



Air Force Space Command Space and **Missiles Systems Center (AFSPC/SMC)**

and Command (TT&C) Service

March 29, 2019

- Space Enterprise User Experience Design System (UXDS)
- Design Guidance And Specifications For Telemetry, Tracking,



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Overview



Overview

The newly designed TT&C application suite is designed to support ground-to-satellite communication to include transmitting commands, monitoring constellations and maintaining the health of spacecraft. There are three tiers of capability upon which the TT&C applications are built:

Monitor

Allows the operator to monitor status, alerts, health and function of an individual satellite and satellite constellations.

Command

Allows the operator to send and receive streams of data to and from a spacecraft using a set of commands, often referred to as a pass plan.

Investigate

Allows the operator to investigate spacecraft alerts and anomalies and analyze subsystem mnemonics, measurements, limits, etc.



Overview - User & Use Case

A common use case and user roles were identified in order to understand and organize TT&C system requirements, as well as to ensure that users can effectively and efficiently accomplish task requirements within their respective roles.

Users

The intended users of the TT&C application suite are operators whose roles can range from entry-level to more advanced engineer-level roles. The primary tasks an operator performs include commanding a pass, monitoring constellation health, and investigating alerts and anomalies.

Use Case

The use case that helped to identify TT&C system requirements was centered around the common operator task of investigating and resolving an alert that occurs during the execution of a pass plan.



Overview - Information Architecture

Information has been organized across the TT&C applications based on system requirements and user and use case discoveries. The applications have several interdependencies that provide users better, more efficient usability.

Command	Monitor	Investigate
	Global Status Bar	
Contextual Alerts	System-Wide Alerts	Subsystems
Command Line	Constellation	Assembly Schematics
System Health	Watcher	Subsystem Details
Subsystems		
Contextual Watcher		



Overview - Application Suite Paradigm (Multi-Display Setup)



The Monitor Application can be launched from the App Switcher Menu and is intended to open at all times. The Investigate Application can be launched from the App Switcher Menu as well as from components within the Monitor and Command Applications. Multiple instances of the application can be open at once and would launch in new browser windows. The Command Application can be launched from the App Switcher Menu as well as from components within the Monitor Application. Multiple instances of the application can be open at once and would launch in new browser windows.



Overview - Application Suite Paradigm (Dual-Display Setup)



The Monitor Application can be launched from the App Switcher Menu and is intended to open at all times.

The Command Application can be launched from the App Switcher Menu as well as from components within the Monitor Application. Multiple instances of the application can be open at once and would launch in new browser windows. The Investigate Application can be launched from the App Switcher Menu as well as from components within the Monitor and Command Applications. Multiple instances of the application can be open at once and would launch in new browser windows.



Global Components



Global Components - Global Status Bar

The Global Status Bar is a full width view across the top of all of the TT&C applications — an area commonly reserved for global status, global command and top-level navigation. The Global Status Bar includes: Application Name, Top Level Navigation, Date & Time, and Monitoring Icons. See the <u>Astro UXDS guidelines</u> to learn more about the Global Status Bar.

	Global Status B
App Switcher Menu	Date Time
The App Switcher Menu allows the user to launch new instances of different apps, log in/log out, and edit preferences.	Date (DOY) and Time appear here across a
The App Name appears directly	

to the right of the menu.

Sar Monitoring Icons* (UTC) Monitoring Icons display the highest level of consolidated Il apps. data along categories specific to each App. Each Monitoring Icon displays a color associated with the status level and a badge to indicate the number of alerts. *Usage and functionality for TT&C Monitoring Icons is to be determined.



Global Components - App Switcher Menu (Launching Applications)

Functionality

The App Switcher Menu allows the user to launch new instances of different TT&C applications, sign in/sign out of the application suite, and edit preferences.

Features & Interactions

1. Clicking an application in the App Switcher Menu, launches an instance of the application in a new browser window.



Image: Construction of the construc
TTC Command TC Investigate Preferences Sign Out Corst Sign Out Severity Viessage Severity Viessage State Actions State Actions Sign Out State Actions State Actions State
TTC Investigate Preferences Sign Out Const
Preferences Sign Out Image: Severity image:
Sign Out Lit Totelline Software Software Actions Software Actions Actions Software Actions Actions Software Actions Actions Software Actions Actions Software Software Actions Software Software Actions Software Software Actions Software Software Software Software
255 14:19:44 UTC 14:11:59 15:24:12 Image: Comment of the second
Severity Category Image: Note Series
Pass Lock -99 Step Instruction Step Instruction or Sit Amet Category HH:MM:SS 1 Verify MNEMONIC = ON Stad Frame Count: 49336 or Sit Amet Category HH:MM:SS 2 Verify MNEMONIC = GO deg Verify MNEMONIC = OPEN or Sit Amet Category HH:MM:SS 3 Verify MNEMONIC = OPEN Bad CMD: 0
Step Instruction Step Verify MNEMONIC = ON Step Verify MNEMONIC = <60 deg Step Verify MNEMONIC = OPEN
Or Sit Amet Category HH:MM:SS Initial Frame Count: 49336 or Sit Amet Category HH:MM:SS 2 Verify MNEMONIC = <60 deg or Sit Amet Category HH:MM:SS 3 Verify MNEMONIC = OPEN
vr Sit Amet Category HH:MM:SS Bad CMD: 0 vr Sit Amet Category HH:MM:SS Bad CMD: 0
or Sit Amet Category HH:MM:SS 4 Verify MNEMONIC = <55 volts • Variation (Control of the control of the contr
Attitude Attitude
Yes
Lorem Ipsum Dolor Propulsion
◆ Thermal C
6-1 Verify MNEMONIC = 1
6-2 Verify MNEMONIC = <60 deg
6-3 Verify MNEMONIC = ENAB Mnemonic Unit Threshold Actual
6-4 Verify MNEMONIC = =50 volts<br A PWST2IA Volts 35.1 22.7 7 ···



Global Components - App Switcher Menu (Sign In/Sign Out)

Operators can sign in or out of the TT&C Application Suite through the App Switcher Menu, which is accessible in every application/ screen by clicking the App Switcher Menu icon in the top left corner.

J. Smith		255 14:0 DATE	6:25 UTC					Comms	Software
TTC Monitor TTC Command Severity Cate	Constellation							List	Timeline
Preferences	Satellite	Next Pass	AOS ↓ LOS	S	Ground Station	Azimuth	Elevation	State	Actions
Sign Out	♦ <u>IRON 4090</u>	255	HH:MM:SS HH:	I:MM:SS	LION-A	-41.97	88.12°	Pass	
	► <u>ECHO 1100</u>	255	HH:MM:SS HH:	I:MM:SS	TIGER-B	153.16°	12.31°	Pre-Pass	
Lorem Ipsum Dolor Sit Amet Category	HH:MM:SS FOXI 3232	255	HH:MM:SS HH:	I:MM:SS	JAGUAR-D	162.94°	41.22°	Scheduled	
Lorem Ipsum Dolor Sit Amet Category	HH:MM:SS	255	HH:MM:SS HH:	I:MM:SS	OCELOT-F	83.65°	73.61°	Scheduled	
Lorem Ipsum Dolor Sit Amet Category	HH:MM:SS + HOTL 0002	255	HH:MM:SS HH:	I:MM:SS	CHEETAH-O	201.09°	10.28°	Scheduled	
Lorem Ipsum Dolor Sit Amet Category	HH:MM:SS ALPH 6648	255	HH:MM:SS HH:	I:MM:SS	TIGER-B	-19.03°	65.53°	Scheduled	
Lorem Ipsum Dolor Sit Amet Category	HH:MM:SS JULI 3309	255	HH:MM:SS HH:	I:MM:SS	BEAR-E	265.98°	34.88°	Scheduled	
Lorem Ipsum Dolor Sit Amet Category	HH:MM:SS	255	HH:MM:SS HH:	I:MM:SS	LION-A	185.31°	88.81°	Scheduled	
Lorem Ipsum Dolor Sit Amet Category	HH:MM:SS LIMA 2017	255	HH:MM:SS HH:	I:MM:SS	JAGUAR-F	-22.92°	23.93°	Scheduled	
Lorem Ipsum Dolor Sit Amet Category	HH:MM:SS	255	HH:MM:SS HH:	I:MM:SS	OCELOT-F	132.22°	11.32°	Scheduled	
Lorem Ipsum Dolor Sit Amet Category	HH:MM:SS NOVB 4500	255	HH:MM:SS HH:	I:MM:SS	TIGER-B	-11.27°	58.72°	Scheduled	
Lorem Ipsum Dolor Sit Amet Category	HH:MM:SS ALPH 6648	256	HH:MM:SS HH:	I:MM:SS	PUMA-C	183.72°	81.23°	Complete	
Lorem Ipsum Dolor Sit Amet Category	HH:MM:SS	256	HH:MM:SS HH:	I:MM:SS	BEAR-E	-102.40°	19.49°	Complete	
Lorem Ipsum Dolor Sit Amet Category	HH:MM:SS	256	HH:MM:SS HH:	I:MM:SS	TIGER-B	151.51°	83.03°	Complete	
Lorem Ipsum Dolor Sit Amet Category	HH:MM:SS DELT 9091	256	HH:MM:SS HH:	I:MM:SS	ABCD	244.66°	78.19°	Complete	
Lorem Ipsum Dolor Sit Amet Category	HH:MM:SS								
Lorem Ipsum Dolor Sit Amet Category	нн:мм:ss Watcher				IRON 4090				
Lorem Ipsum Dolor Sit Amet Category	HH:MM:SS				PWST21A				
Lorem Ipsum Dolor Sit Amet Category	HH:MM:SS			110					
Lorem Ipsum Dolor Sit Amet Category	HH:MM:SS Mnemonic	Unit Threshold	Actual	100			Upper Limit		
Lorem Ipsum Dolor Sit Amet Category	HH:MM:SS	Volts 35.1	22.7 7	••• 90					
Lorem Ipsum Dolor Sit Amet Category	HH:MM:SS	Volts 40.4	32.2 ¥						
Lorem losum Dolor Sit Amet Category	HH:MM:SS + PWHTR08PV	Deg 38.4	38.1 7	70					
Lorem Insum Dolor Sit Amet Category	HH:MM:SS + PWST2VB	Deg 41.4	39.6 7	60					
I orem Insum Dolor Sit Amet Category	HHMMISS			50			/		
Lorem Insum Dolor Sit Amet Category	HH·MM·SS			40					
Acknowledge Dismiss				20 10 0	0800 0900 100	00 1100	Lower Limit) 1400 1	500 1600

TT&C Wireframes.pdf, page 2



Global Components - Sign In/Out Flow

This user flow shows the content and actions involved in signing in or out of the TT&C Application Suite. This flow is available to operators in any of the three TT&C applications via the App Switcher Menu.









Global Components - Sign In Flow Steps

Steps

- 1. Click the App Switcher Menu icon, then click "Sign In".
- 2. Insert a CAC Card into the Reader (external to the TT&C Application Suite)
- 3. Enter a CAC Card PIN.
- 4. Select role, then click "Sign In".
- 5. The operator name appears below the application title, indicating that they in.

	Not Signed In TTC Monitor TTC Command TTC Investigate Preferences Sign In	Severity Cat All - A Category	egory II •
	Sign In with Insert your CAC C	your CAC Card ard into the Reader	
are signed	Sign In with CAC Card PIN *****	your CAC Card **	
	Sign In with	Cancel Co your CAC Card	ntinue
	4 Role Operat	Cancel S	▼ ign In



Global Components - Sign Out Flow Steps

Steps

- 1. Click the App Switcher Menu icon, then click "Sign Out".
- 2. The operator name under the application title changes to "Not Signed In".

Telemetry, Tracking, and Command I Specifications

TTC Monitor	Soverit	,	Category
TTC Investigate		y	
Preferences	7.11	*	7.11
Sign Out			
Severity 1 Miess	age	Category	Time



Monitor



Monitor Overview

The Monitor Application allows operators to monitor the status, health, and function of a satellite constellation at-a-glance.

Data roll-up includes system-wide alerts, constellation status and details, contact schedule, and a telemetry watcher.

J. Smith						25	5 14:0	6:25 UT	ГС						Com	## Software
TTC Monitor			C (1)	Car												
TTC Command	Severity		Category	Cor	istellation										List	Timeline
Preferences	All	×	All		Satellite	Ne	xt Pass	AOS ↓	LOS			Ground Station	Azimuth	Elevation	State	Actions
Sign Out	Message	Category	Time	•	IRON 4090	1	255	HH:MM:SS	HH:MM:S	55	٠	LION-A	-41.97	88.12°	Pass	
	Lawren Jagure Dalar Cit Areat	Catagory		•	ECHO 1100	I	255	HH:MM:SS	HH:MM:S	SS	٠	TIGER-B	153.16°	12.31°	Pre-Pass	
	Lorem Ipsum Dolor Sit Amet	Category	HH:IMIM:SS	•	FOXI 3232		255	HH:MM:SS	HH:MM:S	55	•	JAGUAR-D	162.94°	41.22°	Scheduled	
	Lorem Ipsum Dolor Sit Amet	Category	HH:MM:SS	•	GOLF 5602		255	HH:MM:SS	HH:MM:S	55	•	OCELOT-F	83.65°	73.61°	Scheduled	
	Lorem Ipsum Dolor Sit Amet	Category	HH:MM:SS	•	HOTL 0002		255	HH:MM:SS	HH:MM:S	55	٠	CHEETAH-O	201.09°	10.28°	Scheduled	
• · · •	Lorem Ipsum Dolor Sit Amet	Category	HH:MM:SS	•	ALPH 6648		255	HH:MM:SS	HH:MM:S	SS	٠	TIGER-B	-19.03°	65.53°	Scheduled	
• · · •	Lorem Ipsum Dolor Sit Amet	Category	HH:MM:SS	•	JULI 3309		255	HH:MM:SS	HH:MM:S	SS	٠	BEAR-E	265.98°	34.88°	Scheduled	
▶ <u></u>	Lorem Ipsum Dolor Sit Amet	Category	HH:MM:SS	•	KILO 4684		255	HH:MM:SS	HH:MM:S	SS	٠	LION-A	185.31°	88.81°	Scheduled	
▶ <u></u> ◆	Lorem Ipsum Dolor Sit Amet	Category	HH:MM:SS	•	LIMA 2017		255	HH:MM:SS	HH:MM:S	SS	٠	JAGUAR-F	-22.92°	23.93°	Scheduled	
• • •	Lorem Ipsum Dolor Sit Amet	Category	HH:MM:SS	•	MIKE 7509		255	HH:MM:SS	HH:MM:S	SS	٠	OCELOT-F	132.22°	11.32°	Scheduled	
• • •	Lorem Ipsum Dolor Sit Amet	Category	HH:MM:SS	•	NOVB 4500		255	HH:MM:SS	HH:MM:S	SS	٠	TIGER-B	-11.27°	58.72°	Scheduled	
• • •	Lorem lpsum Dolor Sit Amet	Category	HH:MM:SS	•	ALPH 6648		256	HH:MM:SS	HH:MM:S	55	•	PUMA-C	183.72°	81.23°	Complete	
• •	Lorem Ipsum Dolor Sit Amet	Category	HH:MM:SS	•	BRAV 0210		256	HH:MM:SS	HH:MM:S	55	•	BEAR-E	-102.40°	19.49°	Complete	
• • •	Lorem Ipsum Dolor Sit Amet	Category	HH:MM:SS	•	CHAR 8518		256	HH:MM:SS	HH:MM:S	55	•	TIGER-B	151.51°	83.03°	Complete	
• •	Lorem lpsum Dolor Sit Amet	Category	HH:MM:SS	•	DELT 9091		256	HH:MM:SS	HH:MM:S	55	•	ABCD	244.66°	78.19°	Complete	
• •	Lorem lpsum Dolor Sit Amet	Category	HH:MM:SS													
• •	Lorem lpsum Dolor Sit Amet	Category	HH:MM:SS	Wa	tcher						IRON	4090				
• • •	Lorem lpsum Dolor Sit Amet	Category	HH:MM:SS								PWST2	1A				
• • •	Lorem Ipsum Dolor Sit Amet	Category	HH:MM:SS	▼ IR	ON 4090					110						
• •	Lorem Ipsum Dolor Sit Amet	Category	HH:MM:SS		Mnemonic	Unit	Threshold	Actual		100				Upper Limit —		
• •	Lorem Ipsum Dolor Sit Amet	Category	HH:MM:SS	•	PWST2IA	Volts	35.1	22.7 🛪		90						
· · ·	Lorem Ipsum Dolor Sit Amet	Category	HH:MM:SS	•	PWST2IB	Volts	40.4	32.2 🖌		80						
▶ ○ ◆	Lorem Ipsum Dolor Sit Amet	Category	HH:MM:SS	•	PWHTR08PV	Deg	38.4	38.1 🛪		70						
▶ ○	Lorem Ipsum Dolor Sit Amet	Categorv	HH:MM:SS	•	PWST2VB	Deg	41.4	39.6 7		60						
▶ ○ ◆	Lorem Ipsum Dolor Sit Amet	Category	HH:MM:SS							50						
▶ □ ◆	Lorem Ipsum Dolor Sit Amet	Category	HH:MM:SS							30						
	Acknowledge	Dismiss								20 10 0	0800	0900 10	000 110	Lower Limit -	1300 1400	1500 1600



TT&C Wireframes.pdf, page 2



Monitor - Alerts

Functionality

The Alerts component houses a roll-up of system-wide alerts — including software, communications, ground and spacecraft alerts.

Features & Interactions

- 1. Active Alert Aggregate Number Shows number of active alerts.
- 2. Filter Drop-downs Filters alert list by Severity (All, Critical, Caution, Serious) and Category (All, Communications, Ground, Software, and Spacecraft).
- 3. Expandable List Items Expands to show alert details and Investigate Button, if applicable.
- 4. Investigate Button Launches an instance of the Investigate Application.
- 5. Acknowledge/Dismiss Button* Acknowledges or dismisses alerts.
 - a. Dismissed alerts can be undone and added back to the queue.

*Further functionality to be determined.

Telemetry, Tracking, and Command I Specifications

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Active Alerts



Category

2

Severity

Severity 🕽 Message Time Category ٠ Lorem Ipsum Dolor Sit Amet... Category HH:MM:SS \square ٠ HH:MM:SS Lorem Ipsum Dolor Sit Amet.. Category ٠ Lorem Ipsum Dolor Sit Amet... Category HH:MM:SS ٠ HH:MM:SS Lorem Ipsum Dolor Sit Amet... Category • • Lorem Ipsum Dolor Sit Amet... Category HH:MM:SS Etiam consectetur mi velit, ac hendrerit enim viverra ut. Maecenas tincidunt est efficitur, ut vulputate turpis rhoncus. 3 🗹 Investigate Category HH:MM:SS ٠ Lorem Ipsum Dolor Sit Amet.. Lorem Ipsum Dolor Sit Amet.. Category HH:MM:SS • • HH:MM:SS Lorem Ipsum Dolor Sit Amet... Category • ٠ Category HH:MM:SS Lorem Ipsum Dolor Sit Amet. • Lorem Ipsum Dolor Sit Amet... HH:MM:SS Category Lorem Ipsum Dolor Sit Amet. HH:MM:SS Category **5**a HH:MM:SS 2 items were dismissed. (X) <u>Undo</u> HH:MM:SS HH:MM:SS HH:MM:SS Acknowledge Dismiss HH:MM:SS HH:MM:SS HH:MM:SS Lorem Ipsum Dolor Sit Amet.. Categor • ٠ HH:MM:SS Lorem Ipsum Dolor Sit Amet. Category 5 Acknowledge Dismiss



Monitor - Constellation List View

Functionality

The list view of the Constellation component gives an overview of spacecraft status — including, but not limited to contextual details like next pass, ground station and AOS LOS, azimuth, elevation and current state (Pass, Pre-Pass, Scheduled, Complete).

Features & Interactions

- 1. Status Symbols Indicates current status and severity.
- 2. Command Quick Launch Launches an instance of the Command Application for spacecrafts in an active or upcoming pass state. This interaction is indicated by the solid underline and external link icon.
- 3. View Switch

Switches between List and Timeline views.

	Cons	stellation								3 List T	imeline
		Satellite	Next Pass	AOS ↓	LOS		Ground Station	Azimuth	Elevation	State	Actions
	+	IRON 4090	255	HH:MM:SS	HH:MM:SS	•	LION-A	-41.97	88.12°	Pass	
-	+	<u>ЕСНО 1100</u> 🖪	255	HH:MM:SS	HH:MM:SS	٠	TIGER-B	153.16°	12.31°	Pre-Pass	
	٠	FOXI 3232	255	HH:MM:SS	HH:MM:SS	•	JAGUAR-D	162.94°	41.22°	Scheduled	
	•	GOLF 5602	255	HH:MM:SS	HH:MM:SS	•	OCELOT-F	83.65°	73.61°	Scheduled	
	•	HOTL 0002	255	HH:MM:SS	HH:MM:SS	•	CHEETAH-O	201.09°	10.28°	Scheduled	
	•	ALPH 6648	255	HH:MM:SS	HH:MM:SS	•	TIGER-B	–19.03°	65.53°	Scheduled	
	•	JULI 3309	255	HH:MM:SS	HH:MM:SS	•	BEAR-E	265.98°	34.88°	Sch View Pass Plan	
	•	KILO 4684	255	HH:MM:SS	HH:MM:SS	•	LION-A	185.31°	88.81°	Sch Playback Last Pass	
	•	LIMA 2017	255	HH:MM:SS	HH:MM:SS	•	JAGUAR-F	-22.92°	23.93°	Scheuneu	
	•	MIKE 7509	255	HH:MM:SS	HH:MM:SS	•	OCELOT-F	132.22°	11.32°	Scheduled	
	•	NOVB 4500	255	HH:MM:SS	HH:MM:SS	•	TIGER-B	-11.27°	58.72°	Scheduled	
	•	ALPH 6648	256	HH:MM:SS	HH:MM:SS	•	PUMA-C	183.72°	81.23°	Complete	
	•	BRAV 0210	256	HH:MM:SS	HH:MM:SS	•	BEAR-E	-102.40°	19.49°	Complete	
	•	CHAR 8518	256	HH:MM:SS	HH:MM:SS	•	TIGER-B	151.51°	83.03°	Complete	
	٠	DELT 9091	256	HH:MM:SS	HH:MM:SS	•	ABCD	244.66°	78.19°	Complete	

Telemetry, Tracking, and Command I Specifications





Monitor - Constellation List View (Continued)

Features & Interactions

4. Actions Menu* - View Pass Plan Opens the Contact Details Slide-In Pane (Pass Plan tab view)

*Functionality for 'Playback Last Pass' to be determined.

Cons	stellation	
	Satellite	Next Pass
•	IRON 4090	255
•	ECHO 1100	255
•	FOXI 3232	255
•	GOLF 5602	255
•	HOTL 0002	255
•	ALPH 6648	255
•	JULI 3309	255
•	KILO 4684	255
•	LIMA 2017	255
•	MIKE 7509	255
•	NOVB 4500	255
•	ALPH 6648	256
•	BRAV 0210	256
•	CHAR 8518	256
•	DELT 9091	256

Telemetry, Tracking, and Command I Specifications

• <u>IRC</u>	<u>DN-4090</u> 🗹	Close <<
	Contact Details	Pass Plan
AC	() Next Pass: 255	5 AOS: HH:MM:SS
HH Step	Command	Run Length
нн 1	Verify MNEMONIC = ON	
НН 2	Verify MNEMONIC = <40 ur	nit
HH 3	Verify MNEMONIC = OPEN	
HH 4	Verify MNEMONIC = <90 ur	nit
HH 5	Is "XYZ" Selected?	
HH	Are you receiving telemetry	y?
	81001	00.07.25
HH		00.07.25
нн	6-1 Verity MNEMONIC	- 551
нн	6-3 Verify MNEMONIC	- SEL = RPG 1
HH	6-4 Verify MNEMONIC	= =60 Amps</th
HH	- · · · · · · · · · · · · · · · · · · ·	
• 7	81002	00:07:25
▶ 8	81003	00:07:25
▶ 9	81004	00:07:25
- 84		
		Total Run Length: 00:37:50

	List	Timeline
n	State	Actions
0	Pass	
D	Pre-Pass	
>	Scheduled	
0	Scheduled	
0	Scheduled	
2	cheduled	
C	4 View Pass	Plan
0	Playback I	Last Pass
0	Scheuneu	
0	Scheduled	
D	Scheduled	
0	Complete	
D	Complete	
D	Complete	
0	Complete	



Monitor - Constellation Timeline View

Functionality

The timeline view of the Constellation component shows a schedule of contacts for the constellation.

Features & Interactions

- 1. Spacecraft Names & Status Symbols Indicates spacecraft and current status and severity.
- 2. Time Blocks

Shows contact/pass duration and respective ground station and ground station status. Clicking a time block also launches the Contact Details Slide-In Pane (see next page) where you can view contact details.

3. Zoom Tool

Zooms in and out of the timeline, magnifying the time blocks and stretching and the space between time increments.

4. View Switch Switches between List and Timeline views.



Telemetry, Tracking, and Command I Specifications

				3	۹ ——		م		List	Timeline
	◆ TIGER-B 00:00:00	0 - 00:00:00							4	
		6	+ LION-A						◆ JAGUAR-D	
		2	00:00	0:00 - 00:00:00					00:00:0	0 - 00:00:00
						BEAR-E 00:0	00:00 - 00:00:00			
)	05:00 06:00	0 07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00



Monitor - Contact Details Slide-In Pane

Functionality

The Contact Details Slide-In Pane allows the operator to view contact details for a spacecraft — including but not limited to next pass time, AOS/LOS, state of contact as well as ground station details like name, azimuth and elevation.

The operator can also view the pass plan for the spacecraft's current/ upcoming pass which includes but is not limited to details like AOS commands, steps, and run lengths.

Features & Interactions

- 1. Command Quick Launch Launches related Command Application Window.
- 2. View Switch

Switches between Contact Details and Pass Plan views.

Telemetry, Tracking, and Command I Specifications



• <u>IRON-4090</u> 🗹 1	Close <<		
Contact Details	Pass Plan • IF	RON-4090	Close <<
 Next Pass AOS LOS State Ground Station Azimuth Elevation 	25 HH:MM:S HH:MM:S In-Pas LION- -41.9' 88.1	Contact Details () Next Pass: 255 AOS: HH ep Command 1 Verify MNEMONIC = ON 2 Verify MNEMONIC = <40 unit 3 Verify MNEMONIC = OPEN 4 Verify MNEMONIC = <90 unit 5 Is "XYZ" Selected? Are you receiving telemetry?	Pass Plan :MM:SS Run Length
		6 81001 6-1 Verify MNEMONIC = 1 6-2 Verify MNEMONIC = SEL 6-3 Verify MNEMONIC = RPG 1 6-4 Verify MNEMONIC =	00:07:25 ps
	•	7 81002	00:07:25
		8 81003 9 81004	00:07:25
		Total R	un Length: 00:37:50

TT&C Wireframes.pdf, pages 14 & 15



Monitor - Watcher*

Functionality

The Watcher component allows the operator to flag and watch specific telemetry trends over time such as changes in battery levels and other mnemonic values. Mnemonics are monitored for actual value in relation to the assigned value threshold.

*Further functionality of the Watcher to be determined.

Features & Interactions

1. Collapsible Item List

Items in the watcher are categorized by spacecraft and can be collapsed or expanded to show the subsequent list of mnemonics being monitored.

2. Mnemonics

Hovering over a mnemonic value shows the longhand version of its name. This interaction is indicated by the dashed underline. *Clicking* a mnemonic/watcher item changes the graph on the right to reflect how the values have trended over time.



Telemetry, Tracking, and Command I Specifications





Monitor - Watcher (Continued)

Features & Interactions

3. Editable Threshold Value

Threshold can be edited by clicking on the field, setting the desired value and saving changes by clicking the checkmark icon. To clear the custom value from the field, click the "x" icon.

4. Action Menu

Allows operator to remove items from the watchlist and/or investigate them in the Investigate application.

5. Graph

Show mnemonic value trends over time.

a. Hovering over the trending line shows the mnemonic value at that specific point in time.

Watcher	
▼ IRON 4090	
Mnemonic	Unit
PWST2IA	Volts
PWST2IB	Volts
PWHTR08PV	Deg
PWST2VB	Deg

Telemetry, Tracking, and Command I Specifications







Command



Command Overview

The Command Application allows users to maneuver and monitor a spacecraft and its telemetry.

Data roll-ups suggested include: spacecraft specific alerts, Link Status, including Lock and Signal Strength values, Telemetry and Total Frame Count, Vehicle Command Count, Subsystem statuses and contextual watcher items.

These roll ups can be configured by operational needs to determine the highest level of situational data needed to accomplish the mission.

J. Sn	&C CON	MMAND			
Active	5		Severity All	~	Category All
	Severity ↓	Message		Category	Time
•	•	Lorem Ipsum Dolor Si	t Amet	Category	HH:№
•	٠	Lorem Ipsum Dolor Si	t Amet	Category	HH:№
•	•	Lorem Ipsum Dolor Si	t Amet	Category	HH:№
•	•	Lorem Ipsum Dolor Si	t Amet	Category	HH:№
•	•	Lorem Ipsum Dolor Si	t Amet	Category	HH:N
	•	Lorem Ipsum Dolor Si	t Amet	Category	HH:M

Acknowledge	Dismiss

		_		Link Status			
IRON	4090 Pass Plan	Mode Sem	ii-Auto 👻	LINK Status			
Stop	Pass			Lock		Siį	gnal Strengt
Step	instruction		_	• Telemetry			
1	Verify MNEMONIC = ON					Total	Frame Cou
2	Verify MNEMONIC = <60 deg			◆ VCC			
3	Verify MNEMONIC = OPEN						Ва
			_	Subsystems			
4	Verify MNEMONIC = <55 volts	G	Watching	♦ Attitude			
5	Is "XYZ" selected? Are you receiving telemetry?			Payload			
	Yes 👻 Yes 👻			Power			
	81001	Lorem Ipsum Dolor		 Propulsion 			
			00:07:25	◆ Thermal			
	6-1 Verify MNEMONIC = 1						
	6-2 Verify MNEMONIC = <60 deg					_	
	_			Watcher			
	6-3 Verify MNEMONIC = ENAB			Mnemonic	Unit	Threshold	Actual
	6-4 Verify MNEMONIC = <!--=50 volts</b-->			PWST2IA	Volts	35.1	22.7
	81002			PWST2IB PWHTR08PV	Volts	40.4	32.2
▶7	0 1002	0	00:07:25	PWST2VB	Deg	41.4	39.6
8	Verify MNEMONIC = <60 deg						

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Command – Alerts

Functionality

The Alerts component houses a roll-up of spacecraft specific alerts, as well as communications, software, and its assigned ground station.

Features & Interactions

- Active Alert Aggregate Number
 Shows number of active alerts that have not been dismissed.
- Filter Drop-downs
 Filters alert list by severity (All, Critical, Caution, Serious) and category (All, Communications, Ground, Software, and Spacecraft). Categories may be configured from operation to operation.
- 3. Expandable List Items Expands to show alert details and Investigate Button, if applicable.
- 4. Investigate Button Launches an instance of the Investigate Application.
- 5. Acknowledge/Dismiss Button* Acknowledges or dismisses alerts.
 - a. Dismissed alerts can be undone and added back to the queue.

*Further functionality to be determined.

Telemetry, Tracking, and Command I Specifications



	25 Active Al	erts	Seve All	rity 2	Category All
	S	everity 🕽	Message	Category	Time
	•	٠	Lorem Ipsum Dolor Sit Ame	t Category	HH:MM:SS
	•	٠	Lorem Ipsum Dolor Sit Ame	t Category	HH:MM:SS
	•	•	Lorem Ipsum Dolor Sit Ame	t Category	HH:MM:SS
	•	٠	Lorem Ipsum Dolor Sit Ame	t Category	HH:MM:SS
	•	•	Lorem Ipsum Dolor Sit Ame	t Category	HH:MM:SS
	3 20 6	fficitur, ut	vulputate turpis rhoncus.	4	
	•	•	Lorem Ipsum Dolor Sit Ame	t Category	HH:MM:SS
		•	Lorem Ipsum Dolor Sit Ame	t Category	HH:MM:SS
	•	•	Lorem Ipsum Dolor Sit Ame	t Category	HH:MM:SS
	•	•	Lorem Ipsum Dolor Sit Ame	t Category	HH:MM:SS
	•	•	Lorem Ipsum Dolor Sit Ame	t Category	HH:MM:SS
	•		Lorem Ipsum Dolor Sit Ame	t Category	HH:MM:SS
2 items were disn	nissed.	58	Undo	\propto $^{\prime}$	HH:MM:SS
				· /	HH:MM:SS
				/	HH:MM:SS
	(novelocies		Dismiss	/	HH:MM:SS
Act	knowledge		DISMISS	/	HH:MM:SS
				/	HH:MM:SS
-		•	Lorem Ipsum Dolor Sit Ame	t Category	HH:MM:SS
	•	A	cknowledge	Dismiss	







Command – Pass Plan

Functionality

The Pass Plan feature allows a user to verify telemetry values and/or execute instructions, as well as play commands during the duration of a contact.

Features & Interactions

1. Mode*

Allows users who have access to set the plan to run in Manual, Semi-Auto, or Automated mode. *Further functionality to be determined.

2. Pass Indicator

Allows for the user, at-a-glance, to determine if they are in pre-pass, pass or post-pass, in relation to the AOS/LOS for the contact.

3. Pass Plan

An interactive checklist of instructions an operator is expected to complete during a pass. This includes, but is not limited to: Checkboxes, drop down selectors and play and pause controls.



Telemetry, Tracking, and Command I Specifications

90 Pass Plan	м	ode S	emi-Auto		
2 Pass					
Instruction					
Verify MNEMONIC = ON					
Verify MNEMONIC = <60 deg					
Verify MNEMONIC = OPEN					
Verify MNEMONIC = <55 volts					
"XYZ" selected? Are you receiving telemetry?					
81001	Lorem Ipsum [Dolor	() 00:07:25		
Verify MNEMONIC = 1					
Verify MNEMONIC = <60 deg					
Verify MNEMONIC = ENAB					
4 Verify MNEMONIC = <!--=50 volts</b-->					
81002			() 00:07:25		
Verify MNEMONIC = <60 deg					
Verify MNEMONIC = <45 volts					
typing to search commands	٩	Add	to Queue		



Command – Pass Plan (Continued)

Features & Interactions

4. Mnemonic Snapshot

Allows for users to click a mnemonic they've been instructed to verify the value of via the pass plan. Upon clicking, a "snap shot" shows the user the current value of the mnemonic, as well as the direction it is trending (arrow).

The snapshot also queues the user into which subsystem the mnemonic belongs to, with the capability to quickly access the Investigate application, as well as the ability to add the item to the Watcher list.

If the mnemonic is capable of displaying graph data, a snapshot of the graph can be shown in context with the other data attributes. If the instruction involves a mnemonic of a binary value (on/off, enabled/disabled, 0/1), a graph may not be applicable, in which case, the user would only need to access the attributes of the mnemonic (value, subsystem). If the mnemonic is such that it does not make sense to add it to the watcher, the capability to do so can be omitted for that mnemonic.

IRON Step 1 2 3 4 5



1090 Pass Plan		Mode Semi-Auto 👻
	MNEMONIC	
Verify MNEMONIC = O		
Verify MNEMONIC = OI	VALUE: 63.7 Volts オ SUBSYSTEM: <u>Attitude</u> ∠	
Verify MNEMONIC = <5	□ Add to Watcher	Watching
Is "XYZ" selected? Are yes	ou receiving telemetry?	

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Command – Pass Plan Mnemonic Verification













Command – Command Line

Functionality

The Command Line component allows for a user to access commands needed to maintain the overall health of the pass, as well as retrieve a database of commands needed for anomaly resolution and/or other operational needs.

Features & Interactions

1. Frequently Used Commands

This drop down consists of frequently used commands by the user(s). As to what commands it contains, this may be configured by operation to operation. Through user testing, we suggest the following quick access commands: *Recent Commands, Quick Response Procedures, Ground, Satellite and Payload dump*.

2. Search Commands

Searching commands via the text input will retrieve a database of commands and match them by text string. Once an operator selects a command and adds it to the queue, the command will be inserted at the bottom of the pass plan.





	NAB		
nands:			
	:/=50 volts		
ump 4			0 00 07 05
hand 3			00:07:25
ommand 1	deg		
se Procedures:			
hand	volts		
ping to search commands		Q	Add to Queue

Results:		
mut en mede (Benetien wheeld Opennting Mede)		
rw1_op_mode (<i>keaction wheel 1 Operating Mode)</i>		
rw1_momentum (<i>Reaction wheel 1 momentum</i>)		
rw1_momentum error (Rea ction wheel 1 momentum error)		
rw1_torque (Rea ction wheel 1 torque)		
rw1_torque_error (<i>Reaction wheel 1 torque error</i>)		0 00:07:25
rw1_vm_com (<i>Reaction wheel 1 VM_COM</i>)		00:07:25
rw1_pwm_com (<i>Reaction wheel 1 pulse width modulation</i>)		
rw1_cmd_watchdog (<i>Reaction wheel 1 rtc_h</i>)		
rw1_limit_flags (<i>Reaction wheel 1 limit flags</i>)		
	_	
Rea	Q	Add to Queue

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Command – Link Status

Functionality

The Link Status lock up shows connection and critical health statuses that are mission. The attributes of what displays can differ from operation to operation.

Features & Interactions

- 1. Lock and Signal Strength Displays the lock value and signal strength, as well as a status symbol inc the quality of lock.
- 2. Telemetry and Total Frame Count Displays telemetry value and a status symbol to determine, at-a-glance, the quality of telemetry, as well as the frame count.

3. VCC (Vehicle Command Count)

Displays the total command count of the commands being sent to the spacecraft as well as any bad commands sent or received.

Telemetry, Tracking, and Command I Specifications



	Link Status
-99	1 + Lock
Signal Strength: –72.64	
99.0	2 • Telemetry
Total Frame Count: 49336	
7,290	3 + VCC
Bad CMD: 0	



Command – Subsystems

Functionality

The subsystems display shows a high level roll up status of a spacecraft's subsystems (indicated by status symbol). These systems vary from spacecraft to spacecraft.

Features & Interactions

1. Subsystem Status

The subsystem's health is identified by the accompanying status symbol. The order in which the subsystems display can be configured by the operation. It is suggested to not hide subsystems in a scrolling list, to avoid missing status symbols that require attention. If the list of subsystems is long enough that it does require a scroll, it is recommended that any subsystems that display statuses of anything less than nominal surface to the top of the list, in order of severity.

2. Investigate

A status of anything less than nominal may require the user to investigate the issue and determine what the root cause of a status degradation is. By clicking any subsystem row, a user can open a hierarchal display of the subsystem, as well as its assembly, to gain a better understanding of what is causing the less than nominal status.

Telemetry, Tracking, and Command I Specifications



Subsystems	
◆ Attitude	ľ
◆ Payload	ľ
Power 2	ď
 Propulsion 	ľ
Thermal	ľ



Command – Contextual Watcher

Functionality

The Contextual Watcher exhibits the same behavior as the Monitor Watcher, with the exception that all items displayed are contextual to the satellite in pass. It does not display the full graph data, but that may be accessed via a "snapshot view" by clicking the mnemonic name.

Features & Interactions

1. Mnemonic

Displays the mnemonic being watched and its status. Clicking on the mnemonic name brings up its attributes, as well as a snap shot graph (if applicable).

2. Unit

Displays the unit of measurement associated to the mnemonic. (Example: Volts, Degrees, Magnitude, Amps, etc.).

3. Threshold and Actual Value

Displays the defined threshold range of the mnemonic and its actual, current value. An arrow shows the user which direction the value is trending (may not be applicable to binary values).

4. Action Menu

Allows users to remove the item from the watch list and/or further investigate the mnemonic's subsystem.

Telemetry, Tracking, and Command I Specifications



	atcher _{Mnemonic}	Unit	Threshold	Actual	
•	PWST2IA	Volts	35.1	22.7 7	
•	PWST2IB	Volts	40.4	32.2 Y	
٠	PWHTR08PV	Deg	38.4	38.1 7	
•	PWST2VB	Deg	41.4	39.6 7	



Contextual Watcher – Hierarchy*



*Further functionality to be determined.

Telemetry, Tracking, and Command I Specifications



Key



reaches the input value or above/below

Actual

A measurement value of data that is being streamed down, or, the last registered value when the spacecraft was receiving telemetry



Investigate



Investigate Overview*

The Investigate Application houses all of the subsystems of a spacecraft. It's here that users can investigate anomalies and find useful information on subsystem assemblies such as assembly layouts, mnemonic data, and health and status.

*Further functionality of the Investigate Application to be determined.

J. Smith		
IRON 4090 Subsystems	Star 1	Fracker A
▼ ◆ Attitude		
◆ Star Tracker		
 Earth Sensors 		
Reaction Wheels		
♦ Sun Sensors		
Payload		
▶ ♦ Power		
Propulsion		
	Electr	onics
	Severity ↓	Mnemonic
	•	PWHTR08PV
	-	PWHTR08RV
	-	PWHTR11PV
	-	PWHTR11RV
	-	PWST2IA
	•	PWST21B
	•	PWHTR11PV
	•	PWST2VB
	•	HTR08PPW
	•	HTR08PPW
	•	HTR08PPW
	•	
	•	
	•	HTR11PPW
		HTR11PPW
		HTR11PPW



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Subsystem Drilldown Hierarchy













Investigate - Subsystem Tree Menu

Functionality

The Subsystem Tree Menu shows a hierarchical list of spacecraft's subsystems. When a subsystem is selected, the related subsystem assembly layout and mnemonic data table is shown in the content area to the right.

The subsystem tree can be modeled using a single-column or twocolumn format.

Features & Interactions

- Expandable List Items
 Subsystem menu items expand to show any related subsubsystems.
- 2. Status Symbols Status symbols indicate current subsystem status and severity.

Telemetry, Tracking, and Command I Specifications



Single-Column Menu

IRON 4090 Subsystems IRON 4090 Subsystems Attitude Attitude Earth Sensors Star Tracker Payload Reaction Wheels • Earth Sensors Power Star Tracker Reaction Wheels Propulsion Sun Sensors Sun Sensors Thermal Payload Power Propulsion Thermal

Two-Column Menu



Investigate - Subsystem Assembly Layout

Functionality

The Subsystem Assembly Layout and Mnemonic Data Table work in conjunction to show subsystem health, status and severity, as well as mnemonic data, such as measurements and values.

Features & Interactions

1. Subsystem Assembly Layout The subsystem assembly layout gives the operator an illustrative view of a subsystem assembly. The illustration is color-coded to show status and to help identify the root cause of an issue with the subsystem.

Clicking a component in the assembly layout shows its mnemonic data in the list below.

Star T	racker Assembly	/
		Long
		Lens
Electro	onics	
Severity 🖡	Mnemonic	Measurement
•	PWHTR08PV	Star Tracker 1 Heater 8P Vol
-	PWHTR08RV	Star Tracker 1 Heater 8R Vol
-	PWHTR11PV	Star Tracker 2 Heater 11P Vo
-	PWHTR11RV	Star Tracker 2 Heater 11R Vo
-	PWST2IA	Star Tracker 1 Voltage Monit
•	PWST21B	Star Tracker 2 Voltage Monit
•	PWHTR11PV	Star Tracker 1 Voltage Monit
•	PWST2VB	Star Tracker 2 Voltage Monit
•	HTR08PPW	Star Tracker 1 Heater 8P Sw
•	HTR08PPW	Star Tracker 1 Heater 8P Sw
•	HTR08PPW	Star Tracker 1 Heater 8P Sw
•	HTR08RPW	Star Tracker 1 Heater 8R Sw
•	HTR08RPW	Star Tracker 1 Heater 8R Sw
•	HTR08RPW	Star Tracker 1 Heater 8R Sw
•	HTR11PPW	Star Tracker 2 Heater 11P Sv
<u> </u>	HIRTIPPW	Star Tracker 2 Heater 11P Sv
•	HTR11PPW	Star Tracker 2 Heater 11P Sv Star Tracker 2 Heater 11P Sv

Telemetry, Tracking, and Command I Specifications

t & Mnemo	onic Data	Table
-----------	-----------	-------

Baffle	Detection Module	D	etector mo-Electric Cooler		
			Fliter by name	All	Marginal Critical
	Value	Unit	Watching (2)		
ltage Monitor	74.2	Volts			
tage Monitor	49.9	Volts	Watching		
oltage Monitor	81.4	Volts			
oltage Monitor	63.7	Volts	Add to Watcher		
tor (Via PCDU 2B)	22.7	Volts	-		
tor (Via PCDU 2A)	32.2	Volts	Watching		
tor (Via PCDU 3B)	38.1	Volts			
tor (Via PCDU 3A)	39.6	Volts			
itch Power	89.2	Deg			
itch Power	92.4	Deg			
itch Power	91.9	Deg			
itch Power	88.2	Deg			
itch Power	75.2	Deg			
itch Power	79.3	Deg			
witch Power	66.5	Deg			
		_			
witch Power	90.4	Deg			



Investigate - Subsystem Assembly Layout & Mnemonic Data Table (Continued)

Features & Interactions

2. Status Symbols

Status symbols indicate current mnemonic status and severity and can be sorted by severity as well.

3. Table Filters

The mnemonic data table can be filtered by name in order to narrow down high volumes of content and surface the most relevant results.

The table can also be filtered by severity using the segmented buttons (All/Marginal/Critical).

	Star T	racker Assembly	/	
				Lens
	Electro	onics		
	Severity 🖡	Mnemonic	Measureme	nt
2	•	PWHTR08PV	Star Tracker	1 Heater 8P Volt
2)-	PWHTR08RV	Star Tracker	1 Heater 8R Vol
	-	PWHTR11PV	Star Tracker	2 Heater 11P Vo
	=	PWHTR11RV	Star Tracker	2 Heater 11R Vo
	-	PWST2IA	Star Tracker	1 Voltage Monit
	•	PWST21B	Star Tracker	2 Voltage Monit
	•	PWHTR11PV	Star Tracker	1 Voltage Monit
	•	PWS12VB	Star Tracker	2 Voltage Monit
	•		Star Tracker	1 Heater 8P Swi
	•		Star Tracker	1 Heater 8P SWI
	•		Star Tracker	1 Heater 8P Swi
		HTR08RPW	Star Tracker	1 Heater 8R Swi
		HTR08RPW	Star Tracker	1 Heater 8R Swi
	•	HTR11PPW	Star Tracker	2 Heater 11P Sw
	•	HTR11PPW	Star Tracker	2 Heater 11P Sw
	•	HTR11PPW	Star Tracker	2 Heater 11P Sw
			Ctor Tracker	2 Lastar 11D Cu

Telemetry, Tracking, and Command I Specifications

	_	_	_		_	_
Baffle	Detection Module	De Thern C	etector mo-Electric Cooler	lectronics		
			Fli	ter by name	- 3 All	Marginal Critical
	Value	Unit	Watching (2)			
tage Monitor	Value 74.2	Unit Volts	Watching (2)			
tage Monitor tage Monitor	Value 74.2 49.9	Unit Volts Volts	Watching (2)			
tage Monitor tage Monitor vltage Monitor	Value 74.2 49.9 81.4	Unit Volts Volts Volts	Watching (2)			
tage Monitor tage Monitor Ntage Monitor Ntage Monitor	Value 74.2 49.9 81.4 63.7	Unit Volts Volts Volts Volts	Watching (2) Watching Add to Watcher			
tage Monitor tage Monitor oltage Monitor oltage Monitor or (Via PCDU 2B)	Value 74.2 49.9 81.4 63.7 22.7	Unit Volts Volts Volts Volts Volts	Watching (2) Watching Add to Watcher			
tage Monitor tage Monitor oltage Monitor oltage Monitor cor (Via PCDU 2B) cor (Via PCDU 2A)	Value 74.2 49.9 81.4 63.7 22.7 32.2	Unit Volts Volts Volts Volts Volts Volts	Watching (2) Watching Add to Watcher Watching Watching			
tage Monitor tage Monitor Ditage Monitor Ditage Monitor or (Via PCDU 2B) or (Via PCDU 2A) or (Via PCDU 3B)	Value 74.2 49.9 81.4 63.7 22.7 32.2 38.1	Unit Volts Volts Volts Volts Volts Volts Volts Volts	Watching (2) Watching Add to Watcher Watching			
tage Monitor tage Monitor oltage Monitor oltage Monitor or (Via PCDU 2B) cor (Via PCDU 2A) cor (Via PCDU 3B) cor (Via PCDU 3A)	Value 74.2 49.9 81.4 63.7 22.7 32.2 38.1 39.6	Unit Volts Volts Volts Volts Volts Volts Volts Volts Volts	Watching (2) Watching Add to Watcher Watching			
tage Monitor tage Monitor oltage Monitor oltage Monitor or (Via PCDU 2B) for (Via PCDU 2A) for (Via PCDU 3B) for (Via PCDU 3A) tch Power	Value 74.2 49.9 81.4 63.7 22.7 32.2 38.1 39.6 89.2	Unit Volts Volts Volts Volts Volts Volts Volts Volts Volts Deg	Watching (2) Watching Add to Watcher Watching Watching			
tage Monitor tage Monitor bltage Monitor of Via PCDU 2B) cor (Via PCDU 2A) cor (Via PCDU 3B) cor (Via PCDU 3A) cor (Via PCDU 3A) cor (Via PCDU 3A)	Value 74.2 49.9 81.4 63.7 22.7 32.2 38.1 39.6 89.2 92.4	Unit Volts Volts Volts Volts Volts Volts Volts Volts Deg Deg	Watching (2) Watching Add to Watcher Watching			
tage Monitor tage Monitor oltage Monitor oltage Monitor or (Via PCDU 2B) cor (Via PCDU 2A) cor (Via PCDU 3A) cor (Via PCDU 3A) tch Power itch Power	Value 74.2 49.9 81.4 63.7 22.7 32.2 38.1 39.6 89.2 92.4 91.9	Unit Volts Volts Volts Volts Volts Volts Volts Deg Deg	Watching (2) Watching Add to Watcher Watching Watching			
tage Monitor tage Monitor oltage Monitor oltage Monitor or (Via PCDU 2B) for (Via PCDU 2A) for (Via PCDU 3B) for (Via PCDU 3A) for (Via PCDU 3A) ftch Power ftch Power	Value 74.2 49.9 81.4 63.7 22.7 32.2 38.1 39.6 89.2 92.4 91.9 88.2	Unit Volts Volts Volts Volts Volts Volts Volts Deg Deg Deg Deg	Watching (2) Watching Add to Watcher Watching			
tage Monitor tage Monitor oltage Monitor oltage Monitor or (Via PCDU 2B) cor (Via PCDU 2A) cor (Via PCDU 3A) cor (Via PCDU 3A) cor (Via PCDU 3A) itch Power itch Power itch Power	Value 74.2 49.9 81.4 63.7 22.7 32.2 38.1 39.6 89.2 92.4 91.9 88.2 75.2	Unit Volts Volts Volts Volts Volts Volts Volts Deg Deg Deg Deg	Watching (2) Watching Add to Watcher Watching			
tage Monitor tage Monitor oltage Monitor oltage Monitor oltage Monitor or (Via PCDU 2B) for (Via PCDU 2A) for (Via PCDU 3B) for (Via PCDU 3B) for (Via PCDU 3A) fitch Power fitch Power fitch Power fitch Power	Value 74.2 49.9 81.4 63.7 22.7 32.2 38.1 39.6 89.2 92.4 91.9 88.2 75.2 79.3	Unit Volts Volts Volts Volts Volts Volts Volts Deg Deg Deg Deg Deg Deg	Watching (2) Watching Add to Watcher Watching			
tage Monitor tage Monitor oltage Monitor oltage Monitor oltage Monitor or (Via PCDU 2B) cor (Via PCDU 2A) cor (Via PCDU 3A) cor (Via PCDU 3A) cor (Via PCDU 3A) itch Power itch Power itch Power itch Power itch Power	Value 74.2 49.9 81.4 63.7 22.7 32.2 38.1 39.6 89.2 92.4 91.9 88.2 75.2 79.3 66.5	Unit Volts Volts Volts Volts Volts Volts Volts Deg Deg Deg Deg Deg Deg Deg	Watching (2) Watching Add to Watcher Watching			
tage Monitor tage Monitor oltage Monitor oltage Monitor oltage Monitor or (Via PCDU 2B) cor (Via PCDU 2A) cor (Via PCDU 3B) cor (Via PCDU 3B) cor (Via PCDU 3A) cor (Via PCDU	Value 74.2 49.9 81.4 63.7 22.7 32.2 38.1 39.6 89.2 92.4 91.9 88.2 75.2 79.3 66.5 90.4	Unit Volts Volts Volts Volts Volts Volts Volts Deg Deg Deg Deg Deg Deg Deg Deg Deg	Watching (2) Watching Add to Watcher Watching			
tage Monitor tage Monitor oltage Monitor oltage Monitor or (Via PCDU 2B) or (Via PCDU 2A) or (Via PCDU 3A) or (Via PCDU 3A) tor Power toh Power toh Power toh Power toh Power toh Power toh Power vitch Power	Value 74.2 49.9 81.4 63.7 22.7 32.2 38.1 39.6 89.2 92.4 91.9 88.2 75.2 79.3 66.5 90.4 93.7	Unit Volts Volts Volts Volts Volts Volts Volts Deg Deg Deg Deg Deg Deg Deg Deg Deg Deg	Watching (2) Watching Add to Watcher Watching			



Investigate - Subsystem Assembly Layout (Continued)

Features & Interactions

4. Watcher Item Status Indicators An Add to Watcher checkbox appears when hovering over a row. Clicking the checkbox adds that row item, or mnemonic, to the <u>Watcher component</u> in the Monitor Application.

Once an item has been added to the Watcher, from either here, the Monitor Application or the Command Application, a status indicator is shown in the Watching column to indicate the mnemonic is being watched.



Telemetry, Tracking, and Command I Specifications

	iern	ONI	c Da	ta lable		
Baffle	Detection Module	Therm C	no-Electric	Electronics		
				Fliter by name	All Marginal Critical	1
	Value	Unit	Watching (2)			
Itage Monitor	Value 74.2	Unit Volts	Watching (2)			
Itage Monitor Itage Monitor	Value 74.2 49.9	Unit Volts Volts	Watching (2)			
ltage Monitor ltage Monitor oltage Monitor	Value 74.2 49.9 81.4	Unit Volts Volts Vo	Watching (2)			
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Itage Monitor Itage Monitor oltage Monitor oltage Monitor tor (Via PCDU 2B)	Value 74.2 49.9 81.4 63.7 22.7	Unit Volts Volts Vots	Watching (2) Watching Add to Watch	er		
Itage Monitor Itage Monitor oltage Monitor oltage Monitor tor (Via PCDU 2B) tor (Via PCDU 2A)	Value 74.2 49.9 81.4 63.7 22.7 32.2	Unit Volts Volts Vo 4 Volts	Watching (2) Watching Add to Watch Watching	er		
Itage Monitor Itage Monitor oltage Monitor oltage Monitor tor (Via PCDU 2B) tor (Via PCDU 2A) tor (Via PCDU 3B)	Value 74.2 49.9 81.4 63.7 22.7 32.2 38.1 20.6	Unit Volts Volts Volts Volts Volts	Watching (2) Watching Add to Watch Watching	er		
Itage Monitor Itage Monitor oltage Monitor oltage Monitor tor (Via PCDU 2B) tor (Via PCDU 2A) tor (Via PCDU 3B) tor (Via PCDU 3A)	Value 74.2 49.9 81.4 63.7 22.7 32.2 38.1 39.6 20.2	Unit Volts Volts Volts Volts Volts Volts	Watching (2) Watching Add to Watch Watching	er		
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Itage Monitor Itage Monitor oltage Monitor oltage Monitor tor (Via PCDU 2B) tor (Via PCDU 2A) tor (Via PCDU 3B) tor (Via PCDU 3A) itch Power itch Power	Value 74.2 49.9 81.4 63.7 22.7 32.2 38.1 39.6 89.2 92.4	Unit Volts Volts Volts Volts Volts Volts Deg Deg	Watching (2) Watching Add to Watch Watching	er		
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