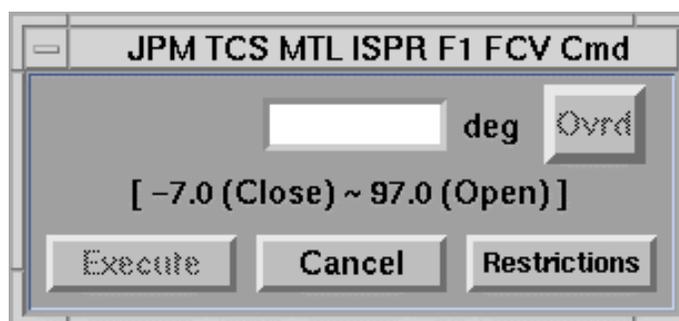


Figure 8-10 Example of SLT Template Command Window

8.3.5 CSA Template Commands Deviation

For MSS displays, the feedback data that indicates the current status of the item being commanded does not necessarily appear as the first field following the GLI, even when it needs to be evaluated before executing the template command. The feedback data may not even appear on the command window.

The MSS does not necessarily use the 'set' label for a button used to issue a template command. The 'Load' button label for the MSS is used to command the target processor to acquire data from an auto sequence set up template command and is not used to populate a template command data buffer in the PCS.

The MSS does not necessarily use 'quick pick list' or 'pull down menus' for operator entry into data input fields and does not necessarily use the 'input' label to identify the fields where data can be entered manually.

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STATION MODING

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SECTION 9.0 STATION MODING

9.1 GENERAL PRINCIPLES AND RATIONALE

ISS moding and commanding support is one of the fundamental purposes of the Crew - Laptop Interface. The Interface should provide:

- Onboard systems monitoring
- Control support

The required high quality of interface dictates the necessity of combining on one Laptop screen the above mentioned different functions.

The monitoring is realized by displays (formats).

To provide integrated evaluation of onboard systems work, the possibility of simultaneous monitoring of several systems (one or few ISS modules) should be realized.

Multilevel access to different control functions (from station moding down to procedure starting and command sending) should be provided.

The control interface should be simple and similar for the different functions (commands, procedures, etc.).

The control interface should foresee enabling/disabling of each control function.

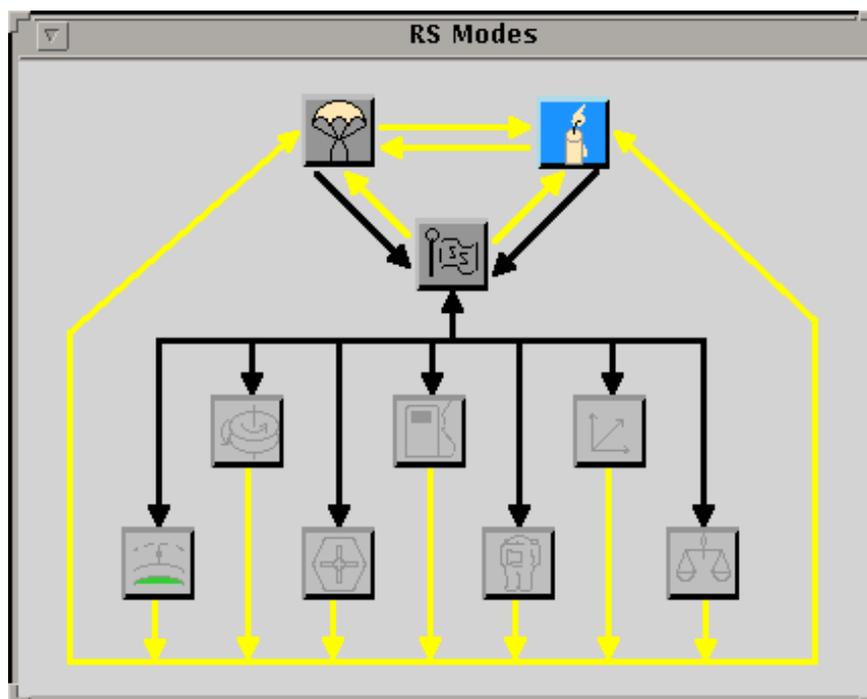


Figure 9-1 Mode Display (typical)

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SECTION 10.0 TELEMETRY

10.1 GENERAL PRINCIPLES AND RATIONALE

Telemetry data fields must provide the user with an easy and quick way to identify the parameters. Icons can be used to identify parameters to enhance usability.

10.2 DATA FIELDS

10.2.1 Labels

When the same list of parameters is used on several displays, nomenclature, and geometrical order shall be preserved unless there is proper rationale for doing otherwise. (This is typical for overviews versus detailed displays.) When similar data parameter fields are used on the same display, they shall be alike in shape and size to prevent an unbalanced look and feel of the displays.

Parameters must be labeled with proper operations nomenclature and showing units as applicable. A label's proximity to an item must make the subject of the label unambiguous. Parameter labels shall be shown to the left of or above the parameter. (Figure 10-1). Labels shall retain the following characteristics:

- Labels shall be left justified.
- It is allowable to put similar parameters or units on top of a column or on the right of the line of data with the same units instead of labeling each line of data.
- Labels shall be located to the left of the value field columns when multiple parameters are shown in a column.
- Parameter labels may be shown below the parameters in a few cases.
- Words should be spelled out rather than abbreviated whenever possible.

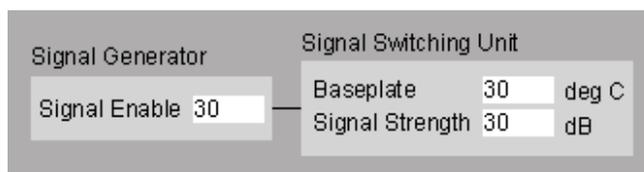


Figure 10-1 Data Fields (typical)

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The portion of the label identifying the units of the parameter shall be left justified against the right side of the data value field they are labeling. Units are not to be shown to the left of the parameter value field except for multiple column tables of values. Numbers within data value fields shall be right justified with sufficient width to show the longest possible parameter value (consider negative signs and decimal points). Consideration must also be given to the size of data quality indicators. Text within data value fields should be center or left justified with sufficient width to show the longest possible word. Where multiple parameter value fields are arranged in a column, they should be arranged such that their decimal points align vertically.

10.2.1.1 NASA Data Fields Deviation

10.2.1.2 RASA Data Fields Deviation

10.2.1.3 ESA-Columbus Data Fields Deviation

The X symbol will not be used. The vertical alignment of the decimal points is not possible, the values are automatically right justified (tool restriction). Where reasonable, the same number of decimal digits will be used to retain decimal point alignment in data columns. The two-character for out-of-limit specification are appended (by the tool) without left-shift of the data values.

10.2.1.4 NASDA Data Fields Deviation

NASDA conforms to the Standard except for some Display development toolkit dependencies. JEM RLT is TBS.

10.2.1.5 CSA Data Fields Deviation

10.3 DATA QUALITY INDICATIONS

Standard character flags are used to indicate the quality of data displayed. A data quality indicator must be provided for each parameter shown in text form and for each icon indicating a parameter value.

Text parameter fields incorporate the data quality indication within the box defining the parameter field (Figure 10-2). The rectangle defining the parameter field changes color based on the parameter's data quality. When two spaces are provided, the first provides room for out-of-limits flags, and the second space is reserved for data availability (Static, Missing, Dead) indications. When a single space is provided, the highest priority out-of-limits or data availability flag is shown. See Table 10-1 for the priority of indications (this table is showing indications in descending priority).

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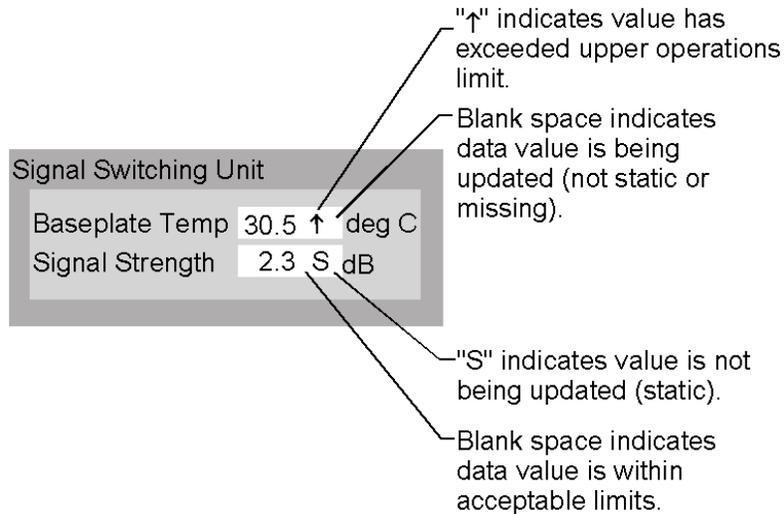
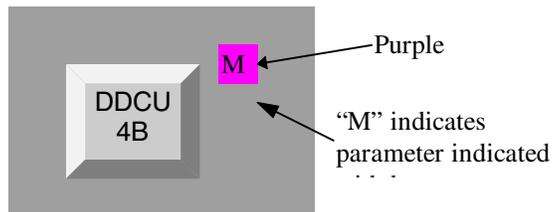
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Figure 10-2 Parameter Fields (typical)

If a parameter has taken on a value which is undefined, the telemetry field shall show a black "Error" on a white field (if abbreviation is necessary, "Err"). This indicates that although good data is flowing between the onboard computer and the object providing the data, the data is in error. If used in a table format where a "□" or "X" is used to indicate that the labeled condition is true, then a black "?" shall be used.

Data quality indicators for icons and other graphical items are shown (when data quality is not nominal) next to the graphical item. The data quality indicator is shown in a rectangle filled with the corresponding data quality color.



Data quality indicators should be used when ever possible and necessary. Examples of possible data quality indicators are identified in Table 10-1. Displays which have parameters that do not have data quality indicators must indicate that they do not have these indicators.

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Symbol	Status	Field Color	Meaning Update/Clarify Meaning
(blank)	Nominal	White	In normal range and status is nominal
M	Missing	Purple	Parameter not found in dictionary, or not being published if in dictionary.
D	Dead	Purple	Parameter in dictionary, but no initial data received.
S	Stale	Cyan	Parameter Data not being updated. Usually associated with LOS.
H	Off-scale high	White (Yellow if caution Limit exceeded, Red if Warning or emergency limit exceeded)	Parameter value greater than sensor range.
L	Off-scale low	White (Yellow if caution Limit exceeded, Red if Warning or emergency limit exceeded)	Parameter value less than sensor range.
↑(up arrow)	Out of limits high	White (Yellow if caution Limit exceeded, Red if Warning limit exceeded)	Parameter value greater than upper limit of nominal range.
↓ (down arrow)	Out of limits low	White (Yellow if caution Limit exceeded, Red if Warning limit exceeded)	Parameter value less than lower limit of nominal range.
↕	Out of limits indeterminate	White (Yellow if caution Limit exceeded, Red if Warning limit exceeded)	Value outside nominal range.

Table 10-1 Data Quality Indicators

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In the case of textual/numerical data, the data quality indicator is shown in the data field to the right of the applicable parameter. For icons representing parameter values, the data quality flag's proximity to an icon must make the subject of the flag unambiguous.

Russian segment telemetry may provide some unique indicators ("Normal" and "Valid" flags) for data quality (Figures 10-3 and 10-4). Although these may be handled in a different way for flight 3A and beyond, these parameters will be shown as separate fields. The "Normal" flag indicates whether the parameter is within or outside a set of boundaries, but it does not indicate which limit (upper or lower) was violated. The "validity" flag indicates whether the parameter is currently being updated.

"Normal" and "Valid" flags shall not be shown on main displays (displays other than popups), but will instead be shown on detail popup windows. The "main" display shall provide an attention symbol to indicate that a parameter's "Normal" or "Valid" flag shows a bad state. The attention symbol then cues the operator to view the details popup window.

Fuel Short		Fuel Hi P 		Fuel Lo P 	
kg	%	kg	%	kg	%
1 79.5	30	0.8	24	1 0.8	0
2 71.6	27			2 0.8	0
3 182.9	69			3 159.0	49
4 159.0	60				

Figure 10-3 FGB Fuel

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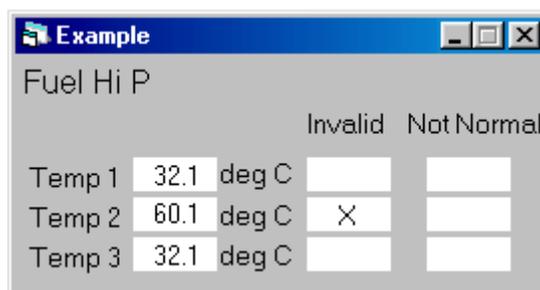
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Figure 10-4 FGB Fuel Tank 1

10.3.1 NASA Data Quality Indications Deviation

NASA uses the '^' and 'v' instead of up and down arrows. NASA does not support the data quality indicator for icons.

10.3.2 RASA Data Quality Indications Deviation

RASA telemetry provides the indicators of an underline beneath a data parameter to represent the data as being 'out-of-limits' low. A line above the data parameter indicate the data is 'out-of-limits' high. An accompanying message may provide more information about these types of problems.

An example of this is shown below:

47 Equals out-of-limit - Low

125 Equals out-of-limit - High

Data quality indicators are defined as shown in Table 10-2.

Line above data	Out of limits high	White (Yellow if caution Limit exceeded, Red if Warning limit exceeded)	Parameter value greater than upper limit of nominal range
Line below data	Out of limits low	White (Yellow if caution Limit exceeded, Red if Warning limit exceeded)	Parameter value less than lower limit of nominal range.
Lines above and below	Out of limits indeterminate	White (Yellow if caution Limit exceeded, Red if Warning limit exceeded)	Value outside nominal range.

Table 10-2 Russian Data Quality Indicators

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10.3.3 ESA-Columbus Data Quality Indications Deviation

For on orbit, any data acquisition problem is reported within the system (System Message Panel). ESA-Columbus MCDs do not provide data quality indications.

10.3.4 NASDA Data Quality Indications Deviation

JEM SLT shows a black "unknown," if a parameter value is undefined. JEM SLT does not provide data quality indicator for icons. NASA uses the '^' and 'v' instead of up and down arrows. Data quality indicators on JEM SLT are defined as shown in Table 10-3. JEM RLT is TBS.

Status	Text	Field Color	Meaning
Nominal	Black	White	In normal range and status is nominal
Stale	Black	Cyan	Parameter Data not being updated by communication loss between data source and SLT
Off-scale	Black	Cyan	Parameter value greater or less than sensor range.
Out of limits high	Black if caution Limit exceeded, White if Warning limit exceeded	Yellow if caution Limit exceeded, Red if Warning limit exceeded	Parameter value greater than upper limit of nominal range
Out of limits low	Black if caution Limit exceeded, White if Warning limit exceeded	Yellow if caution Limit exceeded, Red if Warning limit exceeded	Parameter value less than lower limit of nominal range

Table 10-3 JEM SLT Quality Indicators

10.3.5 CSA Data Quality Indicators Deviation

CSA follows NASA deviations. MSS video graphics overlays do not provide data quality indicators.

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10.4 BOOLEANS

All Boolean (on/off, enable/inhibit, activate/deactivate, 1/0, etc.) software status should be indicated with an appropriate operations name, as shown in Figure 10-5.

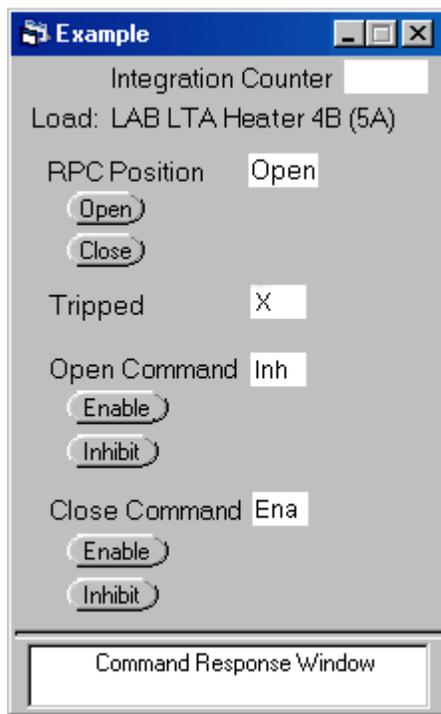


Figure 10-5 Example RPCM with Status

For indication of a Boolean condition state, a symbol filling a telemetry field or box located next to an explicit condition description is often preferred because the presence or absence of the symbol will be more eye catching than alphanumeric information or a word filling the telemetry field in both cases.

For example,

auto antenna 1 control enabled	<input checked="" type="checkbox"/>
auto antenna 2 control enabled	<input type="checkbox"/>
is preferred to	
auto antenna 1 control	<input type="text" value="enabled"/>
auto antenna 2 control	<input type="text" value="disabled"/>

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This is particularly true when several condition states are listed in a column. The operator recognizes more easily:



than

enabled
enabled
disabled
enabled
disabled
enabled

When these symbols are preferred, the following rules will be followed:

1. will be used when the label describes a potential nominal condition.
2. will be used when the label describes a condition which is not expected during nominal operation.
3. In both cases, the presence of or will indicate that the label is true.
4. The label will describe the condition in a very explicit manner such that the presence of the symbol will indicate a clear positive answer (yes) to the question:

Is the 'label' true ?

For that purpose, the label will use simple and clear words compliant with the Operational Nomenclature. When the label indicates a negative condition, it will avoid the combination of negative particle followed by positive words. For example 'Invalid' will be preferred to 'Not Valid'.

In general, the use of Boolean symbols or will enter in one of the three following categories:

1. Operator input field:

Selection of items or conditions by the operator among a list of optional choices will be indicated using . Controls open this function are referenced in section 4.16, Radio Buttons.

2. Telemetry system status field:

When a display presents the status of given equipment or software and only two possible conditions exist, or will be used following the above mentioned rules. For example, the table summarizing the Built-In-Test conditions of a system fits into this category. Depending on the way the test conditions are described by the labels, an all nominal status would be reflected by all or all .

For example:

ORU 1 B.I.T Good

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item 1
 item 2
 item 3

is equivalent to

ORU 1 B.I.T. Anomaly
 item 1
 item 2
 item 3

3. Telemetry task status field:

On task oriented displays, the successful completion of a step can be identified by . A blank would mean that the task is in work.

In some cases the operator will be directed to check the presence of after a certain delay beyond which he/she would assume that the task could not be nominally completed.

In some other cases the system will detect by itself the failed task condition. The display would then look like the following:

	Completed	Failed
task 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>
task 2	<input type="checkbox"/>	<input checked="" type="checkbox"/>
task 3	<input checked="" type="checkbox"/>	<input type="checkbox"/>

When the same system status may reflect a nominal and expected condition during some operation and an off-nominal and unexpected condition during some other operation, the unique Boolean symbol used will be the to remind to the operator the potential off-nominal condition (Figure 10-6).

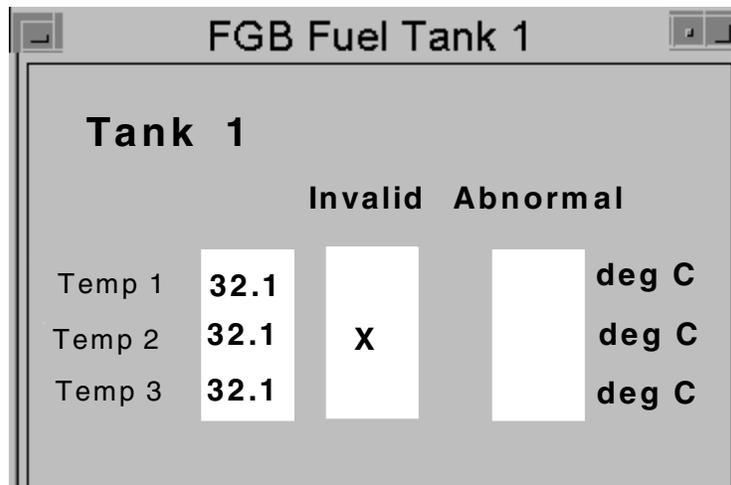


Figure 10-6 "Off-Nominal" Condition

The key rule the operator has to remember is that whether he/she sees or , the condition described by the label is true. However, as opposed to the , the will

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attract his/her attention as an unexpected condition may exist.

10.4.1 NASA Booleans Deviation

10.4.2 RASA Booleans Deviation

10.4.3 ESA-Columbus Booleans Deviation

ESA-Columbus will use word state code. E.g., OPEN, CLOSE, GOOD, BAD, ARMED, DISABLED, to indicate condition status.

10.4.4 NASDA Booleans

JEM SLT uses word state code. E.g., OPEN, CLOSE, GOOD, BAD, ARMED, DISABLED, to indicate condition status. JEM RLT is TBS.

10.4.5 CSA Booleans Deviation

10.5 TEST RESULTS

Results of Built-In Test (BIT) and other automated test functions should be indicated as "Pass" or "Fail."

10.5.1 NASA Test Results Deviation

10.5.2 RASA Test Results Deviation

10.5.3 ESA-Columbus Test Results Deviation

10.5.4 NASDA Test Results Deviation

On the NASDA SLT, the results of BIT is indicated as Normal/Failure instead of Pass/Fail. RLT indicates it as Normal/Error.

10.5.5 CSA Test Results Deviation

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CAUTION & WARNING

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11.2.2	RASA General Methodology Deviation.....	11-Error! Bookmark not defined.
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SECTION 11.0 CAUTION AND WARNING

11.1 GENERAL PRINCIPLES AND RATIONALE

The most important features of the Caution & Warning interface are:

- a. Quick and easy way to silence tones.
- b. Rapid access to C&W information (message, nature of problem).
- c. Do the above without excessive navigation or losing displays currently in use.
- d. Quick access to procedures.
- e. Do the above with either function keys or mouse (for redundancy and to not show preference for the use of function keys or the use of the mouse).
- f. The process of filling out the C&W message page is TBD. (This principle/standard is currently in conflict between the partners and is not part of the baseline.)

In the event there are multiple levels of advisory messages, the developer will supply nomenclature and descriptions for those class designations.

11.2 INTERNATIONAL PARTNER SPECIFIC GENERAL METHODOLOGY

11.2.1 NASA General Methodology Deviation

1. The PCS Caution and Warning System shall enunciate all Caution and Warning events provided to it by the Command and Control MDM.
2. The PCS Caution and Warning System shall illuminate the Home Page button on the Alarm Tool Bar an appropriate color (Yellow for Cautions, Red for Warnings and Emergencies) except while the user is currently at the **Home Page** of the display hierarchy.
3. The PCS Caution and Warning System shall light up the module and system in which the event occurred on the PCS **Home Page** with the appropriate color.
4. Upon the user selecting the module and the appropriate system, the affected blocks/icons/parameters will be lighted with the appropriate color continuing down to the lowest level indication of the C&W event on the PCS.
5. The "Alarm Tool Bar" (C&W buttons and message line) shall be at the top of the **Home Page** and the segment displays. The Alarm Tool Bar shall be visible during all display activities (Viewing, commanding, etc.) and will not be "covered" by other displays. The Alarm Tool Bar will maintain a consistent size at all times (no resize capability). (The Alarm Tool Bar shall also be "floating" such that upon annunciation of a C&W event, the tool bar will appear at the top of any other display which is currently active. The Alarm Tool Bar can be moved to any other location on the PCS screen in order to view any telemetry data which might be covered up by the tool bar.)
6. The message line on the Alarm Tool Bar shall display the oldest unacknowledged event sorted by event criticality (class 1 higher than 2, class 2 higher than 3).
7. Only Emergency, Warning, and Cautions (E, W, and C) shall be displayed on the summary by default. If it is desired to view Advisories (A), then: (1) from the C&W Summ, select "Advisories" "On," or (2) from the C&W Summ select "Filter"/"Class"/"All" or "Filter"/"Class"/"Advisories."
8. A user selectable "Sort" feature is available which can display the oldest message at the top, if desired.
9. Closing and reopening the summary shall return to the default configuration. Defaults cannot be changed by the user.

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10. The display shall have the capability to be manipulated with the “sort” and “filter” options. These options shall be implemented on a COPY of the message listing. The main C&W summary window shall maintain the single configuration outlined herein.
11. The following sort capabilities shall be available to the user:
 - Time (newest top, newest bottom, default to newest bottom)
 - Location
 - Subsystem
 - Status
12. The following filter capabilities shall be available to the user:
 - Class (E, W, C, A, or All)
 - system
 - Location (Node 1, Lab, etc.)
 - Time (from current time, last 12 hr, last 24 hr, and since XX:XX)
 - Status (All, In Alarm, RTN, Ack, Unack)
 - None (the default condition)
13. Sort and Filter functions shall be designed to mimic similar functions in a Windows-based operating system. The Sort and Filter functions shall be modifiable from header toolbar selections based on class, time, etc.
14. The Filter select button shall be labeled “Filter Out.” The selections within the filter out list will then be removed from the active display. The display of what is actively filtered shall be unambiguous to the user (flashing highlight, color change, etc.).
15. When Filter is “active,” new (incoming) messages shall be displayed in an unfiltered state. The filter only applies to “existing” messages.
16. The C&W Summary shall list the status (Alarm or Norm, five characters), class (E, W, C, or A), Acknowledged status (X or blank), Message text, and time (DDD/HH:MM:SS). Inhibited events will not be shown, but suppressed events shall be.
17. A single select and hold, or a right select, on a message line shall bring up a menu with options to Acknowledge, Suppress, Enable, or Inhibit the message, as well as clear individual event Yellow Brick Road mapping for the selected event.
18. The user shall have the capability to acknowledge (ACK) each message in the header. The header shall list the oldest message that has not been acknowledged. Acknowledgment shall not silence the tone or change the event counter.
19. a) The C&W buttons on displays shall mimic behavior of the Master Alarm Light Panel (MALP) panel.
 b) A single select on an Alarm Tool Bar C&W button that is illuminated shall issue a Command to Silence an Event Tone.
 A right select of a non-illuminated Class 1 alarm button shall issue the appropriate Command to Manually Activate Class 1 Alarm.
 c) Cancel manual alarm.
20. Event counters shall be displayed next to Caution and Warning buttons on PCS displays for (1) number of events “In Alarm” and (2) Unacknowledged. The In-Alarm event counters reflect the number of enabled or suppressed events currently in alarm, and decrement as event “Return to Normal” conditions occur. The Unacknowledged event counters display the current number of Unacknowledged events in the active C&W Log.
21. Class I (Emergency) events shall have the capability to bring up dedicated displays for Emergency (Rapid) Depressurization and Fire, and Toxic Spill.
22. The PCS shall provide the capability to determine Event Code numbers for all C&W events. This function shall also provide the ability to sort by system, subsystem, segment, block, and class.

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23. The PCS shall provide the capability to display all currently Inhibited or Suppressed events. This capability shall include a common sort/filter capability as defined for the Summary Page.
24. The PCS shall have a dedicated Robotics Advisory Summary Page that reflects the capabilities of the C&W Summ, but provides for rapid use by the SSRMS operator during periods of robotic operations.

11.2.2 RASA General Methodology Deviation

RASA uses a single button to silence any alarm tone.

RASA has the capability to navigate to alarm displays directly from the current display.

RASA Events window is always at the top and cannot be overlapped by other displays. The principle of displaying C&W data is the following:

1. Event driven
2. priority
3. Automatically called window containing the C&W information.
4. The format may be manually opened by selecting the <Display> field from the window containing the C&W information.
5. The windows may be opened by clicking on the corresponding C&W button.
6. Bringing up of the necessary display with Emergency (Fire, dP/dt, ATM) related data.
7. An additional button is provided for Advisory messages.
8. Registration in the general list of C&W.

11.2.3 ESA-Columbus General Methodology Deviation

ESA-Columbus C&W parameters are monitored and reported to the ISS system level by the ESA-Columbus vital system. Processing is performed by the PCS Caution and Warning System, following the NASA General Methodology.

11.2.4 NASDA General Methodology Deviation

The SLT Caution and Warning System shall display JEM Caution and Warning events. The JEM RLT is TBS.

1. The SLT Caution and Warning System shall illuminate the C&W button on the user Tool Bar on the left side of the Tool Bar with an appropriate color (Yellow for Cautions, Red for Warnings and Emergencies).
2. Upon the user selecting the element and the appropriate subsystem, the affected ORU's/icons/parameters will be lighted with the appropriate color continuing down to the lowest level indication of the C&W event on the SLT.
3. A C&W summary including Emergency, Warning, and Cautions (E, W, and C) shall be displayed when the user pushes the C&W button. The returned-to-normal C&W is deleted from the summary.
4. The C&W Summary on the SLT shall list the class (E, W, C, or A), message text, and time. (DDD/HH:mm:ss) Inhibited events will not be shown.
5. Upon the user selecting the module and the appropriate system, the affected blocks/icons/parameters will be lighted with the appropriate color continuing down to the lowest level indication of the C&W event on the JEM SLT.
6. The newest message shall be shown at the top of the summary by default.

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11.3 CAUTION & WARNING INDICATORS

On a display containing an object in alarm, the object is illuminated. For example, a smoke detector that has announced a fire is illuminated red (Figure 11-1).

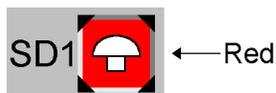


Figure 11-1 Smoke Detector in Alarm

11.3.1 NASA Caution & Warning Indicators Deviation

The **Home Page** provides cues to indicate the displays required to obtain further information on an anomaly. When an alarm event occurs, the Caution and Warning toolbar is lit with the appropriate color (yellow for caution, red for warning or emergency) as shown in Figure 11-2.

In addition, the light for that alarm class is lighted the same color. The location of the alarm is indicated by coloring the associated segment with the alarm's associated color, and the affected system button on the system toolbar is colored appropriately. The examples below show the ECLSS system button first in nominal state, then in caution, then in warning or emergency.

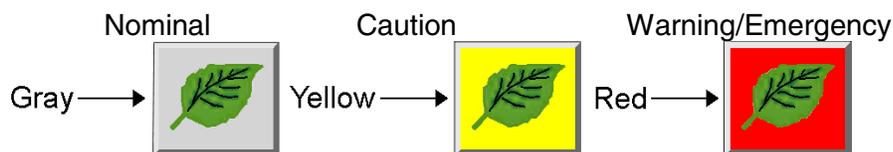


Figure 11-2 ECLSS Button in different states

Note that the colors yellow and red are reserved exclusively for the indication of caution & warning events except when yellow is used on the attention icon (reference section 4.21, Attention Symbol).

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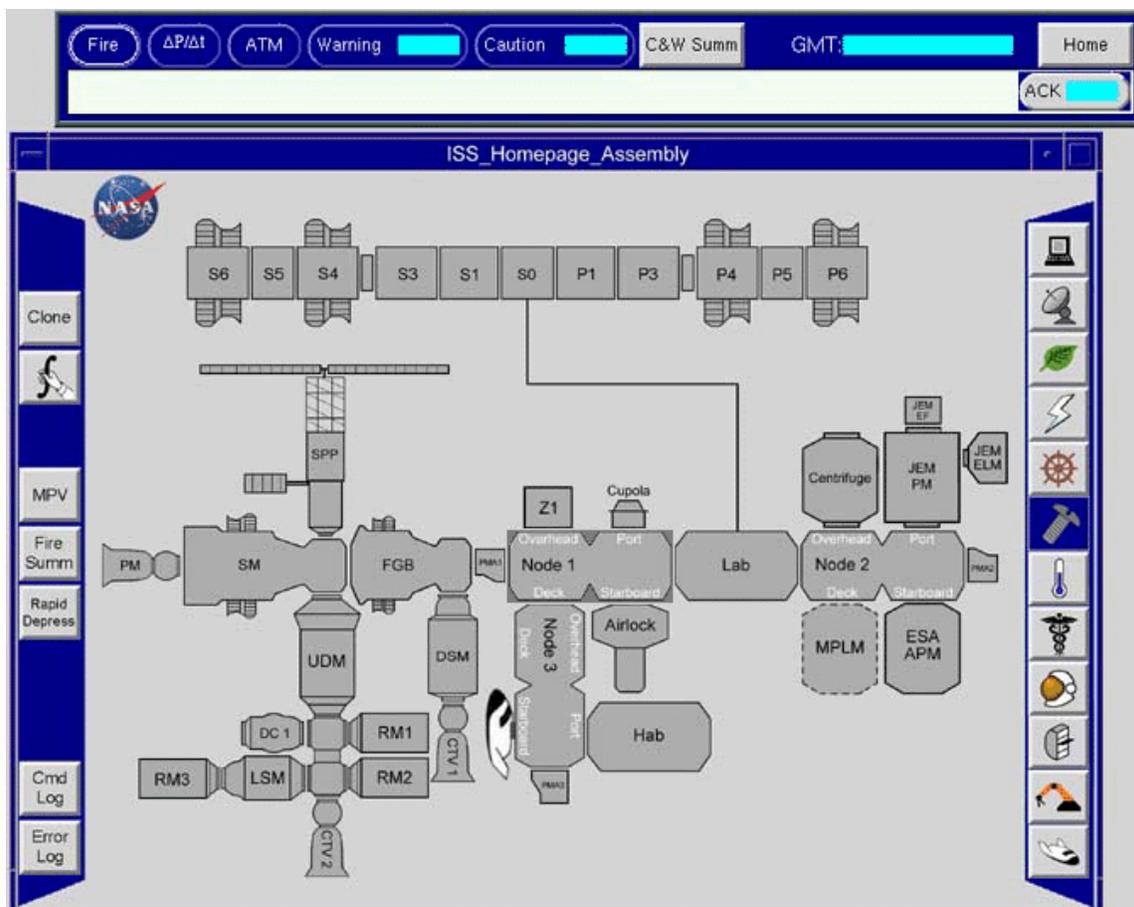
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Figure 11-3 Home Page

By selecting the lighted module or system button, the user may view additional information regarding the alarm. For example, if the user selects the lighted Node 1 module, the Node 1 display is shown (Figure 11-4). If the alarm event is in this module, then the appropriate system button is lighted. If the alarm is not in this module, then the system button is not lighted.

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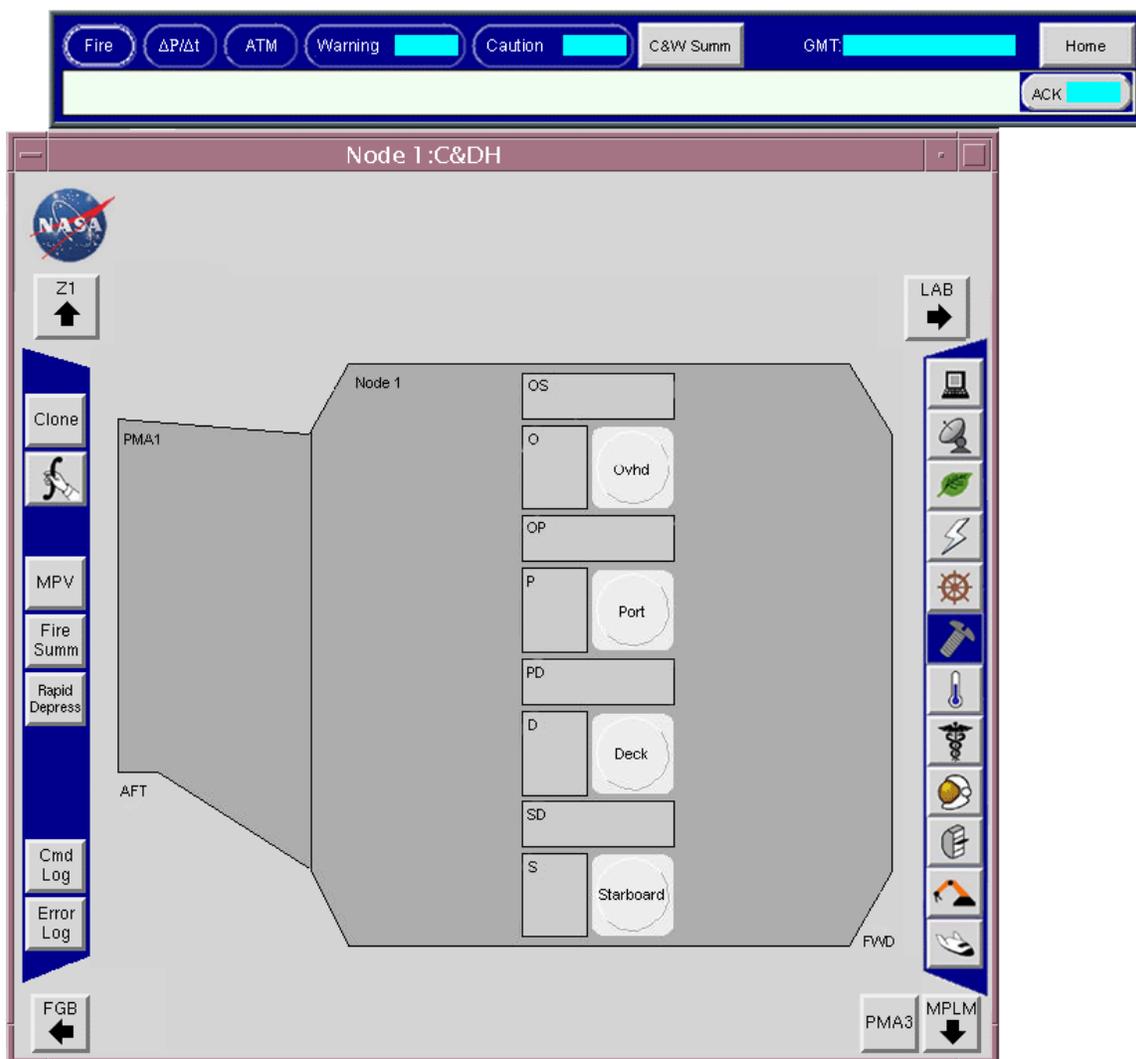
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Figure 11-4 Node 1

The user may select the lighted system icon to view information regarding the system's components in that module (Figure 11-5).

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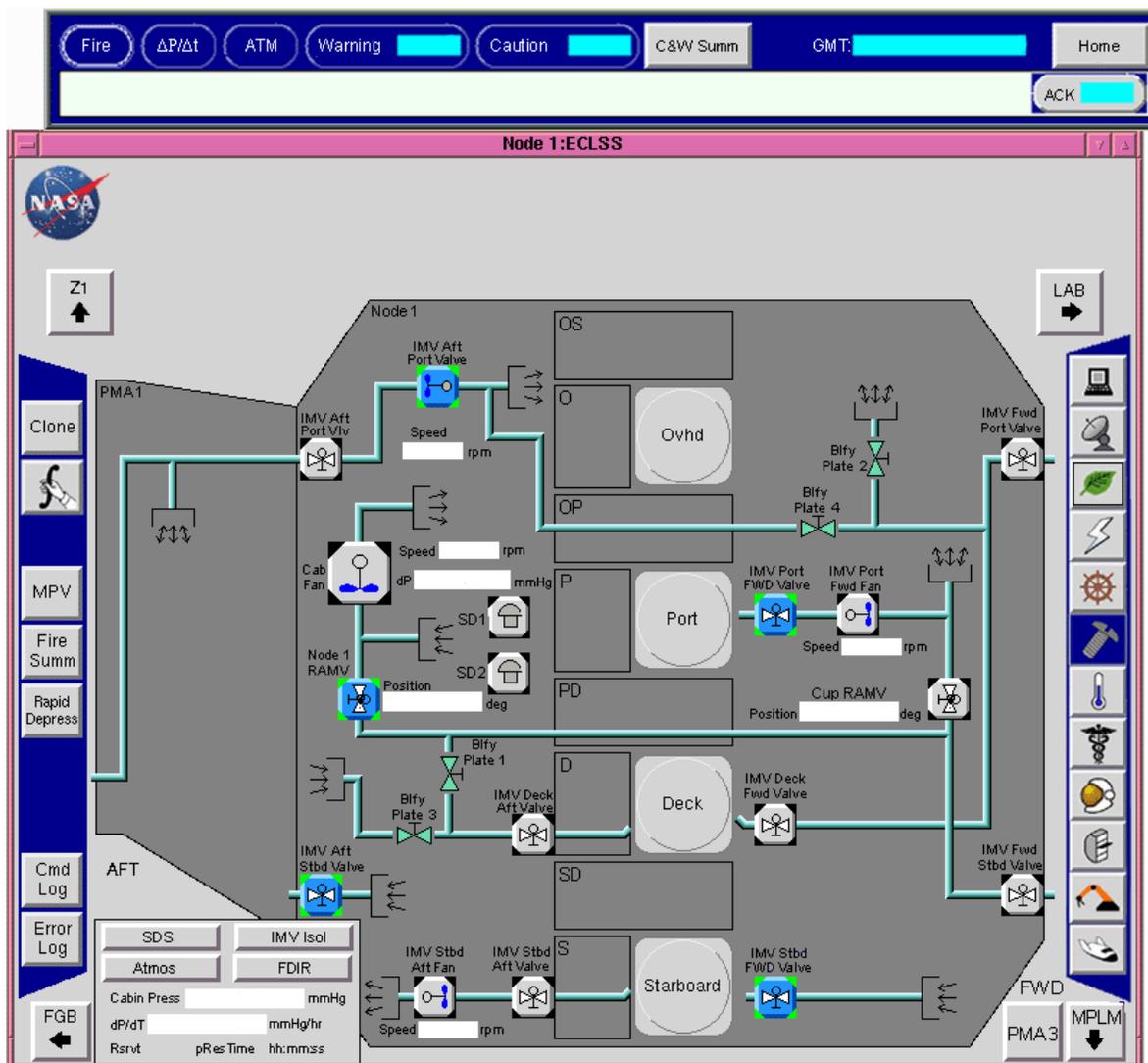
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Figure 11-5 Node 1 ECLSS System

Selecting the Node 1 icon from the **Home Page** calls up a display depicting Node 1. Selecting the ECLSS system icon takes the user to Node 1 Environmental Control and Life Support System status display.

11.3.2 RASA Caution & Warning Indicators Deviation

RASA can delete alarms out of the C&W list.

11.3.3 ESA-Columbus Caution & Warning Indicators Deviation

The ESA-Columbus C&W indication is performed by the PCS Caution and Warning System, following the NASA method.

11.3.4 NASDA Caution & Warning Indicators Deviation

JEM RLT is TBS

11.3.5 CSA Caution & Warning Indicators Deviation

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11.4 CAUTION AND WARNING SUMMARY

The user may access a listing of all event messages by selecting the "C&W Summ" button above the alarm toolbar (Figure 11-6). The resulting window allows the user to view the event logs for Emergency, Warning, Caution, and Advisory. Messages can be sorted and searched by time, system, class, and location. The text shown below the toolbar and to the left of the ACK button is the oldest unacknowledged message sorted by highest event class from the caution & warning server. For example: a class one event will be displayed versus a class 2 even though the event times are identical. No ranking of criticality within a C&W class will be performed (all class 1 events are the same priority, all class 2 events are the same priority, etc.). Once the user selects the ACK button with the left mouse button, the message becomes acknowledged, and the next unacknowledged message is displayed. The text is color coded to reflect the level of emergency/warning/caution of the message.

Below this area is the listing of all caution & warning messages registered with the summary page. These messages can be sorted by status, time, system, and module location. Each message also displays a color coded background to reflect the level of emergency/warning/caution, contains a time stamp, and indicates whether or not the message has been acknowledged.

YBR	STATUS	CL	ACK	SYSTEM	MESSAGE TEXT	TIME OF EVENT
*	ALARM	EF		ECL	FGB FIRE-RS	10 mar99/13:34:49
*	ALARM	EP		ECL	SM RAPID DEPRESS-RS	10 mar99/13:34:49
*	ALARM	EP		ECL	FGB RAPID DEPRESS-RS	10 mar99/13:34:49
*	ALARM	ET		ECL	SM Atmosphere Content-RS	10 mar99/13:34:49
*	ALARM	EF		UNK	FIRE - Manual Alarm	10 mar99/13:34:49
*	ALARM	EP		UNK	RAPID DEPRESS - Manual Alarm	10 mar99/13:34:49
*	ALARM	EF		UNK	TOXIC ATMOSPHERE - Manual Alarm	10 mar99/13:34:49
*	ALARM	EF		ECL	FIRE - Smoke Detector 1-Node 1	10 mar99/13:34:49
*	ALARM	EF		ECL	FIRE - Smoke Detector 2-Node 2	10 mar99/13:34:49
*	ALARM	EF		PL	PL Emergency ISPR-LAP-1	10 mar99/13:34:49
*	ALARM	EF		PL	PL Emergency AFP-S3-4	10 mar99/13:34:49
	ALARM	EF		PL	PL Emergency AFP-S3-1	10 mar99/13:34:49
	ALARM	R		UNK	LAB RWS RHC Coarse/Vernier Sw Xcheck Fail	10 mar99/13:34:49
	ALARM	R		UNK	LAB RWS RHC Rate Hold PB Xcheck Fail	10 mar99/13:34:49
	ALARM	R		UNK	LAB RWS RHC Rocker Sw Xcheck Fail	10 mar99/13:34:49
	ALARM	R		UNK	LAB RWS RHC Safing Sw Xcheck Fail	10 mar99/13:34:49
	ALARM	R		UNK	LAB RWS RHC Joint Sel Sw Xcheck Fail	10 mar99/13:34:49
	ALARM	R		UNK	LAB RWS RHC Pnl/Inst Ltg Sw Xcheck Fail	10 mar99/13:34:49
	ALARM	R		UNK	LAB RWS RHC Analog & BITE Fdbk Sig Rng Err	10 mar99/13:34:49
*	ALARM	C		UNK	FGB Smoke Detector	10 mar99/13:34:49
*	ALARM	C		UNK	SM Russian Vehicles Automatic Docking Impos...	10 mar99/13:34:49
*	ALARM	C		UNK	SM Russian Angular Rate Not Available-RS	10 mar99/13:34:49
*	ALARM	C		UNK	SM Attitude Determination Capability Loss-R...	10 mar99/13:34:49
*	ALARM	C		UNK	SM Attitude Thrusters Not Available-RS	10 mar99/13:34:49
*	ALARM	C		UNK	SM CMG or Gyrodines Desaturation Impossible...	10 mar99/13:34:49
*	ALARM	C		UNK	SM Reboost Aborted-RS	10 mar99/13:34:49
*	ALARM	C		UNK	SM Gyrodines Insufficient For Control (<4...	10 mar99/13:34:49
*	ALARM	W		CNT	SM BITS Command and Matrix Power Off-RS	10 mar99/13:34:49
*	ALARM	W		CNT	SM BITS Logic Controller Bus Power Off-RS	10 mar99/13:34:49
*	ALARM	W		CNT	SM BITS Time Counter DV1(2) Bus Power Off-RS	10 mar99/13:34:49
*	ALARM	W		CNT	SM BITS Telemetry Bus1(2) Power Off-RS	10 mar99/13:34:49
*	ALARM	A		UNK	SM Prop Valve Logic Controller Pwr Redundan...	10 mar99/13:34:49
*	ALARM	A		UNK	SM Fuel Tank BG 1(2) Iso Valve Pwr Redundan...	10 mar99/13:34:49

Figure 11-6 Caution & Warning Summary

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The messages in the summary window can be sorted, filtered, suppressed, or inhibited.

When the "Sort By" button is selected, a pulldown menu appears to select the sort criteria. Messages can be sorted by oldest message on top, newest message on top, level of urgency, location, and status.

Messages can be filtered to show message class, location, time, or all emergency/warning/caution (EWC) messages. Only messages meeting the criteria will be shown in the message area. When the "Filter Out" button is selected, a pulldown menu appears to select the filter criteria. The filter should only act on current events, new events should not be actively filtered.

The "Advisory" button toggles between showing advisory messages with EWC messages (ON) or only EWC messages (OFF). The label below the advisory button indicates the state of the Advisory button.

With each of these buttons, messages are still being logged in the caution & warning server. This message area will show only those messages of interest to the operator, the use of the buttons has no effect on the server.

The "Enable" window allows the operator to fully reactivate (automatic logging and annunciation) any suppressed or inhibited messages. The Enable window will appear requesting the message code to be enabled (Figure 11-7). After the operator enters the message code, the Execute button must be selected to send the command to the C&C MDM. The description of the message, and the status of the enable request, is shown in the text area. The Close button removes this window.



Figure 11-7 Enable Window

The "Suppress" button is used to stop specified messages enunciating by tone and light. When the Suppress button is selected, the window, Figure 11-8 appears with the Arm and Close button selectable. The Disarm and Fire buttons become sensitive after the Arm button is selected.

The action of suppressing a message requires two steps. The Arm button must be selected followed by the Fire button. The status of the command is shown in the Command Status text area below the message code. The suppress command can be canceled by selecting the Disarm button before the Fire button is selected. To remove the window, the Close button is selected.

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Figure 11-8 Suppress Window

The "Inhibit" button is used to stop all annunciation and logging of the specified C&W event. An inhibited message will not be registered with the caution & warning server and, therefore, will not be displayed on the summary page or in the log file. An example of the use of the inhibit command would be to ignore messages from a component that has failed (Figure 11-9). The window interface for inhibiting a message is similar to that of suppressing a message.



Figure 11-9 Inhibit Window

The "Log Menu" allows the operator to view log files of messages. The options available via a pulldown menu are: Merged Log - showing all caution & warning messages, Emergency Log - showing only emergency level messages, Warning Log - showing only warning level messages, Caution Log - showing only caution level messages, Advisory Log - showing all non-EWC level messages, and Robotics Log. The Robotics Log is a place holder and will not become active until flight 6A.

11.4.1 NASA Caution and Warning Summary Deviation

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11.4.2 RASA Events Display Deviation

The Events window is always at the top and cannot be overlapped by other displays. See Russian Events Display, Figures 11-10a and 11-10b.

The Events display will be similar to the C&W toolbar on the US displays on the following items
Buttons for Fire, dP/dt, ATM, Warning and Caution:

1. When active, the buttons will change to the color for respective class of event.
2. There will be a 'Home' button on the far right side of the window.
3. Clicking on the 'Home' button at anytime will bring the Home Page to front of the screen.
4. There will be a space for GMT just to left of the 'Home' button.



Figure 11-10a



Figure 11-10b

The following are areas where RASA is not common with NASA:

1. Sound off (button with icon «crossed speaker»): command to sound off generated by the button click.
2. Advising (button with exclamation mark): the button changes color upon advisory event.
3. Events revision: upon push the button with icon «magnifier» pop up the window.
4. RS Mode: placed on the right of Russian Flag.
5. Station Mode: placed on the right of RS Mode.
6. Language switch: upon EN/RU button click change text from English to Russian and vice versa.
7. Ground link state: Icon to indicate current AOS/LOS state and field for displaying the time remaining to the beginning of AOS/LOS.
8. Ecliptic state: Icon to indicate current Day/Night state and field for displaying the time remaining to the beginning of Day/Night.
9. Alarm handling: When alarm message comes, the priority is kept.
 - a) For example, if during Caution handling Warning message come Warning window placed over Caution window. If during Warning handling come Caution message only Caution button change color the Caution window does not pop up. If click this button, Caution window pop up.
 - b) When Emergency message come needed display pop up.
 - c) When Caution or Warning message come window with this message pop up. Necessary display pop up manually from this window.
 - d) When Advisory message come the button changes color only.

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11.4.3 ESA-Columbus Caution and Warning Summary Deviation

The ESA-Columbus C&W Summary processing is performed by the PCS Caution and Warning System, following the NASA method.

11.4.4 NASDA Caution and Warning Summary Deviation

JEM Local C&W Summary window is on user tool bar. JEM C&W Summary window has no filter or sort function. There are C&W messages which occurred at that time. Message includes class, subsystem, detail information, and time of occurrence. JEM local C&W enable/inhibit function is provided with the SLT limit manager window described in Section 4.22.4. SLT does not provide a suppress or log function. JEM RLT is TBS.

11.4.5 CSA Caution and Warning Summary Deviation

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SECTION 12 ONBOARD PLAN and PROCEDURES VIEWERS

Actions in work. Not included in CR4248.

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SECTION 13

LAPTOP OPERATING SYSTEM CONFIGURATION AND FEATURES

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SECTION 13.0 LAPTOP OPERATING SYSTEM CONFIGURATION AND FEATURES

13.1 GENERAL PRINCIPLES AND RATIONALE

13.2 HOT KEYS AND CURSOR CONTROL DEVICES

Hot key functions/cursor control devices shall be provided to allow expedited access to critical displays. Table 13.1 shows the hot-key standards and each International Partners' deviation or addition to the standard.

Function / Hot Keys	Windows 95	Solaris CDE	Solaris OW	Standard	NASA Deviation /Addition	RASA Deviation /Addition	NASDA SLT Deviation/ Addition	NASDA RLT Deviation/ Addition	NASDA PLT Deviation /Addition	ESA Deviation /Addition
Activation of a selected object	Enter or space	Space	Enter or Space	Enter or Space					Enter	
C&W tool bar & summary				F11		NA	NA	TBS	NA	
C&W tool bar only				Alt F11		NA	NA	NA	NA	NA
Close active window	Alt F4	Alt F4		Alt F4 or Esc	Double L-click	Double R-click	Double L-click	Alt F4	Double L-click or Alt F4	
Cycling through opened windows	Alt – Tab	Alt – Tab		Alt – Tab					Alt Tab	
Cycling through selectable objects in the active window * (including scrolling)	Tab/↔↓	Tab/↔↓		Tab or ↔↓				Tab	Tab	
Decoration controls: - Highlight title menu - Highlight window menu - Cycling menus - Cycling within menus - Minimize - Maximize - Close	Alt Space F10 ↔ ↓ Alt F4	Alt Space F10 ↔ ↓ Alt F9 Alt F10 Alt F4							NA	
Exit from all applications				Alt –X			NA	TBS	NA	
Help	F1			F1			NA	F1 + Alt M or after F10 Space	NA	
Home Page				Alt F12	F12	NA	F12	TBS	NA	
Home page + Close all other windows				F12	NA		NA	TBS	NA	
MDM reconnect					F2	Cntl R	NA	NA	NA	NA

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window										
Resize content of current window ↔↕				X/x Y/y Z/z (ratio =)			NA	TBS	NA	
Rus. – Eng. Language Swap					NA	Cntl L	NA	NA	NA	NA
-										

Table 13.1 Hot Key Table

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Hot Keys	Standard	Windows 95	Solaris CDE	Solaris OW	NASA Deviation/ Addition	RASA Deviation /Addition	NASDA SLT Deviation/ Addition	NASDA RLT Deviation /Addition	NASDA PLT Deviation /Addition	ESA Deviat ion/Ad dition
F1	Help	Help								
F1 +Alt M								Help		
F2					MDM reconnect window					
Alt F4	Close Active Window	Close Active Window; Close Decoration controls	Close Active Window; Close Decoration controls					Close Active Window		
Alt F9		Minimize Decoration controls								
F10		Highlight Decoration controls	Highlight Decoration controls							
Alt F10			Maximize Decoration controls							
F10 Space								Help		
F11	C&W tool bar and summary									
Alt F11	C&W tool bar only									
F12	Home page and close all other windows				Home Page		Home Page			
Alt F12	Home Page									
Cntl L						Rus. – Eng. Language swap				
Cntl R						MDM reconnect window				
Double L-click					Close active window		Close active window			
Double R-click						Close active window				
Enter or Space	Activation of a selected object	Activation of a selected object		Activati on of a selecte d object						

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Hot Keys	Standard	Windows 95	Solaris CDE	Solaris OW	NASA Deviation /Addition	RASA Deviation /Addition	NASDA SLT Deviation /Addition	NASDA RLT Deviation /Addition	NASDA PLT Deviation /Addition	ESA Deviation /Addition
Tab								Cycling through selectable objects in the active window (including scrolling)		
Tab or ↔↕	Cycling through selectable objects in the active window (including scrolling)	Cycling through selectable objects in the active window (including scrolling)	Cycling through selectable objects in the active window (including scrolling)							
Alt Tab	Cycling through opened windows	Cycling through opened windows	Cycling through opened windows							
Space			Activation of a selected object							
Alt Space		Highlight title menu, decoration controls	Highlight title menu; decoration controls							
X/x, Y/y, Z/z (ration =)	Resize content of current window ↔↕									
Alt X	Exit from all applications									

Table 13-2, Hot Key Table listed by Hot Key

13.2.1 NASA Hot Keys Deviation

Additional hot keys shall be reserved for navigation to the ODF/OSTP Crew Interface (OOCI) components: Manual Procedure Viewer (MPV), Automated Procedure Viewer (APV), and Onboard Short Term Plan (OSTP) viewer. These hot key designations are TBD.

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Baseline13.2.2 RASA Hot Keys Deviation

Action	Hot Keys
Action menu	F10
Level Navigation: Down	Enter; Left mouse button click
Level Navigation: Up	Esc; Right mouse button double click
Moving within display	<←>, <↑>, <→>, <↓>;.Mouse cursor
Object choice within display	<←>, <↑>, <→>, <↓>;.Left mouse button click during mouse cursor is near object
Object moving within display with large step	Shift+Left mouse button drag and drop
Object moving within display with small step	CapsLock+Left mouse button drag and drop
Object copy within display	Alt-D
Object cut and paste to new place within display	Ctrl-D
Scrolling	Drag by Left mouse button
Graphic/text switching	Ctrl-G
List sorting/filter	Ctrl-S
Field ordering for sorting	Alt-S
Window menu	Alt-W
Data Base Saving	F2
Fill field from menu	Alt-F3
Field edit	F3
Window close disabling	Ctrl-F4
Open new window	F4
Take data for copying	Ctrl-F8
Take data for reference	F8
Copy data to all active field records	Ctrl-F9
Refer or copy data to active field	F9
Deleting	Ctrl-Y

Table 13-2 RASA Hot Keys
(not otherwise defined in the standard)

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Baseline13.2.3 ESA-Columbus Hot/Function Keys and Keyboard Controls Deviation

The supported keyboard switch action commands are as indicated in Table 13-3.:

Task/Object	Action	MS-Windows Key Combination	OSF/MOTIF Window Manager Key Combination
Navigate Navigate Navigate Navigate Navigate Navigate Navigate Navigate Navigate	<u>S</u> tart, Begin <u>E</u> nd <u>P</u> revious <u>N</u> ext <u>P</u> revious <u>N</u> ext <u>P</u> revious <u>N</u> ext <u>N</u> ext	HOME END PGUP PGDOWN LEFT RIGHT UP DOWN TAB	HOME END PGUP PGDOWN LEFT RIGHT UP DOWN TAB
Action Action Action	Cancel Accept Confirm/Acknowledg e	ESC ENTER ALT+RETURN	ESC ENTER ALT+RETURN
Task Task Task	Rapid Shutdown Stop Application Warm Boot	SHIFT+F4 ALT+F4 CTRL+ALT+DEL	N/A ALT+F4 STOP+A
Navigation Navigation Navigation	Next Application Previous Application Task List	ALT+TAB ALT+ESC CTRL+ESC	N/A N/A N/A

N/A = Not Applicable

Table 13-3 Keyboard Switch Action Commands

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The keyboard navigation bindings are as indicated in Table 13-4:

Virtual Key (OSF/MOTIF)	Keyboard Binding
KTab KBackTab	<Tab> MShift <Tab>
KMenu KMenuBar KCancel	<F4> <F10> <Escape>
KUp KLeft KDown KRight	< _ > < _ > < _ > < _ >
KNextFamilyWindow KPreviousFamilyWindow	MAlt KTab MAlt KBackTab
KNextWindow KPrevious Window	MAlt <F6> MAlt MShift <F6>
KNextField KPreviousField	MCtrl KTab MCtrl MShift KTab
KNextPane	<F6>

Table 13-4 Keyboard Navigation Bindings

The Hot/Fixed Function Keys (FFKs) defined for the APM are listed in Table 13-5. The standard mapping of FFK's to functions shall be applicable to all keyboards, even if the function is not provided, e.g. the Caution and Warning key shall always be allocated F11 and shall not be used for any other purpose.

Fixed Function	Key
Open C&W Window	Rightmost Function Key, presumably F11
Go to Element Application Menu	F2
Help	F1
Cancel	ESCAPE

Table 13-5 Fixed Function Key

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13.2.4 NASDA Hot Keys Deviation

For the SLT, a green border around a button indicates the button is the active field for use with hot keys.

Function Hot Keys	NASDA RLT Deviation/Addition
Show Message Summary Windows	F11

Table 13-6 NASDA RLT Hot Keys

13.2.5 CSA Hot Keys Deviation

13.3 TASK BAR

A Windows-style Task Bar should list available applications (including displays), as well as all application windows currently open. The task bar should provide an “auto-hide” capability so that it appears only when the cursor is placed on a specific edge of a display area.

13.3.1 NASA Task Bar Deviation

NASA does not use the task bar.

13.3.2 RASA Task Bar Deviation

RASA does not use a task bar.

13.3.3 ESA-Columbus Task Bar Deviation

ESA-Columbus does not use a task bar

13.3.4 NASDA Task Bar Deviation

NASDA does not use a task bar

13.3.4 CSA Task Bar Deviation

CSA does not use a task bar.

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APPENDIX A

In work.

DEFINITION AND USE OF STANDARD TERMINOLOGY

The following appendix defines rules for uses of standard terminology for certain functions. Definitions of certain terms not already covered in previous sections will be covered in this appendix.

Abort - Used only to cease operations during which an emergency situation has occurred where the situation is time-critical and the result of continuing the operation will result in injury to personnel or damage hardware. The term "terminate" may be used for all other cases. For payloads, the term 'abort' shall not be used. Payloads uses 'terminate' or 'stop'.

Activate – Initiate a software or hardware function to begin operation of a particular subsystem. The activate function should include multiple automated subactivities that encompass more than enabling or powering a routine or device.

For example, in the case of activating the Common Berthing Mechanism (CBM):

- 1) Clears the values of certain parameters in the MDMs CBM software
- 2) Selects the appropriate CBM RT based on the activate command and enables it on the 1553 bus
- 3) Begins cyclic communication with the CBM's master controller by sending a 1553 command to the CBM
- 4) Enables RT FDIR for the CBM RT after establishing comm with the CBM master controller

Active/Standby – Used to refer to equipment where any number can be selected as active and the rest are therefore in standby.

Animation – Any change in state. For example, on a display, if a graphic symbol changes color or appearance, it is considered animated.

Arm – 1. Used in a 2-step command when an action is being performed that is time critical with respect to the "Arm" and the operator is expected to only have the action available for a short period of time. It is the kind of action where the action command is expected to be sent immediately after the arm command. "Enable" will be used for all the other cases. 2. The hardware portion of a robotic system composed of joints and booms that effects translational and rotational motion.

Authorize – Use Enable, Arm, On.

Auto or Automatic – Being performed by a machine or a system, no human interaction required.

Auto Sequence - Usually used to identify the type of trajectory a robot/payload moves along. When a robot/payload moves through an "auto sequence," it moves from point to point in space without the operator being in the control loop. The sequence is defined by the series of points in the trajectory, each point being composed of a position (X, Y, Z), and attitude (Pitch, Yaw, Roll). Points are either start points, pause points, fly-by points, or last points. The start and last points

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are always pause points. When the trajectory achieves a pause point, it stops until the operator takes a positive action to continue the trajectory (usually via the “proceed button” on the DCP or GUI).

BIT - Built-in Test –

Acceptable forms of BIT:

Active BIT - meaning crew action is necessary to execute the test function. The button shall be labeled "Active BIT."

Passive BIT- meaning that the test is run automatically without crew involvement and the results displayed at the completion of the test or when the BIT detects a fault. (This label will replace any previous labels associated with "cyclic" or continuous BITs.)

Detailed BIT - meaning the Active BIT executed is of a more detailed nature. (This label replaces "extended" BITs.)

Block – A grouping of parts to perform a function for a subsystem. An assembly is generally connected to control signals, electrical supply, thermal support, or other environmental support services to perform its job. Examples include an MDM, a pump package assembly (PPA), a remote power control module (RPCM), latch assembly, and a controller panel assembly (CPA).

Button - a 3D object which allows you to control a system or display with a single mouse click.

Cancel – Design the display to use “Off,” “No,” or “Inhibit” instead. Cancel closes the window without making any changes. Deviation - Robotics, cancel is used to halt a process.

Cartesian - Six degree-of-freedom space defined by three orthonormal directions (right-handed set of three mutually perpendicular vectors), and three Euler sequence angles in the “pitch, yaw, roll” sequence.

Common / or Equivalent Same - Terms used to denote the results of comparisons with other robotic systems elements. A common system component can be either equivalent to its counterpart, or the same as its counterpart. When two systems produce the same result using different hardware, software, or Similar techniques, they can be said to be equivalent. When it is not possible to distinguish one components from the another components, the components that are indistinguishable are the same. In the Robotics appendix, similar is used to mean same.

Confirm – Do not use – Design the display to use “Yes” instead. For payloads: do not use as a button name. The use of ‘confirm’ is allowed in payload labels.

DCP - Acronym for “Displays and Control Panel,” a hardware panel containing switches and light-emitting-diode (LED) indicators for issuing and monitoring critical robot commands.

Dead - Parameter in dictionary, but no initial data received.

Delta and Error - $\Delta = \text{Target} - \text{Current}$; $\text{Error} = \text{Current} - \text{Target}$

Enable/Inhibit – Enable is used when allowing automatic processes (such as software routines) to operate or when allowing the specified action to occur whenever commanded. There may be no time criticality associated with this terminology. Inhibit is used when preventing a command

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from being executed or an action from being performed. Nomenclature used in telemetry fields for feedback may read enable(ed)/inhibit(ed) or if space is limited, ENA/INH.

End Effector / Tool Effector - The hardware at the tip of a robot used to connect to or service a Tool payload. An end effector (EE) that also includes a latch is called a latching end effector (LEE). Both EE and LEE are used with large robots intended for gross translations. "Tool" is a term for the end effector used with small, dexterous robots intended for close-in, servicing tasks.

Euler Sequence:

Pitch: Pitch is positive when rotated in a right-handed manner around the Y-axis

Yaw: Yaw is positive when rotated in a right-handed manner around the Z-axis

Roll: Roll is positive when rotated in a right-handed manner around the X-axis

Inhibit – Used when preventing a command from being executed or an action from being performed.

Fire – Do not use (unless referring to a physical fire or the "firing" of thrusters).

Frame of Resolution (FOR) - Reference frame associated with the end effector or payload: The origin of the FOR is the Point of Resolution (POR), or the point around which rotations will occur. The Display Frame uses the axes of the FOR to compute the Euler Sequence Angles.

Graphical Location Identifier (GLI) - A label on a display used to denote a particular display region. GLI's are referred to in procedures to direct an operator to a particular portion of the display. A label to denote a location on a display identified in procedures to direct the operator to that particular portion of the display.

Graphic Symbol - Conventional graphic designations used in training documentation.

Hardware - The hardware in a robotic system is composed of the workstation panels, video monitors, laptops, trackballs, mounting racks, etc.; arm; and end effectors / tools. Hardware (grapple fixtures) on the payload to be maneuvered; ready-to-latch microswitches; and cameras can be considered robotic hardware when assigning alert categories to feedback generated by these pieces.

Icon - Conventional graphic designations used in onboard displays.

Inhibit – Used when preventing a command from being executed or an action from being performed.

KVC - Acronym for "Kinematic Verification Check," a software routine that can verify that the intended automatic sequence will not encounter "kinematic obstacles" when the robot is commanded along the automatic sequence trajectory.

Load – Used as a command button label on a button used for sending data for a template command to a buffer prior to the command being sent (a second step is required for command execution - see "Set").

Limit-Sensed Parameters - Parameters whose values are monitored by computer software that compares the current value of the parameter with upper- and/or lower- allowable limits, or boolean logicals; violations of these limits are brought to the attention of the operator.

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Manual – Requires human involvement.

Manual Jog - Moving a robot/payload one axis at a time. For example, translating in the X-direction, then in the Y-direction, then rotating in pitch, rather than in all three at once. (ERA does not have hand controllers that allow multi-direction commands.)

Missing - Parameter not found in dictionary, or not being published if in dictionary.

Mode – 1. Primarily used in terms of software configuration at the system level or above.
2. Robotic systems can be controlled by a variety of inputs and can move in a variety of ways. For example, the operator may control robot motion with hand controllers or single switches, and the robot may move in an all-joint-coordinated fashion, a single-joint-at-a-time fashion, change just the pitch joint plane, etc. A “mode”, or “mode of operation,” designates the type of input required by the operator and the type of motion output by the robotic system. For example, the SSRMS has a mode called the “FOR Auto” mode. It requires the operator to select the automatic sequence to be used and to press the “proceed” button on the DCP. The robot, in response, will move the FOR through a series of all-joint-coordinated points.

Module – A single structural element that provides significant additional functionality to the station. Usually contains multiple systems and may be pressurized or unpressurized. Examples include FGB, SM, Node 1, Node 2, and SO Truss.

Nominal - In normal range and status is nominal

OCAS - Acronym for “Operator Commanded Automatic Sequence,” a two point auto sequence; the start point is the robot’s current position, and the last point is operator-definable via display input.

Out of limits indeterminate - Value outside nominal range.

Out of limits high - Parameter value greater than upper limit of nominal range.

Out of limits low - Parameter value less than lower limit of nominal range.

Off-scale low - Parameter value less than sensor range.

Off-scale high - Parameter value greater than sensor range.

Operator - The person who closes the loop in the robotic control system.

Part – The individual pieces that are assembled together to form a block. Examples include a single valve, a controller card, a pump, latch, etc.

Pause - Used when an operation is to be either nominally or off-nominally stopped or canceled and may be resumed from that point in the process.

Primary/Backup – Used when referring to the logical state or designation of equipment where only one can be logically selected as the Primary and all others selected as backup. In the case where the backup is running in a powered state, it can be referred to as "Hot" backup and when it is not powered or not receiving supporting data from the Primary equipment such that it can

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immediately begin to assume the Primary Functions it is referred to as "Cold" backup. Exceptions are: For the Node 1 MDMs, one is considered Primary and the other is considered Secondary. For the C&C MDMs, one is considered Primary, another Backup and the third is Standby.

Relocatable - A term to signify that an automatic sequence can be performed from more than one robot base location.

RSAD - Acronym for "Robotic Situational Awareness Displays," a suite of displays providing the operator with predictive displays, hand controller steering displays, single joint drive assistant displays, "bird's-eye-view" displays, etc.

Segment – A number of modules that can be logically grouped together by form, function, or program responsibility. Examples include the Russian segment and the American segment.

Set – Used as a Command button label for a button used to send a template command.

SODF - Acronym for "Systems Operations Data File," the collection of U.S. System ODF procedures and reference information. An ODF procedure is a set of instructions used by the onboard crew, ground controllers, and the on-orbit procedures executor software to fulfill tasks needed to operate and maintain station systems, payloads, and attached vehicles under both nominal and off-nominal conditions.

State – The physical configuration (On/Off, Open/Close, etc.) at the subsystem level or below.

Station - A group of segments (or modules) that are combined to form a complete orbital complex.

Stale - Parameter Data not being updated. Usually associated with LOS.

Status – A qualitative assessment of the overall condition or health of the system at any level.

Stop - Used specifically with hardware and is defined as the cessation of motion in moving parts (hardware). E.g., a mechanism is commanded to "stop." For payloads, 'stop' should be generally used in cases where there is a pair of buttons labeled 'start' and 'stop' (e.g., a search that you might want to stop as soon as you found the file of interest.) Definition under review.

Subsystem – A collection of blocks that work together to perform a function within a system. One example is the fire detection and suppression components of ECLSS.

Super-System – An organization that includes the orbital station, other space vehicles, and ground facilities.

System – A collection of components that perform unique functions supporting activities in a module, segment, or in the entire station. Some systems may interface across the larger super-system. Examples include the electrical power system (EPS), the thermal control system (TCS), etc. (was "subsystem" in previous designations). NASDA uses subsystems to express "system." For example, "EPS" on SLT, "MA" and "SFA" on RLT are subsystems.

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Telerobot - A robotic system controlled from a remote location. ISS external robots are controlled remotely from workstations located inside the modules.

Terminate - Used when an operation is to be either nominally or off-nominally stopped or canceled and will result in the operation having to restart from the beginning. E.g., software routines may be terminated.

Quick Pick List - A pull down menu that allows the operator to select from a predefined list the desired value instead of entering it manually.

Vernier - A rate slower than coarse rate. Selected to ensure that when the brakes are applied the robot and payload will stop before hitting structure or an obstacle.

Widget – A widget is a user display object, e.g., a Pushbutton or Menubar. It represents a block of program code (a library function) that is grouped together to provide a single-user interface abstraction. The term is associated with X-Windows. (MSFC-STD-1956, Huntsville Operations Support Center Common User Interface Standard, page A-23, 3/95)

APPENDIX B

COLORS

B.1 GENERAL PRINCIPLES AND RATIONALE. Colors should be used sparingly. Use of color shall be limited to a set of well chosen colors. The identified colors shall be used repetitively to maintain consistency across content areas and across displays. Colors should not be used as the sole means of identification of a part or subsystem.

B.2 COLOR STANDARDS. The color standards and definitions have been extracted from many several industry and government standards documents as listed in Section 2.0. A specific exception is the use of industry standard hazardous materials (Haz-Mat) coding and color affiliations which were not deemed pertinent as compared to existing display and drawing accepted color coding. An example is the use of Haz-Mat red for flammable material while display conventions use red to indicate an alarm message or parameter limit violation indicative of an emergency condition, warning, or danger. Colors are chosen from the X-Windows palette and are referenced by the Red- Green –Blue (RGB) values for each color identified. The following guidelines shall be adhered to when using color for the ISS graphics.

- a) Colors shall not be used as the sole means of identification of a status of a part or subsystem. Information on the event or element status shall be redundant, using either labels or other graphical change. Video overlays are not governed by this rule.
- b) Colors used for object identification shall be fully redundant, colors used for object comparison shall be at least partially redundant, colors shall be non-redundant for video applications only.
- b) Colors shall be used only to convey meaning and will not be used for decoration or aesthetic purposes.
- c) When assigning color to an object, the minimum size of that object shall be 0.02391 inches in both the x and y directions.
- d) The default background color for all displays shall be gray(Which gray?).
- e) Colored objects shall not be displayed over filled areas using the same color.
- g) f) Objects colored with highly saturated colors shall not be placed within close proximity one inch of one another. The side by side color combinations to avoid are TBS as follows:
 - h) Red/Green
 - i) Red/Blue
 - j) Yellow/Blue
 - k) Yellow/Magenta
 - l) Green/Blue(All power icons have this combo)
- g) g) Color assignments shall not conflict with standard associations.

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- h) No more than nine colors, including white and black, excluding shading, shall be used for any one display. Optimum use should be limited to five or fewer colors.

NASDA Colors. Some displays of SLT and RLT have more than nine colors.

- h) An important factor to consider when selecting colors is the contrast among colors. This is needed to ensure that each color is easily discriminated from the others. Although contrast is an important consideration, it should not be used without regard to other important factors such as convention or standard, inherent meaning and consistency across displays. The color selections below were also evaluated for shades of gray discrimination for B/W printouts.

NASDA Colors. On SLT, the same label of fluid and gases are displayed outside of the pipe and some are not displayed.

- i) The following colors are reserved:
1. Red (255, 0, 0) (255,0,0) is reserved for indicating an alarm message or parameter limit violation indicative of an emergency condition. Other colors must be at least 30 point radial distance from red.
 2. Yellow (255, 255, 0)(255,255,0) is reserved for indicating an alarm message or parameter limit violation indicative of a caution condition except for the attention symbol. Other colors must be at least 30 point radial distance from yellow.
- j) The following colors and definitions in Table B-1 have been assigned for the specific applications as defined below. The RGB values are provided to ensure exact definition of the color and shade intended for these applications.
- k) Color usage for Training Graphics
Color usage guidelines for training graphics are defined in Appendix J.

At a minimum, the following rules shall apply.

1. Color usage should be consistent between displays and training graphics.
 2. Each training schematic shall include a legend showing color usage.
 3. Color usage should be consistent within each schematic.
 4. Where possible, color usage should be consistent across the entire ISS Program.
- l) **Training Graphics** - While the use of colors for graphical products will adhere as much as possible to the color standards, these standards are not as strict. For training graphics, all colors may be used without restrictions, except for Red - 255, 0, 0, [Green - 0, 255, 0](Why is green restricted?), and Yellow - 255, 255, 0 which are to be used for Caution and Warning.

Training products will use a legend on each drawing to avoid any confusion about what each color on each drawing is being used for. Within each ISS System, the use of colors on training graphic products will be consistent. However, across different ISS Systems there are not enough colors available to avoid duplication of color usage or follow the color codes in this appendix.

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Color	Color	R	G	B	Meaning
Aquamarine, Med		102	205	170	Under Review - Air , RASA uses white
Bisque 3		205	183	158	Agree - Ammonia
Black		0	0	0	Agree - Text, labels, borders, symbols, titles, and generally unrestricted. Used for indicating the power-off state (see section 4.17) of the respective ORU. Also used to represent Vacuum
Blue 4		0	0	139	Under Review - Caution and Warning toolbar background, NASDA will verify
Blue, Dodger		30	144	255	Under Review - Used for indicating the nominal operational status (see section 4.17) of the respective ORU. Also used to indicate the active condition of a line. RASA will verify
Blue, Light		173	216	230	Used to represent Polymethyl Siloxane on Russian Displays (Can we pick Light Blue for a non-toxic generic coolant?)
Blue, Light		173	216	230	Freon (Can we pick one of these three colors for freon based coolant?) Also used as fill color for the Solar Arrays to distinguish them from background
Blue, Royal		65	105	225	Agree - Water
Brown		165	42	42	Agree - Generic Toxic coolant; e.g., Ethylene Glycol
Brown, Sandy		244	164	96	Agree - Nitrogen (Tetroxide?)(Can we use this just for N2 and dark green for oxidizer for N2O4?)
Cyan		0	255	255	Under Review - Used to indicate the parameter in question is unknown within the PCS application (PUI is invalid) or PCS has not received data from the ISP. Also used to indicate that the PCS connection to the MDM has been lost. Crews reported hard to differentiate between other blues. Crew to propose. NASDA wants to use Cyan.
Gray , Light		211	211	211	Agree - Used primarily in ground based simulators and trainers as a background color meaning unavailable or inactive within the simulation, background
Gray 51		130	130	130	Under Review - Baselayer module color
Gray 67		171	171	171	Under Review - Subsection background to distinguish the subsection from the rest of the display. Also used to indicate the non-active status of a device (See section 4.17)
Gray 83		212	212	212	Under Review - Window background and navigation button color
Green		0	255	0	Agree - Generally means good/nominal status. Used for indicating power-on state of the respective ORU or as an aliveness indication for RPCMs, used for ready-to-latch indicators for when the latch is within the latching envelope.
Green, Dark		0	105	0	Agree - Oxidizer other than oxygen
Green 4		0	139	0	Under Review - Oxygen

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Green, Light (also called palegreen 2)		144	238	144	Agree - Helium
Magenta		255	0	255	Agree - Ionizing Radiation
Olive Drab		107	142	35	Agree - Mixed gas & liquid
Orange		255	165	0	Agree - Used to draw operators attention to an important condition, but not critical, for the user to be aware of. Such as advisory annunciation; alerting the operator to the fact that there are currently, hazardous moving parts, payload alerts. Also used to represent Hydrogen
Orchid, Dark		153	50	204	Used primarily in ground based simulators and trainers as a background color indicating which malfunctions are active within the simulation
Pink		255	192	203	Used to represent Triol on Russian Displays(Can we not use a generic coolant color for this(after we pick one)?)
Pink, Hot		255	105	180	Hydrazine
Pink, Light		255	182	193	FC40 Coolant (Can we pick one of these three colors for freon based coolant?)
Plum		221	160	221	Carbon dioxide
Purple		160	32	240	Missing, dead, invalid, or Commfault status condition (the PCS connection to the MDM has been lost.)
Red		255	0	0	Used as background color for icons and data output fields for Emergency or warning conditions annunciated by the Emergency, Caution and Warning System. Also used to indicate Off scale high/low or out of critical limits status indicators(Red H or L next to out of limits values in data output fields).
Violet		238	130	238	FC72 Coolant(Can we pick one of these three colors for freon based coolant?)
White		255	255	255	Background color fill for nominal state data output fields, and text on red and black fields
Yellow		255	255	0	Used as background color for icons and data output fields for Caution conditions annunciated by the Emergency, Caution and Warning System. Also used in the Caution or Attention symbol: out of operational limits status indicator

Table B-1 Colors

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APPENDIX C

ICONS and GRAPHIC SYMBOLS

C.1 GENERAL PRINCIPLES AND RATIONALE

The following guidelines should be used when developing or using icons and symbols. Detailed requirements for Icon and Symbol development are defined in Section 7.

Icons will be simple, clear, easy to understand symbols.

Icons can be used simply as a symbol of an object or function that cannot be manipulated or as a symbol on which the user can directly act (e.g., selecting the icon to open or move applications or files.)

Icons representing components with directional implication (e.g., a blowing fan, a thruster) on schematic displays can be rotated in order to show the correct direction of action or flow. Conversely, icons used in a schematic drawing or display implying direction of flow or action shall be placed properly to reflect the direction of flow.

An icon can change in shape and color over time if, without adding complexity to the symbol, that change adds useful information to the user in an intuitive manner.

The object or action that the icon represents should be visible in the icon. This guideline has two implications: (1) the size of the icon should be large enough for the user to perceive the representation and discriminate it from other icons, and (2) the representation should be pictographic whenever possible.

To the greatest extent possible, icons should be accompanied by a text label, especially when the icons do not closely resemble the symbolized object or action.

To the extent that it does not clutter or cause distortion of the icon, icon labels should be incorporated into the icon itself.

Icons and graphical symbols depicted in these tables may be used in mirror image or rotated in any direction. Graphic symbols may be scaled up or down.

Icons for specific applications that are not defined in Appendix C can be defined by the user. They must, however, comply with the generic standards set forth in Appendix C and should not conflict with current icons.

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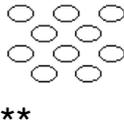
C.1.1 Icon Family Legend

The following legend of letters (Code Number) identifies the families to which each icon belongs;

C = Communication
 E = Electrical
 F = Fluids
 G = Generic
 K = Computers
 L = Logic
 M = Mechanical
 S = Sensors
 NE = New Events
 NM = New Modes
 NS = New Station
 NY = New Systems
 R = Robotics

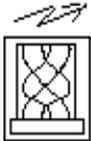
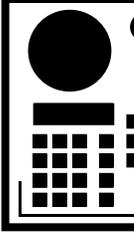
C.2 DISPLAY ICONS AND GRAPHIC SYMBOLS

C.2.1 Communication

English Name	Russian Name	Icon	Schematic	Comments	In use	Code Number
Antenna, Phase Array						C1
Antenna, Dish/ Parabolic	Параболичес .упр. антенна					C2
Antenna, Dipole	Дипольная антенна					C3

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Antenna, GPS			This symbol represents a GPS antenna and its electronics. The triangle represents the antenna portion of the ORU and the box represents the electronics package of the ORU.	 **	C4
Antenna, Helix					C24
Antenna, Horn					C5
Antenna, Horn, Stearable			(ISS S-Band High Gain) Icon signifies international symbol for a steerable horn antenna.	 **	C6
Antenna, Omni-Directional			(ISS S-Band Low Gain)	 **	C7
Audio Terminal Unit (ATU)			**	This symbol represents the Audio Terminal Unit used on the ISS. The symbol is based on the control panel of the ATU.	 C25
Automatic Frequency Control			Icon signifies international symbol for automatic frequency control.		C8

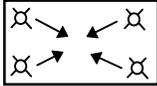
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Band-Pass Filter			Icon signifies international symbol for a band-pass filter.		C9
Band-Pass Filter with Variable Center Frequency			Icon signifies international symbol for a band-pass filter with variable center frequency.		C10
Band-Pass Filter with Variable Pass-Band, Selectivity Control			Icon signifies international symbol for a band-pass filter with variable pass-band with selectivity control.		C11
Band-Stop Filter			Icon signifies international symbol for a band-stop filter.		C12
Band-Stop Filter, Variable			Icon signifies international symbol for a band-stop filter with variable control.		C13
Fiber Optic			Icon signifies international symbol for fiber optics.		C14 C26
Frequency Multiplier					C29
Frequency Divider					

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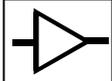
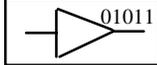
GPS Receiver				Icon symbolizes "triangulation" for position from signals from 4 satellites. GLONASS receiver, Global Navigation System similar to GPS.		C27
Harmonic Generator				Icon signifies international symbol for a harmonic generator.		C28
Headset				Icon signifies international symbol for a headset.		C15
High-Pass Filter				Icon signifies international symbol for a high-pass filter.		C16
Antenna, Kurs				Kurs radar docking system antenna Looks like a Kurs antenna.		C17
Matching Unit				Shows an interface for lower level sensors and systems that run on non-1553 protocol to convert to 1553 protocol. Heavy exterior outline with dashed internal lines symbolize 3 channel nature of devices, with a special communication link between the three units that is not dependent upon exterior 1553 connections.		C31 Under review
Microphone				Icon signifies international symbol for a microphone.		C18
Recorder						C32 Under review
Single Strength Attenuator				Icon signifies international symbol for a single strength attenuator.		C19
Speaker	Динамик			Icon signifies international symbol for a speaker.		C20 Under review

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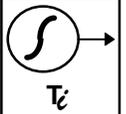
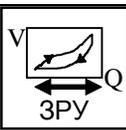
Video Camera, Fixed Mount	Камера			Also Camcorder	  CSA Deviatio n**  or 	C21 M31
Video Tape Recorder (VTR)	Видео Магнитофон					C22
Audio Tape Recorder	Аудио Магнитофон					C23 Under review

C.2.2 Electrical

English Name	Russian Name	Icon	Schematic	Comments	In use	Code Number
Alternating Current	Переменный ток			Icon signifies international symbol for alternating current.		E1
Amplifier				Icon signifies international symbol for an amplifier.	 **	E2
Amplifier - Converter				Icon symbolizes amplifier and encoder.		E39

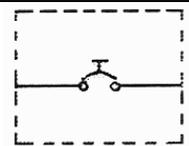
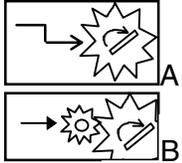
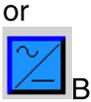
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Battery, generic	Батарея			Batteries are depicted with this symbol. When possible the leads will be shown vertical. The large line indicates the positive terminal of the battery. Icon signifies international symbol for a battery.	 **	E3
Battery, Cell, ISS Pressurized				This symbol represents a pressurized single battery cell used on the ISS. MOD Standard symbol for a pressurized ISS battery cell. The boundary indicates that it is a pressurized vessel and not a free-breathing battery.		E40
Battery, Storage				Icon symbolizes battery circuit symbol.		E41
Bus, Electrical, Complete Return				This symbol designates a complete negative return electrical bus. MOD standard symbol for a complete negative return electrical bus. The rectangle indicates it is a complete bus and the RTN indicates return.		E44
Bus, Electrical, Portion				This symbol designates an incomplete electrical bus. The remainder of the bus is shown in other places. MOD standard symbol for an electrical bus.		E45
Charger				Icon too similar to Signal Generator. Needs redesign.		E4 Under review
Charge/Discharge Current Integrator				Symbol represents current being measured and integrated over time.		E46
Charge/Discharge Unit				Icon symbolizes the charging cycles (charging/discharging) of the battery.		E46

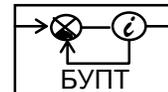
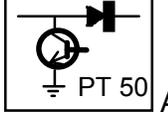
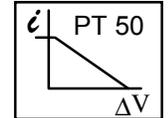
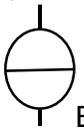
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Circuit Breaker				Icon signifies international symbol for a circuit breaker.		E5
Coil	Катушка			Icon signifies international symbol for a coil.		E6
Communications Unit				Icon symbolizes interface from crew input command to solar array orientation system. Command given to rotate solar array drive motor.		E48A E48B
Connectors			<p>a)  A</p> <p>b)  B</p> <p>c)  C</p> <p>d)  D</p> 	<p>A) Male connector B) Female connector C) De-matable connector D) Permanent connection</p>		E43A E43B E43C E43D E49
Control Rectifier Diode				Icon signifies international symbol for a control rectifier diode. Original ESA input is also the international standard. This icon will be fixed before printing.		E7
Converter, AC/DC	Преобразов. Пер./Пост.	 A or  B		Icon signifies international symbol for an AC/DC converter.	Add ESA deviation	E8A E8B

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Converter, DC to DC	Преобразов. Пост./Пост.	 A or  B			Add ESA deviation	E9A E9B E50
Current Converter Controller				Icon symbolizes the function of the unit to monitor the current and the feedback control to the system.		E52
Current Regulator			 A  B	First icon symbolizes transistor and diode contained within the unit. These components work as a switching function to regulate the solar array output voltage. The second icon is taken from the EPS drawing from the MIR EPS for the same unit. –but the icon is not totally understood.		E53A E53B
Current Source			 A or  B	This symbol represents a current-regulated power supply. The arrow should always point up. MOD Drawing Standard for a current source		E54A E54B
Dangerous Voltage	Опасное напряжение			Icon signifies international symbol for dangerous voltage.	 NASA/ESA deviation**	E10
Current Ideal Source						E55

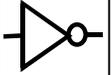
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Current Stabilizer				Symbolizes purpose of unit which is charging batteries for transport vehicles. Unit not fully understood. Maybe a better icon.		E56
Direct Current	Постоянный ток			Icon signifies international symbol for direct current.	Add ESA Deviation	E11
Filter Unit, Electrical				Icon symbolizes a filter (capacitor).		E57
Fuse			 A or B			E58A E58B
Lamp Light Assembly					 **	E12
Field Effect Transistor	Полевой транзистор			Icon signifies international symbol for a field effect transistor.		E13
Fixed Capacitor						E14
Fluorescent Light						E15
Fuse with LED indicator						E59
Ground, Earth	Заземление			Icon signifies international symbol for an earth ground.		E60

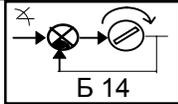
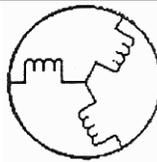
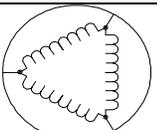
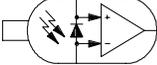
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Ground, Frame	Корпус или шасси		Icon signifies international symbol for a frame or chassis ground.		E61
Heater	Нагреватель электрич.	 A or  B	Heaters are designated using the standard heater icon. Heaters are enabled or disabled. Icon signifies international symbol for a heater. Resistance heater was chosen over heater icon currently. ROS: All USOS: TCCS, CDRA	Add ESA and NASDA deviation	E16A E16B Action: Develop new icon.
Inverter	Инвертор		Icon signifies international symbol for an inverter.		E17
Lamp, Lighting,				 ** Light(GLA)  **	E18
Lamp, Indicator	Лампа				E19
Light Emitting Diode (LED)			Icon signifies international symbol for a light emitting diode (LED).	Add ESA deviation	E20

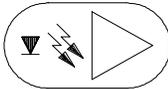
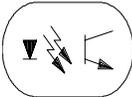
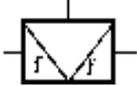
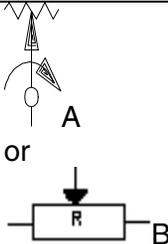
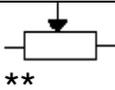
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Baseline

					n	
Light, Indicator, Status						E62
Logic and Control Unit				Icon symbolizes the function of the unit. It calculates the delta between where the sun is and where the arrays are and sends commands to the motor drive unit to rotate the array.		E63
Metal Oxide Semiconductor Field Effector Transistor			 A or  B			E88A E88B
Motor	Мотор			A motor driven system is depicted with this icon. Icon signifies any motor driven system.		E21
Motor, Three phase, AC				Icon signifies international symbol for a three phase AC motor.		E64
Motor, Three phase, Brushless, DC				Icon signifies international symbol for a three phase brushless DC motor.		E65
Optical Combiner						E67
Optical Receiver						E68
Optical Splitter						E69
Optical Transmitter						E70

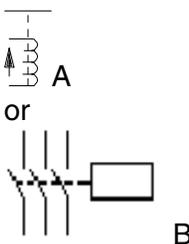
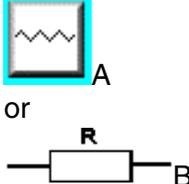
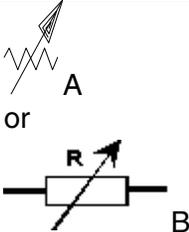
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Opti-Coupler with Amplifier						E71
Opti-Coupler with Transistor						E72
Phase Detector	Фазовый детектор					E22 E73
Polarized Capacitor						E74A E74B
Photodiode				Icon signifies international symbol for a photodiode.		E23
Potentiometer						E75A E75B
Power source, Electrical, Single solar cell						E24
Push-button,						E25A

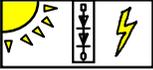
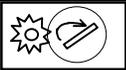
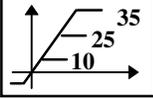
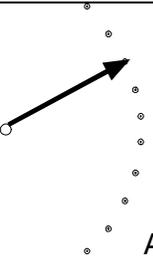
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Baseline

						
Push-button, Momentary, Off						E26
Push-button, Three Contact						E27
Push-button, Three contact, Momentary						E28
Rectifier, General						E76
Remote Bus Isolator						E77A E77B
Resistor				Icon signifies international symbol for a resistor.	 **	E78A E78B
Resistor, Variable					 **	E79A E79B

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Signal Amplifier				Icon symbolizes amplifier. Standard electronic symbol for amplifier.		E80
Solar Array				The icon symbolizes the photovoltaic cells (diodes) of the array. It also portrays the function the array performs which is converting solar energy into electrical energy,	 **	E81
Solar Array Drive				Icon represents the motor drive to rotate the array.		E82
Spotlight					Add Robotics deviation (R4)  Light VLU	E29
Static (data) Converter				Icon symbolizes the unit converting voltage to 3 phase for the motor.		E83
Storage Battery Current Converter				Icon symbolizes the various charging currents the unit uses to charge the battery.		E84
Sun Sensor				Icon symbolizes Sun in field of view of sensor. Slits in sensor represent physical and functional characteristics of the sensor.	Move to sensors	E85
Switch, Multipole						E86A

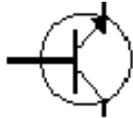
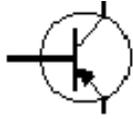
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Switch, Open		get icon 		The switch icon is used to denote a switch is open. The switch icon may be placed within a button to indicate that more detailed data and commands may be accessed by selecting the switch.	NASDA does not have contacts on switch	E30
Switch, Closed	Ключ замкнут	get icon 		The switch icon is used to denote a switch is closed.	 ** NASDA does not have contacts on switch	E31
Switch, Manual, Contact/ Momentary						E32
Switch, Manual, Latching contact				Dots indicate latching. 		E33
Switch, Manual, Momentary, Dual Control				Triangles indicate momentary.		E34
Thermistor						E87
Transformer (Power Converter)				Also Power Converter. Power converters are depicted with this symbol. Icon signifies international symbol for a transformer. Converters are considered to be "On" or "Off" in		E35

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				their operation.		
Transformer, RF	Трансформатор					E36
Transistor, NPN, or PNP	Транзистор	 A or  B NPN  C PNP		Icon signifies international symbol for a NPN or PNP transistor.		E89A E89B E89C
Utility Outlet				Util Out is a class that draws a Utility Output socket, a ring with 7 holes inside. Note: recommended minimum diameter of 30.		E37
Variable Inductor				Icon signifies international symbol for a variable inductor.		E38
Wire/Cable, connecting				Graphics that display lines, etc., that connect shall be shown with a circle at the intersection. The circle should have the same fill color as the line or pipe.		E90
Wire/Cable, crossing				Wires are shown as straight, thin black lines. Graphic images of lines that cross shall be shown as images that overlap. Multiple wires may be bundled as cables to prevent clutter on the display.		E91
Zener Diode				Icon signifies international symbol for a Zener diode.		E92

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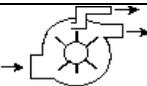
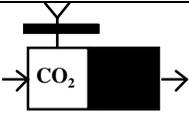
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Baseline

C.2.3 Fluid

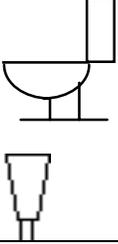
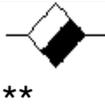
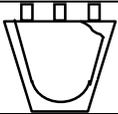
Pipes are shown as thick lines filled with the appropriate color or name to indicate the fluid within the pipe. Graphics that display lines that connect shall be shown with a circle at the intersection, which is four pixels larger than the line, and have the same fill color as the line or pipe:

○ □ ▽

English Name	Russian Name	Icon	Schematic	Comments	In use	Code Number
Accumulator	Аккумулятор	 A or  B		Accumulators contain two separated fluids. Accumulators may be shown using the tank icon. The accumulator icon should indicate both fluids, separated by a bladder. Any associated quantity measurements should be shown in text format only, or with a separate bar meter.	Add NASDA deviation	F1A F1B
Air/Water Separator		 Add F137B		Separator takes water and separates it into a water and an air line. Icon signifies a motor driven separator that takes one line and separates it into two lines.	Add NASDA deviation	F2
Bellows Tank				USOS: Condensate Water Tank		F3
Blower				Blower indicates air circulation. Icon signifies international symbol for a blower.		F4
Burst Diaphragm				Icon signifies international symbol for a burst diaphragm.		F5
Carbon Dioxide Removal Assembly (CDRA) and Vozdukh				The bed which removes the carbon dioxide is regenerated by exposing it to vacuum. ROS: Воздух		F102

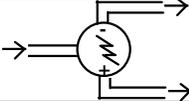
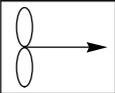
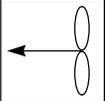
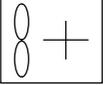
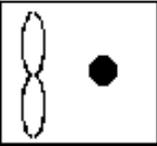
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Choke, Flow Restrictor	Дроссель			Allows a fluid to go through a small area and reduce speed. Icon signifies a line and the way that it is collapsed in. Depicts cross section of line with reduced radius.		F6
Commode/Urinal				A single icon was selected for the commode and urinal since the units are co-located. ROS: ACY Icon signifies what the urinal looks like. Used for fluid waste. ROS: Urinal		F95 F125
Compensator						F96
Compressor	Компрессор			A motor driven compressor used to compress a fluid. Icon signifies a motor driven system with the international abbreviation for compressor.	 11/8/99 RASA	F7
Condensation Collector				Used to collect condensate from the air or the systems.	 **	F97
Diaphragm Pump						F8
Diffuser, Out				Takes air from a line and diffuses it out into the area. Icon signifies the scattering into different directions		F9
Diffuser, with filter				Takes a fluid in to a system from different areas and puts it into a filter to block the possible contaminants. Icon signifies the filter and the fluid coming in from different areas.		F10
EDV tank				This symbol shows generic shape of tank and the three inlet/outlets. Icon signifies the lines coming in and out and the three quick disconnects that can be used. Tank is used to		F99

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				that can be used. Tank is used to store water and then the water can be used from the EDV. The CWCs fill the EDVs. ROS: ЕДВ		
Electric Conductivity Sensor	Датчик электропроводности					F11
Electrolyzer	Электролизер					F12
Elektron/Electrolysis Unit				This illustrates the breakdown of water, by electrical means, into H2 and O2. ROS: Электрон		F100
Fan, Animated	Вентилятор			Used to circulate air in an area. Icon signifies the fan blades and also the major housing.		F13
Fan, Right direction of flow				To have air go to the right of the fan. Icon signifies the right arrow to show the direction of flow.	Add NASDA deviation	F14
Fan, Left direction of flow				To have air go to the left of the fan. Icon signifies the left arrow to show the direction of flow.	Add NASDA deviation	F15
Fan, Inward direction of flow				To have air go into the page or inward to the fan. Icon signifies the fan and the international symbol for inward.		F16
Fan, Outward direction of flow				To have air go out of the page or outward of the fan. Icon signifies the fan and the international symbol for outward.		F17
Fan, Down direction of flow						F18

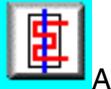
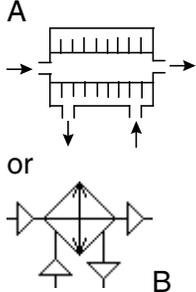
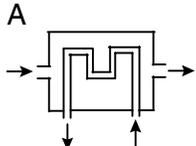
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Fan, Up						F19
Fire Extinguisher				To be used in Fire Suppression. Icon signifies a basic look of what the CO2 tank looks like.		F20
Filter	Фильтр	 (fine) A  B (coarse)		Used to take away contaminants in a system. Filters dust and debris. Icon signifies the crosses of a filter. This type of filter removes particulates. USOS: HEPA, MCA filters	 **  ** Add NASDA deviation	F21A F21B
Filter, Gaseous Contaminants				Shading of box after filter is less dense, illustrating the removal of contaminants. ROS: ФВП, БМП USOS: TCCS		F104
Filter, H2O (desiccant)				Shading of box after filter is less dense, illustrating the removal of humidity (water). ROS: Воздух USOS: CDRA		F105
Flex Hose (Corrugated)				A line that is used where a hard line can not be used or where you will have to stow the line. Icon signifies the line and then the flex of the line. Physically resembles a flexible hose ROS: Ventilation equipment USOS: Connections between vestibules		F22
Flow Indicator	Индикатор сквозняка			Indicates the way that the flow of the fluid is going. Icon indicates an arrow in the direction of flow.		F23 Action: Develop new icon.
Flowmeter, Heat transfer agent	Датчик расхода теплоносителя				Add NASDA Deviation	F24 Action:

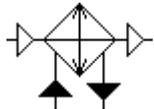
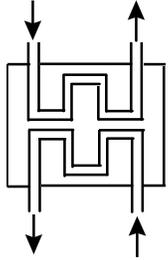
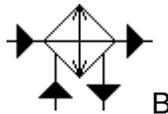
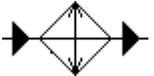
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	л				n	Develop new icon.
Fluid Coil				Tube, maybe even flexible tube, that can be three dimensional.		F25
Gas Analyzer (general)	Газоанализатор			ROS: ГА USOS: MCA		F26
Heat Exchanger	Теплообменник			Heat Exchangers are used throughout the Thermal Control System to effect heat interchange between internal water coolant loops and external ammonia coolant loops. The icon shows the loops involved in the heat transfer passing through a box representing the heat exchanger exterior. Generally, one loop is shown criss-crossing the other, indicating the multiple thermal interfaces between the loops. There is no attempt to represent the actual number of passes involved. The entry and exit points of each loop at the box boundary can be varied as needed. The use of flow direction arrows can further be used to depict the heat exchanger as counterflow or parallel flow type.		F27A
Heat Exchanger, Air-Air				Typical of finned heat exchanger. ROS: Воздух/ГЖТА		F28A F28B
Heat Exchanger, Air-Liquid				ROS: Воздух/ГЖТА USOS: AAA		F29A F29B

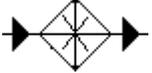
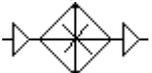
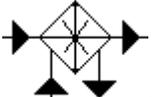
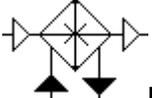
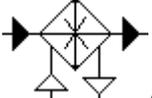
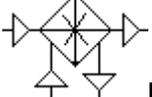
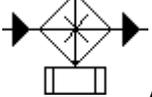
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		<p>or B</p> 			
Heat Exchanger, Air-Liquid (condensing)		A		Same as regular Air-Liquid Heat Exchanger, but drops of liquid represent condensing function. USOS: CCAA	F30A
Heat-Exchanger, Liquid-Liquid		<p>A</p>  <p>or</p>  <p>B</p>			F31A F31B
Heat Exchanger Unit with natural cooling			 <p>A</p> <p>for liquid</p>  <p>B</p>		F107A F107B

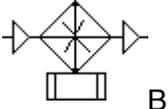
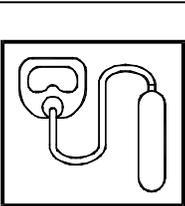
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			for air (gas)			
Heat Exchanger with natural heating			 <p>A</p> <p>for liquid</p>  <p>B</p> <p>for air (gas)</p>			F108A F108B
Heat Exchanger with forced heating by liquid			 <p>A</p> <p>for liquid</p>  <p>B</p> <p>for air (gas)</p>			F109A F109B
Heat Exchanger with forced heating by air (gas)			 <p>A</p> <p>for liquid</p>  <p>B</p> <p>for air (gas)</p>			F110A F110B
Heat Exchanger with forced heating by electric current			 <p>A</p> <p>for liquid</p>			F111A F111B

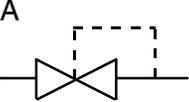
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			 for air (gas)			
Heat Pipe	Тепловые трубы					F32
Inlet				As a fluid come from different directions into one system. Icon indicates the flow from different directions converging on one system.		F33
In/Out				A fluid can either come in or out of the system. Icon indicates that the flow can be either coming in or dispersing out.		F34
Ionator						F35
Liquid Flow Regulator	Регулятор расход. жидк			Icon signifies one line going into two lines. Icon indicates that the flow can be either coming in or dispersing out.		F36
Metal Bellows Sleeve or Flex Hose, Generic	Металлорука сильфонный			Icon indicates the bellows that would be in the system. A Bellows will slow down the flow of the fluid.		F37
Outlet				A fluid is dispersed into a larger area. Icon signifies the arrows that are going into the different directions.		F38
Pipes				Pipes creates and draws pipes connected in an acrylic graph. Pipes can be used in segments to indicate piping is required		F39
Portable Breathing Apparatus	Противогаз			This icon was copied from one of the NASA ECLSS level 1B drawings and represents the actual equipment. Used for when the air is not suitable for crew breathing. Icon indicates what the Portable Breathing Apparatus looks like. Gas mask tied to oxygen bottle.		F40

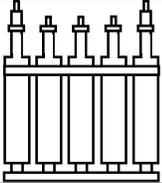
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Pressure Differential Sensor	Датчик перепада давления					F41
Pressure Regulator	Регулятор давления	A  or B 		Icon shows the regulator of a line. Regulates the pressure of a line.		F42A F42B Action: Develop new icon.
Pressure Relay				This symbol is currently used in Russian schematics. It is a good physical representation of the actual device		F118
Pressure Sensor, Low Pressure Warning Indicator	Сигнализатор давления					F43
Pressure Sensor Unit						F121
Pump	Насос			All pumps are indicated with this icon. An arrow may be used to indicate flow direction. Electrically driven pump assembly		F44 F119
Pump, Centrifugal	Насос			Straight lines were chosen because they are less likely than curved lines to be drawn incorrectly. Flow direction can be inferred from position of inlet and outlet.		F45
Pump, Centrifugal, Animated	Насос					F46

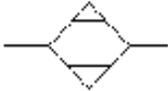
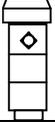
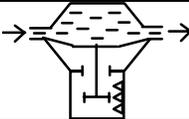
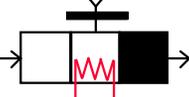
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Pump, Condensation Evacuation	Насос откачки конденсата					F47
Pump, Positive Displacement	Насос			USOS: CDRA		F48
Pump, Manual	Насос ручной					F49
Purification Column Unit	БКО			This is a special device used in the ÑÐÀ-Ê. Its functionality cannot be represented by any of the standard valve symbols. This icon is physically representative of actual hardware. ROS: CPB-K		F120
Quick Disconnect				Represents both halves of the quick disconnect. No ball bearing indicates not self-sealing.		F50
Quick Disconnect, Self Sealing	Быстроразъемное соедин.			Represents both halves of the quick disconnect. (Russian icon) Circle is physically representative of bearing inside that blocks flow.	 *	F51
Radiation Heat Exchanger	Радиацион. теплообмен.					F52
Radiator, Coil Pipe	Змеевик Радиатор			Fluid pipe; two-dimensional heat transfer device.	 **	F53
Receiver, Chamber	Ресивер					F54
Reductor	Редуктор					F55 Action: Develop new icon.
Refueling Device	Заправочное приспособл ен					F56

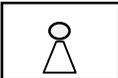
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Regenerator						F98
Sealed Connector						F57
Screen, Debris						F58
Solid Fuel Oxygen Generator	ТГК			The solid fuel oxygen generator has a characteristic shape. The major crew interface is the handle on the front. ROS: ТГК		F122
Tank				Tanks are depicted as circles or ellipses filled with the appropriate color to indicate the fluid contained. Tanks may behave like bar meters, filling from the bottom to indicate tank quantity or pressure. In this case, the minimum and maximum quantity values should be labeled (similar to bar meter labeling).		F59
Tank, animated fluid level	Бак. емкость					F60
Tank, Bellows				The Bellows of a tank is used to reduce the moving of the fluid. Icon indicates a tank with a bellows located within.		F61
Tank, Buffer or Diaphragm				This symbol is currently used in Russian drawings. The USOS has no. ROS: СРВ-К/БРПК/МН, and Электрон/БЕ		F123
Tank, Spherical	Бак			The tank is depicted as a spherical tank. Icon signifies a sphere and also a tank.		F62
TCCS	БМП			БМП and TCCS have three filtering stages which are represented by the three boxes. The second stage of the АИИ is regenerable, using heat and vacuum as stimuli. The TCCS second stage is also regenerable, but is not		F106

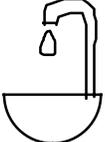
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				exposed to vacuum. Indicates cold plate.		F63
Thermal Plate	Термоплата					
Thruster, Attitude Control	Двигатель ориентации	 A or  B		Typical symbols for a thruster nozzle. For Energia symbol, assumption was that arrow indicated gimbaling nature of Main Engines, versus fixed attitude control thruster. Crew input was that the big heavy arrow of the GTC/DT icon symbolized the prime function of such engines-orbit correction/reboost, and was thus preferred.	 **	F64A F64B
Thruster, Gimbal Drive				Dashed nozzle shows the fact that main engines may be gimbaled by the drives at different angles. Also showed with rotating arrow.		F65

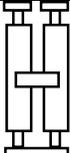
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Thruster, Orbit Correction/Main Engine	Двигатель коррекции орбиты	 A or  B		Typical symbols for a thruster nozzle. For Energia symbol, assumption was that arrow indicated gimballing nature of Main Engines, versus fixed attitude control thruster.	F66A F66B
Tubing showing direction of flow				Icon shows a solid pipe. A pipe that is used for the transfer of a material or fluid.	F115
Tubing with connector				Icon shows the connection of the two pipes. A connector between two pipes used to mate them.	F116
Turbine				This icon is stylized indicating only flow and output. The output arrow is also integrated into the shape of the turbine to indicate that the whole assembly's function is to provide power output. NOTE: by reversing the power arrow (white), the turbine can indicate a compressor.	F67
Vacuum Outlet				Icon indicates the arrows going outward	F126
Wash Fountain				Graphic representation of water washing hands.	F135

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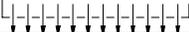
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Water Conditioning Unit	БК БКВ			This is a special device used in the ÑÐÀ-Ë. Its functionality cannot be represented by any of the standard valve symbols. This icon is physically representative of actual hardware.		F136
Water Separator			A	<p>Separates water from systems and puts it in a line. Icon indicates the flow through a separator and shows the line that the water goes in. Air/liquid mixture enters on left port. Water exits at top port and air exits to the right. USOS: CCAA</p>		F137A F137B

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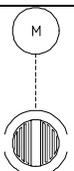
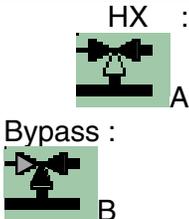
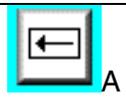
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Baseline

VALVES

English Name	Russian Name	Icon	Schematic	Comments	In Use	Code Number
Valve, Generic Two-way						F68
Valve, Generic Three-way						F69
Manual				A "T" symbol is placed on top of the valve to show it is manually controlled.		F71
Motor						F72
Piccolo Tube						F114
Pneumatic	Клапан пневмоничес					F73
Pressure Relief (Safety)				Icon indicates the valve relief. Used to relieve the pressure of the line.		F74A F74B
Pyrotechnical				This symbol represents a valve which is pyrotechnically operated. An 'N.O' or and 'NC' placed above the symbol indicates whether it is normally open or normally closed. MOD standard symbol for a pyro valve.		F75
Quick opening						F76
Regulating	Клапан регулирующий					F77

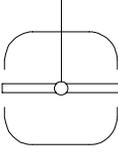
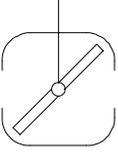
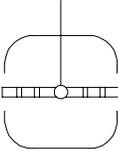
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Solenoid, Latching				Rectangle indicates solenoid. Dotted line indicates latching.		F78
Solenoid, Non-latching						F79
Valve, Ball				Ball valves are used in many parts of the External Active Thermal Control System and the Internal Active Thermal Control System. These valves, in different configurations, perform various functions from simple isolation to three-way mixing. Icon graphically depicts the rotatable ball with appropriate passage(s) inside a housing which includes appropriate inlet(s) and outlet(s).		F80
Valve, Ball, Motor controlled	Клапан от электромотор р					F81
Valve, Bypass						F82A F82B
Valve, Check, Temperature controlled				Bimetallic flow control device This is a special valve used in the CCAA. Its functionality cannot be represented by any of the standard valve symbols. This icon is physically representative of actual hardware. USOS: CCAA		F83
Valve, Check (Reverse Valve)					This depicts a valve that resists reverse flow.	F127A F127B

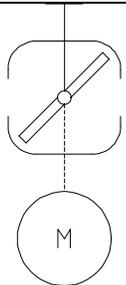
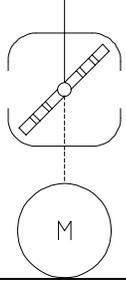
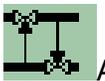
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Valve, Drain	Клапан дренажный					F84
Valve, Gas Trap		Bypass :  A Gas Trap  B				F85A F85B
Valve, Non-Standard				This is a special valve used in the Воздух. Its functionality cannot be represented by any of the standard valve symbols.. ROS: Воздух		F128
Valve, Non standards, ПКО				This is a special valve used in the Воздух. Its functionality cannot be represented by any of the standard valve symbols. ROS: Воздух		F129
Valve, Plate, Manual (open)				This symbol designates a manual plate valve in the open position. NASA/MOD Standard symbol for a configurable plate valve. The 'T' designates that it is manually operated. It is shown in the open position.		F86 F130
Valve, Plate, Manual (closed)				This symbol designates a manual plate valve in the closed position. NASA/MOD Standard symbol for a configurable plate valve. The 'T' designates that it is manually operated. It is shown in the closed position.		F87
Valve, Plate, Perforated, Manual (open)				This symbol designates a manual perforated plate valve in the open position. NASA/MOD Standard symbol for a configurable perforated plate valve. The 'T' designates that it is manually operated. It is shown in the open position.		F88 F133
Valve, Plate, Perforated, Manual				NASA/MOD Standard symbol for a configurable perforated plate valve. The 'T' designates that it is manually operated. It is shown in the closed position.		F89

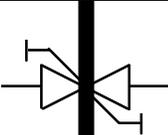
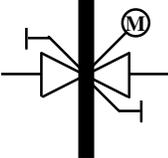
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Manual (closed)				operated. It is shown in the closed position.		
Valve, Plate, Manual/Motorized (closed)				This symbol designates a manual/motorized plate valve in the closed position. NASA/MOD Standard symbol for a configurable plate valve. The 'T' designates that it is manually operated and the motor indicates that it can also be motor driven. It is shown in the closed position.		F132
Valve, Plate, Perforated, Manual/Motorized (closed)				This symbol designates a manual/motorized perforated plate valve in the closed position. NASA/MOD Standard symbol for a configurable perforated plate valve. The 'T' designates that it is manually operated and the motor indicates that it is may also be motor driven. It is shown in the closed position.		F134
Valve, Reverse (Special purpose Diverter)	Обратный клапан					F90 Action: Develop new icon.
Valve, Select 1W/2W (NASDA)		2WCL :  A 1WCL :  B				F91A F91B
Valve, Selector						F92 Action: Develop new icon.

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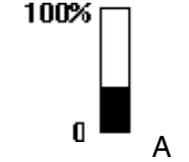
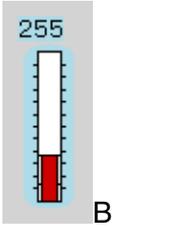
Valve, with Interfaced on Both Sides of Bulkhead				Manual handles are drawn off to the sides to illustrate that only one handle is accessible from a particular side. USOS: MPEV		F112
Valve, Motor with Motor on One Side and Manual Interfaces on Both Sides of Bulkhead				Manual handles are drawn off to the sides to illustrate that only one handle is accessible from a particular side. ROS: КДВ		F113
Vent, Overboard, Non-propulsive				Vents fluids/air overboard. Non-propulsive has an equal distribution at 180 degrees. Icon signifies a pipe that is at 180 degrees along the hatch.		F93
Vent, Overboard, Propulsive				Vents fluids/air overboard. The propulsive vents do not have equal distribution. Icon signifies a pipe that goes overboard but does not vent equally.		F94

C.2.4 General (Indicators/Meters)

English Name	Russian Name	Icon	Schematic	Comments	In Use	Code Number
Arrowhead						G1
Bar Graph, Horizontal	Шкала горизонтальн	 A or				G2A G2B

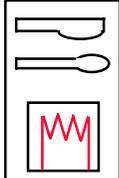
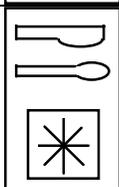
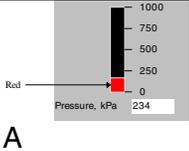
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Baseline

						
Bar Graph, Vertical	Шкала вертикальная	 or 				G3A G3B
Big Bite Bubble						G16
Big Bubble Command				This symbol is used to show command data directly on the drawing. Fields in the symbol allow the PUI, description, range etc. to be specified.		G17
Button						G4
Button, Control						G5
Center Point				Used to show the center of mass of an object when showing its physical characteristics. Standard symbol		G6
Circle Zone Reference				This symbol is used to reference another part of the drawing. Used when power or data lines are routed to a separate area of the drawing.		G18
Continue				Continuation of chart or diagram.		G7
Control Panel, Generic				Icon signifies international symbol for a principal control panel.		G19

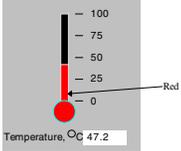
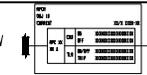
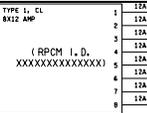
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Baseline

Cow Shed				Used for switch labeling.		G8
Details						G9
Fire Hole				Physically resembles US fire holes. USOS: Panels		G20
Galley, Food Warmer				Combination of symbols for eating utensils, heating element, and a snowflake (for refrigerator).		G21
Galley, Refrigerator				Combination of symbols for eating utensils, heating element, and a snowflake (for refrigerator).		G22
Gauge	Манометр			Physically resembles a gauge. To show a pressure sensor that can be read off of a gauge, combine this icon with icon for pressure sensor. ROS: MB		G10
Huge Telemetry Bubble				This symbol is used to show telemetry data directly on the drawing. Fields in the symbol allow the PUI, description, range etc. to be Specified		G23
Meters Meter symbols, such as bar graphs, filling tank symbols, and thermometers, must include appropriate				Color standards apply to all meters. When a parameter's background color indicates an off-nominal status, the associated bar meter changes its fill color in the same way. For example, if a fluid's temperature exceeds a warning limit, the temperature parameter field shows a red background and the associated thermometer's fill color will be red.		G11A G11B

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<p>labels (typically above, below, or to the left) to indicate the parameter depicted. In most cases, a digital value will be shown near (typically below or to the left) the meter.</p>		 <p>B</p>				
<p>Meter, Panel, Analog</p>						<p>G12</p>
<p>RPC</p>						<p>G24</p>
<p>RPCM</p>				<p>This symbol represents one of the 5 types of RPCMs used on the ISS. NASA/MOD standard symbol for an RPCM. Five different symbols are used, with different RPCM type, ID, # of RPCs and current ratings.</p>		<p>G25</p>
<p>Switch Trip Alarm Indicator</p>					 <p>**</p>	<p>G13</p>
<p>Process Indicator</p>				<p>Appears when the sequence/process is operating.</p>		<p>G14</p>
<p>Timer, Animated</p>				<p>Activates segments based on time in a sequence.</p>		<p>G15</p>

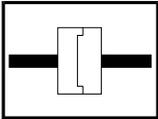
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Telemetry Diamond				This symbol is used to reference a telemetry table. A letter in the left half of the diamond designates the table and the number in the right half of the diamond designates the row of the table.		G26
Telemetry Table Reference				Symbol used on the telemetry table. Referenced by the telemetry diamond. A letter is placed in the diamond.		G27

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Baseline**C.2.5 Computers**

English Name	Russian Name	Icon	Schematic	Comments	In Use	Code Number
Bus Coupler				A bus coupler is a connector that joins 2 1553 busses together. This representation of a connector should use a line thickness as per the type of bus it is connecting (and defined elsewhere). It uses a non-strait line to further emphasize the distinction between the two sides of the connector; this can also be used to indicate male/female sides.		K2
Channel Selector with Logic Control				Use to symbolize a location where more than one logical channel can be selected. Icon signifies international symbol for a channel selector with logic control.		K17
Computer, One Channel	Компьютер 1 канал					K3
Computer, 3 Channel	Компьютер 3 канала					K4
Control Links						K5
Data Bus Arrowhead				Used to indicate the data bus connecting to an ORU. Used for connection indication to MDM.		K19
Data Bus Arrowhead				Arrow head used to indicate the direction of data on a 1553 databus. Arrow filled in with MOD standard pattern for 1553 databus.		K20
Data Bus Corner				Used to indicate a layout change and not a connection point. Indicates bus layout change on drawing for space issues.		K21
Data Bus Joint				Indicates the data bus splits in two directions. T used to indicate branching of data bus.		K22

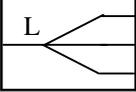
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Data Bus Crossover			Indicates crossover point of multiple data busses. Cross used to indicate crossover data bus.		K23
Discrete Output Card			DO is a class that draws a trapezoid with a rectangle inside and a data line from the bottom of the rectangle down past the trapezoid.		K6 Action: Develop new icon.
Information Flow					K7
Input			Icon signifies international symbol for an input.		
Laptop	Лэптоп		IBM ThinkPad 760ED, 760 XD View of a laptop to signify ports where a laptop can potentially plug in. Differentiation achieved by labeling with US, RS, CHECCS, etc.		K8
EtherNet Data Line			Differentiates from 1553. Non-1553 Ethernet date line.		K9
Data Bus, 1553			Major data bus line. 1553 data bus line.		K10
MDM (Microprocessor)	Микропроцесор MDM		Used to symbolize onboard computer. MDMs are indicated with the quadrilateral symbol.		K11
MDM (Microprocessor)			Used to symbolize onboard computer. MDMs are indicated with the quadrilateral symbol. Trapezoidal shape signifies 'tiered' architecture of microprocessors. Heavy exterior outline with dashed internal lines symbolize 3 channel nature of devices, with a special communication link between the 3 units that is not dependent upon exterior 1553 connections. When icon has a bold		K12

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				outline, the computers are being used as one.		
Monitor	Монитор			Icon signifies a general symbol for a television or computer monitor.	 **	K13
Network Channel Controller	Контроллер сетевых каналов			Icon signifies splitting of input to multiple outputs, and vice versa. A number (L) symbolizes that this splits input busses into (L) outputs. Splits a bus in two and extends it to get around the limitations of bus length and amount of terminals.		K14 Action: Develop new icon. E66
Output				Icon signifies international symbol for an output.		K25
Sampling unit				Icon signifies international symbol for a sampling unit.		K15
Terminal Switching Unit	Коммутатор согл.резист					K16

C.2.6 Logic

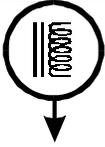
English Name	Russian Name	Icon	Schematic	Comments	In use	Code Number
Gate, AND						L1 Action: Draw to most current international standard.
Gate, NAND						L1 Action: Draw to most current international

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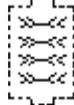
					standard.
Gate, NOR					L3 Action: Draw to most current international standard.
Gate, OR					L4 Action: Draw to most current international standard.
Gate, Exclusive OR					L5 Action: Draw to most current international standard.
Gate Inverter					

C.2.7 Mechanical

English Name	Russian Name	Icon	Schematic	Comments	In use	Code Number
Actuator				An electromechanical device used for actuation. It could be a motor or an electromagnet. The arrow out will point to the object the actuator acts upon. In one case an input arrow is used when it is necessary to indicate where the activation is coming from.		M13 Action: Develop new icon.
Bearing						M14

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Bevel Drive				Cross section of gear train.		M15
Bulkhead Connector						M16
Bulkhead Penetrator						M17 Action: Develop new icon.
Bulkhead Penetrator with Valve						M18 Action: Develop new icon.
Bulls Eye (Berthing Target)				Bulls Eye is a class that draws 3 filled or unfilled concentric circles.		M1
Cap	Заглушка			Illustrates sealing off of flow	 **	M2
CBM (USOS Dock Mechanism)				CBM is a class that draws the Common Berthing Unit icon. CBM is a circular mechanism with 14 retractable latches, used to connect Space Station modules.		M3
Control Moment Gyro (CMG)				This symbol represents an ISS Control Moment Gyro. The shape represents the actual shape of the CMG's.		M4
Direct Drive (gear train)				Cross section of gear train.		
Gamah Fitting				Gamah fittings are used to connect fluid lines to other fluid lines and to components throughout the Thermal Control and Environmental Control and Life Support Systems. These connectors are threaded and are not self-sealing.		M19

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				A Gamah Fitting is a non-self-sealing, keyed, threaded fitting used to join line segments, or a line segment to a component. Both the male and female portions of the fitting include hex flats to facilitate tool use in assembly and disassembly. The icon carries the sense that the fitting is threaded by including the depiction of . The parts of the icon on either side of the hex are indicated larger diameter than the tubes connected by the fitting, identifying the Gamah as a multi-part item, separate from the line (not just a nut somehow appearing on a line). The icon is simplified in that neither the keying provisions nor the second hex flats are indicated.	
Gamah Fitting, Threaded					M20
Grid	Решетка				M5
Grill		XXXXXX			M6
GyroDyne / Gyro SpinUp				Symbolizes spinning momentum wheel seen perpendicular to its outer gimbal. Gyrodine/Control Moment Gyroscope	M7
Hatch, Edge On View	Люк	 A or  B			M8A M8B
Hatch, Front View					 M9

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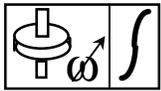
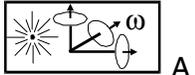
					**	
Mesh				Mesh is a class that draws a filled or unfilled rectangular mesh (checkerboard). It is used in ATU.		M10
Panel				Panel is a class that draws a filled or unfilled rectangle panel background with nuts at each corner.		M11
Reflector				Symbolizes a reflection. Reflector		M21
Spring						M22
Spring, Extension						M23
Spring, Torsion						M24
Spring, spiral						M25
Torque Limiter, Mechanical				Icon signifies international symbol for a mechanical torque limiter.		M12

C.2.8 Sensors

English Name	Russian Name	Icon	Schematic	Comments	In Use	Code Number
Angular Rate Sensor	Датчик ОПТ-М			Angular Rate Sensor, 3 orthogonally mounted gyroscopes) Omega common symbol for Angular rate. Disk symbolizes the gyroscopic principle on which this sensor is based.		S1 S18

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Angular Rate Sensor, Integrating	Дат.вектора угл.скорости ГИВУС			Integrating Angular Rate Sensor, 4 mutually redundant gyroscopes Omega common symbol for Angular rate. Disk symbolizes the gyroscopic principle on which this sensor is based. Integral sign symbolizes that this sensor directly provides an integrated angular rate.		S2 S20
Satellite Navigation (GLONASS)	Аппаратура спутниковой навигации					S3
Infrared Horizon Sensor	Датчик ИКВ 256К			The sensor that thermally looks for the edges of the earth to help estimate attitude with respect to the earth.		S4
Magnetometer	СМ-8М Магнитометр			Icon symbolizes the 3 orthogonally mounted electromagnets that determine attitude with respect to earth's magnetic field. Magnetometer for attitude estimates.		S5 S21
Rate Gyro Assembly			 A	The shape of the symbol is similar to the ring laser gyro portion of the RGA.. A Laser device, the three Cartesian coordinates to indicated that measurement is done on the three axes and the Omega sign to indicate that measurement is done on angular momentum. On the first icon the three "rings" represent each of the three RLGs used for the measurement		S6
Sensor D - Dew point □P- Delta Pressure F - Flow rate H - Position I - Current P - Pressure Q - Quantity R - Rate T - Temperature V - Voltage	Датчик Точка росы Приращение давления Поток Положение? Ток Давление Количество? Скорость Температура Напряжение Влажность			Sensors are shown as small rectangles with an appropriate capital letter to designate the sensor type. These icons are used at different levels of detail. D - Dew point □P- Delta Pressure F - Flow rate H - Position I - Current L- volume P - Pressure Q - Quantity R - Rate T - Temperature	 **  B**  **	S7

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				V - Voltage W - Wetness		
Sun Sensor, Fixed Head	Солнечный			Fixed head sun sensor for attitude estimates. Icon symbolizes sun in field of view.		S10
Sun Sensor, Scanning	Солнечный датчик, 251K			Scanning sun sensor for attitude estimates. Icon symbolizes sun in field of view. Circular arrow differentiates function from a fixed sun sensor.		S11 S23
Smoke Detector				Icon indicates what the smoke detector looks like.		S12
Smoke Detector, Animated	Датчик дыма			Yellow indicates smoke; red indicates fire.		S13
Star Mapper				Star Mapper for attitude estimates. Constellation icon symbolizes lining up set of stars (Star Mapper) within the center of the field of view.		S24
Star Sensor	БОКЗ звезд. датчик			Icons symbolizes lining up a specific star within the center of the field of view. Star tracker for attitude estimates		S14 S25
Strain Gauge Assembly				Wheatstone Bridge		S15
Tachometer						S16
Thermostat	Термостат			Icon signifies international symbol for a thermostat.		S17

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English Name	Russian Name	Icon	Schematic	Comments	In Use	Code Number
Advisory	Уведомление					NE or Ev1
ATM (Atmospheric Contamination)	Атмосфера					NE or Ev2
Caution	Оповещение					NE or Ev3
dP/dT	Разгерметизация					NE or Ev4
Events Details	Просмотр событий				 **	NE or Ev5
Fire	Пожар				 **	NE or Ev6
Ground Connection	Связь с Землей					NE or Ev7
Home Button	Дом					NE or Ev8
Light/Shade (Daylight/Dark Trans Symbol, Animated)						NE or Ev9
Navigation Tree	Навигационное дерево					NE or Ev10

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Help Function	Флаг PC					NE or Ev11
Switch, English/Russian	Ключ En/Ru					NE or Ev12
Turn Off Beep stop	Отключение звука					NE or Ev13
Warning	Предупрежде ние					NE or Ev14

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English Name	Russian Name	Icon	Schematic	Comments	In Use	Code Number
ASCR (Crew Rescue Mode)	Спасение экипажа					NM1
EVA, Crew	ВКД					NM2
Gyro SpinUp	Раскрутка гиродинов			Symbolizes spinning momentum wheel seen perpendicular to its outer gimbal. Gyrodine/Control Moment Gyroscope		NM3
Initial Attitude	Выставка БИНС					NM4
Microgravity	Микрогравитация					NM5
Proximity Operations (Docking Target)	Стыковочные операции					NM6
Reboost	Маневр					NM7
Refuel	Дозаправка	 A or  B				NM8A NM8B

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Standard	Стандартный						NM9
Survival Mode	Выживание станции						NM10

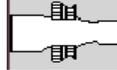
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English Name	Russian Name	Icon	Schematic	Comments	In Use	Code Number
	Транспорт. корабль					NS1
	Стыковоч. отсек					NS2
	СМ					NS3
FGB	ФГБ				 **	NS4
FGB correct	ФГБ прав.пропор					NS5
MPLM Icon				MPLM Icon shows the MPLM module.		NS6
P6 Icon				P6 Icon depicts the P6 module.		NS7
Node 1					 **	NS8
FGB SB	ФГБ СБ					NS9
PMA1 Icon				PMA1 Icon depicts the PMA 1 module.		NS10

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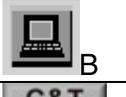
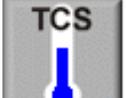
PMA2 Icon				PMA2 Icon depicts the PMA 2 module.		NS11
PMA3 Icon				PMA3 Icon depicts the PMA 3 module.		NS12
SM SB	CM CB				 **	NS13
US Lab Icon				US Lab Icon depicts the US Laboratory Module		NS14
Z1 Icon				Z1 Icon depicts the Z1 module.		NS15

C.2.12 Systems

English Name	Russian Name	Icon	Schematic	Comments	In Use	Code Number
ECLSS	СЖО	 A or  B				NY1A NY1B
EPS	СЭП	 A or  B				NY2A NY2B

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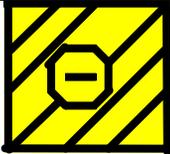
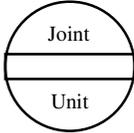
C&DH	БВС	 A or  B				NY4A NY4B
C&T	БРК	 A or  B				NY5A NY5B
	ИТС					NY6
MCS (GNC/P)	СУДН	 A or  B				NY7 Ship's wheel agreed on at Montreal meeting.
ODU Unified Thruster System						NY8 Action: Develop new icon
Robotics						
TCS	COTP	 A or				NY9A NY9B

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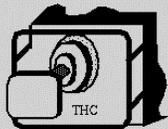
		 B				
EVA, Crew	ВКД				 *  **	NY10
Docking	ССВП					NY11
CPK Radiation Monitor	СРК					NY12
Structures & Mech		 S&M				NY13

C.2.13 Robotics Icons

English Name	Russian Name	Icon	Schematic	Comments	In Use	Code Number
Auto Sequence Switch Hot				When an auto sequence can be commanded to start, stop, pause, proceed, etc., via hardware switch, the Auto Sequence Switch Hot icon shall be displayed in the auto mode window.		R1 Action: Develop new icon.
Robot Joint				Hardware joints shall be represented with the Joint symbol. The name of the joint appears in its abbreviated form (ST, SY, SP, etc.) in the top of the circle, the units (e.g., deg) in the bottom,. The center box is a text field for joint angles, etc.		R2

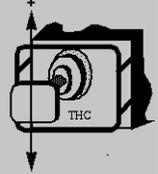
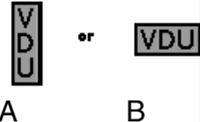
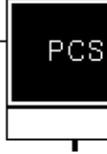
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Hand Controllers				When both the translational and rotational hand controllers are to be represented. If just the translational or rotational hand controller is to be represented, symbols for the THC or RHC, respectively, shall be used.		R3
Robot Lights				On top of robot video camera icon to designate a light is available with this camera.		R4
Rotational Hand Controller (RHC)				When only the rotational hand controller is to be represented. (Use RHC+Roll symbol when the roll axis command directions are to be depicted on the RHC.)		R5
Rotational Hand Controller with Roll Axis (RHC+Roll)				When the roll axis command directions on the RHC are to be depicted.		R6
Hand Controller Hot Icon				When the trigger on the RHC has been configured to issue commands (LEE commands, etc.)		R7
Translational Hand Controller (THC)				When only the translational hand controller is to be represented.		R8

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THC+Directions				When the direction of the Single Joint Mode commands are to be depicted, or as feedback that the system is in the Single Joint Mode.		R9
Video Distribution Unit				When depicting a VDU.		R10A R10B
Workstation Monitors				When workstation monitors are depicted.		R11
Portable Computer System (PCS)				When Portable Computer Systems are depicted.		R12

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APPENDIX D

ROBOTICS

Under Review. Not included in CR4248.

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APPENDIX E

ACRONYMS

AAA	TBS
ACK	Acknowledge
ACP	Automated Crew Procedures
ACS	Attitude Control System
AOC	Axes of Command
AOR	Axis of Resolution
AOS	Acquisition of Signal
APM	Attitude Processor Module
APV	Automated Procedure Viewer
AR	Activity Record
ATU	Audio Terminal Unit
BAF	Base Frame
BIT	Built-in Test
C&DH	Command and Data Handling
C&T	Communication and Tracking
C&W	Caution & Warning
CBM	Common Berthing Mechanism
CCAA	Common Cabin Air Assembly
CDF	Command Frame
CDRA	Carbon Dioxide Removal Assembly
CDT	Crew Documentation Tool
CMG	Control Movement Gyro CMG
COR	Center of Rotation
COTS	Commercial Off-the-Shelf
CPA	Controller Panel Assembly
CPAT	Command Page Authoring Tool
CPL	Crew Procedure language
CSA	Canadian Space Agency
DAD	Decision Action Diagrams
DASA	Daimler-Chrysler Aerospace
DCP	Display and Control Panels
DDCT	Display Data Control Table
DDCU	Direct Current-to-Direct Current Converter
DGCS	Display and Graphics Commonality Standards
DTG	Date and Time Group
DYF	Display Frame
ECLSS	Environmental Control and Life Support
EE	End Effector
EPDS	Electrical Power Distribution System
EPS	Electrical Power System
ERA	European Robotic Arm
ESA	European Space Agency
EVA	Extravehicular Activity
EWC	Emergency/Warning/Caution
FFK	Hot/Fixed Function Keys

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FGB	Functional Cargo Block
FHCI	ESA-Columbus Flight Human Computer Interface Standard
FMA	Force/Moment Accommodation
FOR	Frame of Resolution
GLI	Graphical Location Identifier
GMT	Greenwich Mean Time
GNC	Guidance, Navigation, and Control
GUI	Graphical User Interface
HCI	Human Computer Interface
IDAGS	Integrated Display and Graphics Standards
IDAGSDT	Integrated Display and Graphical Standards Development Team
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IMS	Inventory Management System
ISP	Information Sharing Protocol
ISS	International Space Station
ISSSH	International Space Station System Handbook
ITS	Integrated Truss Segment
JCP	JEM Control Processor
JEM	Japanese Experiment Module
JEMRMS	Japanese Experiment Module Remote Manipulator System
KVC	Kinematic Verification Check
LED	Light-Emitting Diode
LOS	Loss of Signal
LVLH	Local Vertical-Local Horizontal
MALP	Master Alarm Light Panel
MCA	Major Constituent Analyzer
MCC-H	Mission Control Center-Houston
MCD	Monitoring and Control Display
MCS	Motion Control System
MDM	Modulator/Demodulator, Multiplexer/Demultiplexer
MO&UCB	Multilateral Operations and Utilization Control Board
MOC	MSS Operations Center
MOD	Mission Operations Directorate
MPLM	Multi-Purpose Logistics Module
MPV	Manual Procedure Viewer
MSS	Mobile Servicing System
MTL	Master Time Line
NASA	National Aeronautics and Space Administration
NASDA	National Aeronautics and Space Development Agency of Japan
OBAS	Orbiter Body Axis System
OCAS	Operator Commanded Automatic Sequence
ODF	Operations Data File
OOCI	ODF/OSTP Crew Interface
ORA	Operations Requirements Analysis
ORAS	Orbiter Rotation Axis System
ORU	Orbital Replaceable Units
OSF	Open Software Foundation
OSTPV	Onboard Short Term Plan Viewer
PCB	Payloads Control Board

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PCS	Portable Computer System
PDGS	Power/Data Grapple Fixture
PDRP	Payload Display Review Panel
PDU	Power Distribution Units
PGSC	Payload General Support Computers
PI	Principal Investigator
PLMDM	Payload Multiplexer/Demultiplexer
PLT	Payload Laptop Terminal
PMA	Pressurized Mating Adapter
POCB	Payload Operations Control Board
PODF	Payload Operations Data File
POIF	Payload Operation Integration Function
POR	Point of Resolution
PPA	Pump package assembly
PUI	Program Unique Identifier
PVU	TBS
PWS	Portable Work Station
RHC	Rotational Hand Controller
RIC	Rack Interface Controller
RLT	RMS Laptop Terminal
RPC	Remote Power Controller
RPCM	Remote Power Controller Module
RS	Russian Segment
RASA	Russian Space Agency
RSAD	Robotic Situational Awareness Displays
SLT	System Laptop Terminal
SM	Service Module
SODF	U.S. Systems Operations Data File
SRMS	Shuttle Remote Manipulator System
SSFP	Space Station Freedom Program
SSIPC	Space Station Integration and Promotion Center
SSRMS	Space Station Remote Manipulator System
TCCS	Trace Contaminant Control System
TCS	Thermal Control System
TDRSS	Tracking and Data Relay Satellite System
THC	Translational Hand Controller
USOS	United States On-orbit Segment
VDU	Video Distribution Unit

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APPENDIX F

ISS Graphics Training Products Development Manual

This manual was created separate from the Display and Graphics Commonality Standards (DGCS) through NASA and GCTC concurrence. It was added as an addendum to the DGCS as of 7 Jun 99. It has been reviewed and accepted by the ITCB and is proposed to add to the baselined document with full International Partner approval.

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INTERNATIONAL TRAINING CONTROL BOARD APPROVAL NOTICE
INTERNATIONAL SPACE STATION PROGRAM
ISS GRAPHICS TRAINING PRODUCTS DEVELOPMENT MANUAL

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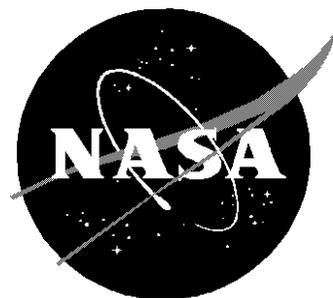
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ISS Graphics Training Products Development Manual

International Space Station Program

Basic
January 8, 1999



National Aeronautics and
Space Administration
Lyndon B. Johnson Space Center
Houston, Texas



Gagarin Cosmonaut
Training Center
Star City, Russia

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ISS Graphics Training Products Development Manual

Basic

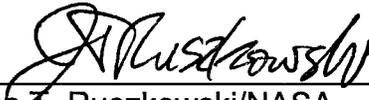
This joint document between the NASA
Space Flight Training Division and the
GCTC Training Department was developed
by



28.08.98

Vasily Cherkashin/GCTC
Training Department Project Lead

Date



8/28/98

James T. Ruszkowski/NASA
Training Division Project Lead

Date

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Baseline**ISS Graphics Training Products
Development Manual****LIST OF EFFECTIVE PAGES**

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PREFACE

The ISS Graphics Training Products Development Manual was prepared by the Space Flight Training Division, Mission Operations Directorate (MOD), Lyndon B. Johnson Space Center (JSC), National Aeronautics and Space Administration (NASA).

Questions concerning the technical content of this document should be directed to the NASA Drawing Project Lead, James T. Ruszkowski, 281-244-7541, DT121.

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1.0 INTRODUCTION

1.1 PURPOSE

The need for consistency across national training products is critical because the International Space Station (ISS) is an international effort. When creating training documentation, there will naturally be issues because each international partner has a different language, and there are national peculiarities in the use of technical terms and symbols. Graphics is one of the primary tools that will be used to improve communications during training.

The ISS Graphics Training Products Development Manual defines the basic requirements, principles, and processes that must be used when developing graphics for ISS crew training. International crewmembers under the ISS program will use the products throughout their training period.

This document was produced jointly by Russian and American specialists in compliance with the ISS Display and Graphics Commonality Standards (DGCS). Its provisions apply to all training graphics products produced by both partners for use by crewmembers during ISS program training.

The objectives for graphics products used in the training process are as follows:

- a. To help crewmembers understand the physical aspect of the topic being discussed.
- b. To help crewmembers form a mental image of the onboard system or scientific hardware¹, its operation, and capabilities.

The graphics used for training may be different from onboard graphics due to differences in purpose and objectives. The developers should strive to ensure visual consistency in compliance with the principles stated in the DGCS and in this document.

1.2 SCOPE

The graphics products for crew training should provide sufficient information for the crewmember to be familiar with the basic design principles of the spacecraft, each of its systems, the major components of each of the systems, the basic operations from the crew perspective, and the primary response for off-nominal situations. Basic operations will include the major modes of operation. It is intended that graphics products will be used as a reference throughout the training cycle, including to the highest level of crew proficiency on specific systems or operations.

¹The term "onboard systems" will be used further in text. This term includes scientific hardware for which graphics will be developed.

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1.3 ROLES AND RESPONSIBILITIES

Each partner is responsible for developing graphics products on the modules and systems contained within that partner's segment. The graphics products will be developed in accordance with guidelines and national traditions of the developing partner's training organization and in compliance with agreements contained in this joint guideline. Updates to the graphics products are the responsibility of the initial developer, who must also ensure that the translated portion of the training manual is properly updated.

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2.0 HIERARCHY OF ISS FUNCTIONAL AND PHYSICAL DIVISIONS

Graphical products such as displays and schematics can be developed using varying levels of detail. In order to establish guidelines to standardize the level of detail contained in a particular graphical product, a hierarchy from more general to more specific must be used. The terminology used to describe these levels is contained below in the Hierarchy of ISS Functional and Physical Divisions. This terminology is not intended to alter the nomenclature of any hardware.

These terms are also defined in the ISS Display and Graphics Commonality Standards (Section 4.10.3) and are included here because they are essential tools in the development of graphics products. They are essential because they are the foundation of the Diagram Level Definitions provided in Section 10

Hierarchy of ISS Functional and Physical Divisions:

- Super-system

- Station

- Segment

- Module

- System

- Subsystem

- Block

- Part

Table 2-1 lists the proposed definitions for the Hierarchy of ISS Functional and Physical Divisions.

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ISS Functional and Physical Divisions**

Division	Definition
Super-system	An organization that includes the orbital station, other space vehicles, and ground facilities.
Station	A group of segments (or modules) that are combined to form a complete orbital complex.
Segment	A number of modules that can be logically grouped together by form, function, or program responsibility. Examples include the Russian segment and the American segment.
Module	A single structural element that provides significant additional functionality to the station. Usually contains multiple systems and may be pressurized or unpressurized. Examples include FGB, SM, Node 1, Node 2, and SO Truss.
System	A collection of components that perform unique functions supporting activities in a module, segment, or in the entire station. Some systems may interface across the larger super-system. Examples include the electrical power system (EPS), the thermal control system (TCS), etc. (was "subsystem" in previous designations).
Subsystem	A collection of blocks that work together to perform a function within a system. One example is the fire detection and suppression components of ECLSS. A part of a system, for example part of a system limited by a given module, is also called a subsystem.
Block	Sometimes referred to for manufacturing purposes as an assembly. A grouping of parts to perform a function for a subsystem. A block is generally connected to control signals, electrical supply, thermal support, or other environmental support services to perform its job. Examples include an MDM, a pump package assembly (PPA), a remote power control module (RPCM), latch assembly, and a controller panel assembly (CPA).
Part	Sometimes referred to for manufacturing purposes as equipment. The individual pieces that are assembled together to form a block. Examples include a single valve, a controller card, a pump, latch, etc.

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3.0 BACKGROUND

When ISS crewmembers study the design and configuration of the ISS and its onboard systems and science hardware, visual aids are an effective means of providing the following:

- a. Clear and rapid comprehension of the subject matter.
- b. Strong memorization of the subject matter.
- c. Basic skills to perform typical actions and activities within the scope of the functions assigned to the crew for the operation and maintenance of an onboard system.
- d. Certainty that the underlying theory of the standard operating procedures are mastered, including off-nominal situations.

In the initial phase of training, when the visual aids serve to illustrate text information, they must conform to the same didactic principles that apply to the presentation of the training material (from the general to the specific, and from the simple to the complex) and must be presented to the student in a specific order. In the final phase of training, the visual aids must provide the student with an overall concept of the design and structure of the onboard system and the functional interrelation of its components.

The process of creating visual aids generally includes the following steps:

- a. Analysis of the design of the object.
- b. Analysis of the characteristics of the object.
- c. Analysis of the operating modes of the object, including off-nominal situations.
- d. Analysis of the crew's functions.
- e. Analysis of the standard operating procedures and maintenance of the object.
- f. Validating the types and number of visual aids needed to study an object, and to support its operation and maintenance.
- g. Determining the sequence for presenting the visual aids.
- h. Selecting and validating the design principles (structure) of various types of visual aids.
- i. Standardization of the symbols used to develop visual aids.
- j. Developing the visual aids, from the schematic of the object to the integrated control schematic of the object.

3.1 GENERAL REQUIREMENTS FOR TRAINING MANUAL VISUAL AIDS

Visual aids are a component part of the training manual and must be integrated into the manual's contents, thus presenting a united format with the text. Drawings, technical figures, schematics, tables, and photographs are classified as visual aids for training manuals.

Training manual visual aids must satisfy the following basic requirements:

- a. Visual aids must ensure the clear and rapid comprehension of the subject matter.

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- b. Only those visual aids that clarify or supplement the text must be included in the manual.
- c. The number of visual aids must be adequate to clarify the accompanying text.
- d. Visual aids may be incorporated in the text, at the end of a section, or in an appendix of a training manual.
 - 1. Incorporate visual aids close to the corresponding text in the text of a training manual.
 - 2. Insert aids at the end of a section.
 - 3. Create an appendix to the training manual for visual aids.
- e. Visual aids, if there are more than one, are numbered within the section using Arabic numerals. The visual aid number consists of the section number and a one-up number for visual aids, separated by a period; for example: "Fig. 1.1." All visual aids must be referenced in text.
- f. Visual aids of each appendix are enumerated separately using Arabic numerals with the appendix designator added before the number; for example, "Figure A.3."
- g. The heading of the visual aid may consist of two parts:
 - 1. A one-up number and a short visual aid title.
 - 2. Explanatory text; for example, a list of item parts.
- h. It is permitted to use colorization of component parts of an item; if possible, the color should correspond to the color in the item itself.
- i. Take into account which colors to use because the possibility of B&W printing or copying. Appendix B of the DGCS states, "Colors shall not be used as the sole means of identification of a status of a part or subsystem. Information on the event or element status shall be redundant, using either labels or other graphical change."

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4.0 DRAWINGS

A drawing is a projection or view image of the objects to scale on a specific medium (paper, tracing paper, film, etc.). Graphic representations such as dots, dashes, segments of curved lines, symbols, and graphic designations are used to create the drawing.

The drawings are used to depict the design (structure) of space hardware and its parts, the layout (configuration) of the blocks and parts, and the restraints and translational gear. In other words, whenever a crewmember must obtain precise quantitative information, these elements are usually borrowed from the developer's design documentation for the item of space hardware.

The following types of drawings are commonly used as visual aids:

- a. Overall view drawing
- b. Dimensional outline
- c. Conceptual drawing
- d. Schematics

4.1 OVERALL VIEW DRAWING

An **overall view drawing** is a drawing that defines the structure of the item (ISS, system, block, etc.) and the interaction of its basic components. It also explains the operating principle of the item (see Figure 4-1).

An overall view drawing must contain the following elements:

- a. An image of the item (views, profiles, cross-sections) with labels and text, as required, to comprehend the design (structure) and the interaction of its components and the item's operating principle.
- b. Designators or names for the item's components that clarify the operating principles. Numerical designations are used as designators and component names. Required explanatory notes are given in a legend to the drawing or in the main text of the training manual. An item component designator or name must not be placed on the component itself. It is placed on a line in the background of the drawing; the other end of the line connects to the component.
- c. Required dimensional, mounting, and installation dimensions and dimensions that simplify clarification of the form of the part elements.

The overall view drawing is simplified as much as possible. The item components are depicted simply (contour shapes are permitted) so long as the design of the item, the interaction of its components, and the operating principle are comprehended.

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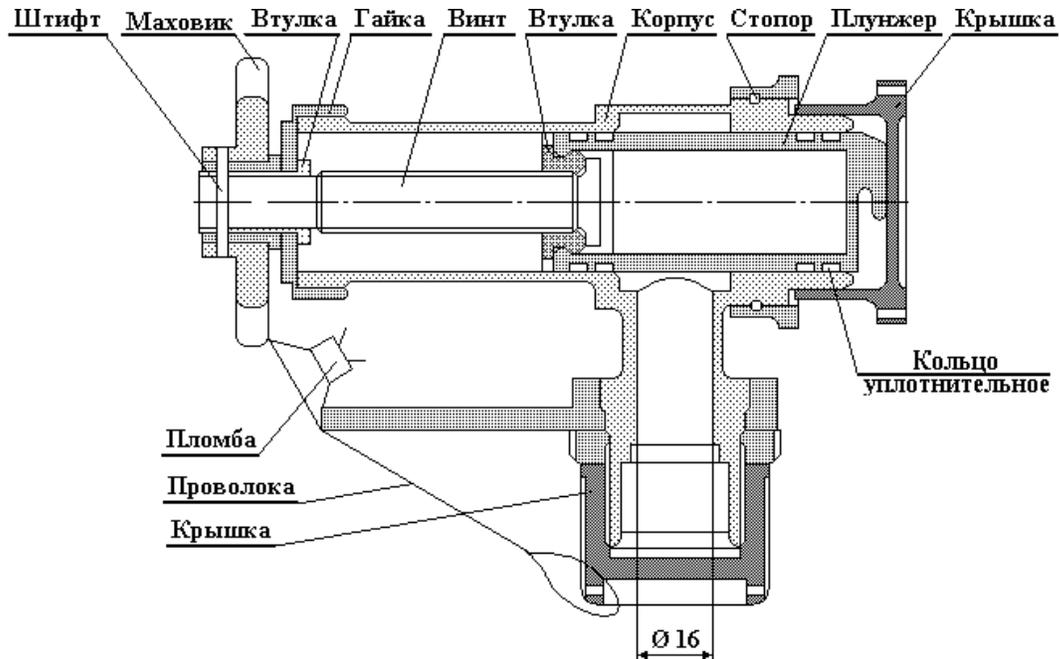
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Figure 4-1. Overall view drawing

4.2 DIMENSIONAL OUTLINE

The **dimensional outline** is a drawing that has a (simplified) contour image of the item with the overall installation and mounting dimensions (see Figure 4-2).

The dimensional outline should contain the least number of views sufficient to provide a thorough representation of the exterior outlines of the item, of positions of protruding parts, and the parts and blocks that make up the component.

The items are pictured as simply as possible in the dimensional outline, so that the extreme positions of moving, extensible, or hinged parts or panels on loops, etc., are visible.

The dimensional outline gives the overall dimensions of the item and installation and mounting dimensions; if necessary, the outline gives the dimensions that define the position of protruding parts.

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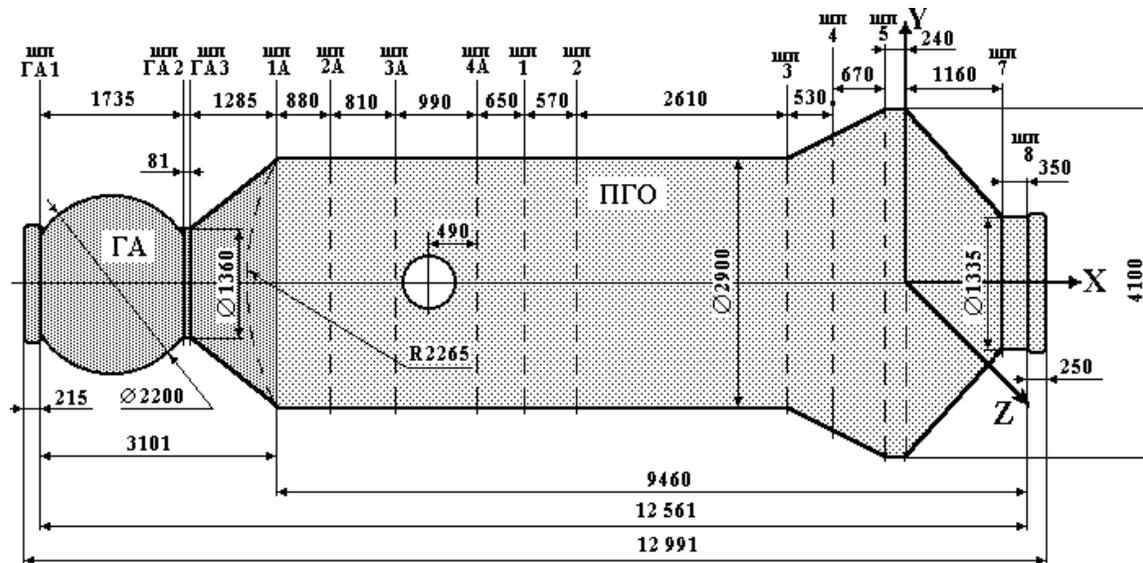
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Figure 4-2. Dimensional outline drawing

4.3 CONCEPTUAL DRAWING

The **conceptual drawing** defines the geometric shape (outlines) of an item and provides the coordinates that show the location of its components. The coordinates of the center of mass may also be shown (see Figure 4-3).

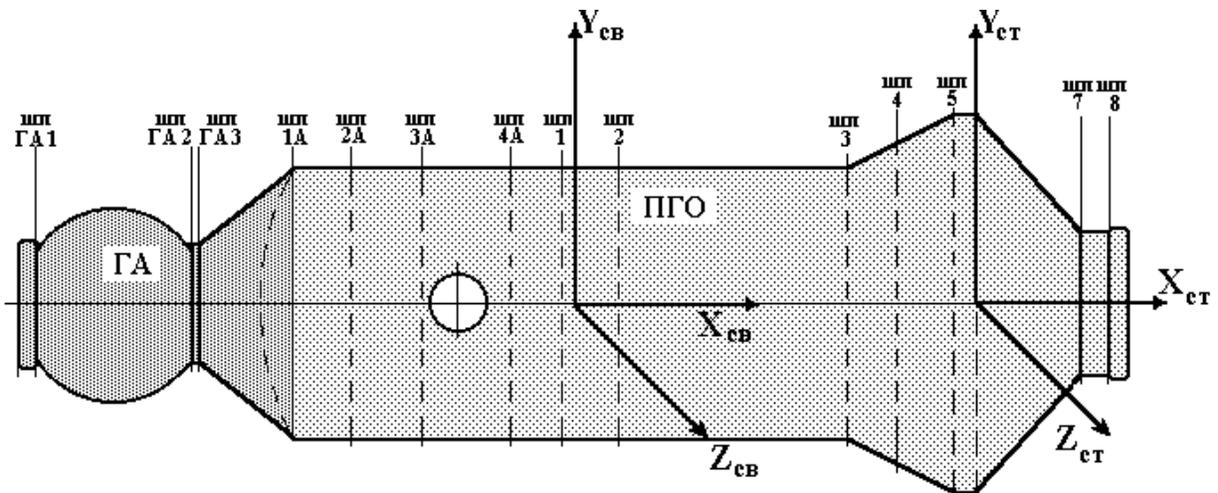


Figure 4-3. Conceptual drawing

The coordinates show the location of FGB components in a structural coordinate system (X_{CT} , Y_{CT} , Z_{CT}).

During independent flight, the FGB uses a body-based axis coordinate system (X_{CB} , Y_{CB} , Z_{CB}) emanating from the center of mass. The system has the following coordinates for the variation with the solar arrays folded:

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Center of mass coordinates, mm		
X	Y	Z
-3.994	-0.040	-0.008

4.4 SCHEMATICS

4.4.1 GRAPHIC SYMBOLS

Graphic symbols are graphic representations of schematic elements. The symbols are created in compliance with the principle for standardization of graphic symbols by the countries participating in the ISS program. The symbols, grouped in tabular form by type and purpose, specify the following:

- a. Designators for flow direction of power, liquid, and gas and the direction and change in movement (straight line, reverse course, etc.).
- b. Designators for mechanical link lines used in hydraulic, pneumatic, and electrical schematics.
- c. Common graphic symbol elements (i.e., device, hardware) and their full and separate view.
- d. Common graphic symbol elements used in electrical (circuit) schematics.
- e. Common graphic symbol elements used in electrological schematics.
- f. Common graphic symbol elements used in hydraulic schematics.
- g. Common graphic symbol elements used in pneumatic schematics.
- h. Common graphic symbol elements used in kinematic schematics.

Graphic symbols may be unique to specific systems or they may be used for several systems simultaneously.

Appendix C of the ISS Display and Commonality Standards contains a list of accepted graphic designators that should be used when developing schematics to be used for crew training.

4.4.2 BASIC REQUIREMENTS FOR SCHEMATICS

Schematics are developed without regard to scale. However, the ratio of the sizes of the graphic symbols of interactive parts on the schematic should approximately correspond to the actual ratio of the dimensions of these parts in the component.

The graphic symbols of parts and blocks and the connections should be placed on the schematic so as to best represent the structure of the item and the interaction of its components.

Schematics should have as few breaks and overlaps in the connecting lines as possible. Individual parts constituting a functional group or block may be set apart on the schematic with a dashed/dotted line, thus indicating the name of the functional group or block.

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One type of schematic may depict individual parts of another type of schematic that have a direct impact on the operation of the type of circuit (for example, a circuit schematic may show mechanical or hydraulic elements).

The schematic may show other parts and blocks that are not part of the item depicted on the schematic. The parts are shown because they are necessary to the understanding of the item and its principles of operation. The graphic symbols of such parts and blocks are set apart with a dashed/dotted line, and the location of these components is indicated in the caption or heading. If these parts and blocks cannot be graphically set apart, then these parts and their connections are depicted using dashed lines.

4.4.3 TYPES AND FORMS OF SCHEMATICS

The forms of schematics are designated according to their basic purpose:

- a. Block schematics
- b. Functional schematics
- c. Principal schematics
- d. Combined schematics

A combined schematic is one which includes two or more types; for example, block and functional schematics.

The following is a list of the various types of schematics, depending on the type of parts or blocks and the connections in a system:

- a. Electrical (circuit) schematics
- b. Electro logical schematics
- c. Logic schematics (TBD)
- d. Hydraulic schematics
- e. Pneumatic schematics
- f. Kinematic schematics
- g. Combined schematics

A combined schematic is one which includes two or more types of schematics, such as an electrical and a hydraulic schematic.

4.4.3.1 Block Schematics

Refer to the level 1 schematic definitions in Section 10.

A block schematic describes the basic functional parts of an onboard system. It describes the purpose and interdependence of the parts and the role of the crew in operating the system. The functional parts are depicted as rectangles or graphic symbols on the schematic.

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The basic components of the onboard system are usually depicted without regard to their actual configuration and details.

The graphic structure of a schematic should provide the clearest representation of the sequence of interaction of the functional parts of the onboard system. It is suggested that the lines of connection be indicated by arrows to show processes that occur within parts.

Block schematics are used to provide a general introduction to an onboard system

4.4.3.2 Functional Schematics

See the level 2 schematic definitions in Section 10.

A functional schematic explains the specific processes occurring within individual functional parts of an onboard system or within the onboard system as a whole, the role of the crew, and the basic parts for monitoring and controlling the system.

Functional schematics should show all the blocks, functional parts, functional groups, and component parts required to explain the processes occurring in the onboard system, and also to show the connections between these blocks and the component parts.

Blocks and parts of the system and also the connections between them are represented by graphic symbols in the schematic. Individual blocks and parts may be depicted as rectangles.

The functional process is usually depicted left to right and (or) from top to bottom (refer to Creating Visually Consistent Graphics, Section 9).

The functional schematic may also give technical data on the functional blocks and parts (next to the graphic symbols or in the free field of the schematic).

The schematic may also contain explanatory headings, schematics, or tables that indicate the time sequence of a process, and also show the parameters at typical points (values of currents and voltages, gas and fluid pressure, mathematical relationships, etc.).

Functional schematics are used to study the operating principles of an onboard system without regard to the details and particulars.

4.4.3.3 Principal Schematics

See the level 3 schematic definitions in Section 10.

A principal schematic defines the full complement of blocks and the connections between them, usually offers a detailed description of the operating principles of the onboard system, and may reflect the scope and content of monitoring and control of data as the crew interacts with the system in both nominal and off-nominal modes.

4.4.3.3.1 Guidelines for Electrical (Circuit) Schematics

Electrical schematics are developed to show the components in their deenergized state.

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The graphic symbols used to represent a system should be properly situated in the schematic so that the schematic is easy to read. At the same time, they should satisfy the requirement for showing the electrical connections with the shortest lines and fewest intersections.

As a rule, parts, blocks, and networks are arranged on the schematic in parallel horizontal and vertical straight lines without regard to their actual position. The arrangement is generally from top to bottom, left to right.

The schematic may use graphic symbols and simplified outlines to depict the individual mechanical, hydraulic, and optical parts and blocks that are functionally related to the electrical parts or blocks in the component.

The following parts of a schematic may be set apart by dashed/dotted lines:

- a. Groups of structurally unified parts or blocks.
- b. Functional groups of parts that together perform a specific function in the component.

If a schematic repeatedly shows identical parts and blocks, it is permissible to fully illustrate just one part or block, and to depict the rest simply as rectangles.

Parts and blocks may be depicted in the schematic using the following methods:

- a. Combined - Separate parts and blocks are depicted together.
- b. Spaced apart - Separate parts or blocks of a component are depicted in different places in the schematic so that the individual circuits of the component are represented most clearly (for example, a winding and relay contact set may be shown separately, at different points in the schematic). This method allows several parts of a component to be represented with their mechanical linkage; i.e., with a dotted line indicating their appurtenance to one part.
- c. Line by line - The graphic symbols of the parts or their components that make up one circuit are shown in sequence one after the next along a straight line, and separate circuits are shown in rows that form parallel (horizontal or vertical) lines.

4.4.3.3.2 Guidelines for Electro Logical Schematics

The electrological schematic shows the logical command of the system by discrete commanding signals. This schematic is usually used to depict relays of the electrical system.

The graphic design of the schematic should provide a clear and obvious representation of the sequence of control actions (commands) in the onboard system.

It is suggested that the route of a command be indicated with arrows on the connecting lines.

The parts and blocks are depicted by graphic symbols. The schematic should represent the parts and blocks of the system in the deenergized (initial) state.

The graphic symbols should be arranged properly in the schematic so that the schematic is easy to read and has the fewest intersections.

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The parts and blocks are ordinarily arranged in parallel, horizontal, and vertical straight lines in the schematic.

Individual mechanical, hydraulic, and optical parts and blocks functionally related to electrical parts and blocks may be depicted by graphic symbols or simplified outlines on the schematic.

The schematic may give technical data for blocks of a circuit (near the graphic symbols or in the free field of the schematic).

The schematic may contain explanatory headings or captions and schematics or tables that indicate the time sequence of commands (processes). It may also indicate parameters at typical points (values of currents, voltages, mathematical relationships, etc.).

4.4.3.3.2 Guidelines for Hydraulic and Pneumatic Schematics

The parts and blocks are depicted by graphic symbols. The parts and blocks may be represented as schematic sections. The locations of the graphic symbols in the schematic should be determined by their functional capabilities. Locations are also determined by the sequence of the processes occurring, the ease of reading the schematic, and the necessity for depicting connections between functional parts. The shortest lines and the fewest intersections should be used. The parts and blocks may be arranged on the schematic in the same way the parts and blocks are arranged in the component.

If a schematic repeatedly shows identical parts and blocks, it is permissible to fully illustrate just one part or block, and to depict the rest simply as rectangles.

The parts and blocks of the circuit are depicted in the deenergized state.

Individual parts of the circuit or the entire circuit may be shown in a selected operating position, with the corresponding mode indicated in the field of the schematic.

It is acceptable to indicate the flow direction of the working medium on the communication lines.

4.4.3.3.4 Guidelines for Kinematic Schematics

The kinematic schematic should represent the collection of mechanical parts and their connections that are designed to execute, regulate, control, and monitor prescribed motions of effectors. Kinematic connections (mechanical and non-mechanical) that are provided within the effector and between separate pairs, circuits, and groups must be depicted. Connections to the source of motion must also be depicted.

All parts on the schematic are represented by graphic symbols or simplified outlines.

If a component consists of several identical mechanisms, the mechanical schematic may be given for one, and a simplified version given for the others.

The relative positions of the parts and blocks on the mechanical schematic should correspond to the initial, intermediate, or working position of the effectors of the component (mechanism). The positions of effectors that are the subject of the schematic may be explained in a caption. If

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the position of a part changes while the component is in operation, then its extreme positions may be shown by thin dashed/dotted lines.

The ratio of the sizes of the graphic symbols of interactive parts on the schematic should approximately correspond to the actual ratio of the dimensions of these parts in the component.

The mechanical schematic of a component indicates the following:

- a. The name of every kinematic group of parts, taking into account its primary functional purpose (for example, feed drive).
- b. The basic characteristics and parameters of the kinematic parts that determine the motions of the effectors of the component.
- c. Onboard labels for the crew (instructions, cautions and warnings, explanations).

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5.0 TECHNICAL DRAWINGS

A technical drawing is a type of visual aid that depicts a space object (orbital station, separate modules, blocks, etc.). It includes both an external view and a cross-section, the design of the object, the functional stages, and so on.

When creating a technical drawing, it is acceptable to deviate from the scale standards; however, the actual proportions (relative dimensions) of the subject depicted must be strictly observed.

The image may be created on the axonometric axes, with directions that closely approximate the direction of the axes selected by the axonometric projection or in the plane.

A technical drawing is created to clearly represent the design of an object. The purpose of the drawing is also to support the process of learning the construction principles, the onboard system hardware, the functional links with other onboard systems, and the sequence and rules for the crew controlling and operating the onboard system (see Figures 5-1, 5-2, and 5-3).

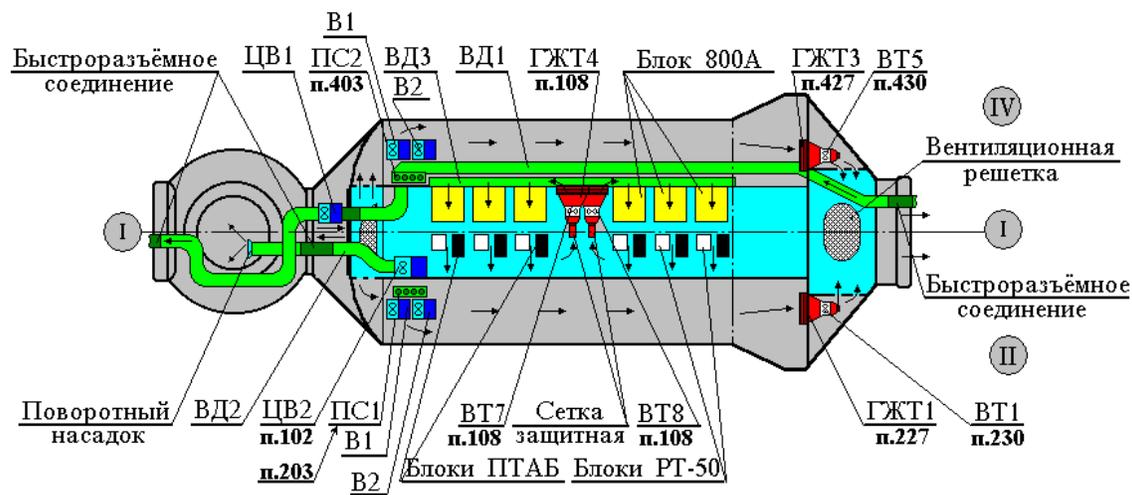


Figure 5-1. FGB ventilation (view of stabilization plane I)

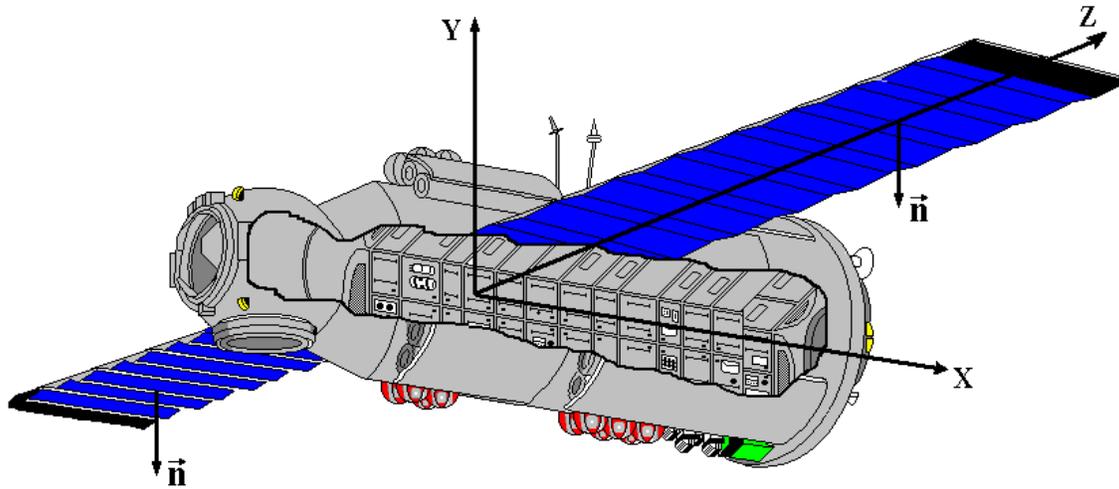


Figure 5-2. FGB (location of electric supply system (□□□ blocks and location of solar arrays)

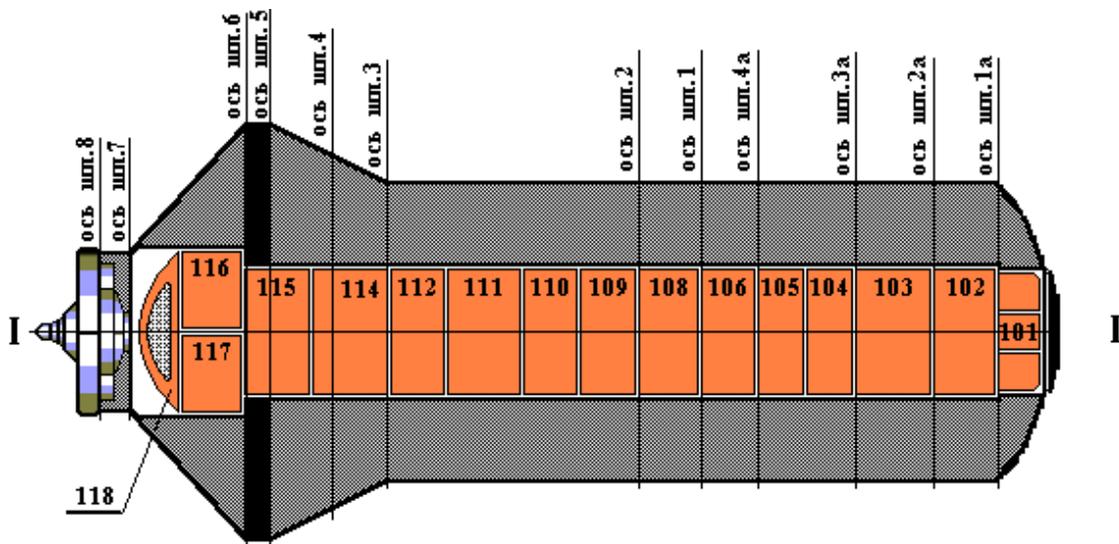


Figure 5-3. FGB (location of electric supply system (□□□) blocks and location of electric supply system storage batteries and automatics on plane I)

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6.0 GRAPHS

A graph is a graphic image that clearly shows the functional relationship of some quantities.

Graphs use either a right-angled or a polar coordinate system.

In a right-angled coordinate system, the values of the quantities that are related to the given functional relationship will fall on the axes as a scale (see Figure 6-1).

Graphs that provide information to show the functional relationship do not need to have a scale. In this case, the coordinate axes will end with arrows indicating the direction of growth for the quantity value.

An independent shift will be shown on the horizontal axis (x-coordinate).

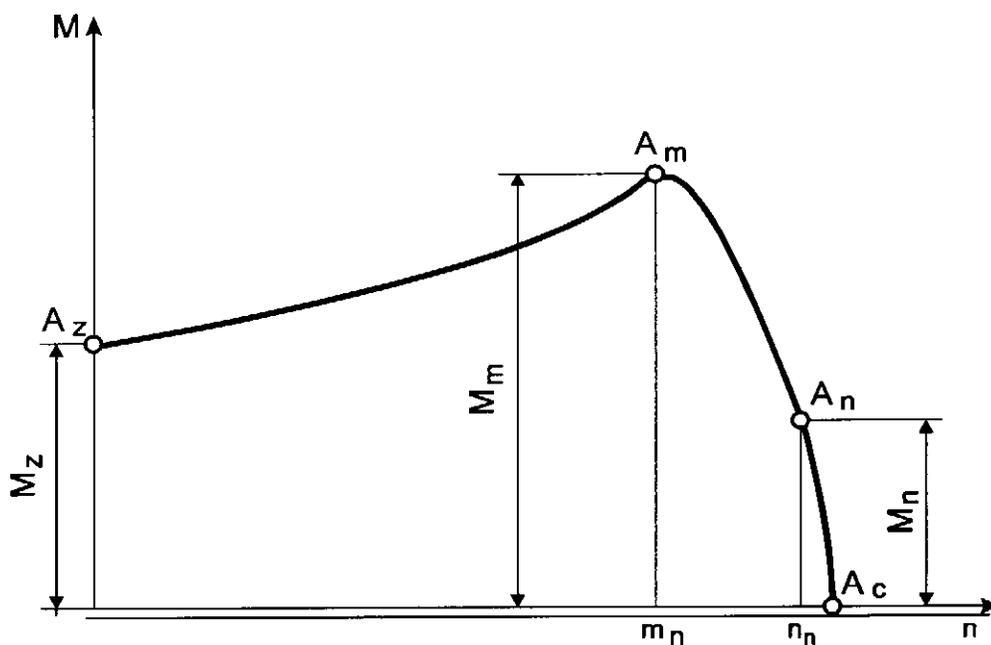


Figure 6-1. Right-angled coordinate system

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In a polar coordinate system, the initial reading angle (angle 0) must be on the horizontal or vertical axis (see Figure 6-2). A positive direction for angular coordinates must correspond to a counterclockwise rotational direction.

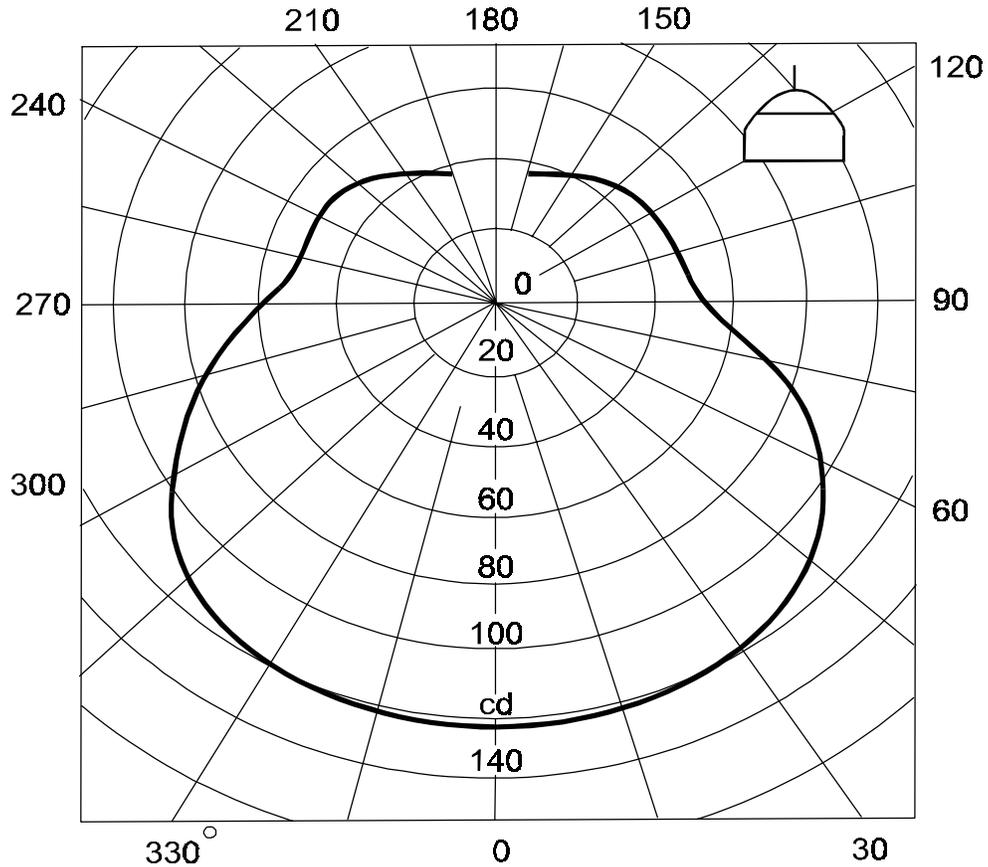


Figure 6-2. Polar coordinate system

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When creating a graph using a right-angled (spatial) three-coordinate system, the functional relationship is depicted in an axonometric projection (see Figure 6-3).

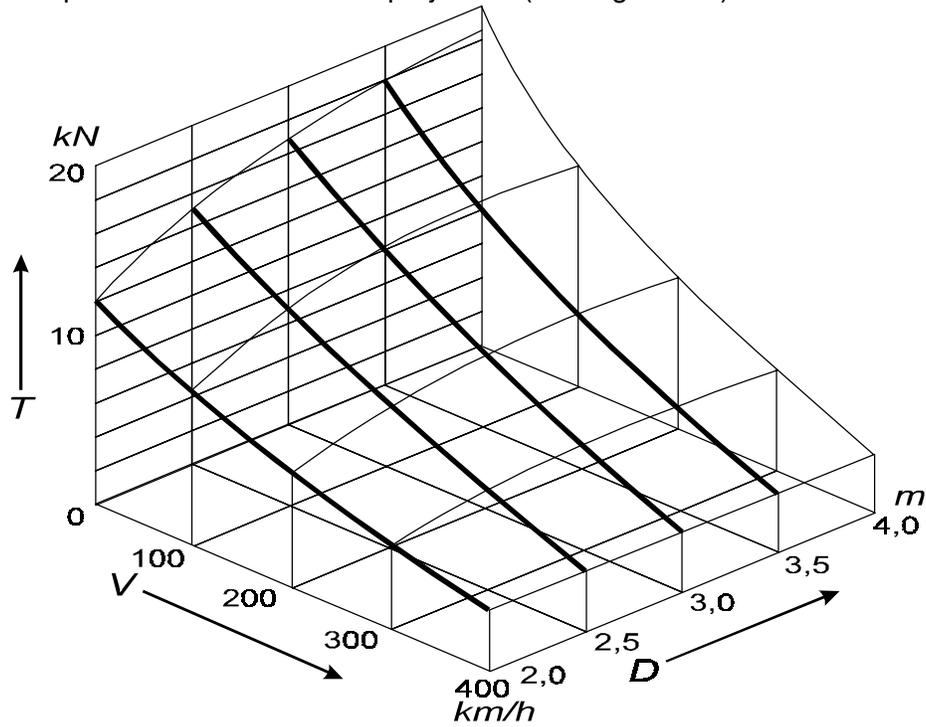


Figure 6-3. Axonometric projection

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The values of the shifting quantities are shown on the coordinate axes in linear or non-linear form; for example, in logarithmic scales of the image (see Figure 6-4).

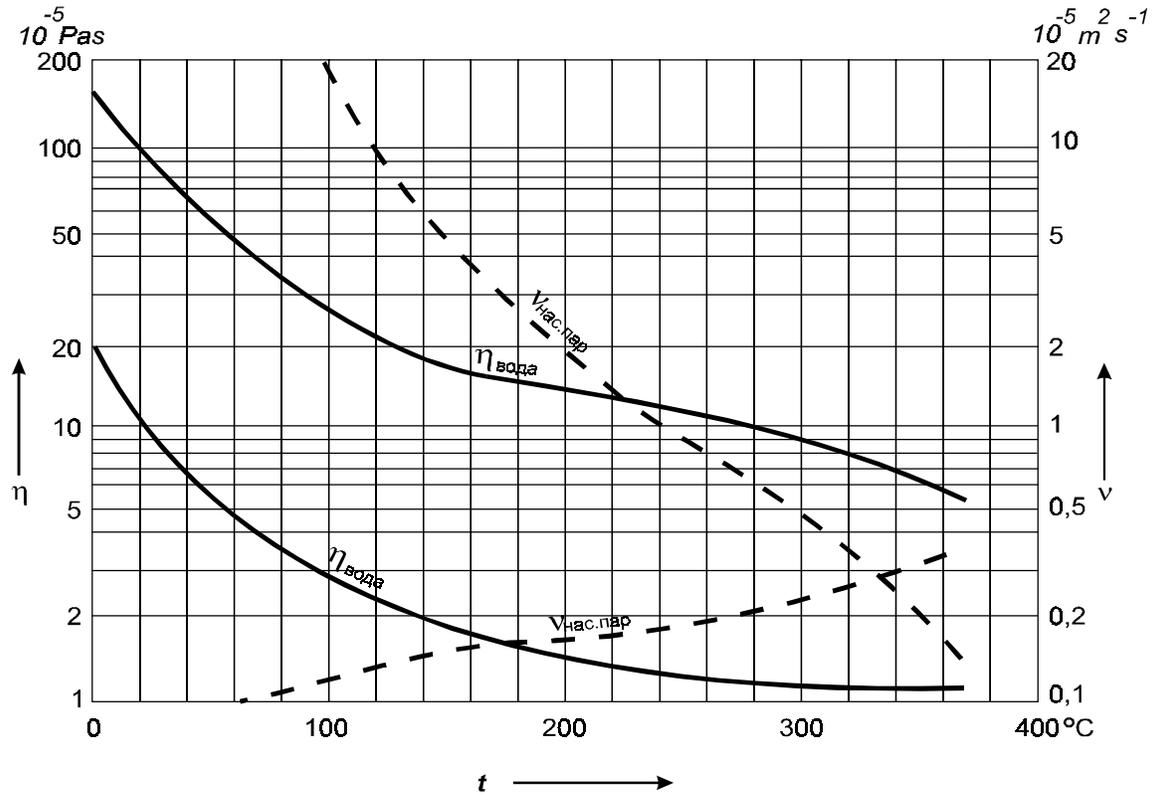


Figure 6-4. Values of shifting quantities shown on coordinate axes

The scale for each direction of the coordinates may be different.

As a scale for the quantity values depicted, the coordinate axes should be separated at graphic intervals by dashed lines, a coordinate grid, or a combination of the coordinate grid and dashed lines.

The distance between the dashed lines and the coordinate grid lines is selected taking into consideration the purpose of the graph and the readability.

The quantity values should be shown together with the grid or dashed lines. Zero will be indicated one time at the intersection point of the scales if it is the initial point of the scale. The frequency for placing numerical values and intermediate scale values is selected taking into consideration the schematic's ease of use.

Designators of changed quantities in a graph without scales will be placed close to arrows that end the axis; in graphics with scales, they will be placed in the center of the scale at the outside.

Units of physical quantities may be placed as follows:

- a. Placed at the end of the scale between the last and next to last numbers of the scale.

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- b. Placed together with the name of the changed quantity, following a comma.
- c. Placed at the end of the scale following the last number together with the designator of the changed quantity as a fraction. The numerator will be the changed quantity designator, and the denominator will be the unit designator. An example would be a graph of force versus area that would have a numerator in pounds and an area of square inches written as lbs/in².

The graph may have a label that explains the functional relationship that is depicted.

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7.0 TABLES

A table is a list of information and numerical data. The content of the table is shown in a specific system and is distributed using graphs. The method for creating a table is shown in Figure 7-1.

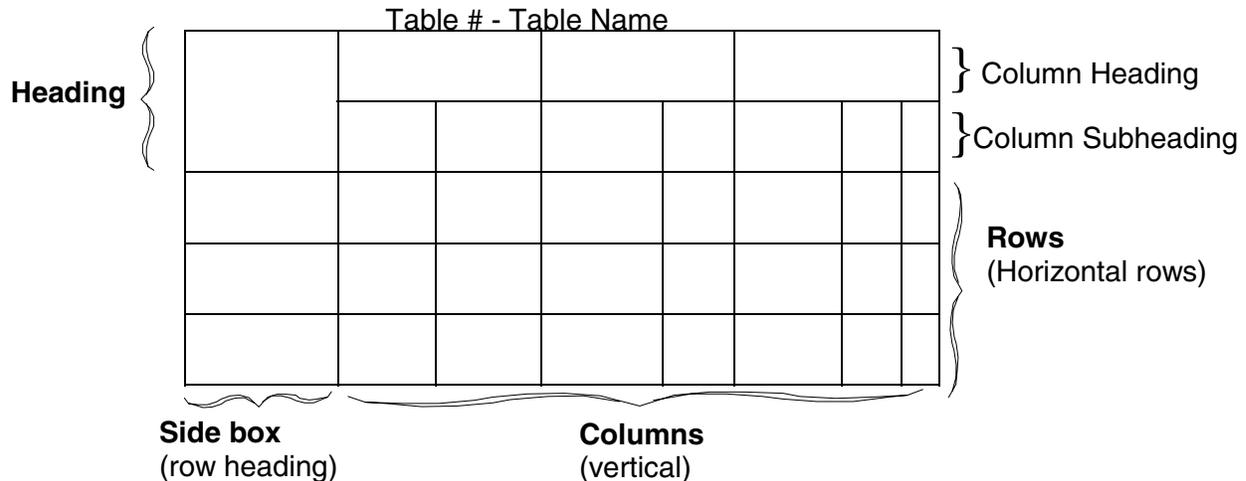


Figure 7-1. Method for creating a table

Column headings and subheadings are placed at the top of the table, and the row headings are placed in side boxes. Headings for table columns and rows must begin with capital letters. Column subheadings that are part of the heading must begin with small letters. If the column subheading has a separate meaning, it should begin with a capital letter. Headings should be in singular form.

Tables are numbered using Arabic numerals within the section numbering. If there is only one table in the document or section of the document, it does not need to be numbered, and the word "Table" does not need to be written. Tables for each appendix must be numbered separately. Use Arabic numerals with a letter prefix to indicate the appendix (for example, "Table B.1").

Above the top left corner of the table, the label "Table" must appear with a one-up number. The word "Table" must begin with a capital letter (for example, "Table 1.2"). It is not underlined. If the table has a title, it is written on the same line as the "Table . . ." label. The table title must be written in small letters (first word is capitalized). The title should be short and should completely describe the table contents. When referencing the table in text that has a number, the word "table" must be abbreviated using small letters (for example, "see tbl. 1.2").

The table columns must be numbered only if they are referenced in text.

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8.0 PHOTOGRAPHIC TRAINING MATERIAL

8.1 BACKGROUND

Photographic training materials include images of components that are produced using photographic technology. The materials are developed for crew training.

If necessary, the component dimensions may be written on the image. Designators that specify the component blocks and parts also may be written on the image.

A component may be shown in both a static position and a dynamic position (illustrating a process) using photographic training materials. In the latter case, a group of images is used to simulate the dynamic process.

Photographic training material may be used for the following components:

- a. Exterior of the station, segment, and modules.
- b. Interior of a module.
- c. Aft panel space of a module.
- d. Technical component (block, part, etc.) or a complete technical component.
- e. Non-technical component (cosmonaut clothing, medical support equipment, onboard food menus, etc.).
- f. Images of people and their body parts.
- g. Collection of various components (for example, a cosmonaut in a flight suit against the background of a module interior, working with a specific assembly, etc.).

Photographic training material may illustrate the following types of processes:

- a. Sequence of operations when working with a system or a separate component.
- b. Sequence for maintenance on a system or separate component.
- c. Methods for using non-technical components.

Depending upon the exposure, photographic training material can be divided into the following categories:

- a. General layout
- b. Intermediate layout
- c. Large-scale layout
- d. Detail

Photographic training material may be in black and white or color. Color images are useful when the colors of the components are necessary to distinguish them from similar components

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8.2 BASIC REQUIREMENTS FOR DEVELOPING PHOTOGRAPHIC MATERIALS

- a. Photography of components on a module must be taken with the standard cable connections and standard positions for effectors.
- b. If the position of the component or its blocks and parts can change, it is required to show the most critical position.
- c. Packages and other components in packing must be shown in stowed and extended states.
- d. The lighting while photographing a component must minimize shadow. Specks of light from the flash should be avoided as much as possible. To set a component apart from others, the use of localized lighting is permitted.
- e. When photographing components outside the station, the use of an artificial background is required. The background must be neutral and must not be the same color and saturation level as the component. The background must not contain any extraneous parts.
- f. The selection of the photography camera angle is based on the objective of the graphic presentation and whether one to three sides of a three-dimensional component are visible. Therefore, it is necessary to calculate the center of the optical interest and, if necessary, concentrate the student's attention on it.
- g. Component panels with connectors and also cable must be photographed in such a way that the contact area of the connectors is clearly visible.
- h. When photographing crewmembers, it is necessary for them to be dressed in the standard equipment that corresponds to the situation illustrated.
- i. To illustrate a process, photographs are used that connect a single subject.
- j. A group of photographs may also be used to statically illustrate different sides or elements of a component.
- k. It is desirable that objects are photographed in a manner that clarifies size; i.e., a ruler or other object whose size is commonly understood should be included in the photo as a reference.
- l. The color used for text or drawings on a photo should be very clear. Photographic material should be post-processed to reduce light effects from camera flashes and to reduce shadows, which will hide important information, such as labels on the hardware.

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9.0 CREATING VISUALLY CONSISTENT GRAPHICS

This section is intended to define a generic concept, the guidelines, and a method for the production of visually consistent graphics products. Attributes that make a drawing visually consistent include flow directions, common layout, and common icons. Figures 9-1 to 9-17 illustrate the steps to creating visually consistent graphics.

9.1 GENERIC CONCEPT

Using the generic concept, a visually consistent set of graphics products can be developed across multiple systems and across different knowledge levels.

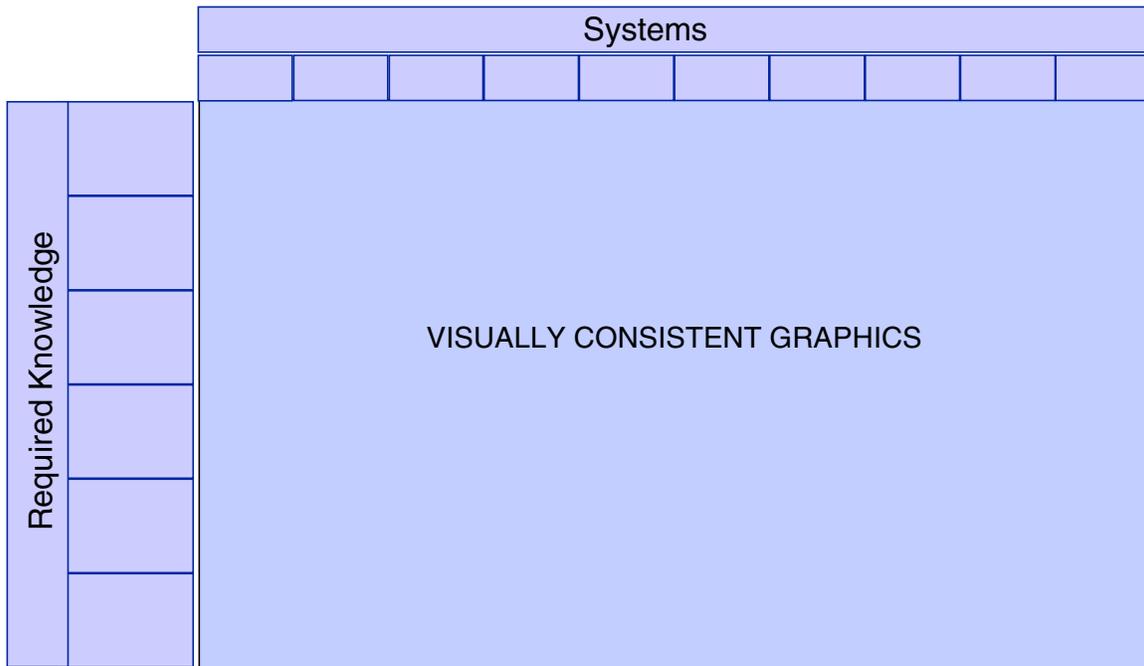
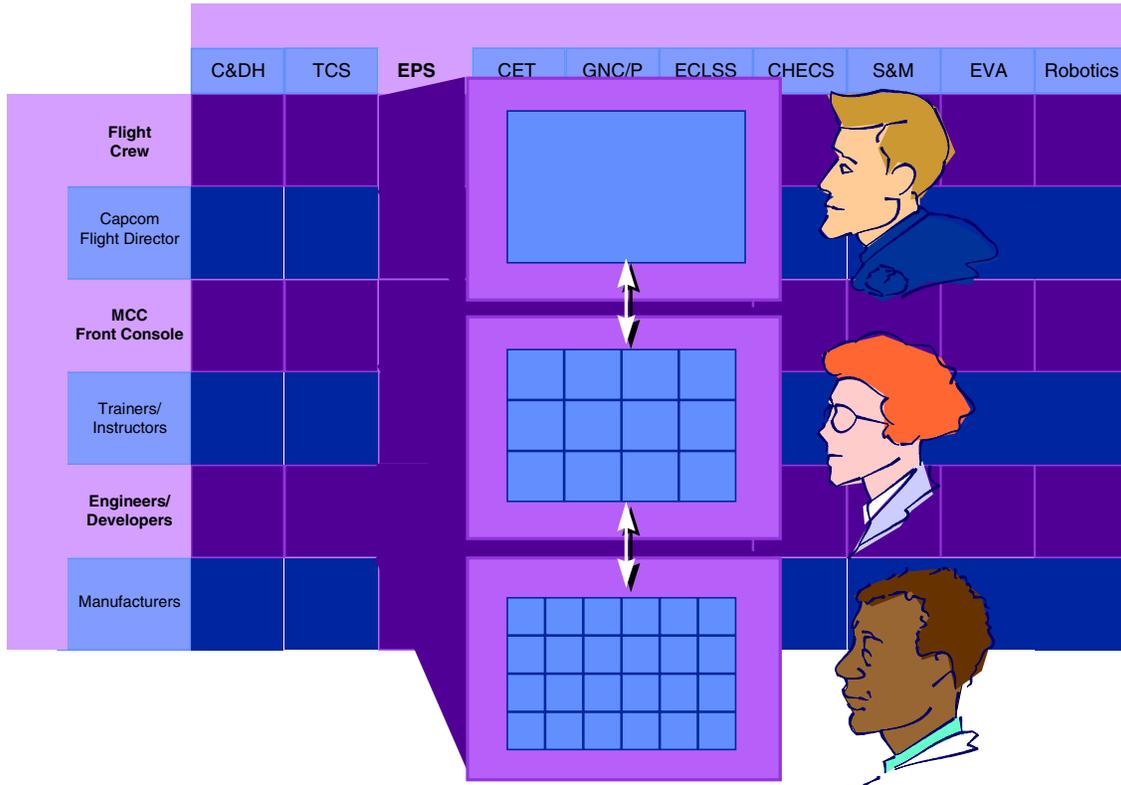


Figure 9-1. Generic concept

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The following examples (from the U.S. ISS program) illustrate this concept across users and across systems.



Across users



Across systems

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9.2 SPECIAL TEMPLATE DEVELOPMENT METHODOLOGY

One of the guidelines in the ISS Display and Graphics Commonality Standards document (Section 4.10.4) addresses spatial consistency. Use of the preferred view convention ensures spatial consistency. From the convention, isometric or orthographic projections can be derived. This convention is not a requirement for all ISS graphics products. It is intended to be used as a first approach when starting the process of developing a drawing.

When looking at graphics material, it is sometimes hard for users to orient themselves to which way is up, down, left, or right. If a convention is not used, then students have to reorient themselves when looking at different graphics products.

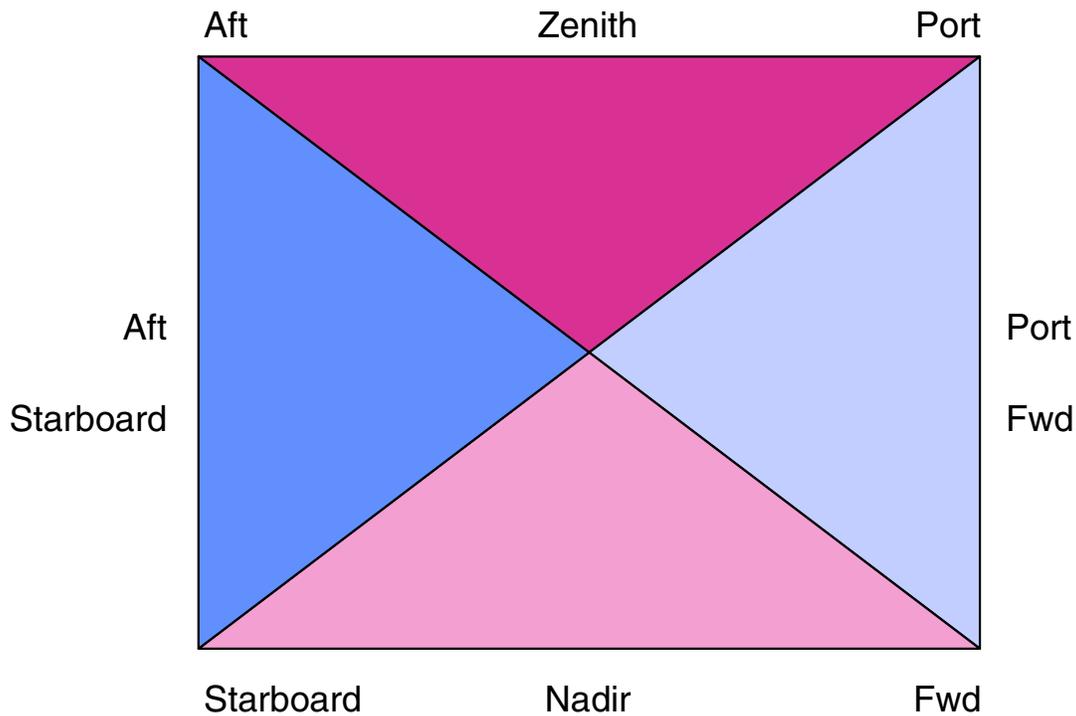


Figure 9-2. Preferred view convention

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Figure 9-2 can also be interpreted as shown in Figure 9-3.

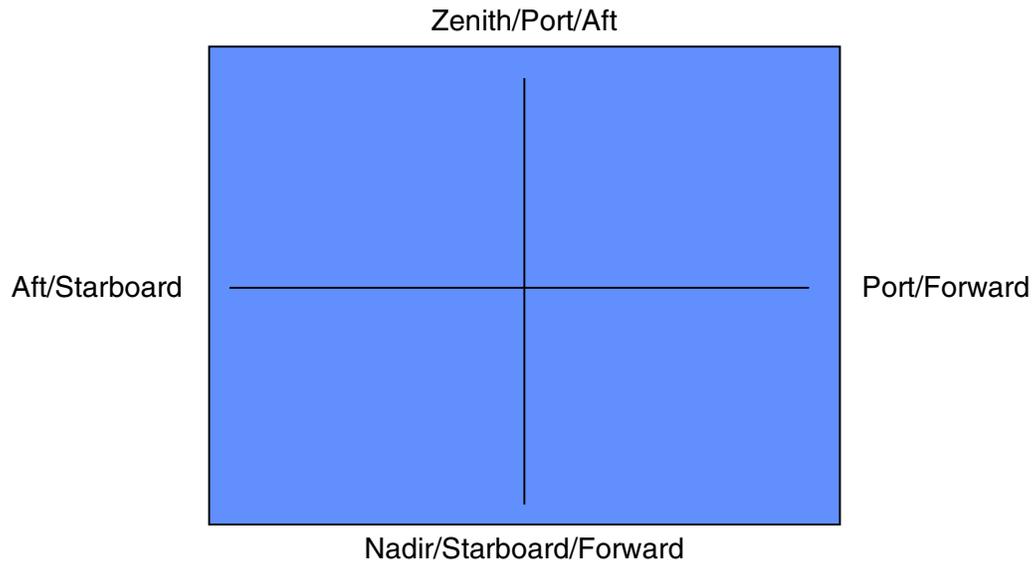


Figure 9-3. Preferred view convention - another interpretation

In order to provide visual consistency when representing the preferred view of the ISS modules, it is necessary to provide an orientation of the ISS on the diagrams that follows these four principles:

- a. Zenith or port or aft at the top.
- b. Aft or starboard on the left.
- c. Nadir or starboard or forward at the bottom.
- d. Port or forward on the right.

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The preferred view convention can be enhanced by integrating the Russian method of using a coordinate system based on “stabilization planes.”

Two mutually perpendicular planes, intersecting along the longitudinal axis, describe the stabilization plane.

A display of the stabilization plane for any ISS module, when viewed from inside facing the forward section, would appear:

- a. Down (floor) - First stabilization plane.
- b. Left (port) - Second stabilization plane.
- c. up (ceiling) - Third stabilization plane.
- d. Right (starboard) - Fourth stabilization plane.

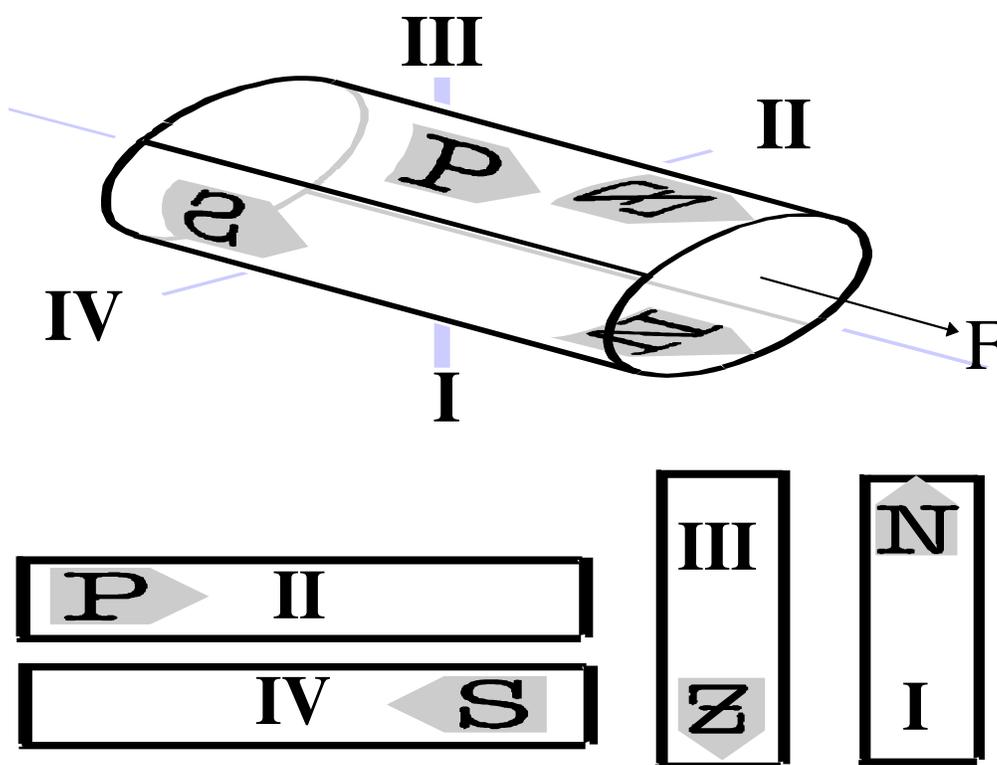


Figure 9-4. Coordinate system based on stabilization planes
(Russian method)

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9.3 STEPS USED TO DEVELOP THE PREFERRED VIEW CONVENTION

1. The development started with this view of the ISS (preferred view).

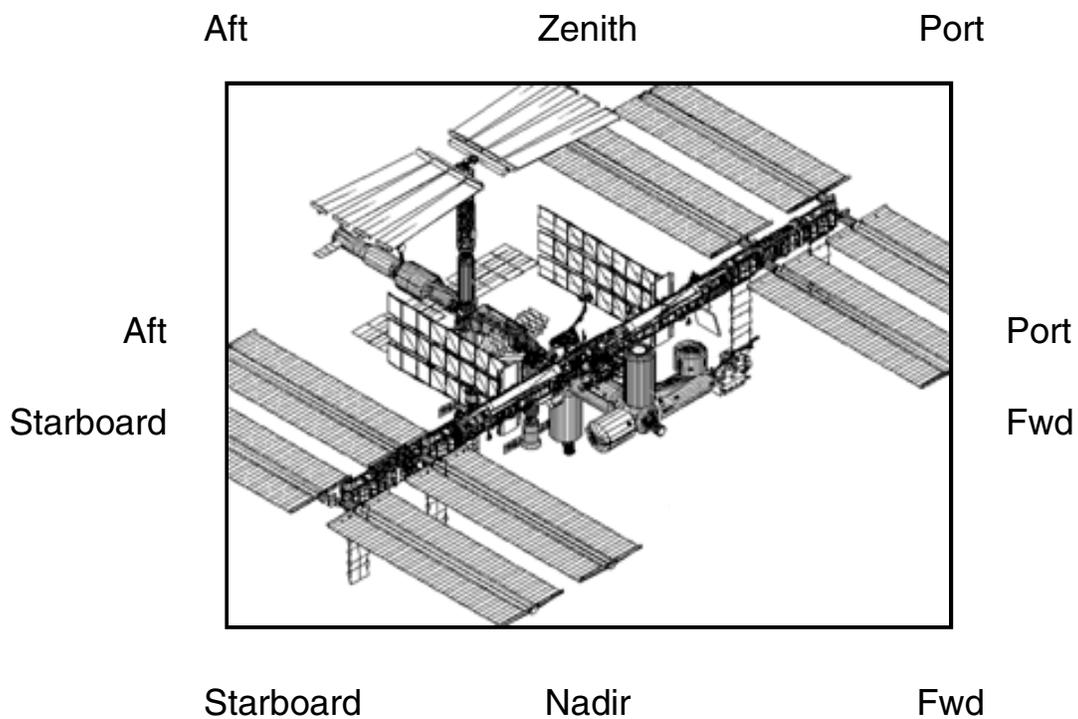


Figure 9-5. Step 1 in the development of the preferred view

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2. This next step simplified the ISS as follows:

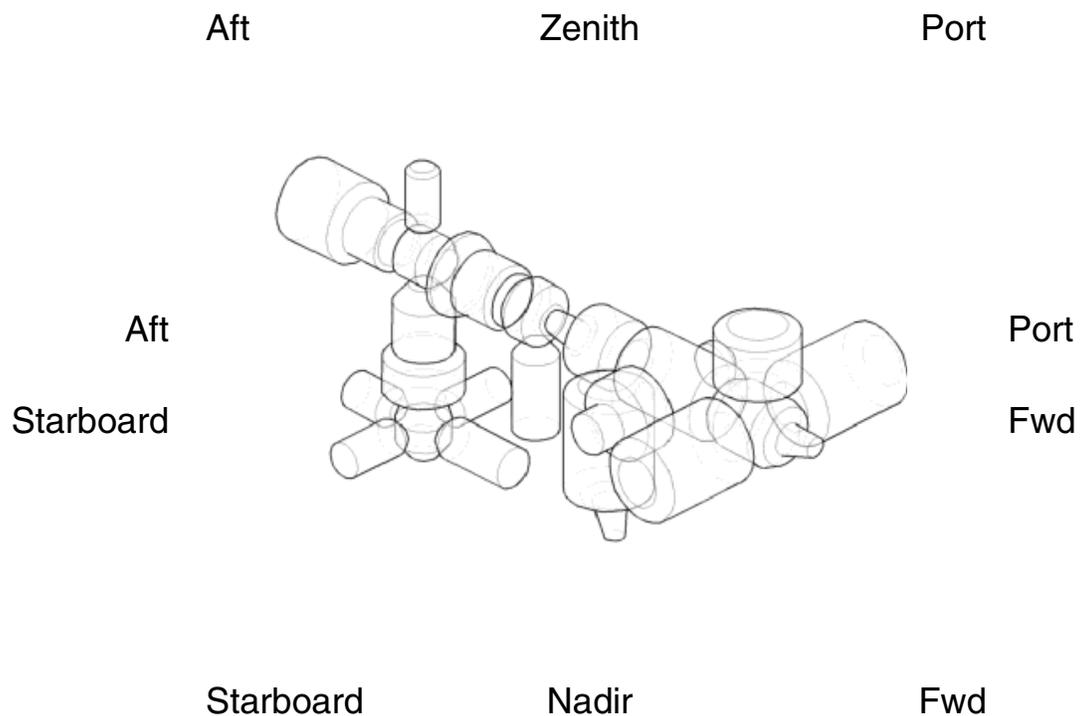


Figure 9-6. Step 2 - Simplification of the ISS

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3. The next step produced the orthographic view:

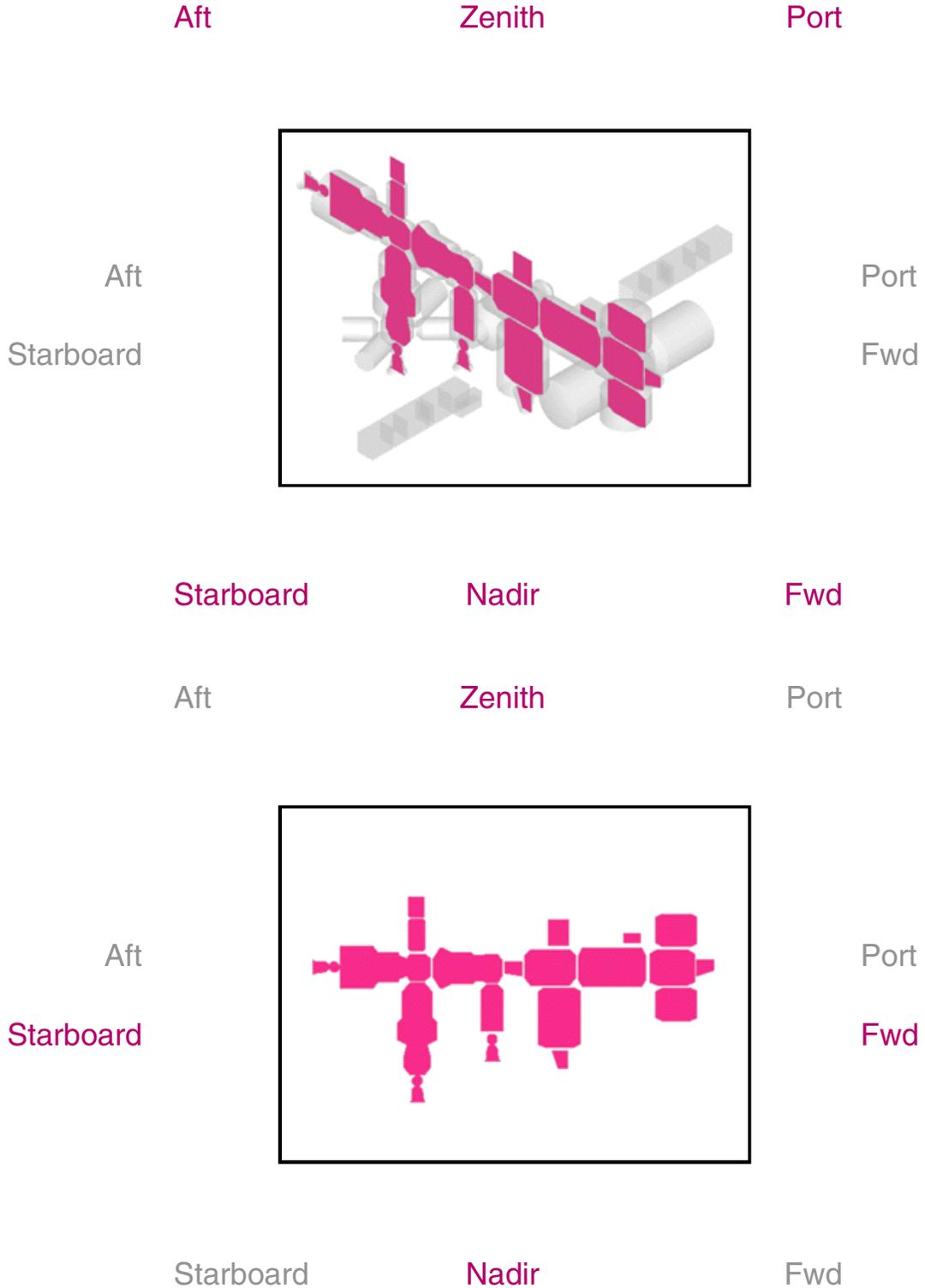


Figure 9-7. Orthographic view (top) to preferred view (bottom)

In Figure 9-8, a template was derived from following the preferred view convention:

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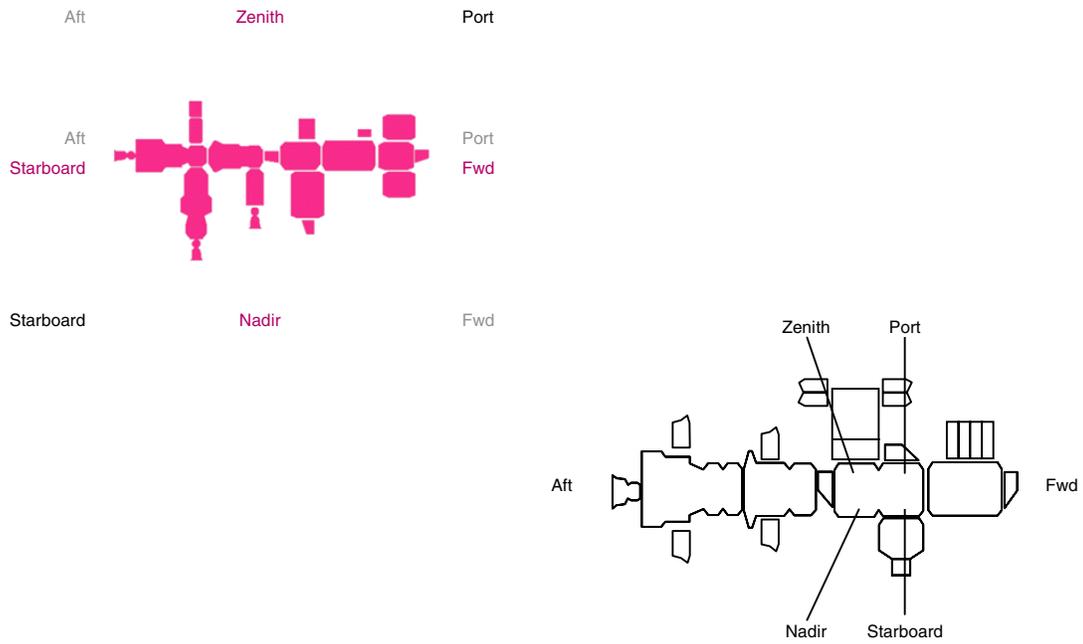


Figure 9-8. Template

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9.4 INFORMATION PRESENTATION GUIDELINES

When looking at diagrams that illustrate functions, the logic flow needs to be consistent across all graphics products. Figures 9-9 to 9-12 illustrate the guidelines that will ensure this consistency (for more information, see Section 4.11 of the ISS Display and Graphics Commonality Standards).

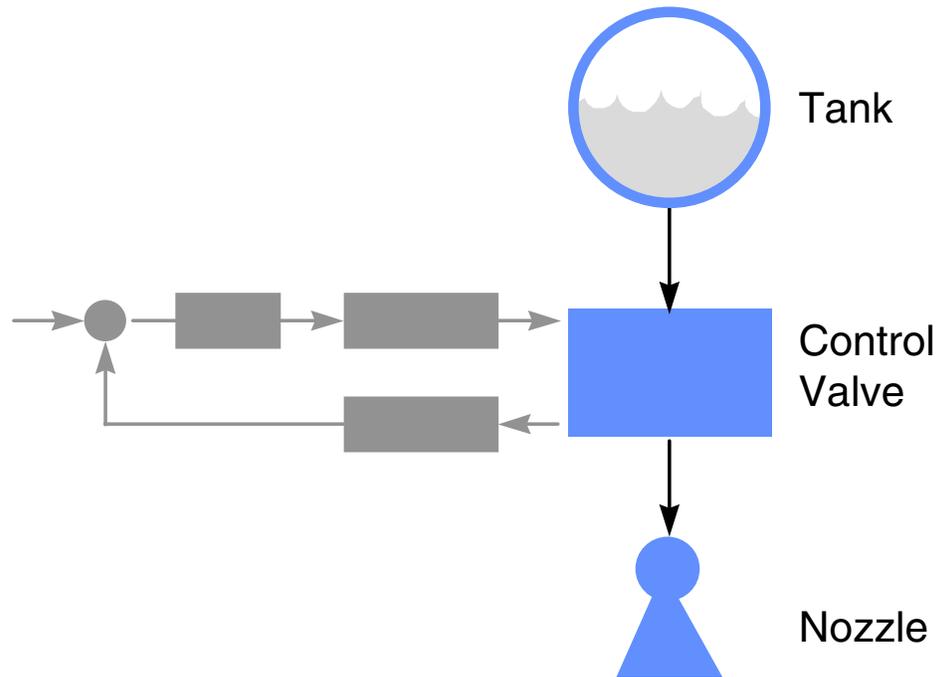


Figure 9-9. Potential flow - Left to right, top to bottom

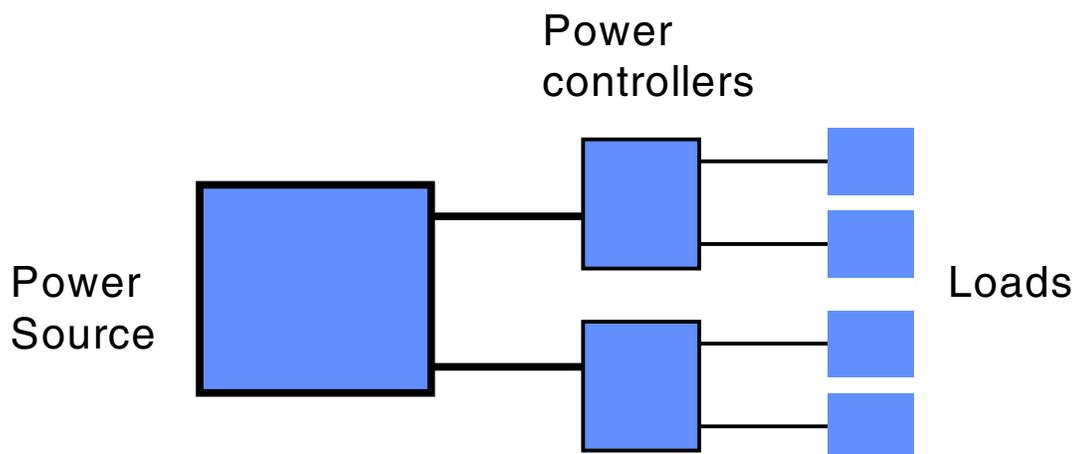


Figure 9-10. Power distribution - Power sources on left and loads on the right

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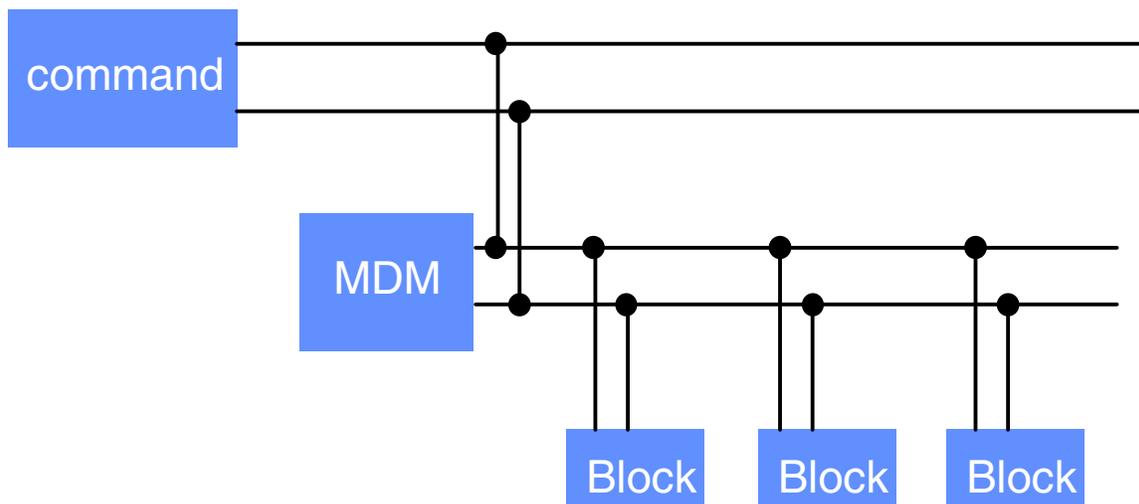
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Figure 9-11. Control hierarchy - Left to right and top to bottom

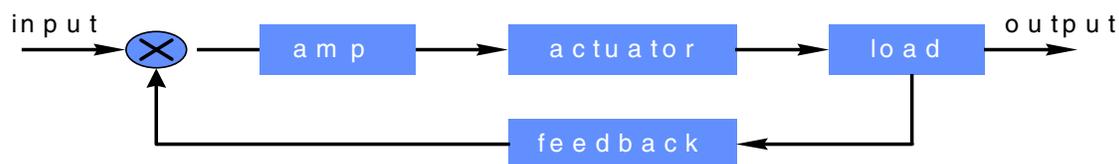


Figure 9-12. Signal flow - Left to right, clockwise loop, and feedback below forward path

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9.5 STEP BY STEP DRAWING DEVELOPMENT METHOD

The following method for producing visually consistent products across all ISS systems is suggested (see Figures 9-13 to 9-16). The first step is to produce a drawing that shows the relationships among the functions within a system.

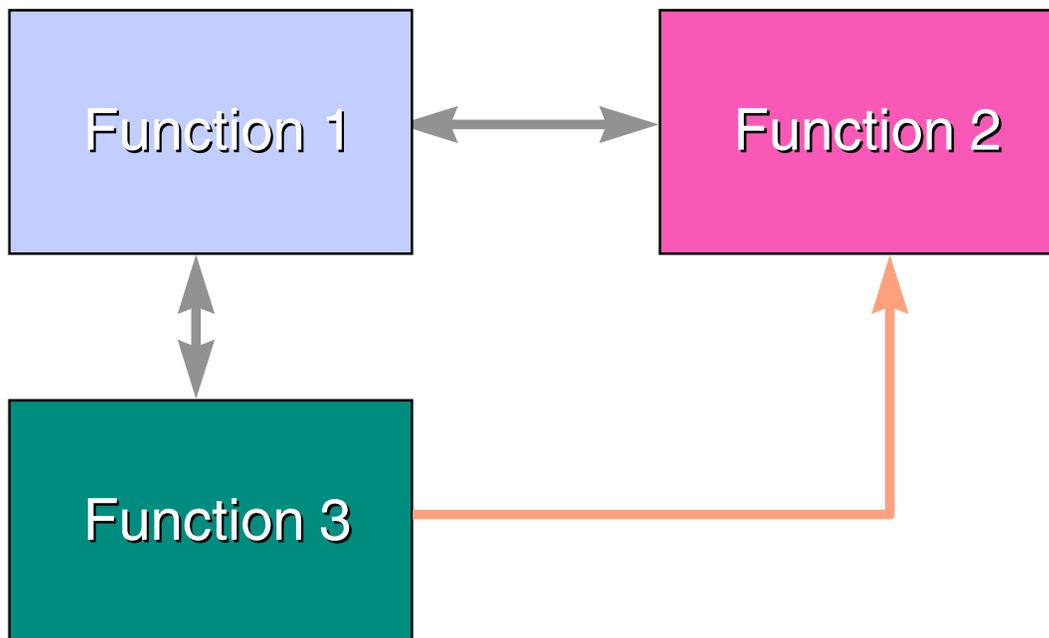


Figure 9-13. Step 1 - Show relationships among the functions within a system

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The second step in the drawing development process is to produce a drawing that shows the blocks and parts that make up each function within a system. One additional visual tool that may be included is color, which can provide an excellent method of linking the blocks and parts in this second drawing to the functions they performed in the first drawing.

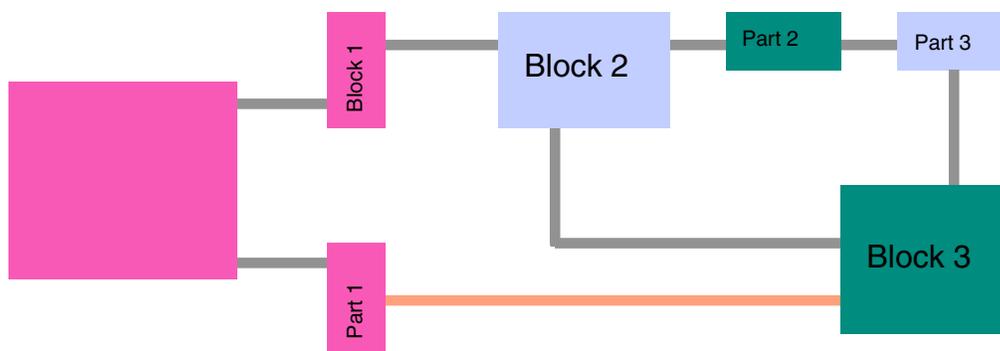
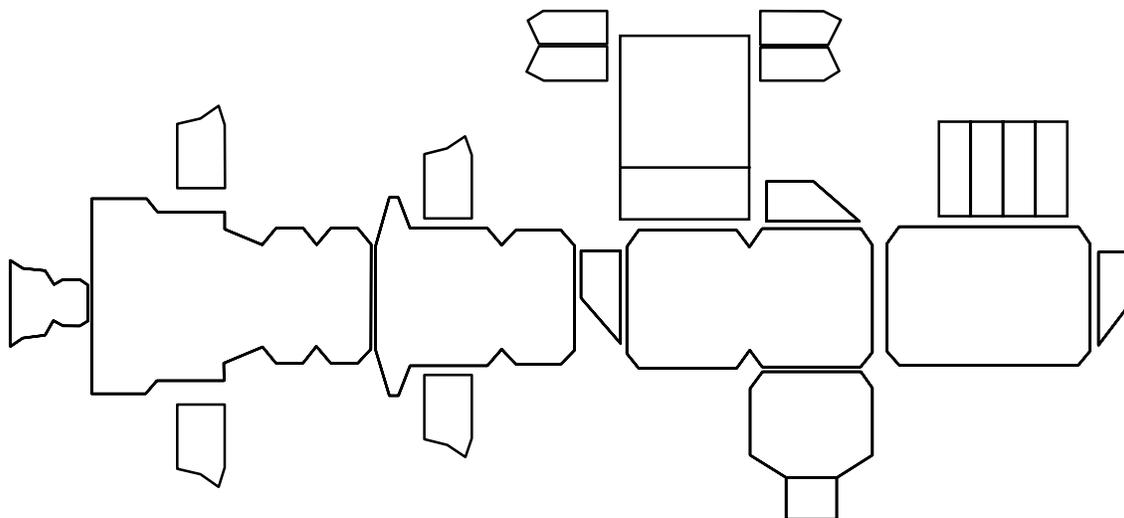


Figure 9-14. Step 2 - Show blocks and parts that make up each function within a system

Because a drawing of this type can be laid out in many different ways, for all drawing developers, a common starting point is needed to ensure visual consistency. A graphics tool described previously in this section is recommended to provide both a common layout and a spatial framework.

The following image of the ISS is the graphics tool (template) (Figure 9-15).



Using the template and then following the “Diagram Level Definitions” in Section 5 results in common layouts.

The next step is to map the drawing developed in step 2 (parts and blocks showing the functions that make up a system) into the template.

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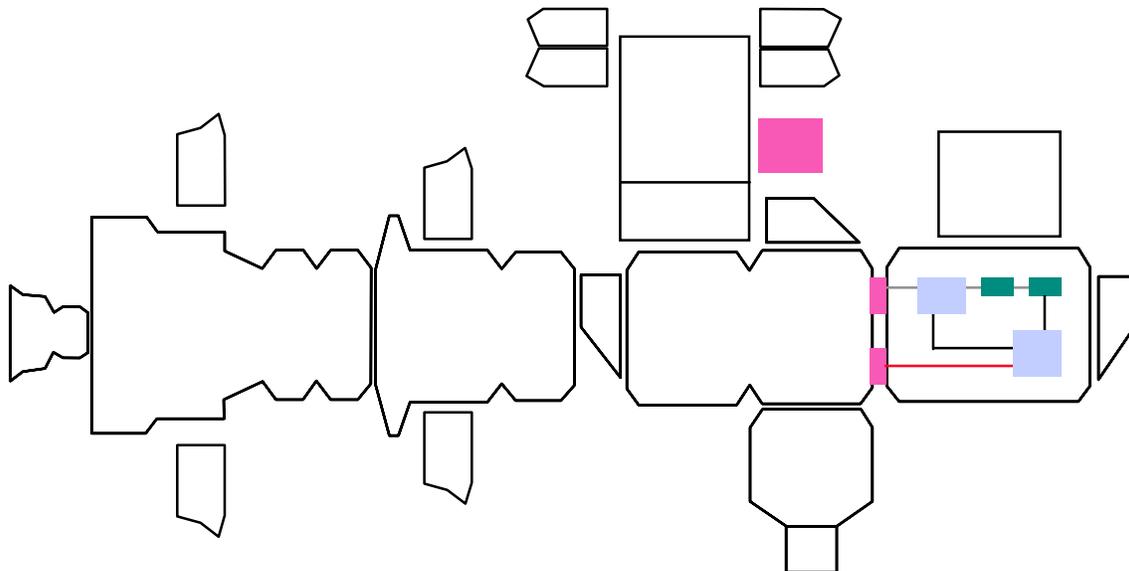
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Figure 9-15. Step 3 – Drawing mapped into template

An additional benefit of the structured approach of showing system function within each module is that it allows the instructor to teach the interactions, or lack of interactions, that take place across multiple modules. For example, a Thermal Control System (TCS) instructor can show that the TCS is a distributed system within the U.S. modules. At the same time, the instructor can show that all Russian modules have their own TCS.

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9.5.1 Summary

Figure 9-16 illustrates the three steps in the drawing development method.

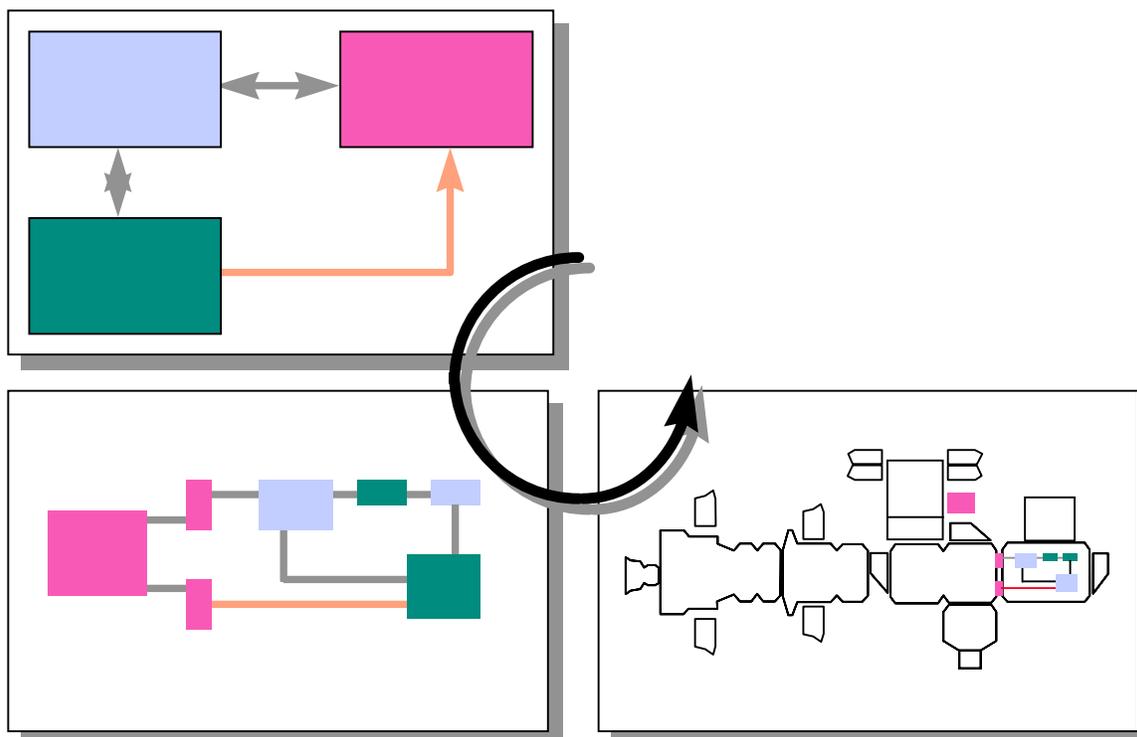


Figure 9-16. Summary of drawing development method

9.6 BASIC TEMPLATE USAGE GUIDELINES

The template is intended to form the foundation for creating a set of visually consistent graphics. It does not restrict the drawing developer from producing graphics that do not follow the template.

The entire template can be used as a whole, in groups of modules, or one module at a time. If a system affects only two modules, those two modules are all that need to be shown in the diagram. However, to provide the user with a visual reference, a template icon should be used with the modules affected by the system clearly indicated (see Figure 9-17).

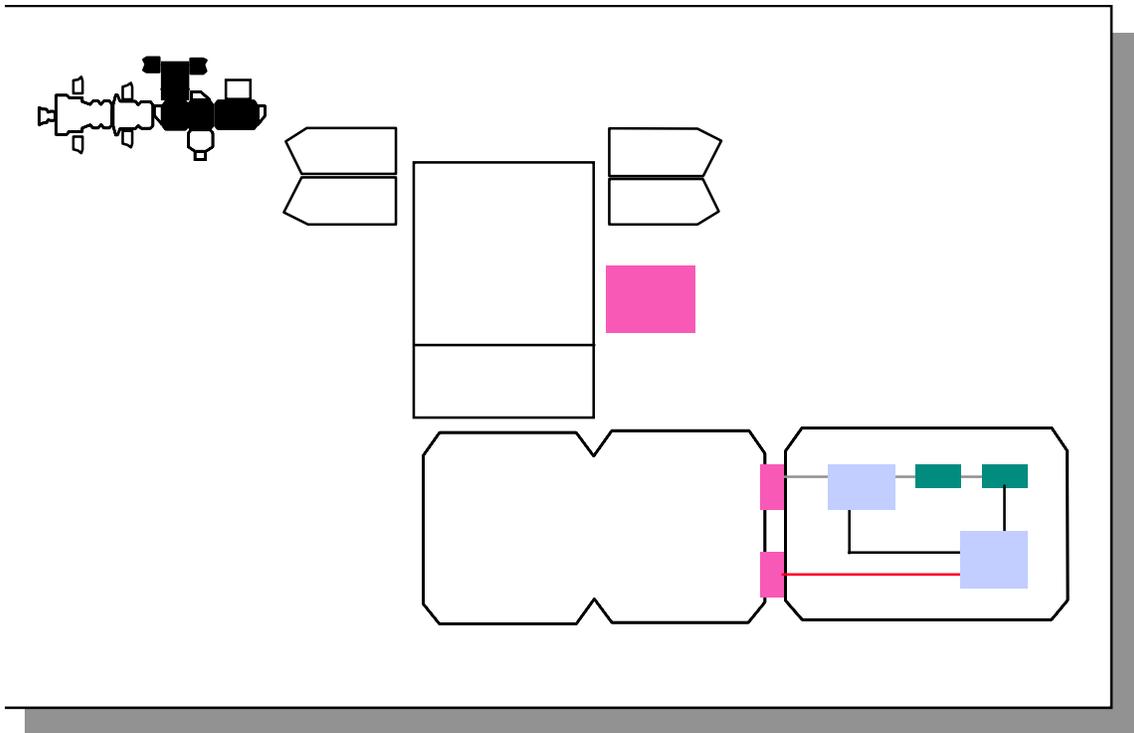


Figure 9-17. Use of template icon

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10.0 SCHEMATIC LEVEL DEFINITIONS FOR ISS TRAINING

The primary purpose of the “Schematic Level Definitions” is to provide a tool for developers to produce schematics with the correct level of detail. If followed, the level 1 schematic definition will produce schematics with a low level of detail, and level 2 and level 3 will produce schematics with progressively more detail.

NASA and GCTC, at the TIM held the week of 9/8/97 at JSC, agreed that drawings need to be categorized in different levels of detail. In order to ensure consistency and to guide drawing developers, each level of detail for drawings (diagrams) needs to be clearly described.

The schematic level definitions provide guidance for three different levels of drawing (schematic) detail. These diagram level definitions are an important tool in the drawing development process. Without detail level definitions that are clear to all developers, it will be extremely difficult to produce consistent drawings (schematics) for all the different ISS systems (see Appendix C).

10.1 LEVEL 1 - BLOCK SCHEMATICS

A level 1 schematic shows spatial and/or functional information about a super-system down to a level of detail including its systems and their subsystems. A single level 1 schematic will generally focus on one system's role in the ISS's capability. Not all blocks inside the system or subsystem need to be included, and detail inside blocks is not generally shown. If a system extends across multiple modules, then multiple sheets may be produced for each module. In this case, connectivity across modules must be annotated.

10.1.1 Three Types of Level 1 Schematics

- a. Type 1A - Schematic shows the function of a given system. The schematic does not have to show spatial orientation.
- b. Type 1B - Schematic shows the major processes and functions that a system performs within modules. Modules have the correct spatial orientation. System and subsystem representation inside each module are functionally correct, but not generally spatially correct. The 1B schematics are block schematics (see Section 4) within a spatial template (see Section 9). - all 1B diagrams use a standard Flight 8A station configuration template.
- c. Type 1C - Schematic is either a 1A or a 1B schematic with dependencies. Schematics Module functional overviews may show a single system which includes software, electrical, or other system dependencies. These overviews are designated 1C. Color may be used to show these dependencies.

10.2 LEVEL 2 - FUNCTIONAL SCHEMATICS

A level 2 schematic shows all blocks of the major processes and system functions represented in level 1. The schematics must show the function of each block. These level 2 schematics are functional schematics (see Section 4). If a template is used, then the schematic is a functional schematic within a spatial template (see Section 9).

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If a system goes across multiple modules, then multiple single module schematics may be produced; (i.e., a schematic is produced for each single ISS module (SM, FGB, NODE, LAB, etc.)). If this is done, then the connectivity across modules must somehow be annotated.

Blocks may be functionally connected without showing all the physical detail of the connections.

10.2.1 Three Types of Level 2 Schematics

- a. Type 2A - System Functional Overview - Schematic shows the function of a given system. The schematic does not have to show spatial orientation.
- b. Type 2B - Module Functional Overview - Schematic is a functional schematic within a spatial template. - All type 2B schematics use a standard template as their foundation.
- c. Type 2C - Schematic is either a 2A or a 2B schematic with dependencies. Schematics include software, electrical, or other system dependencies. Color may be used to show these dependencies.

10.3 LEVEL 3 - PRINCIPAL SCHEMATICS

A level 3 schematic adds all block detail and connectivity. The level of detail should show connectivity between all functional parts of the blocks. These level 3 schematics are principal schematics (see Section 4).

Like level 2, this schematic can be done on the entire template but will most likely be done one module at a time. At this level of schematic, there may be only one subsystem represented per schematic. For example,:

ECLSS may show three subsystems of ECLSS on a single level 1 or 2 schematic, but on these level 3 schematics that might not be possible because of the amount of detail.(do the right thing).

Also at this level, you should provide as much information as possible on the processes taking place within the blocks detail. For example, flow rates, inlet and outlet temperatures and pressures, voltage level, amperage, etc., should be shown.

10.3.1 Three Types of Level 3 Schematics

- a. Type 3A - System Functional Overview - These Schematic shows the function of a given system. The schematic does not have to show spatial orientation.
- b. Type 3B - Schematic is a functional principal schematic (see Section 4) within a spatial template (see Section 9).- all 3B diagrams use a standard 8A template as there foundation.
- c. Type 3C - Schematic is either a 3A or a 3B schematic with dependencies. Schematics include software, electrical, or other system dependencies. Color may be used to show these dependencies.

For order for graphics products to be of value, they must correspond to specific training objectives. Table 10-1 maps the different schematic levels described in this section to the different levels of training detail from Section 2 (the Hierarchy of ISS Functional and Physical

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Divisions), to the training objectives taught at each level, and then to the questions that are answered at that training level.

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Schematic level	Training level detail	Training objectives	Questions answered
Level 1	Super-system, Station, Segment, Module, System Overview	Identify the major functions performed by the system. Identify the subsystems within the system. Identify the system interfaces to other systems.	Overall system purpose, major components, major subsystems, major interfaces, functional interfaces, functional constraints, impact of loss of function on flight operations.
Levels 1 and 2 LEVEL 1 & 2	Super-system, Station, Segment, Module, System, Subsystem Overview	Identify the function(s) of the subsystem. Describe the capabilities/constraints of the subsystem. Describe the subsystem interfaces to other system/subsystems.	Subsystem purpose, what blocks are in each module, functionality, interfaces, operational constraints, redundancy, and impact of loss of function on the systems operations.
Levels 2 and 3 LEVEL 2 & 3	Super-system, Station, Segment, Module, System, Subsystem, Block Overview	Identify the function(s) of the block. Identify the block interfaces to other systems, subsystems, and blocks. Describe the capabilities and operational constraints of the block.	Block purpose, operational capabilities and constraints, interfaces, failure impacts, FDIR capabilities.
Level 3	Super-system, Station, Segment, Module, System, Subsystem, Block, Part Overview	Identify and describe the parts associated with the block including the sensors/actuators. Explain the purpose of every part in block operations. Describe the impact of part failures on the block.	Systems/subsystem sensors at a part level. Block operational principles, performance and part failure impact on block operations.

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11.0 UPDATING GRAPHICS PRODUCTS

11.1 REASONS FOR UPDATES

Graphics products must be updated if any of the substantial information contained in them changes. This includes changes in the design of a system or component as well as changes in the operations. Changes in operations might involve a change in the crew responsibilities and activities with respect to the monitoring and control of the system. If during the practical phase of the training program or during the onboard operational phase, any incorrect information or lacking information within the graphics product is identified, this is also a basis for updating the product. Changes in the use of specific acronym or terminology may also prompt the need to update the graphics product.

11.2 PROCESS FOR UPDATES

Updates to a graphics product must be initiated by the management or the system expert responsible for the maintenance of the graphics product. The technical content of the changes must precisely correspond to documentation approved by the program; this includes design drawings and flight data file products.

The changes are made only to that graphics product of the whole set that is affected. A “change package” must be issued that contains the affected graphics product pages as well as a cover page identifying those drawings that are being replaced in the original set and those that are to be inserted into the set. An example of a change package is included in Appendix A. This change package should provide a brief description of the changes that were made and the rationale for making them. The cover page of the change package must also include reference to the source of changes and the signature of the expert who made the changes and the manager who approved them. The change package will be submitted electronically to the other partners for incorporation into the final document.

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ACS	Atmosphere Control and Supply
C&DH	Command Data Handling
CBT	Computer Based Training
CMP	Configuration Management Plan
CPA	Control Panel Assembly
DCN	Drawing Change Notice
DGCS	Display and Graphics Commonality Standards
DT	Training Division Mail Code
ECLSS	Environmental Control and Life Support System
EPS	Electrical Power System
ETCS	External Thermal Control System
EVA	Extravehicular Activity
FDS	Fire Detection and Suppression
FGB	Functional Cargo Block
GCTC	Gagarin Cosmonaut Training Center
GNC/P	Guidance, Navigation, and Control/Propulsion
IDAGS	Integrated Display and Graphics Standards Panel
ISS	International Space Station
ISSSH	International Space Station Systems Handbook
ITCS	Internal Thermal Control System
JSC	Johnson Space Center
MDM	Multiplexer/Demultiplexer
MOD	Mission Operations Directorate
NASA	National Aeronautics and Space Administration
ORU	Orbital Replacement Unit
PPA	Pump Package Assembly
PTT	Part Task Trainer
RPCM	Remote Power Control Module
S&M	Structures and Mechanical
SM	Service Module
SSTF	Single System Training Facility

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TCS	Thermal Control System
TDSP	Training Development Support Plan
WRM	Water Recovery and Management

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APPENDIX B SIGNATURE REQUIREMENTS AND THE DCN PROCESS

B.1 SIGNATURE REQUIREMENTS

For all drawings created by the U.S., there will be four signatures. Those signatures are:

- a. DT Instructor who created the drawing.
- b. DT Group Lead. This is the group lead for the instructor who created the drawing.
- c. DF Flight Controller who reviewed the drawing for technical accuracy.
- d. DF Group Lead. This is the group lead for the DF flight controller who reviewed the drawing.

For the Russian drawings, the signature process is still TBD.

B.2 DRAWING CHANGE NOTIFICATION (DCN) PROCESS

- a. Page A-2 - "Drawing Change Record" will provide all users with a synopsis of all drawing changes that have taken place. This form will be updated each time a new "Drawing Change Package" is published. The drawing user will be able to use this "Drawing Change Record" to go back and make sure that his/her set of drawings is up to date.
- b. Pages A-3 and A-4 - "Drawing Change Package" will be used to notify all drawing users with information about each change to the complete list of drawings. The changes will be referred to as Drawing Change Notices (DCNs). For U.S. drawings, this drawing change package will be approved by the DT Project Lead and the DT Division Chief. For Russian drawings, the approval process is TBD.
- c. Page A-5 - "ISS Drawing Change Requirement" will be filled out by anyone who wants to make a change to a drawing. After this form is filled out, it needs to be mailed to the respective Drawing Project Manager. For Russian drawing changes, this form should be submitted to GCTC/V. Cherkashin. For U.S. drawing changes, this form should be submitted to NASA/JSC/DT121/J. Ruskowski.

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Drawing Change Record (sample)

**ISS Graphics
May 1998
Drawing Change Notices**

DCN-1	6/18/98	Remove drawing ECLS1A-OV-8A
DCN-2	6/30/98	Add drawings CDH2A-PMCU-8A (Rev 2) and CDH2A-GNC-8A (Rev 2)
DCN-3	6/31/98	Remove drawing CT1A-OV-8A (Rev 1) and replace with CT1A-OV-8A (Rev 2)

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Drawing Change Package (sample)

ISS Graphics
U. S. Drawing Changes

DCN-1
June 1998
Prepared by:

DT121/J. Ruskowski
NASA Drawing Project Lead

Approved by:

DT/F. Hughes
NASA Training Division Manager

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ISS GRAPHICS

DCN-1

June 2, 1997

DRAWING CHANGE INSTRUCTION SHEET

Remove and replace the following drawings:

ECLS1A-OV-8A
CDH1A-CW1-8A
CT1A-OV-8A

Add the following new drawings:

CT1A-RSOV-1R
CT2A-SM-TLM-1R

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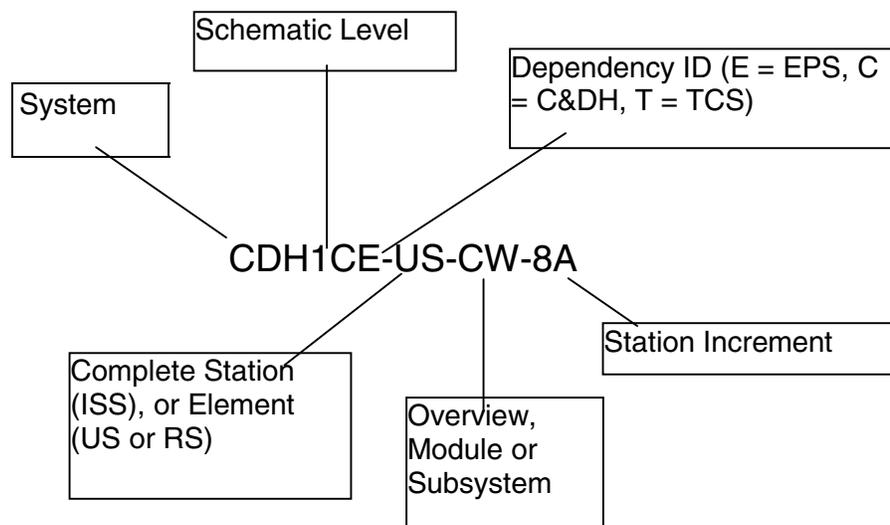
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ISS Drawing Change #	ISS Drawing Change Requirement		Page 1 of —
Change Initiated by:			
Name: _____			
Organization: _____			
Phone: _____			
Drawing Title:			
Reference Documentation (vendor drawing, ISSSH document, etc.):			
Operational Need Date: _____	Shuttle Flight: _____ Soyuz Flight: _____ ISS Increment: _____		
Description of Change:			
(use continuation page if necessary)			
Justification for Change:			
(use continuation page if necessary)			
Impact of Non-Incorporation:			
(use continuation page if necessary)			
Concurrence: Signature/Organization/Date	ISS Crew Member:	Project Lead: (NASA - DT121/J. Ruskowski) (GCTC - V. Cherkashin)	
Change Initiator	Date	Change Initiators Immediate Supervisor	Date
Mail Completed form to the respective Project Lead. Changes to Russian Drawings should be mailed to GCTC/ V. Cherkashin. Changes to United States drawings should be mailed to NASA/JSC/DT121/J. Ruskowski.			

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To assist in the documentation and tracking of these schematics, a numbering system was derived from ANSI Y32.16 (Panel Reference Designations). This in combination with definitions from the ISS Schematics Meeting held on 11-18-97 created the following pattern.

**C.1 SYSTEM**

a. For the U.S.-produced schematics, the ISS has been broken into the following systems:

1. CDH - Command and Data Handling
2. CT - Communications and Tracking
3. ECLS - Environmental Control and Life Support
4. EPS - Electrical Power System
5. GNC - Guidance, Navigation, and Control
6. SM - Structural and Mechanical
7. TCS - Thermal Control System
8. ROBO - Robotics

b. For the Russian-produced schematics, the following additional system is used:

1. ÑÓÁÊ - Onboard Complex Control System Command Matrix

Note: For this naming convention, the ampersand (&) usually present in some of these system names has been left out. For example, C&DH is simplified to CDH.

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C.2 SCHEMATIC LEVEL

All schematics have a level designation that indicates that amount of detail provided in each drawing. The definitions for these different levels are provided in Section 10 of this document.

C.3 DEPENDENCY

By definition, schematics at levels 1C, 2C, and 3C will show not only the function of a system but also the C&DH, EPS, or TCS dependencies. In the naming convention, schematics that show the C&DH dependencies of the system will have an additional "C" following the schematic level in the title. Schematics that show the EPS dependencies of the system will have an "E" following the schematic level in the title. Schematics that show the TCS dependencies of the system will have a "T" following the schematic level in the title.

C.4 COMPLETE STATION OR ELEMENT

This portion of the naming convention is intended to show the users how much of the Station is visible.

- a. ISS - The system's role (based on schematic level) in both U.S. and Russian elements.
- b. US - The system's role (based on schematic level) in a U.S. module or modules.
- c. RS - The system's role (based on schematic level) in a Russian module or modules.

C.5 OVERVIEW, MODULE, OR SUBSYSTEM

If the schematic provides an overview of a system, then an "OV" will be in this portion of the drawing name. If the schematic shows information about a specific module, one of the following module designators will be in this portion of the schematic name (these are US and Russian segment designators all other partners will need to develop designators to represent their respective modules):

- a. LAB - U.S. Laboratory
- b. N1 - U.S. Node 1
- c. AL - U.S. Airlock
- d. SM - Russian Service Module
- e. FGB - Russian FGB

If the schematic shows information about a specific subsystem, a subsystem designator will be in this section of the drawing name. Subsystem designations come in many different forms. Here are some examples from the ECLS schematics:

- a. ACS - Atmosphere Control and Supply
- b. FDS - Fire Detection and Suppression
- c. WRM - Water Recovery and Management

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For the initial training products, most of the drawings provide information about each system through ISS increment 8A.

Table C-1 provides examples of how this naming convention has been used:

Table C-1. Use of naming convention

System	Level	Connectivity Dependency E = EPS C = CDH	Station or element	Module, subsystem, or overview	Station increment	Combined name
ECLS	1B		US	OV	8A	ECLS1B-US-OV-8A
ECLS	2C	C	US	OV	8A	ECLS2CC-US-OV-8A
ECLS	2B		US	ACS	8A	ECLS2B-US-ACS-8A
ECLS	2C	C		LAB	8A	ECLS2CC-US-LAB-8A
ECLS	3C	E	US	OV	8A	ECLS3CE-US-OV-8A
ECLS	3C	E	US	AL	8A	ECLS3CE-US-AL-8A
ECLS	2B		ISS	OV	8A	ECLS2B-ISS-OV-8A
ECLS	2B		RS	OV	8A	ECLS2B-RS-OV-8A

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The Russian and American sides use many terms that have different meanings for each partner. It is essential to have a list of commonly used graphics terms to produce drawings that have the same level of detail based on common graphics rules.

Block	A grouping of separate parts into a group to form a single structure to perform a function for a subsystem. A block is generally connected to control signals, electrical supply, thermal support, or other environmental support services to perform its job. Examples include a Multiplexer/Demultiplexer (MDM), a Pump Package Assembly (PPA), a Remote Power Control Module (RPCM), a latch assembly, and a Controller Panel Assembly (CPA).
Connection line	Line segment that indicates a connection between functional parts of an article.
Dimensional drawing	A drawing that shows a contour (outline) representation (simplified) of the article with dimensional, installation, and connectivity sizes.
Drawing	A scale projection or image of objects on a certain medium (paper, tracing paper, film, etc.) using graphical images such as points, straight and curved lines, symbols, and conventional graphical designations.
Electrical schematic	A diagram that shows the functions of systems using electricity.
Electro logical schematic	A diagram to show the logical control of a system with discrete control signals. This diagram is primarily used to depict electrical relay systems.
Functional group	A collection of separate parts performing a unique function in the component that are not combined into a single structure (amplifier, modulator, generator, etc.).
Functional part	A part, functional group, or device that performs a unique function.
Functional schematic	Explains the specific processes occurring within individual functional parts of an onboard system or within the onboard system as a whole, the role of the crew, and the basic components for monitoring and controlling the system.

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General viewdrawing	A graphic that defines the structure of the article (ISS, system, block, etc.) and the interaction of its basic components and explains the principle of operation of the article.
Graph	A graphic that clearly shows functional relationship between some values.
Graphic symbols	Graphic representations of diagram elements created in compliance with the principle for standardization of graphic symbols by the International Partners in the ISS program; grouped in tabular form by type and purpose.
Graphic training material	A collection of drawings, technical drawings, diagrams, tables, and photographs that are related by the information they contain or the procedures they describe; used in the crew training process; employs various guidelines and symbols in its development.
Hydraulic schematic	A diagram that shows the functions of systems using liquids.
Kinematic schematic	A diagram that shows the kinematic functions of mechanical objects at the block or part level.
Module	A single structural element that provides significant additional functionality to the ISS; usually contains multiple systems and may be pressurized or unpressurized. Examples include FGB, SM, Node 1, and S0 Truss.
Part	Separate component elements that perform a unique function and cannot be separated into parts that have an independent functional purpose. Examples include a single valve, a resistor, a controller card, a pump, a latch, etc.
Photographic training material	Images of objects produced using photographic technology and that are intended for use in the crew training process.
Pneumatic schematic	A diagram that shows the functions of systems using gases.

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Principal (complete) schematic	Defines the full complement of an onboard system parts and their interrelationships; usually offers a detailed description of the operating principles of the onboard system, scope, and content of monitoring and control data as the crew interacts with the system in both nominal and off-nominal modes.
Schematic	A graphic that uses conventional graphical symbols to show electrical, hydraulic, and other components of the article and their interrelationships.
Segment	A number of modules that can be logically grouped together by form, function, or program responsibility. Examples include the Russian segment and the American segment.
Spatial drawing	This paragraph appears twice in the original. A spatial drawing provides the correct physical location of objects to a particular level of detail. For example, within the ISS or one of its segments, systems and subsystems are located in their respective modules.
Station	A group of segments (or modules) that are combined to form a complete orbital complex.
Structural schematic	A diagram that identifies the main functional parts of an onboard system, their purpose, interrelationships, and the crew involvement in the system operation.
Subsystem	A collection of blocks, functional groups and parts that function together to perform a function within a system. One example is the fire detection and suppression components of the Environmental Control and Life Support System (ECLSS).
Super-system	An organization that includes the orbital station, other functionally connected space vehicles, and also ground facilities.
System	A collection of blocks, functional groups, or parts that function together to perform a unique function supporting activities in a module, segment, or in the entire ISS. Some systems may interface across the larger super-system. Examples include the Electrical Power System (EPS), the Thermal Control System (TCS), etc.
Table	A list of information and numerical data compiled in columnar format; uses a specific system.

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Technical drawing

Type of graphic that depicts a space object (orbital station, separate modules, block, etc.) including both an external view and a cross-section, its design, functional stages, and so on. When creating a technical drawing, it is acceptable to deviate from the scale standards; however, the actual proportions (relative dimensions) of the object depicted must be strictly observed.

Template

A template is a drawing that provides a consistent means for showing how ISS modules are arranged. The template will normally be an orthogonal view, but isometric templates are permitted. Standard rules will define how views of modules may be reoriented or otherwise distorted.

Theoretical drawing

Identifies a geometrical shape (outline) of the article and the coordinates of its main components. The center of mass coordinates may also be shown.

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The following guidelines should be used when developing and using symbols for figures and drawings:

- a. Symbols must be clear and easy to comprehend.
- b. Symbols may change their shape and color if it helps the user gain additional information and if the symbol does not become complicated.
- c. The object or function represented by the symbol must be unique. This provision has two requirements:
 1. The size of the symbol must be adequate to determine its purpose and to distinguish it from other symbols.
 2. Whenever possible, the symbols must be pictographic in form.
- d. Only when possible, must symbols be accompanied by textual markers, especially if the symbol represents an object or function that is not sufficiently symbolic. In those cases when the symbol itself does not become distorted, the textual markers should be placed inside the symbol.

New symbols must be submitted using the change request process to the ISS Integrated Display and Graphics Standards (IDAGS) Panel for inclusion into the "ISS Display and Graphics Commonality Standards (DGCS)."

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This appendix provides examples of different ISS diagrams that have been created using the guidelines in this document. Observe the following in the examples:

- a. Schematic Naming Convention from Appendix C
- b. Schematic Level Definitions from Section 10
- c. Template usage and using the template as an icon from Section 9.6

The following schematics are included in this appendix as examples:

Level	Schematic name	Schematic description
1A	CDH1A -US-PL-8A	US C&DH 1A - Payload Network
1B	CDH1B-US-CW-8A	US C&DH 1B - Caution & Warning
1C	SM1CE-US-OV-8A	US S&M 1C - US OV W/EPS Dependencies
2A	GNC2A-US-PS-8A	US GNC 2A - US Pointing and Support SW
2B	TCS2B-US-I-8A	US TCS 2B - Internal TCS
2C	ROBO2CE-US-MT-8A	US ROBO 2C - Mobile Transporter W/EPS Dependencies
3A	ECLS3A-RS-ACY-8A	RS ECLS 3A – Waste Control System
3B	EPS3B-US-LAB-8A	US EPS 3B - LAB
3C	TCS3C-US-N1&AL-8A	US TCS 3C - Node 1 and Airlock

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APPENDIX G
ISS DGCS DEVIATIONS FROM STANDARDS
REQUEST FORM

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Document: SSP 50313, ISS Display and Graphics Commonality Standard	DGCS Change Request				No.:	
TO: Integrated Display And Graphic Standards Panel Chairman:	Initiator/Mail Code/Phone Number:				Date:	
Title:					Page No./Paragraph No. of standard affected:	
Description of Request:					Category of Deviation/Change/Addition: ___ Single Flight ___ Unique Application ___ Multi-Flights ___ Generic	
Rationale for deviation/change/addition:						
Recommendation (attach examples).						
				_____ Initiator	_____ Date	
IDAGS Panel Response:					Recommended Disposition: ___ Approved ___ Approved with modification ___ Disapproved ___ CR required ___ Withdrawn ___ Open	
				_____ Approval	_____ Date	
					_____ Date of closure	
IDAGS Panel Members Concurrence:						
Organization	NASA	RASA	NASDA	ESA	CSA	
Date						
Initials						

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SECTION H1.0

INTRODUCTION

H1.1 PURPOSE

This appendix serves as a guide for the design of payload displays. It contains guidelines and standards for designing displays that:

- minimize crewmember training,
- minimize the number and severity of crewmember errors,
- provide rapid recovery from errors, and
- enhance productivity and science return.

This appendix supports the evaluation of onboard ISS payload displays which shall be reviewed and approved prior to crew training and flight. The International Partner (IP) authority responsible for approving payload displays will check the display for consistency with other payloads and correlation with procedures. In the U.S., this authority is the Payload Display Review Panel (PDRP).

H1.2 SCOPE

This appendix, which supplements the ISS Display and Graphics Commonality Standards (DGCS), shall apply to all onboard ISS payload displays. Unless otherwise stated, Appendix H shall take precedence over all guidelines and standards provided in Commercial Off-the-Shelf (COTS) software products reference material.

Appendix H contains information unique to payload displays. Payload Developers (PD) should refer to the parent document (DGCS) of this appendix for guidance on overall design concepts and guidelines. This appendix contains information unique to payload displays.

H1.3 PAYLOAD DESIGN CONSIDERATIONS

ISS payload displays must be designed to enhance crewmember productivity and achieve scientific objectives. To develop displays that meets these goals, it is important to have an understanding of the crewmembers as payload users, and the payload operations environment.

The ISS onboard payload displays will be operated by a rotating complement of crewmembers from many different countries. The crewmembers will have varying degrees of English proficiency and varying degrees of experience with software.

ISS crewmembers will have minimal pre-launch training, a long interval between training and flight, and a large number of diverse payloads to operate. In addition, retention of the payload training is uncertain with long duration spaceflight, particularly when payload displays may not be used on a regular basis. For these reasons, use of displays should be intuitive and common across payloads.

ISS software will be hosted on a variety of computer platforms. The primary vehicle displays run under Solaris (UNIX), the Manual Procedures Viewer (MPV) software runs under Windows, and payload software built by developers all over the world may run on a variety of different platforms. Given that crewmembers will frequently move among these diverse operating systems, adherence to display standards to achieve a common "look and feel" is paramount to a safe and usable onboard environment.

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H1.4 PAYLOAD DISPLAY DEVELOPMENT PROCESS

Payload display development is typically the responsibility of the individual PD team. For U.S. payloads and payloads flying under a U.S. Science Program, the Payload Display Review Panel (PDRP) acts as a mentor to payload developers, assisting them through the payload display development process. This process is documented in the Payload Operations Data File (PODF) Management Plan, Annex 5 SSP58700-ANX5. International payloads are encouraged to follow a similar process to ensure usable, common displays. The list below shows the recommended display development process steps for payload developers. This list is intended as a guide only.

- 1) Review applicable display standards and guidelines.
- 2) Obtain rapid prototyping tool.
- 3) Receive display development training and guidance.
- 4) Perform operations requirements analysis to support display development.
- 5) Submit early products for review and discussion.
- 6) Develop preliminary displays and procedures.
- 7) Submit early displays/prototypes for review.
- 8) Update/iterate displays and procedures based on the review.
- 9) Submit product when mature and support crewmember usability testing.
- 10) Update displays and procedures based on results from testing.
- 11) Deliver final displays and procedures.
- 12) Receive approval for training/flight.
- 13) Support training.
- 14) Support integration.

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SECTION H2.0

DISPLAY DESIGN

The following section is under review by IDAGS for inclusion in the parent document. (Sect. 5 Display Organization & Hierarchy)

H2.1 GENERAL PRINCIPLES AND RATIONALE

All onboard displays should be based on a complete operations requirements analysis. Display layout and groupings, and choice of widgets, icons, and objects should be driven by operational requirements. Display layouts should follow operational flows, and should allow task completion with the minimum number of actions. The goals of minimizing the number of crewmember actions and providing uncluttered displays (i.e., containing only information relevant for task execution) must be balanced. The standards and general guidelines that follow are provided to facilitate this balance, and to aid in the development of an efficient, usable Human Computer Interface (HCI).

H2.1.1 Usability (move changes to Section 3.1.1)

- a) The user interface appearance, interaction, and results should be consistent across tasks and applications.
- b) The user interface should facilitate error-free operations. Should errors occur, the user interface should facilitate quick recovery.
- c) Software-provided reference materials should be readily accessible to the crewmembers.
- d) Within system limitations, user feedback should be provided with minimal delay for the following cases:
 - Input has been made to the interface (local feedback)
 - Process has been initiated
 - Process has been completed or terminated
- e) If a delay in processing time occurs, notification of the delay shall be provided to the crewmembers.
- f) The display should have an indication that it is alive (i.e., not frozen). An example indication is the display of a Greenwich Mean Time (GMT) clock.

H2.1.2 Information Organization

- a) The primary window should contain the primary focus for the crewmembers when the application is started. Supplemental or secondary information should be provided, via secondary windows or dialog boxes, upon crewmember request only.
- b) Each display should contain only the information, in the proper format, that is relevant to the current task. Information layering, via secondary windows or dialog boxes, should be implemented to provide supplemental information in support of the primary window (e.g.,

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specify options available to the crewmember or to provide details about information displayed on the primary window).

- c) Information layering should be used to limit display data to that needed for a specific task. For most displays, information should be layered no deeper than four layers.
- d) Crewmembers should be able to see where they are in the task flow.
- e) Crewmembers should have access to any level at any time via a clear navigational path.
- f) Crewmembers should be able to return to the initial task display with a single action (e.g., via a navigational aid).
- g) Information should be logically grouped according to purpose, function, or sequence of use (e.g., either a left-to-right or top-to-bottom orientation).
- h) Information/display objects that are to be used together should be placed in close proximity on the screen.
- i) Headers, titles, and labels should be used appropriately throughout the displays.
- j) Schematics should show components in the actual physical representation relative to other components (e.g., if A is on top of B, it should be shown that way in the schematic).
- k) The orientation of schematics should be consistent among displays, procedures and training materials.

SECTION H3.0**DISPLAY ORGANIZATION AND HIERARCHY****H3.1 GENERAL PRINCIPLES AND RATIONALE**

For payload developers using Windows NT/Windows (at a minimum Windows 95) operating systems, the displays should reflect the Microsoft Windows “look and feel.” Displays running under UNIX should be designed with general Motif characteristics (per the Open Software Foundation/(OSF) Motif Style Guide). If there is a conflict between the standards defined in this appendix and the Microsoft Windows and Motif Style Guides, the standards in this section will take precedence. COTS building toolkits (e.g., Labview) can be used if the end product adheres to the general guidelines in this document.

H3.1.1 Window Management

Payload tasks can often involve working with many different types of information, contained in more than one window or view. There are different display techniques that can be used to manage a set of windows. For payload displays, these techniques include the Single Document Interface (SDI) and the Multiple Document Interface (MDI). An SDI consists of only one display with dialog boxes for commanding and option selection. An MDI consists of more than one display in addition to dialog boxes for commanding and option selection. Refer to the “Windows Interface Guidelines for Software Design” for more information regarding the characteristics of SDI and MDI window management.

H3.1.2 Window Types

Window types are classified according to the kinds of information to which they provide access. These types are primary and secondary windows. The primary window provides a starting point and top level information to begin payload operations. It also provides an interface to access secondary windows. Secondary windows provide specific details about the objects and actions included in the primary window and are used to specify parameters. Secondary windows appear within the workspace of the primary window and have a title bar and window decorations similar to the primary window. An example of a secondary window within a primary window is depicted in Figure H3-1.

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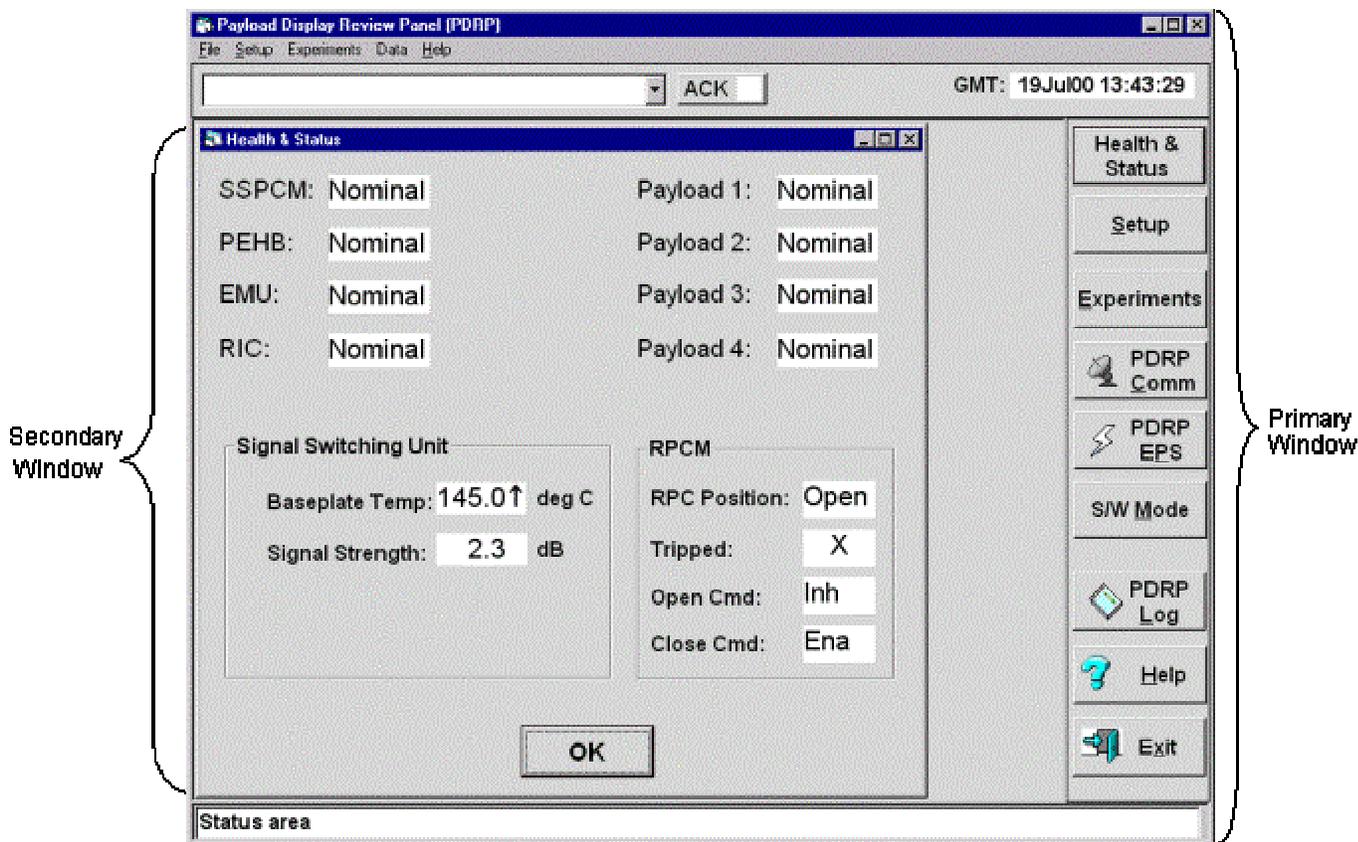
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Figure H3-1 Primary Window with a Secondary Window

H3.1.2.1 Dialog Boxes

A dialog box is a secondary window used to issue commands, gather information, provide feedback, and deliver messages (Figure H3-2). Dialog boxes that gather information are typically displayed after choosing a particular menu item or a command button. Message dialog boxes provide feedback and are used to ask questions, confirm actions, and warn of problems. A dialog box that confirms a crewmember's action is called a confirmation dialog box (Figure H3-3). Refer to Section H3.2.1.1 for information on dialog box title bars and Section H5.1.2 for information on confirmation dialog boxes.

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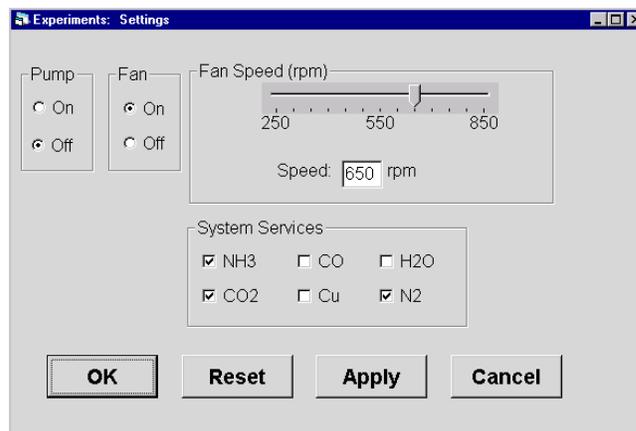
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Figure H3-2 Dialog Box

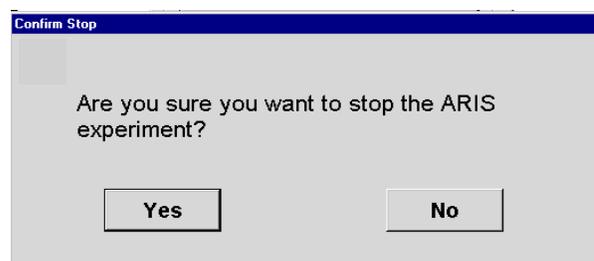


Figure H3-3 Confirmation Dialog Box

- a) The name in the title bar of the dialog box should be consistent with the name of the menu option or push button used to display the dialog box.
- b) Related items within the dialog box should be grouped (Figure H3-2).
- c) The “OK” button shall be used when a message requires no choices to be made, but only an acknowledgement.
- d) The “OK”, “Cancel” button pair shall be used when a message requires selection of options which do not include commands.
- e) The “Yes”, “No” button pair should be used when a message is phrased in the form of a question. However, if these choices are unclear, label the buttons with the name of specific actions (e.g., “Save” and “Delete”).
- f) The message provided in confirmation dialog boxes should be structured as a question (i.e., ‘Do you want to...’, ‘Are you sure you want to...’).
- g) The consequences of confirming an action should be explained.

Example: Are you sure you want to delete this file? This file will be permanently removed from your hard drive.

- h) The default choice for an exit confirmation dialog box shall be “No”.

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- i) An icon shall not be used in a confirmation dialog box.
- j) The information icon can be used on information dialog boxes. Refer to Section H4.3.4.
- k) The shortcut key assigned to the "Cancel" button should be the Escape key. No alt-key should be assigned.

H3.2 U.S. STANDARD PAYLOAD LAYOUT

To achieve cross-payload consistency, a standard payload layout has been defined (Figure H3-4). The sections that follow describe the required and optional components of the standard payload layout. For color standards and additional icons for displays, refer to Appendix B and Appendix C respectively.

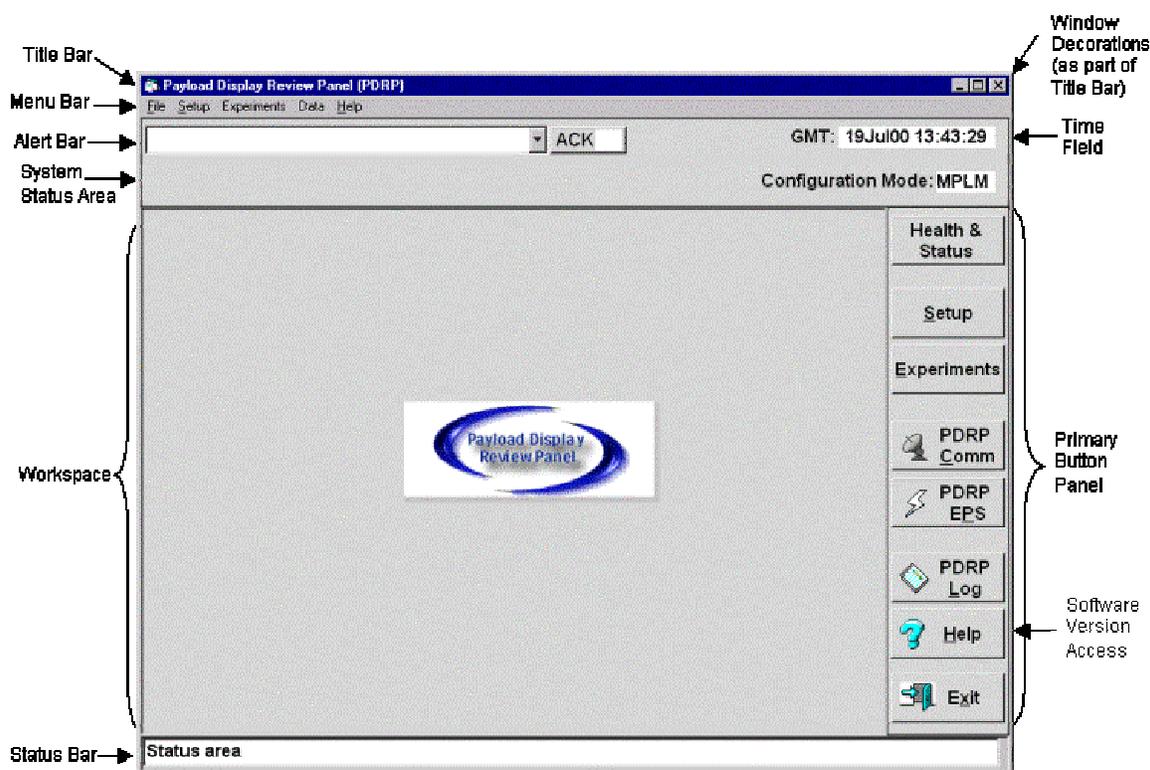


Figure H3-4 Standard Payload Layout

H3.2.1 Required Components

Some components in the standard payload layout are required on all payload displays. These components are the title bar, time field, primary button panel, Exit button, workspace, and access to the software version number. The following sections discuss the standards and guidelines associated with each component.

H3.2.1.1 Title Bar

The title bar identifies each display and contains the navigation path used to get to the display (Figure H3-4). Title bars indicate to the crewmember the current location within a set of displays at a glance.

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- a) All payload displays shall have a title bar containing a title.
- b) Title bar titles shall be in title case (i.e., initial capitalization of all major words).
- c) Title bar titles shall be left justified.
- d) The title bar of the primary window shall always be visible.
- e) The primary window title shall be the payload name completely spelled out and followed by the approved short name or acronym in parenthesis.
- f) The secondary window title shall represent the navigation path, where each item in the navigation path is separated by a colon and two spaces. Because the title of the primary window is always visible, there is no need to repeat the short payload name in the navigation path.

Example: If the button labeled 'Setup' is clicked, then the 'Equipment' button on the Setup window is clicked, the window that appears would be titled: "Setup: Equipment".

- g) Tab labels shall not be included in the navigational path of the display title.
- h) The title of a confirmation dialog box to exit the payload software shall be "Exit".
- i) The title of a confirmation dialog box shall be "Confirm", followed by a short descriptor.

Example: "Confirm Downlink" would be the title of a confirmation dialog box within the Downlink function.

- j) The title of an error dialog box shall only contain a short descriptor.

Examples: "File not Found", "Invalid Input", "Flashcard Full", "Value out of Range"

H3.2.1.2 Time Field

GMT format standards are described in Section 4.9.

- a) The GMT shall be visible on all primary payload displays in the upper right-hand corner below the menu bar, if one is provided (Figure H3-5).
- b) The GMT field shall be preceded by the label "GMT: " with one or two spaces between the colon and the field.
- c) The GMT label shall appear as a static label on the background.
- d) The time/date information shall appear on a flat non-dimensional field with a white background and no border.

H3.2.1.3 Primary Button Panel

The right-hand side of the standard payload layout contains the primary button panel (Figure H3-4). The purpose of this button panel is to provide access to functions that crewmember

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needs frequently or quickly. The use of a button panel is consistent with vehicle displays and is beneficial for accurate cursor control in microgravity.

- a) The primary button panel shall contain buttons that represent the primary functions of the payload.
- b) Primary buttons should be navigation buttons (i.e., bring up windows within the workspace). Commanding should be done inside secondary windows.
- c) Secondary or supplementary functions shall be accessed through a cascading button group on the primary button panel, menu items in a menu bar (Section H3.2.2.3), or buttons within the workspace.
- d) The primary buttons should appear in a logical sequence.
- e) The primary buttons should be grouped by function using the spacing shown in Figure H3-4 (i.e., less space between buttons within a group, and more space between the button group and other buttons).
- f) The primary buttons should include icons selected from Appendix C if the functions can be easily represented as icons. Refer to Section H4.3.4 for further information on icons.
- g) Primary button labels shall be used, even when icons are included.
- h) Primary button icons shall appear to the left of the labels if icons are used.
- i) Payloads that display system-like information (e.g., Electrical Power System) shall use the same icons as the system displays.
- j) Payload buttons that display system-like information shall be labeled with the payload name followed by the system name.

Example: "EXPRESS EPS" would be used to label an electrical power system display for EXPRESS.

- k) The order of system-like buttons shall be the same as the order specified in the DGCS for system buttons.
- l) Shortcut keys (i.e., Alt + key) shall be assigned to all buttons on the primary button panel.
- m) Shortcut key assignments within an application shall not be duplicated or violate the standards in Section 13.2.

H3.2.1.4 Required Button

Within the primary button panel, Exit is the only required button (Figure H3-4).

- a) An Exit button shall be included in the primary button panel to exit the payload software.
- b) The Exit button shall be labeled "Exit".

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- c) The Exit button shall have Alt + "x" as the shortcut key.
- d) The Exit button shall be placed at the extreme bottom of the primary button panel (i.e., not just the last button in the sequence).
- e) The exit icon shall be used on the Exit button Refer to Section H4.3.4

H3.2.1.5 Workspace

The large area to the left of the primary button panel is referred to as the workspace (Figure H3-4). The secondary windows appear in this area.

H3.2.1.6 Software Version

The version number of each piece of software shall be available for viewing to maintain compatibility between the ground and onboard software. Two methods for viewing version information are through an "About" dialog under Help, or by right clicking on the payload logo in the workspace (Figure H3-4).

H3.2.2 Optional Components

Each payload will have different operational requirements that determine display content. Based on these operational requirements, optional areas within the standard payload layout have been defined. Optional areas include the alert bar, payload status area, menu bar, optional primary buttons and the status bar. This section addresses the standards and guidelines associated with each of these areas. If these areas are not included, the space should not be allocated within the display.

H3.2.2.1 Alert Bar

Most payloads will use dialog boxes or the status bar for presenting messages to the crewmembers. However, some complex payloads need to present messages that do not require crewmember action, but do require crewmember acknowledgement. In these cases, an alert bar is included as a component on the payload display (Figure H3-5). Refer to Section H6 for information about payload alerts.

- a) The alert bar shall be located in the top left portion of the display area below the menu bar if one is provided.
- b) The alert bar should have a drop-down text field.
- c) The alert bar shall have an acknowledge button to the right of the text field with a counter field.
- d) The alert bar text field shall contain the oldest unacknowledged alert message and the GMT when the message occurred.
- e) The alert message in the text field shall be left justified and the GMT shall be right justified.
- f) The alert message and the GMT within the text field shall be separated by a minimum of two spaces to visually distinguish each at a glance.
- g) The alert bar text field shall have a white background and a sunken (etched in) appearance.

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- h) Alert bar text shall be bolded to enhance readability.
- i) Sentence case shall be used in alert bar text.
- j) The alert shall fit within the text field and be viewable without using a horizontal scroll bar.
- k) The text field shall drop-down to a maximum of five viewable lines.
- l) If there are more than five unacknowledged alerts, a vertical scroll bar shall be used.
- m) The alert currently displayed in the text field of the alert bar shall not be repeated in the drop-down list.
- n) Wrap around text shall not be used in the alert bar text field.
- o) An acknowledge button, labeled "ACK", shall appear to the right of the text field and include a counter field with a white flat background.
- p) The ACK button counter field shall display the total number of unacknowledged alerts.

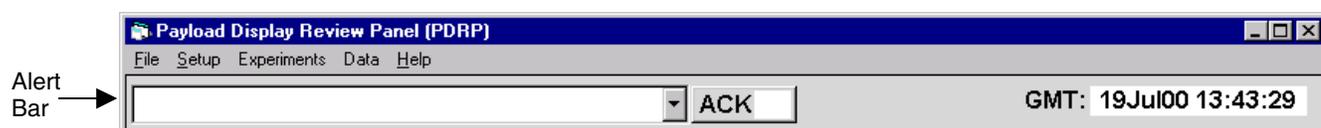


Figure H3-5 Alert Bar

H3.2.2.2 Payload Status Area

The payload status area is a display area reserved for rack or payload critical information that is required to be displayed at all times (Figure H3-6). This area is never hidden by secondary windows or dialog boxes.

- a) A payload status area shall be included only if the payload has data that must be visible to the crewmember at all times.
- b) A payload status area should be visually grouped/separated from the rest of the display through borders or spacing.
- c) The telemetry fields within the payload status area should have a white, flat background with no border.



Figure H3-6 Payload Status Area and Menu Bar

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H3.2.2.3 Menu Bar

The menu bar appears across the top of a display below the title bar (Figure H3-6). The menus displayed in the menu bar present a list of actions/options that provide supplemental or duplicate functions from the actions/options provided in the primary button panel. If the function is duplicated from the primary button panel, the menu name and the button label should be consistent with each other. Each menu contains a vertical list of choices in drop-down form. Refer to Section 4.23 for further information about menus.

H3.2.2.4 Optional Primary Buttons

This section addresses the physical attributes for the optional buttons that can appear on the primary button panel. These buttons are Home, Setup, Log, and Help (Figure H3-4). For further information concerning the Setup, Log, and Help functions, refer to Section H5.

H3.2.2.4.1 Home

- a) A Home button returns to the first in a series of displays that provide the payload status at a glance.
- b) The Home button shall be located at the top of the primary button panel.
- c) The label for the Home button is not restricted to the word "Home" (e.g. "Health & Status").

H3.2.2.4.2 Setup

- a) The Setup button should be located near the top of the primary button panel since it is typically one of the first functions performed.
- b) The Setup button shall be labeled "Setup".
- c) The Setup button shall use Alt + "s" as the shortcut key.

H3.2.2.4.3 Log

- a) The Log button should be located near the bottom of the primary button panel, above the Help and Exit buttons.
- b) The Log button shall be labeled with the payload name or abbreviation and the word "Log" or "Logs" if there is more than one log file.
- c) The Log button shall contain the log icon. Refer to Section H4.3.4.
- d) The Log button shall use Alt + "l" as the shortcut key.

H3.2.2.4.4 Help

- a) The Help button should be located immediately above the Exit button.
- b) The Help button shall be labeled "Help".
- c) The Help button shall contain the help icon. Refer to Section H4.3.4.
- d) The Help button shall have Alt + "h" as the shortcut key.

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H3.2.2.5 Status Bar

A status bar is used to present messages that are supplemental and do not require a response (Figure H3-7). The status bar may be separated into two to four panels that represent different types of messages. For example, the first panel could be used for instructional prompts (e.g., "Enter password") and second panel may be used for feedback (e.g., "Downlink completed").

- a) The status bar shall be included only if the payload is providing messages that do not require a crewmember response.
- b) The status bar should provide ample feedback to the crewmember about the functioning of the payload.
- c) The status bar field shall have a white background and a sunken (etched in) appearance.
- d) The text in the status bar shall be bolded to enhance readability.
- e) Sentence case shall be used for messages in the status bar.
- f) The status bar shall not have a vertical scroll bar to view previous messages.



Figure H3-7 Status Bar

H3.3 ESA Payload Display Template

If a web-based application is being developed for an ESA payload, it should follow the template shown in Figure H3-8. This template takes advantage of the user's familiarity with Web interaction style, as well as the availability of a vast array of development environments for creating and delivering Web based displays and content. This template also allows for integrated procedures.

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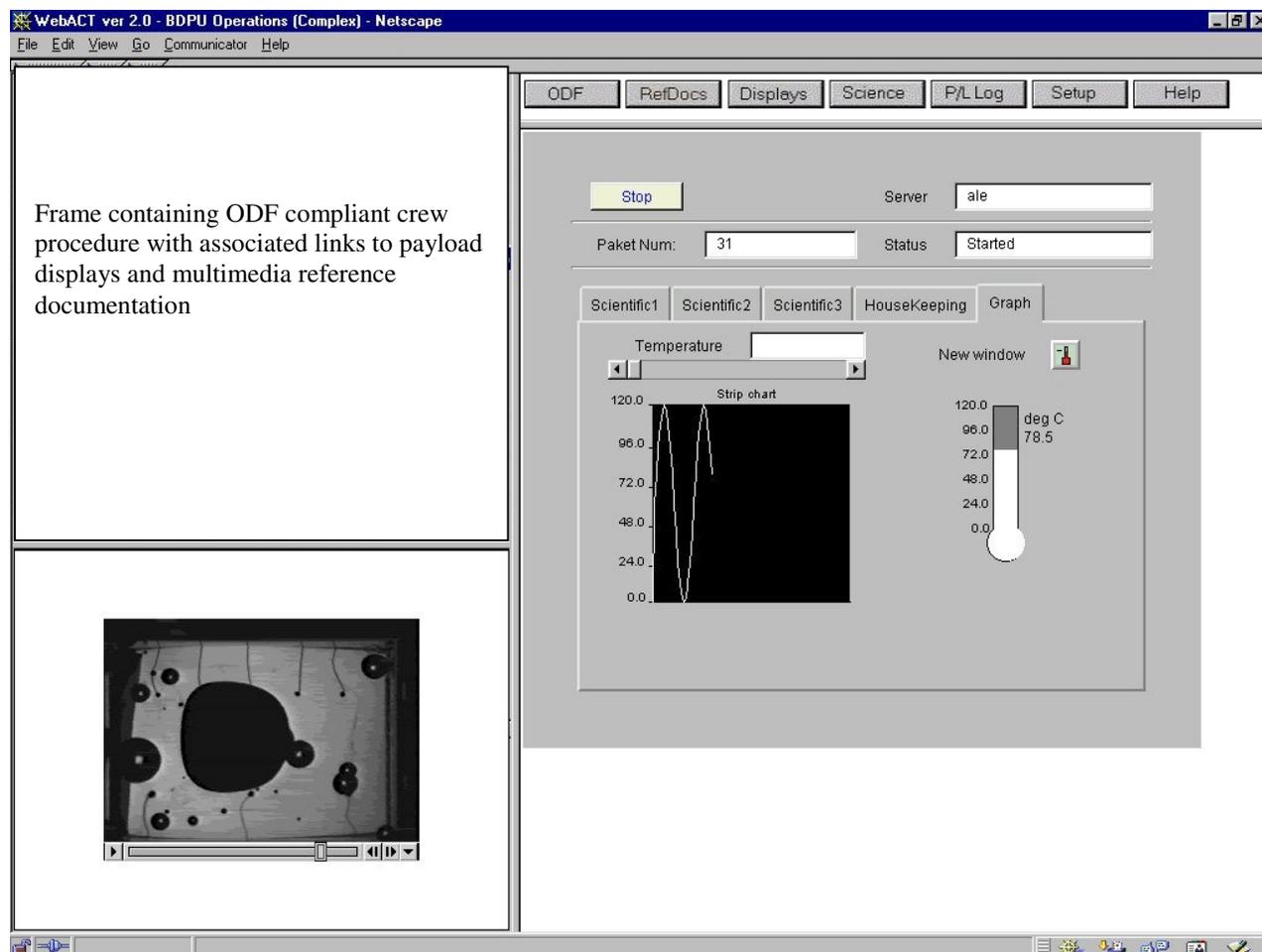
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Figure H3-8 Example of a Web based integrated P/L display

The main operational feature supported by the ESA web-based template is a direct mapping of the operations support requirements established in the initial payload operations analysis phase to functions available at the laptop. This is accomplished by dividing the Web page into frames. Number of frames, content, and size, will be optimized for the current task at hand. However, location and orientation of the main services are fixed, as per illustration above (e.g., procedures on the left, main display on the right). Application of this template will also facilitate the process of achieving coherence between procedures and displays.

Frame content will feature task transparent hyperlinks as established in the analysis phase. Optionally, the operator will also be able to call up any available service of his/her choice, on an as-needed basis. Navigation in the ESA web-based template will be supported by a 'toolbar' frame from which all operations support services are accessible.

The buttons on the toolbar call up the following services:

ODF
RefDocs
Displays
Science

ODF procedures for the payload
Payload reference/supporting documentation
Task and (sub)rack displays
Visualization of, and interaction with, payload

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P/L Log	data displays, including video (where applicable) Access to required payload logs (where P/L is the payload name – e.g., BDPU Log)
Setup	Setup of the payload and its operations support interface
Help	Help on both payload and display topics, in HTML format

SECTION H4.0

DISPLAY AND CONTROL OBJECTS

H4.1 GENERAL PRINCIPLES AND RATIONALE

There are some basic display components that will be used across payload displays. This section identifies those components with standards about their usage, functionality, and physical attributes. These standards are another method for maintaining commonality across payloads. The figures in this section were developed in Visual Basic and do not preclude the use of Motif objects.

H4.2 COMMON CONTROLS

Controls are graphic objects on payload displays that provide interfaces for the crewmembers to navigate, input data, change settings, and send commands. This section will identify how these controls should be used. (propose to move H4.2.1-H4.2.6 to 4.16. Rename display and control objects)

H4.2.1 Check Boxes

A check box is a control used to turn independent attributes or states on and off (Figure H4-1). Any number of check boxes can be set, including none. Check boxes are usually square and have text with or without iconic (picture) labels. The “on” setting is indicated by a marked box.

- a) Check boxes shall only be used for option setting/selection (i.e., not for commanding, navigating, or changing modes).
- b) Check boxes should be used when setting six or less independent attributes.

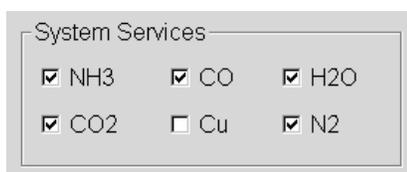


Figure H4-1 Check Box

H4.2.3 List Boxes

A list box is a scrollable list from which one or more items can be selected or viewed (Figure H4-2). The three primary types of list boxes are as follows:

- Single selection - A list box that presents a scrollable list from which only one item can be selected.
- Multiple selection - A list box that presents a scrollable list from which more than one item can be selected at a time.
- Drop-down - A list box that presents a single selection list box that drops down from an entry field. A drop-down list box should be used when display space is limited.

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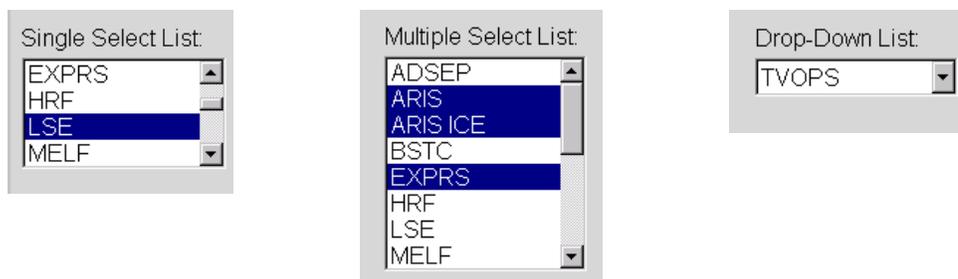
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Figure H4-2 List Boxes

H4.2.4 Combination or Combo Box

A combination or combo box is a combination of a list box and a text entry field. There are two types of combo boxes: simple and drop-down (Figure H4-3). The simple combo box is an entry field with a selection list below it. The drop-down combo box is an entry field with a down arrow button to its right, which when clicked, drops the selection list down. For each type of combo box, the list box allows only single selections. In addition, the combo box allows manual entry of a selection.

- a) Simple combo boxes should be used when the list contains greater than four items. If there are four or fewer items, use radio buttons.
- b) Drop-down combo boxes should be used instead of simple combo boxes when space is limited.

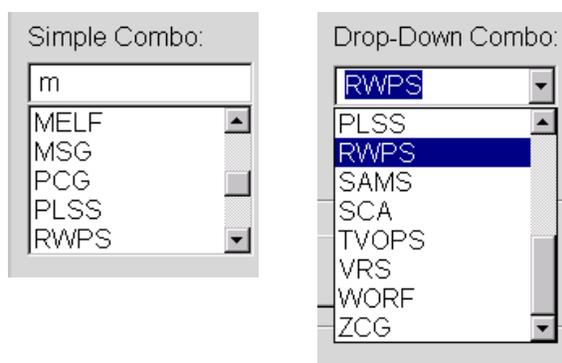


Figure H4-3 Combo Boxes

H4.2.5 Spin Box (Spinner/UpDown Control)

A spin box is a one line entry field with up and down arrows at one end (Figure H4-4). Values in the entry field can be updated by either clicking the arrow buttons to increment/decrement the value displayed, or by typing in a value. Spin boxes are best used for applications with limited screen space, and for setting predictable, customary, or consecutive values with the cursor.

- a) Spin boxes shall be used for entering numeric values only.
- b) The arrow buttons should appear to the right side of the entry field.
- c) Spin boxes should be used when there are ten or fewer values. If there are more than ten values, a combo box or slider should be used instead (Sections H4.2.4 and H4.2.6).

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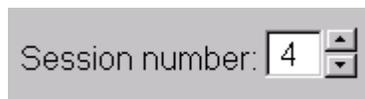
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Figure H4-4 Spin Box

H4.2.6 Slider

A slider is a scale that allows a value to be selected from a continuous range of values (Figure H4-5). An indicator (e.g., arrow pointer) shows the current setting. The slider selects one value or point from a continuous range of values or points.

- a) Slider labels shall mark the low, intermediate, and high ends of the operable limits of the scale.
- b) Slider tick marks should be provided with consistent increments at consistent intervals.
- c) Slider labels shall give the proper units of measure.
- d) If the range of values is greater than ten, or if an exact value must be entered, a data field showing the value at the pointer shall be provided.

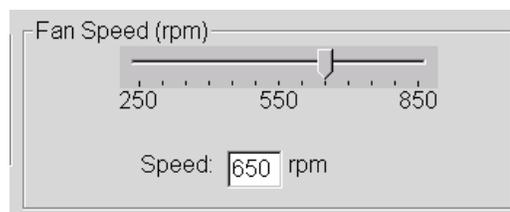


Figure H4-5 Slider

H4.2.7 Radio/Option Button

A radio/option button shall be used to select mutually exclusive settings, not for commanding or navigating (Figure H4-6). Only one radio button in a group can be selected at a time. Radio buttons are usually round in Windows or diamond shaped in Motif. Refer to Section 4.16.3 for additional standards.

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Figure H4-6 Radio/Option Buttons

H4.2.8 Momentary Push Button

A momentary push button is a control used for commanding or navigating. Refer to Section 4.16 for additional standards and examples. For standard button colors, refer to Appendix B.

- a) A momentary push button shall be used for commanding or navigating.
- b) The default push button should be indicated with a dashed outline or rectangle box around the button.
- c) When selected, the push button should appear as a momentary depression.
- d) The color for buttons shall be the standard background color.

H4.2.9 Toggle Button

A toggle button is a control used to set states. It can be represented as a push button or a graphical switch.

- a) The labels on toggle buttons shall remain constant (i.e., should not switch or change).
- b) When selected, the toggle push button should appear as depressed until deselected.
- c) The color for buttons shall be the standard background color.

[The following section is under review by IDAGS for inclusion in the parent document.](#)

H4.2.10 Fields

Fields provide an area to view, enter, and edit data.

- a) Fields that are editable shall have a white background and a sunken (etched in) appearance.
- b) Fields that are not editable (e.g., telemetry) shall have a white, flat background with no border.

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- c) The field shall be labeled on top or to the left of the data field, followed by a colon and a minimum of one space (e.g., "Pressure: psi").
- d) When feasible, field labels should provide cues beside the label in parenthesis (Figure H4-6).
- e) If all data within a group have the same unit of measure, the unit shall appear after the graphical location identifier (GLI) in parenthesis (Figure H4-5, "Fan Speed (rpm)").
- f) If all data within a group do not have the same unit of measure, each data item shall include the unit of measure.
- g) When filling in a form-like display, the ability to use the Tab key to advance to the next field and Shift+Tab to return to the previous field should be provided.
- h) The ability to directly place the cursor into the entry field should be provided.
- i) Fields should not require case-sensitive entries unless required by the operating system or COTS application.
- j) When an entry field is used for input of a restricted set of values, crewmember input should be validated immediately and feedback provided.
- k) If the entry field contains multiple lines, text wrap around should be provided for each line.
- l) Single line fields shall be sized to accept the full entry.

H4.2.11 Tab Window

A tab window provides a set of related displays within a single window (Figure H4-7).

- a) Tab windows shall only be used when the tabbed displays are functionally related.
- b) Tabs shall have a 3-dimensional appearance.
- c) Only one row of tabs should be used.
- d) The active tab shall be clearly indicated.

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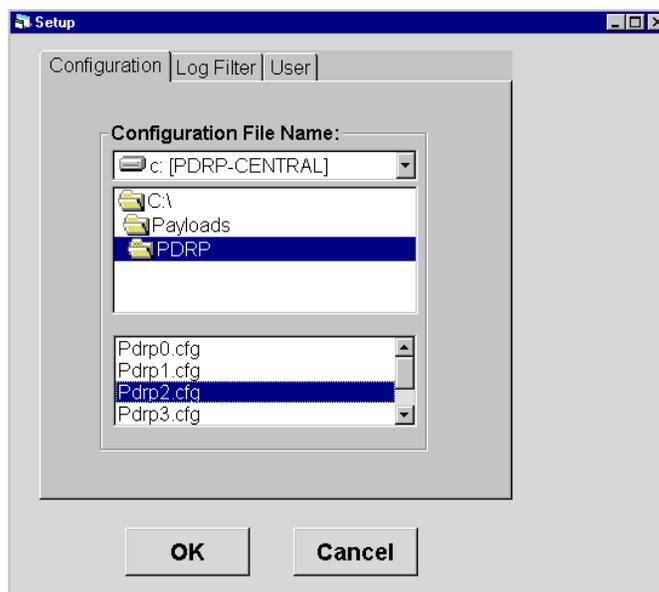
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Figure H4-7 Tab Window

H4.3 DATA DISPLAY

H4.3.1 Color

Specific standards and uses of color for ISS displays are described in Section 4.20 and Appendix B.

H4.3.2 Text

Arial or Helvetica font shall be used on payload displays. Specific standards for text may be found in Section 4.15.

H4.3.3 Labels

Labels are necessary to identify objects that the crewmembers will interact with while operating a payload. Refer to Section 4.13 and Section 10 for further information.

- a) All display and control objects shall be labeled.
- b) Labels of input and output objects shall be followed by a colon and a minimum of one space.
- c) GLIs shall not be followed by a colon.
- d) Button labels shall remain static.
- e) Button labels should be limited to one word or line. If more than one line of text must be used, then the lines of text within the button label shall be center aligned.
- f) Field labels should be limited to one word or line. If more than one line of text must be used, then the lines of text within the label should be left justified with each other.
- g) For command buttons, the label should include a verb.

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Example: Save, Terminate, Initiate Shutdown

- h) Controls that involve the selection of options should not include a verb.
- i) GLIs should not begin with a verb.

Example: Use "Laptop Comm" as a label instead of "Select Laptop Comm"

- j) All displays and menu items should be named to facilitate recognition.

H4.3.4 Icons

Icons should follow the standards and guidelines outlined in Section 7, Appendix C, and Appendix H. Payload icons found to be unique (i.e., not represented by an existing icon in the DGCS) must be submitted for approval and inclusion in Appendix C. Payload icons that can be used on primary buttons (Figure H4-8) and dialog boxes (Figure H4-9) are shown below.



Figure H4-8 Primary Button Panel Icons



Information Icon



Payload Alert Icon



Payload Caution Icon

Figure H4-9 Dialog Box Icons

H4.3.5 Attention Symbol

Payload displays shall not use the attention symbol (Figure H4-10). Refer to Section H6 for other methods of alerting the crewmembers.



Figure H4-10 Attention Symbol

SECTION H5.0

COMMON PAYLOAD FUNCTIONS

H5.1 CROSS-PAYLOAD COMMONALITY

To achieve cross-payload commonality, which results in increased productivity onboard, payload display functions that are common across payloads should be designed in the same way. This allows crewmembers to very quickly perform common functions, regardless of the type of payload or software platform. The high-level functions described in this section have been identified as common to many payloads. The standards and guidelines in each category should be followed to ensure that cross-payload commonality is achieved. Some common functions identified include indication of processing delays, confirmation of actions and commands, experiment setup, data capturing, and downlink.

H5.1.1 Indication of Processing Delay

Some payload functions such as initializing an experiment or saving files will require a processing delay. The crewmember should be provided feedback concerning the length of the delay. The following list provides the standards and guidelines for indicating processing delays.

- a) A short processing delay (e.g., one to five seconds) shall be indicated (e.g., with a “busy” cursor, status bar message, or progress bar). ESA-Columbus and NASDA cannot support this requirement due to software limitations.
- b) If a significant processing delay (e.g., greater than two minutes) is expected, then a text message explaining the long delay should accompany the progress indicator.
- c) All processes involving a delay greater than five seconds should have a mechanism for canceling the process (e.g., “Cancel” button, “Stop” button).

H5.1.2 Confirmation of Actions

It is important that all functions that are critical or that could result in errors or lost productivity be safeguarded against accidental activation. Refer to Section H3.1.2.1 for further information on dialog box standards.

- a) A confirmation dialog box shall be used as the payload equivalent to “two-step” commanding.
- b) The following functions shall be safeguarded with a confirmation dialog box:
 - Controls which exit an application (i.e., Exit button and ‘x’ in primary window decorations);
 - Controls associated with critical functions; and
 - User actions that could result in unintended negative consequences (e.g., loss of data).

H5.1.3 Experiment Setup

Many experiments have a common function known as experiment setup (Figure H5-1). This function provides for the input of data items such as crewmember identification, session number, and condition.

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- a) Whenever the crewmember is required to enter information for setting up an experiment, the information shall be grouped together in a setup function and controlled by a “Setup” button on the primary button panel.
- b) The setup dialog box shall contain all of the experiment setup information to be entered (e.g., crewmember identification, trial number, etc.).
- c) Fields for entering crewmember identification shall be labeled “Crew ID”.
- d) “Crew ID” should be the first parameter listed in the Setup dialog box when used.
- e) Input of experiment setup information should be accomplished using controls that do not require free form typing (e.g., drop-down lists).
- f) If the setup parameters are shown as status information on the main display, they shall appear above of the workspace in the Payload Status Area (Section H3.2.2.2).

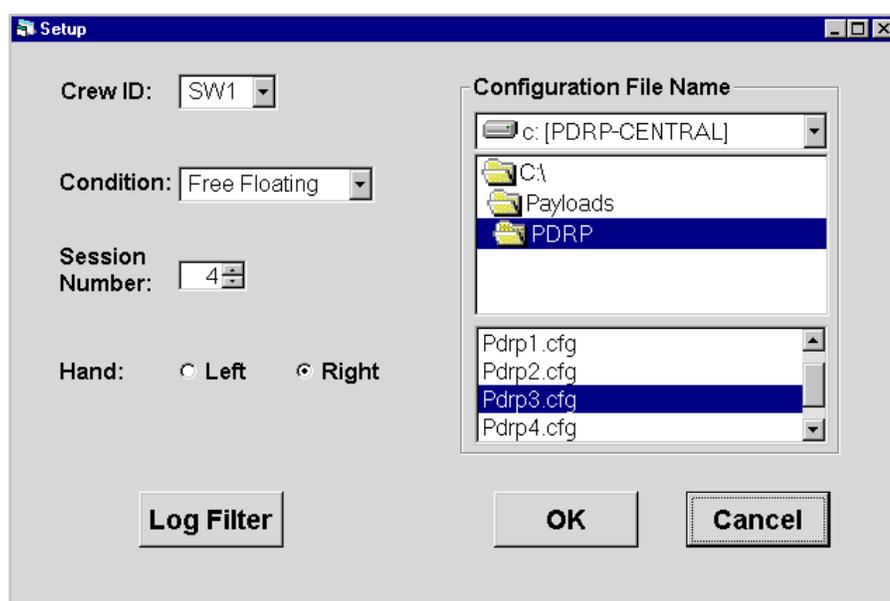


Figure H5-1 Experiment Setup

H5.1.4 Help/Online Assistance (Propose to move to section 4.18. Rename Help/Online Assistance)

Assistance should always be quickly accessible and easily understood from within the payload display. There are three basic types of help: context sensitive, non-context sensitive, and tooltips.

H5.1.4.1 Context Sensitive Help

Context sensitive help is on-line assistance that provides information about a particular object and its context. It answers questions such as “What is this?” and “Why would I use it?” The Help information provided is specific to the object selected or the display currently active. For example, the “What’s This?” command, available in most Help drop-down menus and associated buttons, pop-ups, etc., provides context sensitive help.

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- a) Context sensitive help should be provided where possible.
- b) Help should be available for all error messages generated by the payload software.

H5.1.4.2 Non-context Sensitive Help

Non-context sensitive help provides general help information that is not specific to the display object or active window currently open. It is typically a searchable document of information, and the content is very similar to the information found in a help manual.

An example of a Help File is shown in Figure H5-2.

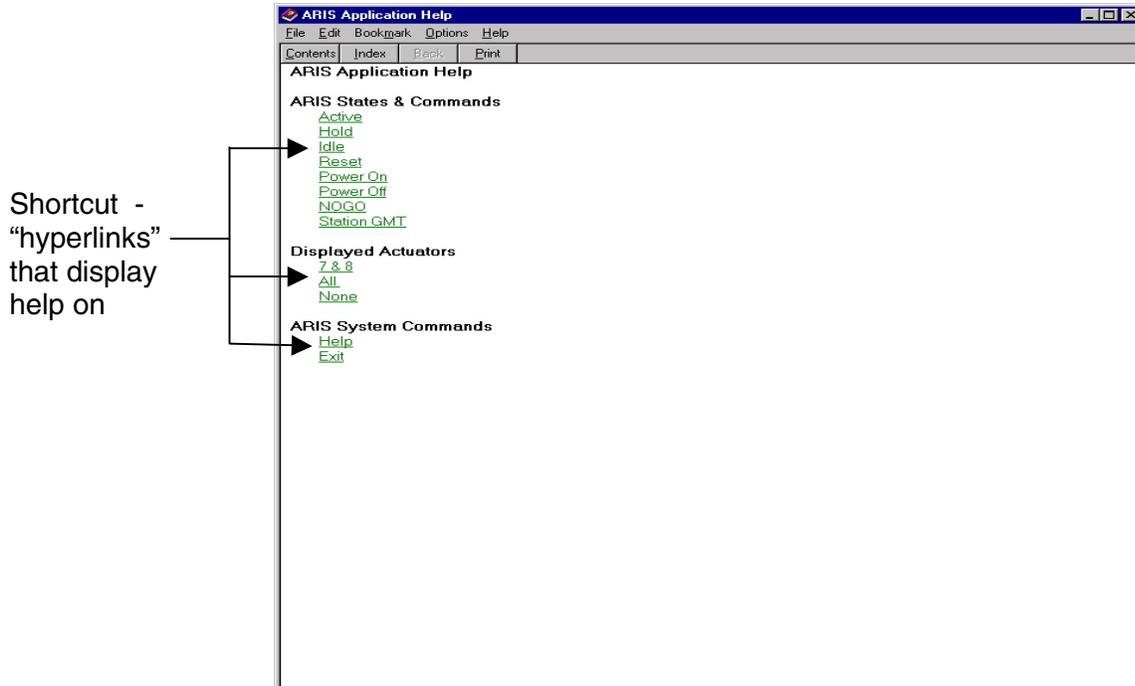


Figure H5-2 Help File

- a) Non-context sensitive help shall include the capability for the crewmembers to enter a term for which help is desired. The system should locate the help text or allow the crewmembers to browse a list of help topics and select one to read.
- b) Help should be provided via a push button on the primary button panel and/or menu bar (Figure H5-3 and H5-4).
- c) Definitions for all acronyms and abbreviations used within an application should be available in the "Help File."

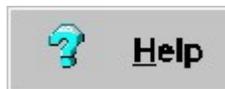


Figure H5-3 Help Button on the Primary Button Panel



Figure H5-4 Help on Menu Bar

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(THIS SECTION IS UNDER REVIEW BY IDAGS FOR INCLUSION IN THE DGCS. SECTION TBD)

H5.1.4.3 Tooltips

An additional type of help that can be provided is tooltips. Tooltips are small informational pop-up windows that appear when the cursor is placed over a display object.

- a) Tooltips should be available for every push button.
- b) Tooltips should explain the function of the button in greater detail than the button label.

H5.1.5 Log Files

Several types of log files will be accessible by onboard crewmembers. One type resides in the manual procedure viewer (MPV) on the station support computer (SSC). These log files are accessed through a link within MPV and are for crewmembers to make annotations as requested by the payload.

A second type of log file is a paper log. Crewmembers can record the same type of information on these paper logs as they do in MPV log files. Use of paper log files is discouraged.

A third type of log file, accessed through payload displays, is one that automatically captures and records data events that are generated by the payload hardware and software (Figure H5-5). These automatically captured and recorded log files should be provided and used where crewmembers will be requested to review the history surrounding an event (or troubleshoot a problem with the payload). A payload may automatically record all events into one log file, or multiple log files. Automatically captured and recorded log file use is strongly encouraged.

- a) If a log file is used, it shall be accessed through a log button on the primary button panel.
- b) If there are multiple logs, they should be accessed via a cascade menu, where the individual logs cascade from the log button on the primary button panel.
- c) If a payload generates any alert and/or caution to the crewmember, a log file shall be provided.
- d) Files that have been downlinked should be recorded in a log file, which includes filename, file location (folder), and sent date and time.
- e) Log files shall be formatted as a table (i.e., columns of data).
- f) Columns within the log files shall be labeled to facilitate recognition.
- g) If an alert bar is used, a column to indicate acknowledged or unacknowledged messages shall be provided.
- h) If a payload annunciates caution (Class 3) messages, a column indicating the class shall be provided.

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- i) Log files shall have GMT, in the proper format, as the first column of data.
- j) Log files shall have the capability of being sorted by any column.
- k) The default sort shall be based on the GMT from newest to oldest.
- l) Log files should be read only (i.e., not modifiable).

GMT	ACK	Description
22Jul99 10:01:43	X	Flashcard is full
22Jul99 09:47:30		Batch downlink has failed
22Jul99 09:47:28	X	Laptop comm has been interrupted
22Jul99 09:42:12	X	Flashcard is 90% full
22Jul99 07:19:33		Temperature sensor 1 is out of limit high

Log Entries (200 max): 5

Figure H5-5 Log File

H5.1.6 Data Downlink

Data downlink will be primarily commanded from the ground and will be affected by communication opportunity, Acquisition of Signal (AOS), and available bandwidth. Thus, downlink should be a passive activity for the crewmembers. Downlink capabilities for each payload will vary depending on the planning requirements defined by the payload developer in the Payload Data Library (PDL).

- a) Data files to be downlinked shall be configured by the payload developer to be ready for downlink without crewmember intervention (e.g., automatically entered into a downlink list).
- b) If a crewmember is required to view a list of downlinked files, the following information should be included: filename, file location (folder), and associated GMT time stamp.
- c) An open downlink display shall not be a requirement for file downlink to occur.

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SECTION H6.0

PAYLOAD ALERTS

H6.1 GENERAL PRINCIPLES AND RATIONALE

Payloads may generate alerts and/or cautions (Class 3) related to the functioning of the payload hardware and software. Alerts are defined in this appendix. Cautions are defined in the Pressurized Payloads Interface Requirements Document SSP57000 and approved by the Payload Safety Review Panel.

H6.1.1 Payload Alerts

There are two types of payload alerts. The first type of alert only requires crewmember acknowledgement. An example of an alert that only requires acknowledgement is "Flashcard 90% full". The second type of alert requires crewmember action to continue nominal operations or prevent the loss of science or hardware. An example of an alert that requires an action would be "Flashcard is full. Replace card to continue data collection." Refer to Section H3.2.2.1 and H3.1.2.1 for further alert bar and dialog box requirements.

- a) Payload alerts that only require acknowledgement should be presented in an alert bar.
- b) Payload alerts that require crewmember action to continue nominal operations or prevent the loss of science or hardware shall be shown in a modal popup dialog box in the center of the display. These alerts shall not be repeated in the alert bar.
- c) Payload alerts in popup dialog boxes should clearly describe the error condition and should provide guidance.
- d) Payload alerts shall be logged into a log file if one is being provided.
- e) Orange, as defined in Appendix B, shall be used to indicate a payload alert on data field and icon backgrounds.
- f) On alert dialog boxes, the payload alert icon shall be used (Section H4.3.4).
- g) If an alert bar is used, the oldest unacknowledged alert shall be presented in the text field of the alert bar.
- h) When the "ACK" button in the alert bar is clicked, the alert shall be acknowledged and disappear from the alert bar text field.
- i) When an alert appears in the alert bar, the counter shall increment the number of unacknowledged alerts. When an alert is acknowledged, the counter shall decrement.

H6.1.2 Payload Cautions

Some payloads may issue Class 3 cautions.

- a) Class 3 cautions shall be allowed only when approved by the Payload Safety Review Panel.

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- b) Class 3 cautions shall appear in a modal popup dialog box in the center of the display and shall not be repeated in the alert bar.
- c) The dialog box that appears as a result of a Class 3 caution should clearly describe the error condition and should provide guidance.
- d) Class 3 cautions shall be logged into a log file if one is being provided.
- e) Class 3 caution dialog boxes shall be accompanied by the payload caution icon. Refer to Section H4.3.4.

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SECTION H7.0

ACRONYMS

The following section is under review by IDAGS for inclusion in the parent document.

AOS	Acquisition of Signal
COTS	Commercial Off-the-Shelf
ESA	European Space Agency
GLI	Graphical Location Identifier
GMT	Greenwich Mean Time
HCI	Human-Computer Interface
HTML	Hypertext Markup Language
IDAGS	Integrated Display and Graphics Standards
IP	International Partner
ISS	International Space Station
MDI	Multiple Document Interface
MPV	Manual Procedures Viewer
NASDA	National Space and Development Agency of Japan
ODF	Operation Data File
PD	Payload Developer
PDL	Payload Data Library
PDRP	Payload Display Review Panel
PODF	Payload Operations Data File
POIF	Payload Operation Integration Function
SDI	Single Document Interface
SSC	Station Support Computer

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SECTION H8.0

REFERENCES

Payload Developer Resources (documents, links, icons, etc.) may be found at the PDRP website: <http://payloads.msfc.nasa.gov/pdrp/>

Information from the following documents was used in the development of this document and may be helpful to display developers.

Ergonomic Requirements for Office Work with Visual Display Terminals (VDT): Part 11 Guidelines on Usability, (ISO DIS 9241-11 Draft, September 1994).

Flight Crew Operations Concept (JSC 27099, Rev. 2). NASA Johnson Space Center.

GUI Design Handbook. Fowler, S. (1998). New York: McGraw Hill.

Human-Computer Interface (HCI) Design Guide (LS-71130; November 14, 1997). Human Research Facility (HRF), NASA Johnson Space Center.

ISS Flight Crew Integration Standard (SSP 50005, Rev B). NASA Johnson Space Center.

ISS Payload Accommodations Handbook (52000-PAH-PRP Rev. A, Draft 1, 9/30/96). NASA Space Station Program Office.

Open Look: Graphical User Interface Application Style Guidelines (1993). Sun Microsystems, Addison-Wesley Publishing Company, (for Solaris).

OSF/Motif Style Guide (1993). Open Software Foundation, Prentice Hall PTR.

Portable Computer System (PCS) Displays Software Requirements Specification (JSC 26975, 3/20/97). NASA Space Station Program Office.

PCS Displays Software Design Document (JSC 26976). NASA Space Station Program Office.

PCS Project Technical Requirements Specification (JSC 27337). NASA Space Station Program Office.

PCS Command and Data Software Interface Definition Document (JSC 27439). NASA Space Station Program Office.

Payload IRD (SSP 57000). NASA Johnson Space Center.

The Windows Interface Guidelines for Software Design (1995). Redmond, Washington; Microsoft Press.

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U.S. Department of Transportation Federal Aviation Administration Standard Preliminary: Human Factors Design Standard for Airway Facilities. (FAA-STD-XX AF HM1, May 28, 1993 with changes: August 23, 1993; April 23, 1994).

U.S. Payloads Display Management and Process Plan (SSP 50319)

The following additional documents may also be useful to payload developers in display design.

Design Guide for Multiplatform Graphical User Interfaces. Bellcore (1995). Piscataway, NJ: Bell Communications Research.

Designing the User Interface: Strategies for Effective Human-Computer Interaction. Schneiderman, B. (1987). Reading, Massachusetts: Addison-Wesley Publishing Corporation.

GUI Design Essentials for Window 95, Windows 3.1, and the World Wide Web. Weinschenk, S., Jamar, P., & Yeo, S. C. (1997). New York: John Wiley & Sons.

Human-Computer Interface Design. Brown, C. M. (1989). Northwood, New Jersey: Alex Publishing Corporation.

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The Cross-GUI Handbook For Multiplatform User Interface Design. Marcus, A., Smilonich, N., Thompson, L. (1995). Reading Massachusetts: Addison-Wesley Publishing Company.

The Human Factor: Designing Computer Systems for People. Rubinstein, R. and Hersh, H. Burlington, Massachusetts: Digital Press.

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