International Space Station
Assembly Operations Book

ISS-13A

Mission Operations Directorate
Operations Division

23 FEB 07

This publication replaces all previous publications.

These procedures are available electronically on the SODF Homepage
at http://mod.jsc.nasa.gov/do3

National Aeronautics and Space Administration
Lyndon B. Johnson Space Center
Houston, Texas
INTERNATIONAL SPACE STATION
ASSEMBLY OPERATIONS BOOK
ISS-13A

23 FEB 07

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<td>326</td>
<td>23 FEB 07</td>
<td>376</td>
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</tbody>
</table>

* - Omit from flight book

23 FEB 07     vi     ASSY OPS
377 .......................... 23 FEB 07
378 .......................... 23 FEB 07
379 .......................... 05 FEB 07
380 .......................... 05 FEB 07
381 .......................... 05 FEB 07
382 .......................... 23 FEB 07
383 .......................... 09 FEB 07
384 .......................... 09 FEB 07
385 .......................... 09 FEB 07
386 .......................... 09 FEB 07
387 .......................... 09 FEB 07
388 .......................... 09 FEB 07
389 .......................... 09 FEB 07
390 .......................... 23 FEB 07
391 .......................... 07 DEC 06
392 .......................... 07 DEC 06
393 .......................... 05 FEB 07
394 .......................... 05 FEB 07
395 .......................... 05 FEB 07
396 .......................... 05 FEB 07
397 .......................... 05 FEB 07
398 .......................... 05 FEB 07
399 .......................... 05 FEB 07
400 .......................... 05 FEB 07
401 .......................... 05 FEB 07
402 .......................... 23 FEB 07
403 .......................... 09 J AN 07
404 .......................... 09 J AN 07
405 .......................... 09 J AN 07
406 .......................... 23 FEB 07
407 .......................... 05 J AN 07
408 .......................... 05 J AN 07

* - Omit from flight book
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ACTIVATION AND CHECKOUT
OBJECTIVE:
Safe connectors for S1 to S3/S4 umbilical connections and activate S3 ITS after umbilicals are mated.

INITIAL CONDITIONS:
LAB RWS Active and Cupola RWS in Backup, MSS LB Channel A selected. MT at Worksite 2 with 3A and 4B heaters powered. MBS and SSRMS Operational on Prime (4B) string, MBS Keep-Alive on Redundant (3A) string, MBS VDU(s) powered from Prime (4B) string.

1. CONFIGURING 1553 TO CHANNEL A AND EXT RM

NOTE
ODIN will configure to Channel A on all of the targeted buses one night prior to the EVA. Only checks performed during procedure execution.

1.1 Inhibiting Auto Transition to Diag in the PMCU and PL MDMs

CDH Summary

sel Primary PMCU MDM

Primary PMCU MDM

sel Processing State

PMCU Processing State Transitions

cmd Auto Transition to Diag Inhibit Execute (Verify – Inh)

CDH Summary

sel Primary PL MDM

Primary PL MDM

sel Processing State

PL Processing State Transitions

cmd Auto Transition to Diag Inhibit Execute (Verify – Inh)

1.2 Verifying 1553 Configured to Channel A

CDH Summary

sel Primary PMCU MDM

Primary PMCU MDM
CDH Summary

2. **POWERDOWN ITS S0, S1, P1 AND P3 LOADS FOR NADIR TRAY CONNECTIONS**

2.1 Powering MBS Redundant Off

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Expect ‘<strong>R1E - MSS Active OCS MBS Redun MCU SRT Comm Fail</strong>’ Robotics Advisory messages (SCR 17730).</td>
</tr>
<tr>
<td>2. Expect ‘<strong>R2O - MBS CRPCM 1R(2R, 3R) Cat-2 Transmit (Receive) Msg Err</strong>’ Robotics Advisory messages (SCR 21744).</td>
</tr>
</tbody>
</table>

MSS: MBS: MCU

**MCU**

**cmd** ‘Redundant’ Off (Verify – Off)

<table>
<thead>
<tr>
<th>Ops Name</th>
<th>CIPUI</th>
</tr>
</thead>
<tbody>
<tr>
<td>MBS_Power_Off_Redun_Pre_SPDM</td>
<td>CMRM96IM0207K</td>
</tr>
</tbody>
</table>
CAUTION

The Operational and Survival Rail Heaters for a single power bus should never be powered at the same time. The following commands could place some heaters at risk of damage (SCAN-44 heaters). Reconfiguration of the redundant heater strings may be necessary.

2.2 Configuring DDCU P13A Powered Utility Rail Heaters

Table 1. DDCU P13A Powered Utility Rail Heaters

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>P1 Pwr Buses P11A P14B Rail Htrs</td>
<td>P11A</td>
<td>Survival</td>
<td></td>
</tr>
<tr>
<td>P1 Pwr Buses P11A P14B Rail Htrs</td>
<td>P14B</td>
<td>Survival</td>
<td></td>
</tr>
<tr>
<td>P1 Pwr Buses P12B P13A Rail Htrs</td>
<td>P13A</td>
<td>Operational</td>
<td></td>
</tr>
<tr>
<td>P3 P3 Rail Heaters</td>
<td>P31A</td>
<td>Survival</td>
<td></td>
</tr>
<tr>
<td>P3 P3 Rail Heaters</td>
<td>P34B</td>
<td>Survival</td>
<td></td>
</tr>
<tr>
<td>P3 P3 Rail Heaters</td>
<td>P33A</td>
<td>Operational</td>
<td></td>
</tr>
<tr>
<td>S0 Pwr Bus S01A Rail Htrs</td>
<td>S01A</td>
<td>Survival</td>
<td></td>
</tr>
<tr>
<td>S0 Pwr Bus S04B Rail Htrs</td>
<td>S04B</td>
<td>Survival</td>
<td></td>
</tr>
<tr>
<td>S0 Pwr Bus S03A Rail Htrs</td>
<td>S03A</td>
<td>Operational</td>
<td></td>
</tr>
<tr>
<td>S1 Pwr Buses S11A S14B Rail Htrs</td>
<td>S11A</td>
<td>Survival</td>
<td></td>
</tr>
<tr>
<td>S1 Pwr Buses S11A S14B Rail Htrs</td>
<td>S14B</td>
<td>Survival</td>
<td></td>
</tr>
<tr>
<td>S1 Pwr Buses S12B S13A Rail Htrs</td>
<td>S13A</td>
<td>Operational</td>
<td></td>
</tr>
</tbody>
</table>

Refer to Table 1 for [XX], [DISPLAY], [RAIL], and [TYPE] references that follow.

PCS [XX]: [DISPLAY]
[DISPLAY]

Utility Rail [RAIL]
[TYPE]
Availability – Inhibit
RPC Position
RPC Position – Op
Repeat
2.3 Configuring Redundant Utility Rail Heaters

Table 2. Redundant Heaters For DDCU P13A Powered Utility Rail Heaters

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>Pwr Buses P11A P14B Rail Htrs P11A</td>
<td>P11A</td>
<td>Operational</td>
</tr>
<tr>
<td>P1</td>
<td>Pwr Buses P11A P14B Rail Htrs P14B</td>
<td>P14B</td>
<td>Operational</td>
</tr>
<tr>
<td>P1</td>
<td>Pwr Buses P12B P13A Rail Htrs P13A</td>
<td>P13A</td>
<td>Survival</td>
</tr>
<tr>
<td>P3</td>
<td>P3 Rail Heaters P31A</td>
<td>P31A</td>
<td>Operational</td>
</tr>
<tr>
<td>P3</td>
<td>P3 Rail Heaters P34B</td>
<td>P34B</td>
<td>Operational</td>
</tr>
<tr>
<td>P3</td>
<td>P3 Rail Heaters P33A</td>
<td>P33A</td>
<td>Survival</td>
</tr>
<tr>
<td>S0</td>
<td>Pwr Bus S01A Rail Htrs S01A</td>
<td>S01A</td>
<td>Operational</td>
</tr>
<tr>
<td>S0</td>
<td>Pwr Bus S04B Rail Htrs S04B</td>
<td>S04B</td>
<td>Operational</td>
</tr>
<tr>
<td>S0</td>
<td>Pwr Bus S03A Rail Htrs S03A</td>
<td>S03A</td>
<td>Survival</td>
</tr>
<tr>
<td>S1</td>
<td>Pwr Buses S11A S14B Rail Htrs S11A</td>
<td>S11A</td>
<td>Operational</td>
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<tr>
<td>S1</td>
<td>Pwr Buses S11A S14B Rail Htrs S14B</td>
<td>S14B</td>
<td>Operational</td>
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<tr>
<td>S1</td>
<td>Pwr Buses S12B S13A Rail Htrs S13A</td>
<td>S13A</td>
<td>Survival</td>
</tr>
</tbody>
</table>

Refer to Table 2 for [XX], [DISPLAY], [RAIL], and [TYPE] references that follow.

[XX]: [DISPLAY]

[[DISPLAY]]

’Utility Rail [RAIL]’

’[TYPE]’

√Availability – Enable

Repeat

3. DEACTIVATING DDCU P13A AND VERIFYING MBSU 3 RBI CONFIGS

NOTE
Prior to removing Channel 3A power, it is necessary to ensure that the downstream EPS ORUs do not have ORU health flags set (i.e., EEPROM Bit Flips). If the health flag is set due to an ORU flip bit, failure to check the ORU health prior to powering it down may result in loss of ORU function upon powering it back. If repowered, these ORUs will boot from unhealthy EEPROM Firmware.
3.1 Verifying RPCM S02B-B RPC 2 Open
EPS Summary: S0

sel RPCM S02B B
sel RPC 2

**RPCM S02B B RPC 2**

√RPC Position – Op
√Close Cmd – Inh

3.2 Verifying MBSU 3 RBI 1 and RBI 8 are Open
EPS Summary: S0

sel MBSU 3

**MBSU 3**

√RBI 1 Position – Open

Verify RBI 1 Voltage = -4.2 to 4.2 V

√RBI 8 Position – Open

Verify RBI 8 Voltage = -4.2 to 4.2 V

sel RBI 1

**MBSU 3 RBI 1**

√Close Cmd – Inh

EPS Summary: S0: MBSU 3: RBI 8

**MBSU 3 RBI 8**

√Close Cmd – Inh

3.3 Inhibiting RT FDIR DDCU P13A and ORUs

**NOTE**

1. Inhibit RT FDIR to RTs that will lose power, but will still be monitored during the powerdown (i.e., RPCMs).

2. Expect multiple loss of comm messages when DDCU P13A converter powered off.

3. ODIN to perform via command script.

CDH Summary: S0 2 MDM

**S0 2 MDM**
sel UB SEPS S0 23
sel RT Status

[S0 2 UB SEPS S0 23 RT Status]

**cmd** RPCM S03A [X] RT FDIR Status – Inhibit FDIR  **Execute**
(Verify – Inh)  where [X] = [A] [B] [C] [D] [E] [F]

CDH Summary: Primary EXT MDM
[Primary EXT MDM]

sel LB MT 1
sel RT Status
sel RT Status Cont. RT#16-25

[LB MT 1 RT Status Cont]

**cmd** ‘23 RPCM MT 3A A’ Inhibit FDIR  **Execute** (Verify – Inh)

CDH Summary: S1 2 MDM
[S1 2 MDM]

sel UB SEPS S1 23
sel RT Status

[S1 2 UB SEPS S1 23 RT Status]

**cmd** RPCM S13A [X] RT FDIR Status – Inhibit FDIR  **Execute**
(Verify – Inh)  where [X] = [E] [F] [G]

CDH Summary: P1 2 MDM
[P1 2 MDM]

sel UB SEPS P1 23
sel RT Status

[P1 2 UB SEPS P1 23 RT Status]

**cmd** RPCM P13A [X] RT FDIR Status – Inhibit FDIR  **Execute**
(Verify – Inh)  where [X] = [E] [F] [G]

CDH Summary: P3 2 MDM
[P3 2 MDM]

sel UB SEPS P3 23
sel RT Status

[P3 2 UB SEPS P3 23 RT Status]

**cmd** RPCM P33A [X] RT FDIR Status – Inhibit FDIR  **Execute**
(Verify – Inh)  where [X] = [C] [E] [F]
CDH Summary: Primary PMCU MDM

`Primary PMCU MDM`

`sel LB PMCU 2`

`sel RT Status`

`LB PMCU 2 RT Status`

**cmd** ‘18 DDCU P1 3A’ RT FDIR Status – Inhibit FDIR  **Execute**

(Verify – Inh)

### 3.4 Deactivating DDCU P13A

EPS Summary: S0: DDCU P13A

`DDCU P13A`

`sel Converter`

`DDCU P13A Converter`

`Converter`

**cmd** Off (1-step command, arm not required)

√ Output Voltage < 12.8 V

**MCC-H** ↑ ISS, “Go to connect nadir tray utilities.”

### 3.5 Receiving Go for Channel 2/3 Powerup

**NOTE**

Crew will give GO for powerup after nadir tray connections completed.

ISS ↓ **MCC-H**, “Go for nadir tray powerup.”

### 4. CONFIGURING 1553 DATA BUS TO CH B

Configuring 1553 to Channel B

C&DH Summary: Primary PMCU

`Primary PMCU MDM`

`sel LB_PMCU-1`

`sel Bus Status`

`LB PMCU-1 Bus Status`

**cmd** select channel – B  **Execute**

Verify channel selected – B

C&DH Summary: Primary PMCU

`Primary PMCU MDM`

`sel LB_PMCU-3`

`sel Bus Status`
LB_PMCU_Bus Status

**cmd** select channel – B  **Execute**

Verify channel selected – B

C&DH Summary: Primary EXT

Primary Ext MDM

sel LB_Sys_S-1
sel Bus Status

LB_Sys_S-1 Bus Status

**cmd** select channel – B  **Execute**

Verify channel selected – B

Primary Ext MDM

sel LB_Sys_S-2
sel Bus Status

LB_Sys_S-2 Bus Status

**cmd** select channel – B  **Execute**

Verify channel selected – B

Primary Ext MDM

sel LB_Mech_S-1
sel Bus Status

LB Mech S-1 Bus Status

**cmd** select channel – B  **Execute**

Verify channel selected – B

Primary Ext MDM

sel LB_Mech_S-2
sel Bus Status

LB Mech S-2 Bus Status

**cmd** select channel – B  **Execute**
Verify channel selected – B

C&DH Summary: Primary PL

- sel LB_PL_1
- sel Bus Status

  LB PL 1 Bus Status

**cmd select channel – B Execute**

Verify channel selected – B

CDH Summary

- sel Primary C&C MDM

**Primary C&C MDM**

- sel CB CT-1
- sel Bus Status

  CB CT-1 Bus Status

**cmd select channel – B Execute**

Verify channel selected – B

5. **ACTIVATING DDCU P13A**

5.1 Activating DDCU P13A

EPS Summary: P1: DDCU P13A

**DDCU P13A**

- sel Converter

  **DDCU P13A Converter**

  ‘Converter’

**cmd Converter On – Arm**

**cmd Converter On – On**

**DDCU P13A**
5.2 Powering On S3 2 MDM and RPCM S32B-A

S3: EPS

sel S02B B RPC 02

[RPCM S02B B RPC 02]

Verify Integration Counter – incrementing

√ Close Cmd – Ena

cmd RPC Position – Close (Verify – Cl)

NOTE
Closing the S02B B RPC 2 will immediately provide power to the S3-2 MDM through RPCM S32B A RPC 1 as this RPC is launched in the preset closed position.

Wait 5 minutes for MDM to go through bootup and POST.

5.3 Closing MBSU 3 RBI 1

S0: EPS: MBSU 3

[MBSU 3]

sel RBI 1

[MBSU 3 RBI 1]
‘HOT Cross Tie – PMCA R3’
‘MBSU 3 Hot Cross Tie’

cmd Enable – Arm

cmd Enable – Enable

Verify MBSU 3 Hot Cross Tie – Ena

‘Cmded Position’

cmd Close – Arm

cmd Close – Close (Verify – Cl)

Verify MBSU 3 RBI 1 Voltage > 148 to 163 V
‘HOT Cross Tie – PMCA R3’
‘MBSU 3 Hot Cross Tie’

**cmd** Inhibit – Arm
**cmd** Inhibit – Inhibit

Verify MBSU 3 Hot Cross Tie – Inh

6. **REPOWERING ITS S0, S1, P1 AND P3 LOADS ON NADIR TRAY**

6.1 Verifying MT TUS 2 Gearbox Closed Loop Heater

MSS: MT: Thermal: ‘RPCM S03A E’ 3

MT TUS 2 Gearbox Heater

√‘Htr Availability’ – ENA

<table>
<thead>
<tr>
<th>Ops Name</th>
<th>CIPUI</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTCS_MSS_MT_TUS_2_Htr_Ena</td>
<td>S0TH96IM0040K</td>
</tr>
</tbody>
</table>

√‘Control Mode State’ – Closed Loop

<table>
<thead>
<tr>
<th>Ops Name</th>
<th>CIPUI</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTCS_MSS_MT_TUS_2_Htr_Closed_Loop</td>
<td>S0TH96IM0217K</td>
</tr>
</tbody>
</table>

**CAUTION**

The Operational and Survival Rail Heaters for a single power bus should never be powered at the same time. The following commands could place some heaters at risk of damage (SCAN-44 heaters). Reconfiguration of the redundant heater strings may be necessary.
6.2 Configuring DDCU S14B Powered Utility Rail Heaters

Table 5. DDCU S14B Powered Utility Rail Heaters

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>Pwr Buses P12B P13A Rail Htrs</td>
<td>P12B</td>
<td>Survival</td>
</tr>
<tr>
<td>P1</td>
<td>Pwr Buses P12B P13A Rail Htrs</td>
<td>P13A</td>
<td>Survival</td>
</tr>
<tr>
<td>P1</td>
<td>Pwr Buses P11A P14B Rail Htrs</td>
<td>P14B</td>
<td>Operational</td>
</tr>
<tr>
<td>P3</td>
<td>P3 Rail Heaters</td>
<td>P32B</td>
<td>Survival</td>
</tr>
<tr>
<td>P3</td>
<td>P3 Rail Heaters</td>
<td>P33A</td>
<td>Survival</td>
</tr>
<tr>
<td>P3</td>
<td>P3 Rail Heaters</td>
<td>P34B</td>
<td>Operational</td>
</tr>
<tr>
<td>S0</td>
<td>Pwr Bus S02B Rail Htrs</td>
<td>S02B</td>
<td>Survival</td>
</tr>
<tr>
<td>S0</td>
<td>Pwr Bus S03A Rail Htrs</td>
<td>S03A</td>
<td>Survival</td>
</tr>
<tr>
<td>S0</td>
<td>Pwr Bus S04B Rail Htrs</td>
<td>S04B</td>
<td>Operational</td>
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<td>S1</td>
<td>Pwr Buses S12B S13A Rail Htrs</td>
<td>S12B</td>
<td>Survival</td>
</tr>
<tr>
<td>S1</td>
<td>Pwr Buses S12B S13A Rail Htrs</td>
<td>S13A</td>
<td>Survival</td>
</tr>
</tbody>
</table>

Refer to Table 5 for [XX], [DISPLAY], [RAIL], and [TYPE] references that follow.

[XX]: [DISPLAY]

[DISPLAY]

‘Utility Rail [RAIL]’

‘[TYPE]’

√Availability – Inhibit

‘RPC Position’

√RPC Position – Op

Repeat
6.3 Configuring Redundant Utility Rail Heaters

Table 6. Redundant Heaters For DDCU P13A Powered Utility Rail Heaters

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>Pwr Buses P12B P13A Rail Htrs</td>
<td>P12B</td>
<td>Operational</td>
</tr>
<tr>
<td>P1</td>
<td>Pwr Buses P12B P13A Rail Htrs</td>
<td>P13A</td>
<td>Operational</td>
</tr>
<tr>
<td>P1</td>
<td>Pwr Buses P11A P14B Rail Htrs</td>
<td>P14B</td>
<td>Survival</td>
</tr>
<tr>
<td>P3</td>
<td>P3 Rail Heaters</td>
<td>P32B</td>
<td>Operational</td>
</tr>
<tr>
<td>P3</td>
<td>P3 Rail Heaters</td>
<td>P33A</td>
<td>Operational</td>
</tr>
<tr>
<td>P3</td>
<td>P3 Rail Heaters</td>
<td>P34B</td>
<td>Survival</td>
</tr>
<tr>
<td>S0</td>
<td>Pwr Bus S02B Rail Htrs</td>
<td>S02B</td>
<td>Operational</td>
</tr>
<tr>
<td>S0</td>
<td>Pwr Bus S03A Rail Htrs</td>
<td>S03A</td>
<td>Operational</td>
</tr>
<tr>
<td>S0</td>
<td>Pwr Bus S04B Rail Htrs</td>
<td>S04B</td>
<td>Survival</td>
</tr>
<tr>
<td>S1</td>
<td>Pwr Buses S12B S13A Rail Htrs</td>
<td>S12B</td>
<td>Operational</td>
</tr>
<tr>
<td>S1</td>
<td>Pwr Buses S12B S13A Rail Htrs</td>
<td>S13A</td>
<td>Operational</td>
</tr>
<tr>
<td>S1</td>
<td>Pwr Buses S11A S14B Rail Htrs</td>
<td>S14B</td>
<td>Survival</td>
</tr>
</tbody>
</table>

Refer to Table 6 for [XX], [DISPLAY], [RAIL], and [TYPE] references that follow.

[XX]: [DISPLAY]

[DISPLAY]

'Utility Rail [RAIL]'

'TYPE'

√Availability – Enable

Repeat

7. CONFIGURING VIDEO FOR DDCU S14B POWERDOWN

7.1 Coordinating with ISS Crew

MCC-H

MCC-H notifies ISS crew that MSS video will be lost temporarily, and directs ISS crew to halt all MSS video routing.

Wait for **MCC-H GO** before resuming routing.

7.2 VDS Auto Route - Deroute

To deroute all MSS camera views, perform **{2.601 VDS AUTO ROUTE - DEROUTE}**, steps 5 and 6 (SODF: C&T: NOMINAL: VIDEO), then:
7.3 VDS Trunkline Configuration

**NOTE**

VDS Trunkline Configuration, VDS Activation, and VDS Deactivation (steps 7.3 and 7.4) can be performed in parallel to reduce execution time.

Perform **(4.602 VDS TRUNKLINE CONFIGURATION)**, steps 1 to 3 for USOS TLs 19, 20, 21 and 22, and steps 5 to 7 for MSS TLs 1, 8 and 9 (SODF: C&T: NOMINAL: VIDEO), then:

7.4 EVSU 3 Power Reconfiguration

C&T: Video: EVSU 3: RPCM S02B E RPC 3

[RPCM S02B E RPC 3]

√RPC Position – CI

**NOTE**

1. To reduce execution time, the RT Inhibit portion of **1.603 VDS DEACTIVATION** (SODF: C&T: ACTIVATION AND CHECKOUT: VIDEO) step 9 can be omitted with ODIN concurrence as long as RT FDIR is inhibited.

2. Expect the Robotics Advisory message ‘**R6D - MBS VDU 2 PFM Carrier On Sync 1 Err.**’

For EVSU 3 Ops Pwr only

Perform **(1.603 VDS DEACTIVATION)**, steps 9 and 12 (SODF: C&T: ACTIVATION AND CHECKOUT: VIDEO), then:

8. CONFIGURING MSS/MT FOR ZENITH TRAY POWERDOWN

8.1 Verifying I/O with Worksite 2 Redundant RPCM

MSS: MT: Worksite Power: RPCM S13A E RPC 1

[RPCM S13A E RPC 1]

Verify Integration Counter – incrementing

8.2 Video Derouting

Coordinate with CATO to verify all MSS video derouted.

8.3 Powering MSS Redundant to KA

MSS: MBS: MCU

[MCU]
cmd ‘Redundant’ Keep-Alive (Verify – Keep-Alive)

Table 7.

<table>
<thead>
<tr>
<th>Ops Name</th>
<th>CIPUI</th>
</tr>
</thead>
<tbody>
<tr>
<td>MBS_Power_Keep_Alive_Redun</td>
<td>CMRM96IM0203K</td>
</tr>
</tbody>
</table>

**NOTE**
Expect the ‘R1E - LAB RWS CEU MLB ACU Cmd Resp Sync Msg Err’ Robotics Advisory message (SCR 31294).

MSS: SSRMS: Power

SSRMS Power


Table 8.

<table>
<thead>
<tr>
<th>Ops Name</th>
<th>CIPUI</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSRMS_Power_Keep_Alive_Prime</td>
<td>CMRM96IM0114K</td>
</tr>
</tbody>
</table>

cmd ‘SSRMS’ ‘Redundant’ – Keep-Alive (Verify – Keep-Alive)

Table 9.

<table>
<thead>
<tr>
<th>Ops Name</th>
<th>CIPUI</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSRMS_Power_Keep_Alive_Redun</td>
<td>CMRM96IM0115K</td>
</tr>
</tbody>
</table>

8.4 Powering MSS Prime to Off

MSS: SSRMS: Power

SSRMS Power

cmd ‘SSRMS’ ‘Prime’ – Off (Verify – Off)

Table 10.

<table>
<thead>
<tr>
<th>Ops Name</th>
<th>CIPUI</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSRMS_Power_Off_Prime_Pre_SPDM</td>
<td>CMRM96IM0116K</td>
</tr>
</tbody>
</table>

**NOTE**
Expect a transient ‘R1E - MSS Active OCS SSRMS Prime MCU SRT Comm Fail’ Robotics Advisory messages (SCR 17730).

MSS: MBS: MCU

MCU

cmd ‘Prime’ Off (Verify – Off)

Table 11.

<table>
<thead>
<tr>
<th>Ops Name</th>
<th>CIPUI</th>
</tr>
</thead>
<tbody>
<tr>
<td>MBS_Power_Off_Prime_Pre_SPDM</td>
<td>CMRM96IM0205K</td>
</tr>
</tbody>
</table>
8.5 RPCM MT3A Powerup
MSS: MT: RPCM MT-3A: RPCM S03A E
RPCM S03A E RPC 18

Verify ‘Integration Counter’ – incrementing

**cmd** ‘RPC Position’ – Close (Verify – Cl)

<table>
<thead>
<tr>
<th>Ops Name</th>
<th>CIPUI</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPCM_S03A_E_RPC_18_MSS_</td>
<td>S0PR96IM0257K</td>
</tr>
<tr>
<td>MT_3A_CI</td>
<td></td>
</tr>
</tbody>
</table>

MSS: MT: RPCM MT-3A
RPCM MT3A A

Verify ‘Integration Counter’ – incrementing

8.6 MT3A Heater Powerup
MSS: MT: Thermal: RPCM-MT-3A
RPCM MT3A A Details

sel RPC [X] where [X] = 8 12 13 14 16

**cmd** ‘RPC Position’ – Close (Verify – Cl)

Repeat

<table>
<thead>
<tr>
<th>RPC</th>
<th>Ops Name</th>
<th>CIPUI</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>RPCM_MT3A_A_RPC_08_MSS_MT_IUA_Htr_2_UMA_Htr_1_Cl</td>
<td>S0PR96IM0347K</td>
</tr>
<tr>
<td>12</td>
<td>RPCM_MT3A_A_RPC_12_MSS_MT_LTU_Htr_2_Cl</td>
<td>S0PR96IM0351K</td>
</tr>
<tr>
<td>13</td>
<td>RPCM_MT3A_A_RPC_13_MSS_MT_APM_1_Htr_2_and_Operational_Pwr_Cl</td>
<td>S0PR96IM0352K</td>
</tr>
<tr>
<td>14</td>
<td>RPCM_MT3A_A_RPC_14_MSS_MT_APM_2_Htr_2_and_Operational_Pwr_Cl</td>
<td>S0PR96IM0353K</td>
</tr>
<tr>
<td>16</td>
<td>RPCM_MT3A_A_RPC_16_MSS_MT_ED_Htr_1_RSU_Htr_2_Cl</td>
<td>S0PR96IM0355K</td>
</tr>
</tbody>
</table>
8.7 Activating TUS-1 Video Signal Converter Heater 2
MSS: MT: Thermal: RPCM-S0-3A-F: RPC 4
RPCM S03A F RPC 04

**cmd** ‘RPC Position’ – Close (Verify – Cl)

Table 14.

<table>
<thead>
<tr>
<th>Ops Name</th>
<th>CIPUI</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPCM_S03A_F_RPC_04_MSS_MT_TUS_1_VSC_Htr_2_Cl</td>
<td>S0PR96IM0261K</td>
</tr>
</tbody>
</table>

8.8 Activating TUS-2 Video Signal Converter Heater 1
MSS: MT: Thermal: RPCM-S0-3A-E: RPC 4
RPCM S03A E RPC 04

**cmd** ‘RPC Position’ – Close (Verify – Cl)

Table 15.

<table>
<thead>
<tr>
<th>Ops Name</th>
<th>CIPUI</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPCM_S03A_E_RPC_04_MSS_MT_TUS_2_VSC_Htr_1_Cl</td>
<td>S0PR96IM0243K</td>
</tr>
</tbody>
</table>

8.9 Activating TUS-1 Video Signal Converter Power 2
MSS: MT: Thermal: RPCM-S0-3A-F: RPC 2
RPCM S03A F RPC 02

**cmd** ‘RPC Position’ – Close (Verify – Cl)

Table 16.

<table>
<thead>
<tr>
<th>Ops Name</th>
<th>CIPUI</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPCM_S03A_F_RPC_02_MSS_MT_TUS_1_VSC_Pwr_2_Cl</td>
<td>S0PR96IM0259K</td>
</tr>
</tbody>
</table>

8.10 Activating TUS-2 Video Signal Converter Power 1
MSS: MT: Thermal: RPCM-S0-3A-E: RPC 2
RPCM S03A E RPC 02

**cmd** ‘RPC Position’ – Close (Verify – Cl)

Table 17.

<table>
<thead>
<tr>
<th>Ops Name</th>
<th>CIPUI</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPCM_S03A_E_RPC_02_MSS_MT_TUS_2_VSC_Pwr_2_Cl</td>
<td>S0PR96IM0241K</td>
</tr>
</tbody>
</table>

8.11 Verifying RPCM MT-3A Closed Loop Heater
MSS: MT: Thermal: ‘RPCM-MT-3A’ RPC 15
RPCM MT 3A Bracket Heater

√‘Htr Availability’ – ENA
Table 18.

<table>
<thead>
<tr>
<th>Ops Name</th>
<th>CIPUI</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTCS_RPCM_Brkt_Htr2_Ena</td>
<td>S0TH96IM0001K</td>
</tr>
</tbody>
</table>

**cmd** ‘Control Mode State’ Closed Loop (Verify – Closed Loop)

Table 19.

<table>
<thead>
<tr>
<th>Ops Name</th>
<th>CIPUI</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTCS_RPCM_Brkt_Htr2_Closed_Loop</td>
<td>S0TH96IM0007K</td>
</tr>
</tbody>
</table>

9. TRANSITIONING MSS TO OPERATIONAL ON CHANNEL 3A

9.1 Selecting MSS LB Channel B

MSS: LAS5(LAP5) Bus Config

**LAS5(LAP5) CEU Bus Configuration**

**cmd** ‘Local Bus’ ‘MSS’ B (Verify – B)

Table 20.

<table>
<thead>
<tr>
<th>OPS Name</th>
<th>CIPUI</th>
</tr>
</thead>
<tbody>
<tr>
<td>CUP_RWS_Bus_Ch_Select_MSS_LB_Ch_B</td>
<td>CMRM96IM0170K</td>
</tr>
<tr>
<td>LAB_RWS_Bus_Ch_Select_MSS_LB_Ch_B</td>
<td>CMRM96IM0067K</td>
</tr>
</tbody>
</table>

9.2 MBS Redundant String Transition from Keep-Alive to Operational

**NOTE**

1. The transition from Keep-Alive to Operational can be stopped at any time by commanding SAFING on the DCP.

2. Expect the following Robotics Advisory messages:

   - ‘R2O - MBS CRPCM 1P Cat-2 Transmit Msg Err’
   - ‘R2O - MBS CRPCM 2P Cat-2 Transmit Msg Err’
   - ‘R2O - MBS CRPCM 3P Cat-2 Transmit Msg Err’
   - ‘R2O - MBS CRPCM 1P Cat-2 Receive Msg Err’
   - ‘R2O - MBS CRPCM 2P Cat-2 Receive Msg Err’
   - ‘R2O - MBS CRPCM 3P Cat-2 Receive Msg Err’

   (SCR 21744)

3. Expect an ‘**R2O - MBS CRPCM … Output Voltage … Stat Err**’ Robotics Advisory message for the SSRMS Redundant string.

MSS: MBS: MCU: MCU

**MCU**

**cmd** ‘Redundant’ Operational (Verify – Operational) (~3 minutes)

Table 21.

<table>
<thead>
<tr>
<th>Ops Name</th>
<th>CIPUI</th>
</tr>
</thead>
<tbody>
<tr>
<td>MBS_Power_Operational_Redun_Pre_SPDM</td>
<td>CMRM96IM0211K</td>
</tr>
</tbody>
</table>
9.3 SSRMS Redundant String Transition from Keep-Alive to Operational

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. SSRMS transition from Keep-Alive to Operational will require at least 6 minutes to complete. The time is contingent on file transfer activity from the C&amp;C MDM.</td>
</tr>
<tr>
<td>2. The operator can follow the transition to Operational by looking at the MSS discrete log.</td>
</tr>
</tbody>
</table>

MSS: SSRMS: Power

`SSRMS Power`

**cmd** ‘SSRMS’ Redundant – Operational

Table 22.

<table>
<thead>
<tr>
<th>Ops Name</th>
<th>CIPUI</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSRMS_Power_Operational_Redun_Pre_SPDM</td>
<td>CMRM96IM0119K</td>
</tr>
</tbody>
</table>

Verify ‘Systems State’ – Operational

9.4 Turning MSS VDUs On

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Expect ‘R6F - MBS... PFM Carrier On Video 1 Err’ Robotics Advisory message as each VDU is powered on. Message may toggle in and out of alarm until video is routed to the defined VDU (SCR 24376).</td>
</tr>
<tr>
<td>2. Robotics Advisory message ‘R6E - MBS ... Baseband Sync Output Err’ may appear for one cycle when MBS VDU 2 is powered on (SCR 30307).</td>
</tr>
<tr>
<td>3. If VDU does not power on within 10 seconds of the On command being issued, safe and reattempt.</td>
</tr>
</tbody>
</table>

MSS: SSRMS: VDU

`MSS VDUs`

- sel ‘[X]’ as required where [X] =
  - `MBS 2`
  - `Base LEE`
  - `Base Elbow`
  - `Tip Elbow`
  - `Tip LEE`

**cmd** On (Verify – On)

Repeat
Table 23.

<table>
<thead>
<tr>
<th>Unit</th>
<th>Ops Name</th>
<th>CIPUI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base LEE</td>
<td>SSRMS_Base_LEE_VDU_Power_On</td>
<td>CMRM96IM0045K:001</td>
</tr>
<tr>
<td>Base Elbow</td>
<td>SSRMS_Base_Elb_VDU_Power_On</td>
<td>CMRM96IM0045K:002</td>
</tr>
<tr>
<td>Tip Elbow</td>
<td>SSRMS_Tip_Elb_VDU_Power_On</td>
<td>CMRM96IM0045K:003</td>
</tr>
<tr>
<td>Tip LEE</td>
<td>SSRMS_Tip_LEE_VDU_Power_On</td>
<td>CMRM96IM0045K:004</td>
</tr>
<tr>
<td>MBS VDU 2</td>
<td>MBS_VDU2_Power_On</td>
<td>CMRM96IM0045K:014</td>
</tr>
</tbody>
</table>

9.5 MBS VDU 2 Sync 2 Selection

MSS: Video: VSU1: MSS Sync Config

<table>
<thead>
<tr>
<th>MSS Sync Config</th>
</tr>
</thead>
<tbody>
<tr>
<td>sel ‘Sync Source’ – MSS Sync Line 2</td>
</tr>
<tr>
<td>sel ‘MBS VDU 2’ – Enable</td>
</tr>
<tr>
<td>sel all others – Inhibit</td>
</tr>
</tbody>
</table>

**cmd** Set (Verify VDU Sync Status – as commanded)

Table 24.

<table>
<thead>
<tr>
<th>Ops Name</th>
<th>CIPUI</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSS_Video_Sync_Route_Tmplt</td>
<td>CMRM96IM0158K</td>
</tr>
</tbody>
</table>

Table 25.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sync_Id</td>
<td>2 (Sync_2)</td>
</tr>
<tr>
<td>SPDM Body LEE</td>
<td>2 (Disabled)</td>
</tr>
<tr>
<td>MBS VDU 2</td>
<td>1 (Enabled)</td>
</tr>
<tr>
<td>MBS VDU 1</td>
<td>2 (Disabled)</td>
</tr>
<tr>
<td>MBS POA</td>
<td>2 (Disabled)</td>
</tr>
<tr>
<td>Tip LEE</td>
<td>2 (Disabled)</td>
</tr>
<tr>
<td>Tip Elbow</td>
<td>2 (Disabled)</td>
</tr>
<tr>
<td>Base Elbow</td>
<td>2 (Disabled)</td>
</tr>
<tr>
<td>Base LEE</td>
<td>2 (Disabled)</td>
</tr>
<tr>
<td>SPDM Body 2</td>
<td>2 (Disabled)</td>
</tr>
<tr>
<td>SPDM Body 1</td>
<td>2 (Disabled)</td>
</tr>
</tbody>
</table>

**cmd** Set (Verify VDU Sync Status – as commanded)

Verify Sync selection – Sync 2
Verify sync output to MBS Mast Camera.
9.6 Configuring MSS Cameras

MSS: MBS: MBS Central Camera Icon

<table>
<thead>
<tr>
<th>Unit</th>
<th>Ops Name</th>
<th>CIPUI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Elbow</td>
<td>SSRMS_Base_Elb_Camera_Power_On</td>
<td>CMRM96IM0045K:006</td>
</tr>
<tr>
<td>Tip Elbow</td>
<td>SSRMS_Tip_Elb_Camera_Power_On</td>
<td>CMRM96IM0045K:007</td>
</tr>
<tr>
<td>Tip LEE</td>
<td>SSRMS_Tip_LEE_Camera_Power_On</td>
<td>CMRM96IM0045K:008</td>
</tr>
<tr>
<td>MBS Mast</td>
<td>MBS_Mast_Camera_Power_On</td>
<td>CMRM96IM0045K:016</td>
</tr>
</tbody>
</table>

| sel [X] as required where [X] = B-Elb 22 | T-Elb 24 | LEE 25 | MBS 37

| cmd | Power’ On (Verify – On)

Repeat

Table 26.

<table>
<thead>
<tr>
<th>Unit</th>
<th>Ops Name</th>
<th>CIPUI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Elbow</td>
<td>SSRMS_Base_Elb_Camera_Color_Bal_Metal</td>
<td>LARM96IM0001K:077</td>
</tr>
<tr>
<td>Tip Elbow</td>
<td>SSRMS_Tip_Elb_Camera_Color_Bal_Metal</td>
<td>LARM96IM0001K:080</td>
</tr>
<tr>
<td>Tip LEE</td>
<td>SSRMS_Tip_LEE_Camera_Color_Bal_Metal</td>
<td>LARM96IM0001K:007</td>
</tr>
<tr>
<td>MBS Mast</td>
<td>MBS_Mast_Camera_Color_Bal_Metal</td>
<td>LARM96IM0001K:071</td>
</tr>
</tbody>
</table>

| sel [X] as required where [X] = B-Elb 22 | T-Elb 24 | LEE 25 | MBS 37

| cmd | Color Bal – Metal

Repeat

Table 27.
Table 28.

<table>
<thead>
<tr>
<th>Unit</th>
<th>Ops Name</th>
<th>CIPUI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Elbow</td>
<td>SSRMS_Base_Elb_Camera_Gamma_0.45</td>
<td>LARM96IM0001K:078</td>
</tr>
<tr>
<td>Tip Elbow</td>
<td>SSRMS_Tip_Elb_Camera_Gamma_0.45</td>
<td>LARM96IM0001K:081</td>
</tr>
<tr>
<td>Tip LEE</td>
<td>SSRMS_Tip_LEE_Camera_Gamma_0.45</td>
<td>LARM96IM0001K:075</td>
</tr>
<tr>
<td>MBS Mast</td>
<td>MBS_Mast_Camera_Gamma_0.45</td>
<td>LARM96IM0001K:072</td>
</tr>
</tbody>
</table>

9.7 VDS Auto Route

MCC-H

To reroute views per FD4 Robotics Video Configuration Flight Note, perform \{2.601 VDS AUTO ROUTE - DEROUTE\}, steps 1 to 4 (SODF: C&T: NOMINAL: VIDEO), then:

9.8 Coordinating with ISS Crew

NOTE

Due to the EVSU 3 powerdown, only two SSRMS Camera views will be available.

MCC-H gives ISS crew Go to resume video routing using a maximum of two simultaneous SSRMS Cameras.

10. ACTIVATING AND C/O S3 2 MDM

10.1 Enabling S3 2 MDM RT

CDH Summary: S3 2

S3 2 MDM

sel LB SYS S2

LB SYS S2

sel RT Status

LB SYS S2 RT Status

cmd ‘16 S3 2 MDM RT Status’ – Enable Execute (Verify – Ena)

10.2 Verifying S3 2 MDM Status in Wait State

S3 2 MDM

S3 2 MDM

Verify Frame Count – incrementing
Verify Processing State – Wait

S3 2 MDM

‘MDM ID’

√Sync Status – In Sync
If not In Sync

```
* sel Sync Status
* S3 2 Sync Status
* cmd Sync To BIA Execute
* Wait at least 30 seconds.
* S3 2 MDM
* Verify Sync Status – In Sync
```

sel MDM BIT Status

```
S3 2 MDM BIT Summary Table A
'Word 1: Summary'

Record all non-blank fields.

Table 29.

<table>
<thead>
<tr>
<th>Hard Fail</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Rev. Soft Fail</td>
<td></td>
</tr>
<tr>
<td>Soft Fail</td>
<td></td>
</tr>
<tr>
<td>POST Stat</td>
<td></td>
</tr>
<tr>
<td>BIT Stat</td>
<td></td>
</tr>
<tr>
<td>I/O Bus Stat</td>
<td></td>
</tr>
<tr>
<td>I/O List Stat</td>
<td></td>
</tr>
<tr>
<td>SX Card Slot</td>
<td></td>
</tr>
<tr>
<td>I/O BIT Stat</td>
<td></td>
</tr>
<tr>
<td>POST in Prog</td>
<td></td>
</tr>
</tbody>
</table>
```

If BST not blank

```
* CDH Summary: S3-2 MDM: MDM Utilities
* 'Software Control'
* S3 2 MDM Utilities
* 'Clear Latched Data in BST A'
* cmd Clear Execute
```
10.3 Transitioning S3 2 MDM to Normal State

CDH Summary: S3 2 MDM

sel Processing State

[S3 2 Processing State Transitions]

'Current State'

**cmd** Transition to Normal State  **Execute**

Wait 60 seconds.

10.4 Verifying S3 2 MDM in Normal State

CDH Summary: S3 2 MDM

Verify Frame Count – incrementing

Verify Processing State – Normal

10.5 Enabling S3 2 MDM RT FDIR

CDH Summary: S3 2 MDM

sel LB SYS S2

[LB SYS S2]

sel RT Status

[LB SYS S2 RT Status]

**cmd** 16 S3 2 MDM RT FDIR Status – Enable  **Execute**

(Verify – Ena)

10.6 Verifying S3 2 MDM SEPS Control

[S3 2 MDM]

'SPD 1'

Verify UB SEPS S3 14 – RT

Verify UB SEPS S3 23 – RT
10.7 Enabling SEPS Control 23 in S3 2 MDM
CDH Summary: S3 2 MDM
'Software Control'

sel Applications

S3 2 Applications

**cmd** UB_SEPS_S3_23 – Ena **Execute** (Verify – Ena)

S3 2 MDM
'SPD 1'

Verify UB_SEPS_S3_23 – BC

10.8 Verifying S3 1 MDM Heater Control is Closed Loop
CDH Summary: S3 1

sel S3-1 MDM Heater

S3 1 MDM Heater

√Heater Control – Closed_Loop

10.9 Verifying S3 2B/3A RPCM Integration Counters
S3: EPS

sel RPCM S32B A

RPCM S32B A

Verify Integ Cnt – incrementing

sel RPCM S33A [X] where [X] = C E F

RPCM S33A [X]

Verify Integ Cnt – incrementing

Repeat
10.10 Enabling PTCS in MDM S3 2
CDH Summary: S3 2 MDM
S3 2 MDM
'Software Control'

Sel Applications

S3 2 Applications

Cmd PTCS – Ena Execute (Verify – Ena)

10.11 Inhibiting Utility Rail Survival Heaters

**CAUTION**
Scan 44 identified multi-element heaters that are susceptible to heater burnthrough. These include the Utility Rail Heaters on S3. PPLs that would prevent this configuration have not been delivered. Therefore, user action is required to mitigate this risk of heater burnthrough.

S3: EPS: S3 Rail Heaters
S3 Rail Heaters
'S31A Survival (Htr 1)'

Cmd Inhibit – Arm (Verify Avail Status – Inh Arm)
Cmd Inhibit – Inhibit (Verify Avail Status – Inh)

√RPC Position – Op

'S34B Survival (Htr 1)'

Cmd Inhibit – Arm (Verify Avail Status – Inh Arm)
Cmd Inhibit – Inhibit (Verify Avail Status – Inh)

√RPC Position – Op

10.12 Enabling SARJ Controller in MDM S3 2
CDH Summary: S3 2 MDM
S3 2 MDM
'Software Control'

Sel Applications

S3 2 Applications

Cmd SARJ Controller – Ena Execute (Verify – Ena)
11. DEACTIVATING DDCU S14B AND VERIFYING MBSU RBI 1 CONFIGS

**NOTE**
Prior to removing Channel 4B power, it is necessary to ensure that the downstream EPS ORUs do not have ORU health flags set (i.e., EEPROM Bit Flips). If the health flag is set due to an ORU flip bit, failure to check the ORU health prior to powering it down may result in loss of ORU function upon powering it back. If repowered, these ORUs will boot from unhealthy EEPROM Firmware.

11.1 Verifying RPCM S01A-B RPC 2 Open
EPS Summary: S0: RPCM S01A B
sel RPC 2
RPCM S01A B RPC 2
√RPC Position – Op
√Close Cmd – Inh

11.2 Verifying MBSU 1 RBI 1 and RBI 8 are Open
EPS Summary: S0
sel MBSU 1
MBSU 1
√RBI 1 Position – Open
Verify RBI 1 Voltage = -4.2 to 4.2 V
√RBI 8 Position – Open
Verify RBI 8 Voltage = -4.2 to 4.2 V
sel RBI 1
MBSU 1 RBI 1
√CloseCmd – Inh
EPS Summary: S0: MBSU 1: RBI 8
MBSU 1 RBI 8
√Close Cmd – Inh
11.3 Inhibiting RT FDIR on ORUs and DDCU S14B

**NOTE**

1. Inhibit RT FDIR to RTs that will lose power, but will still be monitored during the powerdown (i.e., RPCMs).

2. Expect multiple loss of comm messages when DDCU S14B converter powered off.

3. ODIN to perform via command script.

CDH Summary: Primary EXT MDM

```
Primary EXT MDM

sel LB MT 1
sel RT Status
sel RT Status Cont. RT#16-25
```

**LB MT 1 RT Status Cont.**

```
cmd '25 RPCM MT 4B A' RT FDIR Status – Inhibit FDIR  Execute
(Verify – Inh)
```

CDH Summary: S1 1 MDM

```
S1 1 MDM

sel UB SEPS S1 14
sel RT Status
```

**S1 1 UB SEPS S1 14 RT Status**

```
cmd RPCM S14B [X] RT FDIR Status – Inhibit FDIR  Execute
(Verify – Inh) where [X] = [E] [F] [G]
```

CDH Summary: S0 1 MDM

```
S0 1 MDM

sel UB SEPS S0 14
sel RT Status
```

**S0 1 UB SEPS S0 14 RT Status**

```
cmd RPCM S04B [X] RT FDIR Status – Inhibit FDIR  Execute
(Verify – Inh) where [X] = [A] [B] [C] [D] [E] [F]
```

CDH Summary: P1 1 MDM

```
P1 1 MDM

sel UB SEPS P1 14
sel RT Status
```

**P1 1 UB SEPS P1 14 RT Status**

```
cmd RPCM P14B [X] RT FDIR Status – Inhibit FDIR  Execute
(Verify – Inh) where [X] = [E] [F] [G]
```
CDH Summary: P3 1 MDM

Sel UB SEPS P3 14
Sel RT Status

**P3 1 UB SEPS P3 14 RT Status**

**cmd** RPCM P34B [X] RT FDIR Status – Inhibit FDIR  **Execute**
(Verify – Inh) where [X] = [C] [E] [F]

CDH Summary: Primary PMCU MDM

[MDM Primary PMCU]

Sel LB PMCU 1
Sel RT Status

**LB PMCU 1 RT Status**

**cmd** ‘18 DDCU S1 4B’ RT FDIR Status – Inhibit FDIR  **Execute**
(Verify – Inh)

11.4 **Deactivating DDCU S14B**

**EPS Summary: S1: DDCU S14B**

[DDCU S14B]

Sel Converter

[DDCU S14B Converter]

‘Converter’

**cmd** Off (1-step command, arm not required)

√ Output Voltage < 12.8 V

**MCC-H ↑ ISS, “Go to connect zenith tray utilities.”**

11.5 **Receiving GO for Channel 1/4 Powerup**

**NOTE**
Crew will give GO for powerup after zenith tray connections completed.

ISS ↓ **MCC-H**, “Go for zenith tray powerup.”

12. **ACTIVATING DDCU S14B**

12.1 **Activating DDCU S14B**

**EPS Summary: S0: DDCU S14B**

[DDCU S14B]

Sel Converter
12.2 Powering On S3 1 MDM and RPCM S31A-A

S3: EPS

sel RPCM S01A B RPC 02

RPCM S01A B RPC 02

Verify Integration Counter – incrementing

√Close Cmd – Ena

cmd RPC Position – Close (Verify – Cl)

NOTE
Closing the S01A B RPC 2 will immediately provide power to the S3-1 MDM through RPCM S31A A RPC 1 as this RPC is launched in the preset closed position.

Wait 5 minutes for MDM to go through bootup and POST.

12.3 Closing MBSU 1 RBI 1

S0: EPS: MBSU 1

MBSU 1

sel RBI 1

MBSU 1 RBI 1

'HOT Cross Tie – PMCA R3'
'MBSU 1 Hot Cross Tie'

cmd Enable – Arm

cmd Enable – Enable
Verify MBSU 1 Hot Cross Tie – Ena

cmd Close – Arm

cmd Close – Close (Verify – Cl)

Verify MBSU 1 RBI 1 Voltage: 148 to 163 V

‘HOT Cross Tie – PMCA R3’
‘MBSU 1 Hot Cross Tie’

cmd Inhibit – Arm

cmd Inhibit – Inhibit

Verify MBSU 1 Hot Cross Tie – Inh

13. ACTIVATING AND C/O S3 1 MDM

13.1 Enabling S3 1 MDM RT

CDH Summary: S3 1

sel LB SYS S1

LB SYS S1

sel RT Status

LB SYS S1 RT Status

cmd ‘16 S3 1 MDM’ RT Status – Enable Execute (Verify – Ena)

13.2 Verifying S3 1 MDM Status in Wait State

S3 1 MDM

‘S3 1 MDM’

Verify Frame Count – incrementing
Verify Processing State – Wait

S3 1 MDM

‘MDM ID’

√Sync Status – In Sync
If not In Sync
sel Sync Status
S3 1 Sync Status
cmd Sync To BIA Execute
Wait at least 30 seconds.
S3 1 MDM
Verify Sync Status – In Sync

sel MDM BIT Status

S3 1 MDM BIT Summary Table A
‘Word 1: Summary’
Record all non-blank fields.

<table>
<thead>
<tr>
<th>Table 30.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Hard Fail</td>
</tr>
<tr>
<td>Rev. Soft Fail</td>
</tr>
<tr>
<td>Soft Fail</td>
</tr>
<tr>
<td>POST Stat</td>
</tr>
<tr>
<td>BIT Stat</td>
</tr>
<tr>
<td>I/O Bus Stat</td>
</tr>
<tr>
<td>I/O List Stat</td>
</tr>
<tr>
<td>SX Card Slot</td>
</tr>
<tr>
<td>I/O BIT Stat</td>
</tr>
<tr>
<td>POST in Prog</td>
</tr>
</tbody>
</table>

If BST not blank
CDH Summary: S3-1 MDM: MDM Utilities
‘Software Control’
S3 1 MDM Utilities
‘Clear Latched Data in BST A’
cmd Clear Execute

*******************************************************************************
13.3 Transitioning S3 1 MDM to Normal State
CDH Summary: S3 1 MDM

Sel Processing State

>S3 1 Processing State Transitions
'Current State'

**cmd** Transition to Normal State  **Execute**

Wait 60 seconds.

13.4 Verifying S3 1 MDM in Normal State
CDH Summary: S3 1 MDM

Verify Frame Count – incrementing
Verify Processing State – Normal

13.5 Enabling S3 1 MDM RT FDIR
CDH Summary: S3 1 MDM

Sel LB SYS S1

>LB SYS S1

Sel RT Status

>LB SYS S1 RT Status

**cmd** ‘16 S3 1 MDM’ RT FDIR Status – Enable  **Execute**
(Verify – Ena)

13.6 Verifying S3 1 MDM SEPS Control

>S3 1 MDM

'SPD 1’

Verify UB SEPS S3 14 – RT
Verify UB SEPS S3 23 – RT
13.7 Enabling SEPS Control 14 in S3 1 MDM
CDH Summary: S3 1 MDM

'Software Control'

sel Applications

S3 1 Applications

**cmd** UB_SEPS_S3_14 – Ena **Execute** (Verify – Ena)

S3 1 MDM

'SPD 1'

Verify UB_SEPS_S3_14 – BC

13.8 Verifying S3 2 MDM Heater Control is Closed Loop
CDH Summary: S3 2

sel S3-2 MDM Heater

S3 2 MDM Heater

√Heater Control – Closed_Loop

13.9 Verifying S3 2B/3A RPCM Integration Counters
S3: EPS

sel RPCM S31A A

RCPM S31A A

Verify Integ Cnt – incrementing

sel RPCM S34B [X] where [X] = [C E F]

RCPM S34B [X]

Verify Integ Cnt – incrementing

Repeat
13.10 Inhibiting S3 Utility Rail Survival Heaters RPCs

**NOTE**
Scan 44 identified multi-element heaters that are susceptible to heater burnthrough. These include the Utility Rail Heaters on S3. PPLs that would prevent this configuration have not been delivered. Since these individual heaters can not be inhibited prior to enabling the S3-1 PTCS Logic Thread, these heaters RPCs are close inhibited.

S3: EPS: S3 Rail Heaters: RPCM S34B C RPC 02

```
cmd Close Command – Inhibit (Verify – Inh)
RPC Position – Op
```

S3: EPS: S3 Rail Heaters: RPCM S34B C RPC 01

```
cmd Close Command – Inhibit (Verify – Inh)
RPC Position – Op
```

13.11 Enabling PTCS in MDM S3 1

CDH Summary: S3 1 MDM

S3 1 MDM

‘Software Control’

```
  sel Applications

S3 1 Applications
```

```
cmd PTCS – Ena Execute (Verify – Ena)
```

13.12 Inhibiting S3 Utility Rail Survival Heaters

S3: EPS: S3 Rail Heaters

```
S3 Rail Heaters
‘S32B Survival (Htr 1)’
```

```
cmd Inhibit – Arm (Verify Avail Status – Inh Arm)
cmd Inhibit – Inhibit (Verify Avail Status – Inh)
‘S33A Survival (Htr 1)’
```

```
cmd Inhibit – Arm (Verify Avail Status – Inh Arm)
cmd Inhibit – Inhibit (Verify Avail Status – Inh)
```

13.13 Enabling S3 Utility Rail Survival Heaters RPCs

S3: EPS: S3 Rail Heaters: RPCM S34B C RPC 02

```
cmd Close Command – Enable (Verify – Ena)
```
S3 ACTIVATION
(ASSY OPS/13A/FIN 1)

S3: EPS: S3 Rail Heaters: RPCM S34B C RPC 01

cmd Close Command – Enable (Verify – Ena)

13.14 Enabling SARJ Controller in MDM S3 1
CDH Summary: S3 1 MDM

'Software Control'

sel Applications

S3 1 Applications

cmd SARJ Controller – Ena Execute (Verify – Ena)

14. LOADING DEFAULT PPLs INTO EEPROM OF PMCU MDMs

NOTE
ODIN will load new default ORU Existence Table PPL to the Primary and Backup PMCU MDMs.

15. REENABLING FDIR ON ORUS AND DDCUS
15.1 Enabling RT FDIR on DDCU P13A and ORUs

NOTE
1. Enable RT FDIR to RTs from step 3.3.
2. ODIN to perform via command script.

CDH Summary: S0 2 MDM

S0 2 MDM

sel UB SEPS S0 23
sel RT Status

S0 2 UB SEPS S0 23 RT Status

cmd RPCM S03A [X] RT FDIR Status – Enable FDIR Execute 
(Verify – Ena) where [X] = [A] [B] [C] [D] [E] [F]

CDH Summary: Primary EXT MDM

Primary EXT MDM

sel LB MT 1
sel RT Status
sel RT Status Cont. RT#16-25
LB MT 1 RT Status Cont

**cmd** '23 RPCM MT 3A A' Enable FDIR  **Execute** (Verify – Ena)

CDH Summary: S1 2 MDM

S1 2 MDM

sel UB SEPS S1 23
sel RT Status

S1 2 UB SEPS S1 23 RT Status

**cmd** RPCM S13A [X] RT FDIR Status – Enable FDIR  **Execute**
(Verify – Ena)  where [X] = [E] [F] [G]

CDH Summary: P1 2 MDM

P1 2 MDM

sel UB SEPS P1 23
sel RT Status

P1 2 UB SEPS P1 23 RT Status

**cmd** RPCM P13A [X] RT FDIR Status – Enable FDIR  **Execute**
(Verify – Ena)  where [X] = [E] [F] [G]

CDH Summary: P3 2 MDM

P3 2 MDM

sel UB SEPS P3 23
sel RT Status

P3 2 UB SEPS P3 23 RT Status

**cmd** RPCM P33A [X] RT FDIR Status – Enable FDIR  **Execute**
(Verify – Ena)  where [X] = [C] [E] [F]

CDH Summary: Primary PMCU MDM

Primary PMCU MDM

sel LB PMCU 2
sel RT Status

LB PMCU 2 RT Status

**cmd** '18 DDCU P1 3A' RT FDIR Status – Enable FDIR  **Execute**
(Verify – Ena)
15.2 Enabling RT FDIR on ORUs and DDCU S14B

**NOTE**
1. Enable RT FDIR to RTs from step 11.3.
2. ODIN to perform via command script.

CDH Summary: Primary EXT MDM

Primary EXT MDM

sel LB MT 1
sel RT Status
sel RT Status Cont. RT#16-25

LB MT 1 RT Status Cont.

cmd '25 RPCM MT 4B A’ RT FDIR Status – Enable FDIR  **Execute**
(Verify – Ena)

CDH Summary: S1 1 MDM

S1 1 MDM

sel UB SEPS S1 14
sel RT Status

S1 1 UB SEPS S1 14 RT Status

cmd RPCM S14B [X] RT FDIR Status – Enable FDIR  **Execute**
(Verify – Ena)  where [X] = [E] [F] [G]

CDH Summary: S0 1 MDM

S0 1 MDM

sel UB SEPS S0 14
sel RT Status

S0 1 UB SEPS S0 14 RT Status

cmd RPCM S04B [X] RT FDIR Status – Enable FDIR  **Execute**
(Verify – Ena)  where [X] = [A] [B] [C] [D] [E] [F]

CDH Summary: P1 1 MDM

P1 1 MDM

sel UB SEPS P1 14
sel RT Status

P1 1 UB SEPS P1 14 RT Status
cmd RPCM P14B \([X]\) RT FDIR Status – Enable FDIR  **Execute**  
(Verify – Ena)  \(\text{where } [X] = [E][F][G]\)

CDH Summary: P3 1 MDM  
[**P3 1 MDM**]

sel UB SEPS P3 14  
sel RT Status  
[**P3 1 UB SEPS P3 14 RT Status**]

**cmd** RPCM P34B \([X]\) RT FDIR Status – Enable FDIR  **Execute**  
(Verify – Ena)  \(\text{where } [X] = [C][E][F]\)

CDH Summary: Primary PMCU MDM  
[**Primary PMCU MDM**]

sel LB PMCU 1  
sel RT Status  
[**LB PMCU 1 RT Status**]

**cmd** ‘18 DDCU S1 4B’ RT FDIR Status – Enable FDIR  **Execute**  
(Verify – Ena)

15.3  **Enabling Auto Transition to Diag in the PMCU and PL MDMs**  

CDH Summary

sel Primary PMCU MDM  
[**Primary PMCU MDM**]

sel Processing State  
[**PMCU Processing State Transitions**]

**cmd** Auto Transition to Diag Enable  **Execute**  (Verify – Ena)

sel Primary PL MDM  
[**Primary PL MDM**]

sel Processing State  
[**PL Processing State Transitions**]

**cmd** Auto Transition to Diag Enable  **Execute**  (Verify – Ena)
15.4 Configuring STR MDM Survival Heaters

PCS

CDH Summary: STR MDM: STR Surv Htr:

STR Survival Heater

sel RPCM S13A G RPC 11

RPCM S13A G RPC 11

‘RPC Position’

√RPC Position – Cl

15.5 Configuring PTR MDM Survival Heaters

CDH Summary: PTR MDM: PTR Surv Htr:

PTR Survival Heater

sel RPCM P14B G RPC 11

RPCM P14B G RPC 11

‘RPC Position’

√RPC Position – Cl

16. REPOWERING ITS S0, S1, P1 AND P3 LOADS

16.1 Powering MBS Prime to Keep-Alive

MSS: MBS: MCU

MCU

cmd ‘Prime’ Keep-Alive (Verify – Keep-Alive)

Table 31.

<table>
<thead>
<tr>
<th>Ops Name</th>
<th>CIPUI</th>
</tr>
</thead>
<tbody>
<tr>
<td>MBS_Power_Keep_Alive_Prime</td>
<td>CMRM96IM0201K</td>
</tr>
</tbody>
</table>

16.2 Verifying TUS 1 Gearbox Heater Activation

MSS: MT: Thermal: ‘RPCM S04B F’ Heater 3

MT TUS 1 Gearbox Heater

√‘Htr Availability’ – ENA

Table 32.

<table>
<thead>
<tr>
<th>Ops Name</th>
<th>CIPUI</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTCS_MSS_MT_TUS_1_Htr_Ena</td>
<td>S0TH96IM0011K</td>
</tr>
</tbody>
</table>

√‘Control Mode State’ – Closed Loop

Table 33.

<table>
<thead>
<tr>
<th>Ops Name</th>
<th>CIPUI</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTCS_MSS_MT_TUS_1_Htr_Closed_Loop</td>
<td>S0TH96IM0188K</td>
</tr>
</tbody>
</table>
16.3 RPCM MT4B Powerup
MSS: MT: RPCM MT-4B: RPCM S04B F
RPCM S04B F RPC 17

Verify ‘Integration Counter’ – incrementing

**cmd** ‘RPC Position’ – Close (Verify – Cl)

<table>
<thead>
<tr>
<th>Ops Name</th>
<th>CIPUI</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPCM_S04B_F_RPC_17_MSS_MT_4B_Cl</td>
<td>S0PR96IM0320K</td>
</tr>
</tbody>
</table>

16.4 MT-4B Heater and Amp Power Activation
MSS: MT: Thermal: RPCM-MT-4B
RPCM MT4B A Details

sel RPC [X] where [X] = 8 12 13 14 16

RPCM MT4B A RPC [X]

**cmd** ‘RPC Position’ – Close (Verify – Cl)

Repeat

<table>
<thead>
<tr>
<th>RPC</th>
<th>Ops Name</th>
<th>CIPUI</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>RPCM_MT4B_A_RPC_08_MSS_MT_IUA_Htr_1_UMA_Htr_2_Cl</td>
<td>S0PR96IM0329K</td>
</tr>
<tr>
<td>12</td>
<td>RPCM_MT4B_A_RPC_12_MSS_MT_LTU_Htr_1_Cl</td>
<td>S0PR96IM0333K</td>
</tr>
<tr>
<td>13</td>
<td>RPCM_MT4B_A_RPC_13_MSS_MT_AMP_1_Htr_1_and_Operational_Pwr_Cl</td>
<td>S0PR96IM0334K</td>
</tr>
<tr>
<td>14</td>
<td>RPCM_MT4B_A_RPC_14_MSS_MT_AMP_2_Htr_1_and_Operational_Pwr_Cl</td>
<td>S0PR96IM0335K</td>
</tr>
<tr>
<td>16</td>
<td>RPCM_MT4B_A_RPC_16_MSS_MT_ED_Htr_2_RSU_Htr_1_Cl</td>
<td>S0PR96IM0337K</td>
</tr>
</tbody>
</table>
16.5 Activating TUS-2 Video Signal Converter Heater 2  
MSS: MT: Thermal: RPCM-S0-4B-E: RPC 4  
[RPCM S04B E RPC 04]  
cmd ‘RPC Position’ – Close (Verify – Cl)  

Table 36.  

<table>
<thead>
<tr>
<th>Ops Name</th>
<th>CIPUI</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPCM_S04B_E_RPC_04_MSS_MT_TUS_2_VSC_Htr_2_Cl</td>
<td>S0PR96IM0289K</td>
</tr>
</tbody>
</table>

16.6 Activating TUS-2 Video Signal Converter Power 2  
MSS: MT: Thermal: RPCM-S0-4B-E: RPC 2  
[RPCM S04B E RPC 02]  
cmd ‘RPC Position’ – Close (Verify – Cl)  

Table 37.  

<table>
<thead>
<tr>
<th>Ops Name</th>
<th>CIPUI</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPCM_S04B_E_RPC_02_MSS_MT_TUS_2_VSC_Pwr_1_Cl</td>
<td>S0PR96IM0287K</td>
</tr>
</tbody>
</table>

16.7 Activating TUS-1 Video Signal Converter Heater 1  
MSS: MT: Thermal: RPCM-S0-4B-F: RPC 4  
[RPCM S04B F RPC 04]  
cmd ‘RPC Position’ – Close (Verify – Cl)  

Table 38.  

<table>
<thead>
<tr>
<th>Ops Name</th>
<th>CIPUI</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPCM_S04B_F_RPC_04_MSS_MT_TUS_1_VSC_Htr_1_Cl</td>
<td>S0PR96IM0307K</td>
</tr>
</tbody>
</table>

16.8 Activating TUS-1 Video Signal Converter Power 1  
MSS: MT: Thermal: RPCM-S0-4B-F: RPC 2  
[RPCM S04B F RPC 02]  
cmd ‘RPC Position’ – Close (Verify – Cl)  

Table 39.  

<table>
<thead>
<tr>
<th>Ops Name</th>
<th>CIPUI</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPCM_S04B_F_RPC_02_MSS_MT_TUS_1_VSC_Pwr_1_Cl</td>
<td>S0PR96IM0305K</td>
</tr>
</tbody>
</table>

16.9 RPCM MT-4B Closed Loop Heater Activation  
MSS: MT: Thermal: ‘RPCM-MT-4B’ RPC 15  
[RPCM MT 4B Bracket Heater]  

‘Htr Availability’ Ena – ENA
Table 40.

<table>
<thead>
<tr>
<th>Ops Name</th>
<th>CIPUI</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTCS_RPCM_Brkt_Htr1_Ena</td>
<td>S0TH96IM0000K</td>
</tr>
</tbody>
</table>

cmd 'Control Mode State' Closed Loop (Verify – Closed Loop)

Table 41.

<table>
<thead>
<tr>
<th>Ops Name</th>
<th>CIPUI</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTCS_RPCM_Brkt_Htr1_Closed_Loop</td>
<td>S0TH96IM0006K</td>
</tr>
</tbody>
</table>

16.10 IUA Cable Cutter Close Inhibits

NOTE

ROBO will perform this sub-step via a command script.

MSS: MT: RPCM MT4B

RPCM_MT4B_A

sel RPC [X] where [X] = 3 6 17

RPCM MT4B A RPC [X]

cmd Close Cmd Inhibit (Verify – Inh)

Repeat

Table 42.

<table>
<thead>
<tr>
<th>Ops Name</th>
<th>CIPUI</th>
<th>Owner</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPCM_MT4B_A_RPC_3_Cl_Inh</td>
<td>S0PR96IM0378K:1</td>
<td>PHALCON</td>
</tr>
<tr>
<td>RPCM_MT4B_A_RPC_6_Cl_Inh</td>
<td>S0PR96IM0378K:2</td>
<td>PHALCON</td>
</tr>
<tr>
<td>RPCM_MT4B_A_RPC_17_Cl_Inh</td>
<td>S0PR96IM0378K:3</td>
<td>PHALCON</td>
</tr>
</tbody>
</table>

MSS: MT: RPCM MT3A

RPCM_MT3A_A

sel RPC [X] where [X] = 3 6 17

RPCM MT3A A RPC [X]

cmd Close Cmd Inhibit (Verify – Inh)

Repeat

Table 43.

<table>
<thead>
<tr>
<th>Ops Name</th>
<th>CIPUI</th>
<th>Owner</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPCM_MT3A_A_RPC_3_Cl_Inh</td>
<td>S0PR96IM0379K:1</td>
<td>PHALCON</td>
</tr>
<tr>
<td>RPCM_MT3A_A_RPC_6_Cl_Inh</td>
<td>S0PR96IM0379K:2</td>
<td>PHALCON</td>
</tr>
<tr>
<td>RPCM_MT3A_A_RPC_17_Cl_Inh</td>
<td>S0PR96IM0379K:3</td>
<td>PHALCON</td>
</tr>
</tbody>
</table>
16.11 VDS Trunkline Configuration

**NOTE**
VDS Trunkline Configuration and VDS Activation (steps 16.11 and 16.12) can be performed in parallel to reduce execution time.

Perform {4.602 VDS TRUNKLINE CONFIGURATION}, step 4 for USOS TLs 19, 20, 21 and 22; step 8 for MSS TLs 1, 8 and 9 (SODF: C&T: NOMINAL: VIDEO), then:

Confirm all other TLs are available.

16.12 VDS Activation
For EVSU 3 Ops Pwr only
Perform {1.601 VDS ACTIVATION}, steps 21 to 23 (SODF: C&T: ACTIVATION AND CHECKOUT: VIDEO), then:

16.13 Coordinating with ISS Crew
MCC-H notifies ISS crew that full video routing capability has been restored.

16.14 ESP-2 Heater Repower
S0: EPS: RPCM S04B-F

```
RPCM _S04B_F
```

sel RPC [X] where [X] = 10 12 13

```
RPCM S04B F RPC [X]
```

**cmd** ‘RPC Position’ – Close (Verify – Cl)

Repeat

**CAUTION**
The Operational and Survival Rail Heaters for a single power bus should never be powered at the same time. The following commands could place some heaters at risk of damage (SCAN-44 heaters). Reconfiguration of the redundant heater strings may be necessary.
16.15 Recovering Redundant Utility Rail Heaters

Table 44. Redundant Utility Rail Heaters

<table>
<thead>
<tr>
<th>Truss</th>
<th>Display [DISPLAY]</th>
<th>Utility Rail [RAIL]</th>
<th>Heater Type [TYPE]</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>Pwr Buses P12B P13A Rail Htrs</td>
<td>P12B</td>
<td>Survival</td>
</tr>
<tr>
<td>S0</td>
<td>Pwr Bus S01A Rail Htrs</td>
<td>S01A</td>
<td>Survival</td>
</tr>
<tr>
<td>S0</td>
<td>Pwr Bus S02B Rail Htrs</td>
<td>S02B</td>
<td>Survival</td>
</tr>
<tr>
<td>S0</td>
<td>Pwr Bus S03A Rail Htrs</td>
<td>S03A</td>
<td>Survival</td>
</tr>
<tr>
<td>S0</td>
<td>Pwr Bus S04B Rail Htrs</td>
<td>S04B</td>
<td>Operational</td>
</tr>
<tr>
<td>S1</td>
<td>Pwr Buses S12B S13A Rail Htrs</td>
<td>S13A</td>
<td>Survival</td>
</tr>
<tr>
<td>S1</td>
<td>Pwr Buses S11A S14B Rail Htrs</td>
<td>S14B</td>
<td>Operational</td>
</tr>
</tbody>
</table>

Refer to Table 44 for [XX], [DISPLAY], [RAIL], and [TYPE] references that follow.

[XX]: [DISPLAY]

[DISPLAY]

‘Utility Rail [RAIL]’

[TYPE]

√ Availability – Enable

Repeat

16.16 Recovering P1 1/4 Rail Heaters

P1: EPS: Pwr Buses P11A and P14B Rail Heaters

Pwr Buses P11A P14B Rail Htrs

‘Utility Rail P11A’

‘Operational Htr’

√ Availability – Inhibit

‘RPC Position’

√ RPC Position – Op

‘Survival Htr’

√ Availability – Enable

If Temp, deg C < -23

√ RPC Position – Cl

Wait until Temp, deg C > -23
16.17 Recovering P1 2/3 Rail Heaters

P1: EPS: Pwr Buses P12B and P13A Rail Heaters

Pwr Buses P12B P13A Rail Htrs

‘Utility Rail P13A’

‘Operational Htr’

√Availability – Inhibit

‘RPC Position’

√RPC Position – Op

‘Survival Htr’

√Availability – Enable

If Temp, deg C < -23

√RPC Position – Cl

Wait until Temp, deg C > -23

‘Operational Htr’

√Availability – Enable
16.18 Recovering P3 1/4 Rail Heaters
P3: EPS: P3 Rail Heaters

'Utility Rail [XX]' where [XX] = P31A P34B

'Survival Htr'
√Availability – Inhibit

'RPC Position'
√RPC Position – Op

'Operational Htr'
√Availability – Enable

Repeat

16.19 Recovering P3 2/3 Rail Heaters
P3: EPS: P3 Rail Heaters

'Utility Rail [XX]' where [XX] = P32B P33A

'Survival Htr'
√Availability – Inhibit

'RPC Position'
√RPC Position – Op

'Operational Htr'
√Availability – Enable

Repeat

16.20 Recovering S1 2/3 Rail Heaters
S1: EPS: Pwr Buses S12B and S13A Rail Heaters

'Utility Rail S12B'
'Operational Htr'

√Availability – Inhibit
‘RPC Position’

√RPC Position – Op

‘Survival Htr’

√Availability – Enable

If Temp, deg C < -23

√RPC Position – Cl

Wait until Temp, deg C > -23

‘Operational Htr’

√Availability – Enable

17. **CONFIGURING 1553 DATA BUS TO CH A**

Configuring 1553 to Channel A

C&DH Summary: Primary PMCU

Primary PMCU MDM

| sel LB_PMCU-1
| sel Bus Status

LB PMCU 1 Bus Status

**cmd** select channel – A **Execute**

Verify channel selected – A

C&DH Summary: Primary PMCU

Primary PMCU MDM

| sel LB_PMCU-3
| sel Bus Status

LB PMCU 3 Bus Status

**cmd** select channel – A **Execute**

Verify channel selected – A

C&DH Summary: Primary EXT

Primary Ext MDM

| sel LB_Sys_S-1
| sel Bus Status
LB Sys S-1 Bus Status

`cmd` select channel – A  **Execute**
Verify channel selected – A

Primary Ext MDM

sel LB_Sys_S-2
sel Bus Status

LB Sys S-2 Bus Status

`cmd` select channel – A  **Execute**
Verify channel selected – A

Primary Ext MDM

sel LB_Mech_S-1
sel Bus Status

LB Mech S-1 Bus Status

`cmd` select channel – A  **Execute**
Verify channel selected – A

Primary Ext MDM

sel LB_Mech_S-2
sel Bus Status

LB Mech S-2 Bus Status

`cmd` select channel – A  **Execute**
Verify channel selected – A

C&DH Summary: Primary PL

Primary PL MDM

sel LB_PL_1
sel Bus Status

LB PL 1 Bus Status

`cmd` select channel – A  **Execute**
Verify channel selected – A
18. **PERFORMING POWER ON RESET**
For RPCMs [XX]
Perform \{5.420  RPCM POWER ON RESET\} (SODF: GND SYSTEMS: EPS: CORRECTIVE: SECONDARY POWER SYSTEM).

19. **C&W CONFIGURATIONS**

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ODIN will enable the applicable 13A Caution and Warning events in the C&amp;C MDM.</td>
</tr>
<tr>
<td>2. If a change to the C&amp;W PPL in the Primary C&amp;C is required, the PPL will need to be incorporated prior to the EVA as the C&amp;C MDMs will require a State transition to incorporate.</td>
</tr>
</tbody>
</table>
## S3/S4 Activation Flowchart

### (ASSY OPS/13A/FIN 1) Page 2 of 2 pages

<table>
<thead>
<tr>
<th>Tray</th>
<th>CNNCTR</th>
<th>Function</th>
<th>Inhibit</th>
<th>Verification Feedback</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1 TO J1</td>
<td>S4 1A Pri Pwr to S0 Ch 1A MBSU</td>
<td>MBSU 1 RBI 1 OPEN</td>
<td>1.108 S4 PVCU MDM ACTIVATION AND CHECKOUT (SODF: C&amp;DH: ACTIVATION AND CHECKOUT): step 4 for 1A Ch</td>
<td></td>
</tr>
<tr>
<td>P2 TO J2</td>
<td>S6 1B Pri Pwr to S0 Ch 1B MBSU</td>
<td>MBSU 1 RBI 8 OPEN</td>
<td>15A mission</td>
<td></td>
</tr>
<tr>
<td>P3 TO J3</td>
<td>RPCM S01A_B Sec Pwr to RPCM S13A</td>
<td>RPCM S01A B RPC 2 OPEN</td>
<td>Step 13.2: S3 Activation (checked in 13.9 per procedure)</td>
<td></td>
</tr>
<tr>
<td>P4 TO J4</td>
<td>DDCU S14B Sec Pwr to RPCM S34B</td>
<td>DDCU S14B CONVERTER OFF</td>
<td>Step 13.2: S3 Activation (checked in 13.9 per procedure)</td>
<td></td>
</tr>
<tr>
<td>P5 TO J5</td>
<td>EXT MDM 1553 CH A</td>
<td>None Required</td>
<td>Step 17: 1553 buses to Ch A</td>
<td></td>
</tr>
<tr>
<td>P6 TO J6</td>
<td>HRDL (PAS 2/3) &amp; Video</td>
<td>None Required</td>
<td>PAS C/O (post 13A)</td>
<td></td>
</tr>
<tr>
<td>P11 TO J11</td>
<td>S4 3A Pri Pwr to S0 Ch 3A MBSU</td>
<td>MBSU 3 RBI 1 OPEN</td>
<td>1.108 S4 PVCU MDM ACTIVATION AND CHECKOUT (SODF: C&amp;DH: ACTIVATION AND CHECKOUT): step 4 for 3A Ch</td>
<td></td>
</tr>
<tr>
<td>P12 TO J12</td>
<td>S6 3A Pri Pwr to S0 Ch 3B MBSU</td>
<td>MBSU 3 RBI 8 OPEN</td>
<td>15A mission</td>
<td></td>
</tr>
<tr>
<td>P13 TO J13</td>
<td>RPCM S02B_B Sec Pwr to RPCM S32B</td>
<td>RPCM S02B B RPC 2 OPEN</td>
<td>Step 10.2: S3 Activation (checked in 10.9 per procedure)</td>
<td></td>
</tr>
<tr>
<td>P14 TO J14</td>
<td>DDCU P13A Sec Pwr to RPCM S33A</td>
<td>DDCU P13A CONVERTER OFF</td>
<td>Step 10.2: S3 Activation (checked in 10.9 per procedure)</td>
<td></td>
</tr>
<tr>
<td>P15 TO J15</td>
<td>EXT MDM 1553 CH B</td>
<td>None Required</td>
<td>Step 10.2: S3-2 MDM bootup</td>
<td></td>
</tr>
<tr>
<td>P16 TO J16</td>
<td>HRDL (PAS 1/4)</td>
<td>None Required</td>
<td>PAS C/O (post 13A)</td>
<td></td>
</tr>
<tr>
<td>P17 TO J17</td>
<td>INSTM</td>
<td>None Required</td>
<td>SDMS data take (post 13A)</td>
<td></td>
</tr>
</tbody>
</table>
OBJECTIVE:
This procedure will unlatch the blanket boxes and release the Blanket Restraint System (BRS) pins for a single USOS solar array wing. Steps are also included to relatch the blanket boxes in order to protect the hardware from on-orbit loads until the wing can be fully deployed.

CAUTION
1. To avoid damage to solar array hardware, all PVM Upper and Lower EPS Prep EVA activities must be completed prior to performing this procedure. Upper and Lower EPS Prep includes the deployment of the 4-bar linkage, the release of three bolts on the Mast tip fitting and rotation of the blanket boxes 90 degrees from the launch configuration.

2. This procedure assumes that the associated BGA and the nearest SARJ are locked. This procedure can also be performed, if the SARJ launch restraints are still in place. The solar array hardware could be damaged if a Solar Array Blanket Box (SABB) unlatch is attempted while the BGA and SARJ are rotating.

3. Steps that involve mechanical motion (e.g., latch, unlatch, deploy, retract) of the SAW hardware must
   a. Be performed during insolation to support crew visual cues.
   b. Be performed with ISS and orbiter thrusters inhibited to avoid damage to solar array mechanisms.

NOTE
MCC-H will be primary for performing all steps if video downlink is available. If crew is available, they may elect to perform the visual verification steps 2.3, 2.9, 3.8, 4.3, 4.9, and 5.8.

1. CONFIRMING STATUS (MCC-H)
   1.1 Verifying EPS Prep Complete
   Verify Upper(Lower) EPS Prep has been completed by EVA crew. Refer to Table 1 for PVM and EVA reference.

Table 1. PVM and EVA Reference

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PVM</td>
<td>XX</td>
<td>EVA Ref</td>
</tr>
<tr>
<td>S4</td>
<td>1A</td>
<td>LWR</td>
</tr>
<tr>
<td>S4</td>
<td>3A</td>
<td>UPR</td>
</tr>
<tr>
<td>S6</td>
<td>1B</td>
<td>UPR</td>
</tr>
<tr>
<td>S6</td>
<td>3B</td>
<td>LWR</td>
</tr>
<tr>
<td>P4</td>
<td>2A</td>
<td>LWR</td>
</tr>
<tr>
<td>P4</td>
<td>4A</td>
<td>UPR</td>
</tr>
<tr>
<td>P6</td>
<td>2B</td>
<td>UPR</td>
</tr>
<tr>
<td>P6</td>
<td>4B</td>
<td>LWR</td>
</tr>
</tbody>
</table>
1.2 Verifying ECU Activation Complete

Verify MCC-H has completed {1.3.400 ECU XX ACTIVATION} (SODF: EPS: ACTIVATION AND CHECKOUT: CHANNEL ACTIVATION), then:

1.3 Verifying Comm with SAW Controller

PCS

PVM: EPS: SAW XX

SAW XX

‘ECU XX’

Verify ECU/SAW Integration Counter – incrementing

1.4 Verifying Initial SAW C&W Flags and MDA Data

Configure for continuous data dump of SAW XX. To build dump command, perform {1.230 CCS BUILD DATA DUMP COMMAND} (SODF: GND: AVIONICS: C&DH: NOMINAL). For unique PVCU start location addresses, refer to {5.294 EPS MDM BDT/50Hz ADDRESS} (SODF: GND: SYSTEMS: EPS: NOMINAL), for SAW XX with 1 Hz Data Collection, 224 words.

**WARNING**

Verify EVA crew is clear of SAW XX SABB mechanisms before proceeding.

**NOTE**

Note SABB limit switches are sensitive to thermal conditions and may indicate inaccurate values during eclipse and the first 15 minutes of insolation.

2. UNLATCHING LEFT BLANKET BOX (LBB)

2.1 Verifying Temperatures are Within Nominal Ranges Prior to Unlatch

PCS

PVM: EPS: SAW XX

SAW XX

Verify SAW PS Temp, deg C: -33 to 51
Verify BGA PS Temp, deg C: -33 to 51
Verify LBB MDA Temp, deg C: -54 to 48

2.2 Powering on LBB Motor Drive Assembly (MDA)

**NOTE**

MDA Slow Alert will be Nominal until MDA power is applied. Once this is done, the indication is Slow.

SAW XX

‘LBB’

sel LBB Commands
1.3.450 SAW XX SABB INITIAL UNLATCH
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**SAW XX LBB Commands**

'MDA'

'Power'

**cmd** On – Arm

**cmd** On – On

\(\sqrt{\text{MDA Voltage, V: 120 to 125}}\)

### 2.3 Performing Initial SABB Visual Verification Via Cameras

ISS must be in insolation to perform this verification.

#### NOTE

1. Crew or **MCC-H**, if video is available, perform a visual verification prior to, during, and at the completion of each blanket box unlatch operation. There are eight latches and seven BRS pins to be released for each blanket box prior to SAW deployment. Seven gold colored posts protrude through the containment box base to provide visual indication of successful pin release.

SAW 4A LBB = Aft Zenith SABB (when Port SARJ = 180 deg, BGA 4A = 0 deg) Fwd Nadir SABB (when Port SARJ = 0 deg, BGA 4A = 60 deg)

SAW 2A LBB = Fwd Nadir SABB (when Port SARJ = 180 deg BGA 2A = 0 deg) Aft Zenith SABB (when Port SARJ = 0 deg, BGA 2A = 300 deg)

SAW 3A LBB = Aft Nadir SABB (when Stbd SARJ = 0 deg, BGA 3A = 0 deg)

SAW 1A LBB = Fwd Zenith SABB (when Stbd SARJ = 0 deg, BGA 1A = 0 deg)

SAW 4B LBB = Aft Zenith SABB (when Port SARJ = 0 deg, BGA 4B = 0 deg)

SAW 2B LBB = Fwd Nadir SABB (when Port SARJ = 0 deg BGA 2B = 0 deg)

SAW 3B LBB = Fwd Zenith SABB (when Stbd SARJ = 0 deg, BGA 3B = 0 deg)

SAW 1B LBB = Aft Nadir SABB (when Stbd SARJ = 0 deg, BGA 1B = 0 deg)

2. The BRS Pin status can be ignored for arrays on the P6 truss, or SABBs that have been previously unlatched. They have already been released.

Refer to Figure 1 for SABB launch configuration.

Verify BRS Pin (seven) – Restraint pins engaged

Verify Latch Position (four of eight) – Latched
1.3.450 SAW XX SABB INITIAL UNLATCH

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Figure 1.- SABB Launch Configuration.

Notify **MCC-H** of Configuration.

If orbiter is performing mated attitude control, proceed to step 2.6. Otherwise, proceed to step 2.9 and wait for **MCC-H** to unlatch the left blanket box.

**MCC-H** proceed to step 2.4.

2.4 Verifying Initial SAW Left Blanket Box Configuration

Verify parameters in Latched column in step 2.8 before executing unlatch command.

2.5 Verifying Conditions are Correct for Visual Verification

**CAUTION**

Steps 2.7 and 2.9 are to be performed during insolation to support crew visual cues used to determine correct SABB latch configuration.

Verify ISS is in insolation.
2.6 Preventing Thruster Firings

**CAUTION**

To minimize the potential for structural damage to hardware while the solar array mechanisms are in motion, nonpropulsive CMG control or Free Drift will be maintained. Anytime the latches are not in motion, thrusters may be enabled.

If ISS is performing attitude control and ISS is in TEA (MCC-H)

|MCC-H|
---|---|
|MCS: MCS Configuration: Manual CMG Desat|
|Manual CMG Desat|

√Desat Request – Inh

MCC-H  ISS, Orbiter, “Desats are Inhibited.”

Go to step 2.7.

*If ISS is performing attitude control and ISS is not in TEA (MCC-H)*

*Perform [2.404 MODING CMG TA TO FREE DRIFT], (SODF: MCS: NOMINAL: GNC MODING), then:

*MCC-H  ISS, Orbiter, “ISS is in Free Drift.”*

*Go to step 2.7.*

2.7 Unlatching SAW Left Blanket Box

**CAUTION**

Confirm no crew exercise or Max EVA loads before proceeding.

Verify ISS is in insolation.

MCC-H  ISS, Orbiter, “Ready to unlatch the left blanket box.”
NOTE
Upon successful Unlatch commanding, the MDA current will increase (0.2 to 3.0 amps) and the Slow Alert will go to Nominal during transition, then return to Slow. Once power is removed from the MDA, the Slow Alert will indicate Nominal.

PCS

PVM: EPS: SAW XX

SAW XX

‘LBB’

sel LBB Commands

SAW XX LBB Commands

‘LBB’

**cmd**

Unlatch – Arm

**cmd**

Unlatch – Unlatch (Be ready to visually monitor latch motion and check parameters in step 2.8 before sending this command. Unlatch nominally takes 14 seconds to complete.)

2.8 Monitoring LBB BRS Pin and Latch Parameters During Unlatch

(Approximately 14 Seconds)

Refer to Table 2 for LBB parameters.

---

**NOTE**

1. Perform a visual verification prior to, during, and at the completion of each blanket box unlatch operation. Monitor for any obvious anomalies and verify blanket box unlatch operation.

2. Note SABB limit switches are sensitive to thermal conditions and may indicate inaccurate values during eclipse and the first 15 minutes of insolation.

---

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Latched→</th>
<th>Transition→ Approximately 14 Seconds</th>
<th>Unlatched</th>
</tr>
</thead>
<tbody>
<tr>
<td>LBB SW 01,02 Pin Released</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>LBB SW 01,02 Latched</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>LBB SW 01,02 Unlatched</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>MDA Slow Alert</td>
<td>Slow</td>
<td>Nominal</td>
<td>Slow</td>
</tr>
<tr>
<td>MDA Voltage, V</td>
<td>120 to 125</td>
<td>120 to 125</td>
<td>120 to 125</td>
</tr>
<tr>
<td>MDA Temp, deg C</td>
<td>-54 to 48</td>
<td>-54 to 48</td>
<td>-54 to 48</td>
</tr>
<tr>
<td>MDA Over Temp Trip</td>
<td>blank</td>
<td>blank</td>
<td>blank</td>
</tr>
<tr>
<td>MDA Current, A</td>
<td>~0.10 (±0.4)</td>
<td>0.20 to 3.00 (±0.4)</td>
<td>~0.10 (±0.4)</td>
</tr>
<tr>
<td>MDA Over Current Trip</td>
<td>blank</td>
<td>blank</td>
<td>blank</td>
</tr>
</tbody>
</table>
1.3.450  SAW XX SABB INITIAL UNLATCH
(EPS/E12 - ALL/FIN 1)  Page 7 of 26 pages

******************************************************************************
* If one Latched or Unlatched or Pin Released limit switch fails
  * Confirm configuration visually and notify MCC-H before proceeding.
  *
(SABB limit switch status that would restrict Mast commanding has already been overridden in the
* 1.3.400 ECU XX Activation procedure.)
* 
* If two Latched or Unlatched or Pin Released limit switches fail
  * Perform steps 2.9 and 2.10 (if orbiter performing attitude control), then notify MCC-H before proceeding.
******************************************************************************

2.9 Performing Visual Verification Via Cameras
Refer to Figure 2 for bottom view of blanket boxes and Figure 3 for SABB unlatched configuration.

![Figure 2.- Bottom View of Blanket Boxes (BRS Pin Map).](image)

NOTE
The BRS Pin status can be ignored for arrays on the P6 truss. They have already been released.

Verify BRS Pin Release (seven) – Restraint pins released
Verify Latch Position (four of eight) – Unlatched

CAUTION
Visual verification of all seven BRS pins is required before performing the 1.3.452 SAW XX Deploy procedure.
ISS $\uparrow$ MCC-H, “We confirm, seven BRS Pins released and the left blanket box is unlatched.”

MCC-H $\uparrow$ ISS, “We confirm nominal unlatch.”

If orbiter is performing mated attitude control, proceed to step 2.10; otherwise, proceed to step 2.11.

**MCC-H** proceed to step 2.10.

**********************************************************************

* If unlatch sequence is not successful, notify MCC-H before proceeding.

* If MCC-H unavailable
  * Perform {3.190 SAW XX FAILURE TO UNLATCH SABB REMOTELY} (SODF: EPS: MALFUNCTION: PRIMARY POWER), then:

**********************************************************************

2.10 Configuring for Nominal Attitude Control

**MCC-H**

If ISS is performing attitude control and ISS is in TEA (MCC-H)

Go to step 2.11.
1.3.450 SAW XX SABB INITIAL UNLATCH
(EPS/E12 - ALL/FIN 1) Page 9 of 26 pages

*******************************************************************************
* If ISS is performing attitude control and ISS is not in TEA (MCC-H)  
  Perform {2.405 MODING FREE DRIFT TO CMG TA}, (SODF:  
  MCS: NOMINAL: GNC MODING), then:  
  
  * MCC-H ↑ ISS, Orbiter, “ISS is in Attitude Control.”  
  * Go to step 2.11.  
*******************************************************************************

C3(A6)

*******************************************************************************
* If orbiter is performing mated attitude control  
  Perform rate damping DOCKED CONFIGURATION DAP  
  REFERENCE, (FDF: ORB OPS, REBOOST/DAP), then:  
  
  * Go to step 2.11.  
*******************************************************************************

2.11 Determining SABB Relatch Operations

Check with MCC-H.

If latches are to remain unlatched, proceed to step 4.3.

  MCC-H perform step 2.12 then proceed to step 4.1.

If immediately relatching

  If orbiter is performing mated attitude control, proceed to step 3.5  
  and wait for MCC-H Go. Otherwise, proceed to step 3.8 and  
  wait for MCC-H to latch the left blanket box.

  MCC-H proceed to step 3.4.

If not immediately relatching, proceed to step 4.3.

  MCC-H perform step 2.12; then, proceed to step 4.1. Perform  
  step 3 when ready to relatch.

2.12 Powering Off Left Blanket Box MDA

PCS

PVM: EPS: SAW XX

[SAW XX]

‘LBB’

sel LBB Commands

[SAW XX LBB Commands]

‘MDA’

‘Power’

cmd Off – Off

√MDA Voltage, V < 10 (±2.8)
3. RELATCHING LEFT SOLAR ARRAY BLANKET BOX (If Necessary to Support Operational Loads Until Array is Deployed)

If orbiter is performing mated attitude control, proceed to step 3.5. Otherwise, proceed to step 3.8 and wait for MCC-H to latch the left blanket box.

MCC-H proceed to step 3.1.

3.1 Verifying Temperatures are Within Nominal Ranges Prior to Latch

<table>
<thead>
<tr>
<th>PCS</th>
<th>EPS: SAW XX</th>
</tr>
</thead>
</table>

Verify SAW PS Temp, deg C: -33 to 51
Verify BGA PS Temp, deg C: -33 to 51
Verify LBB MDA Temp, deg C: -54 to 48

3.2 Powering on LBB Motor Drive Assembly (MDA)

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MDA Slow Alert will be Nominal until MDA power is applied. Once this is done, the indication is Slow.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SAW XX</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘LBB’</td>
</tr>
</tbody>
</table>

sel LBB Commands

<table>
<thead>
<tr>
<th>SAW XX LBB Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘MDA’</td>
</tr>
<tr>
<td>‘Power’</td>
</tr>
</tbody>
</table>

cmd On – Arm

cmd On – On

√MDA Voltage, V: 120 to 125

3.3 Verifying SAW Left Blanket Box Configuration

<table>
<thead>
<tr>
<th>SAW XX LBB Commands</th>
</tr>
</thead>
</table>

Verify parameters in Unlatched column in step 3.7 before executing latch command.

3.4 Verifying Conditions are Correct for Visual Verification

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steps 3.6 and 3.8 are to be performed during insolation to support crew visual cues, use to determine correct SABB latch configuration.</td>
</tr>
</tbody>
</table>

Verify ISS is in insolation.
3.5 Preventing Thruster Firings

**CAUTION**

To minimize the potential for structural damage to hardware while the solar array mechanisms are in motion, nonpropulsive CMG control or Free Drift will be maintained. Anytime the latches are not in motion, thrusters may be enabled.

If ISS is performing attitude control and ISS is in TEA (MCC-H)

**MCC-H**

MCS: MCS Configuration: Manual CMG Desat

\Desat Request – Inh

**MCC-H** \ISS, Orbiter, “Desats are Inhibited.”

Go to step 3.6.

* If ISS is performing attitude control and ISS is not in TEA (MCC-H)
* Perform \{2.404 MODING CMG TA TO FREE DRIFT\}, (SODF: MCS: NOMINAL: GNC MODING), then:
* **MCC-H** \ISS, Orbiter, “ISS is in Free Drift.”
* Go to step 3.6.

---

C3(A6)

* If orbiter is performing mated attitude control
* DAP: FREE
* Orbiter \\ ISS, **MCC-H**, “Orbiter is in Free Drift.”
* Go to step 3.8 and wait for **MCC-H** to latch the left blanket box.
* **MCC-H**, go to step 3.6.

---

3.6 Latching SAW Left Blanket Box (Engage High Tension Mode)

**CAUTION**

Confirm no crew exercise or Max EVA loads before proceeding.

Verify ISS is in insolation.

**MCC-H** \ISS, Orbiter, “Ready to latch the left blanket box.”
NOTE
Upon successful Latch commanding, the MDA current will increase (0.2 to 3.0 amps) and the Slow Alert will go to Nominal during transition, then return to Slow. Once power is removed from the MDA, the Slow Alert will indicate Nominal.

PCS

PCS PVM: EPS: SAW XX

SAW XX

'SBB'

sel LBB Commands

SAW XX LBB Commands

'SBB'

cmd Latch – Arm

cmd Latch – Latch (Be ready to visually monitor latch motion and check parameters in step 3.7 before sending this command. Latch nominally takes 14 seconds to complete.)

3.7 Monitor LBB Latch Parameters During Latch (Approximately 14 Seconds)

Refer to Table 3 for LBB parameters.

NOTE
1. Perform a visual verification prior to, during, and at the completion of each Blanket Box unlatch operation. Monitor for any obvious anomalies and verify Blanket Box latching operation.

2. Note SABB limit switches are sensitive to thermal conditions and may indicate inaccurate values during eclipse and the first 15 minutes of insolation.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unlatched</th>
<th>Transition</th>
<th>Latched</th>
</tr>
</thead>
<tbody>
<tr>
<td>LBB SW 01,02 Pin Released</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>LBB SW 01,02 Latched</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>LBB SW 01,02 Unlatched</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>MDA Slow Alert</td>
<td>Slow</td>
<td>Nominal</td>
<td>Slow</td>
</tr>
<tr>
<td>MDA Voltage, V</td>
<td>120 to 125</td>
<td>120 to 125</td>
<td>120 to 125</td>
</tr>
<tr>
<td>MDA Temp, deg C</td>
<td>-54 to 48</td>
<td>-54 to 48</td>
<td>-54 to 48</td>
</tr>
<tr>
<td>MDA Over Temp Trip</td>
<td>blank</td>
<td>blank</td>
<td>blank</td>
</tr>
<tr>
<td>MDA Current, A</td>
<td>~0.10 (±0.4)</td>
<td>0.20 to 3.00 (±0.4)</td>
<td>~0.10 (±0.4)</td>
</tr>
<tr>
<td>MDA Over Current Trip</td>
<td>blank</td>
<td>blank</td>
<td>blank</td>
</tr>
</tbody>
</table>
If one Latched or Unlatched or Pin Released limit switch fails
* Confirm configuration visually and notify MCC-H before proceeding.
* (SABB limit switch status that would restrict Mast commanding has already been overridden in the 1.3.400 ECU XX Activation procedure.)

If two Latched or Unlatched or Pin Released limit switches fail
Perform steps 3.8 and 3.9 (if orbiter is performing attitude control), notify MCC-H before proceeding.

3.8 Perform Visual Verification Via Cameras
Verify Latch Position (four of eight) – latched (tensioned position)

Refer to Figure 4 for SABB relatched configuration.

Figure 4.- SABB Relatched.

ISS ➣ MCC-H, “We confirm, the left blanket box is latched.”

MCC-H ➤ ISS, “We confirm nominal latch.”
If right blanket box is unlatched
  If orbiter is performing mated attitude control, perform step 3.9; then, proceed to step 5.5 and wait for MCC-H Go.
  Otherwise, proceed to step 5.8 and wait for MCC-H to latch the right blanket box.

**MCC-H** proceed to step 3.9.

If right blanket box is latched
  If orbiter is performing mated attitude control, perform step 3.9, then, proceed to step 4.3. Otherwise, proceed to step 4.3.

**MCC-H** proceed to step 3.9.

* If latch sequence is not successful, notify MCC-H before proceeding.
* If **MCC-H** unavailable
  * Perform {3.193 SAW XX FAILURE TO LATCH (TENSION) SABB REMOTELY} (SODF: EPS: MALFUNCTION: PRIMARY POWER), then:

*******************************************************************************

3.9 Configuring for Nominal Attitude Control
**MCC-H**
  If ISS is performing attitude control and ISS is in TEA (**MCC-H**) Go to step 3.10.

*******************************************************************************

* If ISS is performing attitude control and ISS is not in TEA (**MCC-H**) Perform {2.405 MODING FREE DRIFT TO CMG TA}, (SODF: MCS: NOMINAL: GNC MODING), then:
  * **MCC-H**  ISS, Orbiter, “ISS is in Attitude Control.”
  * Go to step 3.10.

*******************************************************************************

C3(A6)
* If orbiter is performing mated attitude control
  * Perform rate damping DOCKED CONFIGURATION DAP REFERENCE, (FDF: ORB OPS, REBOOST/DAP), then:
    * If right blanket box is unlatched
      * Proceed to step 5.5 and wait for MCC-H Go.
    * **MCC-H** proceed to step 3.10.
  
* If right blanket box is latched
  * Proceed to step 4.3.
  * **MCC-H** proceed to step 3.10.

*******************************************************************************
3.10 **Power Off Left Blanket Box MDA**

PCS

- PVM: EPS: SAW XX
  
  | SAW XX |
  
  | 'LBB' |

Sel LBB Commands

| SAW XX LBB Commands |
| 'MDA' |
| 'Power' |

**cmd** Off – Off

√MDA Voltage, V: < 10 (±2.8)

If right blanket box is unlatched

- MCC-H proceed to step 5.1.

If right blanket box is latched

- MCC-H proceed to step 4.1.

4. **UNLATCHING RIGHT BLANKET BOX (RBB)**

4.1 **Verifying Temperatures Are Within Nominal Ranges Prior to Unlatch**

PCS

- PVM: EPS: SAW XX

| SAW XX |

Verify SAW PS Temp, deg C: -33 to 51
Verify BGA PS Temp, deg C: -33 to 51
Verify RBB MDA Temp, deg C: -54 to 48

4.2 **Powering on RBB Motor Drive Assembly (MDA)**

**NOTE**

MDA Slow Alert will be Nominal until MDA power is applied. Once this is done, the indication is Slow.

| SAW XX |
| 'RBB' |

Sel RBB Commands

| SAW XX RBB Commands |
| 'MDA' |
| 'Power' |

**cmd** On – Arm

**cmd** On – On

√MDA Voltage, V: 120 to 125
4.3 Performing Initial SABB Visual Verification Via Cameras
ISS must be in insolation to perform this verification.

**NOTE**

1. Crew or **MCC-H**, if video is available, perform a visual verification prior to, during, and at the completion of each blanket box unlatch operation. There are eight latches and seven BRS pins to be released for each blanket box prior to deployment. Seven gold colored posts protrude through the containment box base to provide visual indication of successful pin release.

   - SAW 4A RBB = Aft Nadir SABB (when Port SARJ = 180 deg, BGA 4A = 0 deg) Fwd Nadir SABB (when Port SARJ = 0 deg, BGA 4A = 60 deg)
   - SAW 2A RBB = Fwd Zenith SABB (when Port SARJ = 180 deg, BGA 2A = 0 deg) Aft Zenith SABB (when Port SARJ = 0 deg, BGA 2A = 300 deg)
   - SAW 3A RBB = Aft Zenith SABB (when Stbd SARJ = 0 deg, BGA 3A = 0 deg)
   - SAW 1A RBB = Fwd Nadir SABB (when Stbd SARJ = 0 deg, BGA 1A = 0 deg)
   - SAW 4B RBB = Aft Nadir SABB (when Port SARJ = 0 deg, BGA 4B = 0 deg)
   - SAW 2B RBB = Fwd Zenith SABB (when Port SARJ = 0 deg BGA 2B = 0 deg)
   - SAW 3B RBB = Fwd Nadir SABB (when Stbd SARJ = 0 deg, BGA 3B = 0 deg)
   - SAW 1B RBB = Aft Zenith SABB (when Stbd SARJ = 0 deg, BGA 1B = 0 deg)

2. The BRS Pin status can be ignored for arrays on the P6 truss, or SABBs that have been previously unlatched. They have already been released.

Verify BRS Pin (seven) – Restraint pins engaged
Verify Latch Position (four of eight) – Latched

Notify **MCC-H** of Configuration (refer to Figure 1 in step 2.3).

If orbiter is performing mated attitude control, proceed to step 4.6. Otherwise, proceed to step 4.9 and wait for **MCC-H** to unlatch the right blanket box.

**MCC-H** proceed to step 4.4

4.4 Verifying Initial SAW Right Blanket Box Configuration

<table>
<thead>
<tr>
<th>SAW XX RBB Commands</th>
</tr>
</thead>
</table>

Verify parameters in Latched column in step 4.8 before executing unlatch command.
4.5 Verifying Conditions are Correct for Visual Verification

**CAUTION**

Steps 4.7 and 4.9 are to be performed during insolation to support crew visual cues use to determine correct SABB latch configuration.

Verify ISS is in insolation.

4.6 Preventing Thruster Firings

**CAUTION**

To minimize the potential for structural damage to hardware while the solar array mechanisms are in motion, nonpropulsive CMG control or Free Drift will be maintained. Anytime the latches are not in motion, thrusters may be enabled.

If ISS is performing attitude control and ISS is in TEA (MCC-H): MCC-H

MCS: MCS Configuration: Manual CMG Desat

\[\text{Manual CMG Desat} \]

\[\text{\textbackslash Desat Request – Inh} \]

MCC-H \(\uparrow\) ISS, Orbiter, “Desats are Inhibited.”

Go to step 4.7.

* If ISS is performing attitude control and ISS is not in TEA (MCC-H):
  * Perform {2.404 MODING CMG TA TO FREE DRIFT}, (SODF: MCC: NOMINAL: GNC MODING), then:
    * MCC-H \(\uparrow\) ISS, Orbiter, “ISS is in Free Drift.”
    * Go to step 4.7.

************************************************************************************

C3(A6)

* If orbiter is performing mated attitude control
  * DAP: FREE

  * Orbiter \(\Rightarrow\) ISS, MCC-H, “Orbiter is in Free Drift.”
  * Go to step 4.9 and wait for MCC-H to unlatch the right blanket box.
  * MCC-H, go to step 4.7.

************************************************************************************
4.7 Unlatching SAW Right Blanket Box

**CAUTION**

Confirm no crew exercise or Max EVA loads before proceeding.

Verify ISS is in insolation.

**MCC-H** ũ ISS, Orbiter, “Ready to unlatch the right blanket box.”

**NOTE**

Upon successful Unlatch commanding, the MDA current will increase (0.2 to 3.0 amps) and the Slow Alert will go to Nominal during transition, then return to Slow. Once power is removed from the MDA, the Slow Alert will indicate Nominal.

PCS

PVM: EPS: SAW XX

SAW XX

‘RBB’

sel RBB Commands

**SAW XX RBB Commands**

‘RBB’

**cmd** Unlatch – Arm

**cmd** Unlatch – Unlatch (Be ready to visually monitor latch motion and check parameters in step 4.8 before sending this command. Unlatch nominally takes 14 seconds to complete.)

4.8 Monitoring RBB BRS Pin and Latch Parameters During Unlatch

(Approximately 14 Seconds)

Refer to Table 4 for RBB parameters.

**NOTE**

1. Perform a visual verification prior to, during, and at the completion of each Blanket Box unlatch operation. Monitor for any obvious anomalies and verify Blanket Box unlatch operation.

2. Note SABB limit switches are sensitive to thermal conditions and may indicate inaccurate values during eclipse and the first 15 minutes of insolation.
Table 4. RBB Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Latched</th>
<th>Transition→</th>
<th>Unlatched</th>
</tr>
</thead>
<tbody>
<tr>
<td>RBB SW 01,02 Pin Released</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>RBB SW 01,02 Latched</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>RBB SW 01,02 Unlatched</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>MDA Slow Alert</td>
<td>Slow</td>
<td>Nominal</td>
<td>Slow</td>
</tr>
<tr>
<td>MDA Voltage, V</td>
<td>120 to 125</td>
<td>120 to 125</td>
<td>120 to 125</td>
</tr>
<tr>
<td>MDA Temp, deg C</td>
<td>-54 to 48</td>
<td>-54 to 48</td>
<td>-54 to 48</td>
</tr>
<tr>
<td>MDA Over Temp Trip</td>
<td>blank</td>
<td>blank</td>
<td>blank</td>
</tr>
<tr>
<td>MDA Current, A</td>
<td>~0.10 (±0.4)</td>
<td>0.20 to 3.00 (±0.4)</td>
<td>~0.10 (±0.4)</td>
</tr>
<tr>
<td>MDA Over Current Trip</td>
<td>blank</td>
<td>blank</td>
<td>blank</td>
</tr>
</tbody>
</table>

* If one Latched or Unlatched or Pin Released limit switch fails
  * Confirm configuration visually and notify MCC-H before proceeding.
  * (SABB limit switch status that would restrict Mast commanding has already been overridden in the 1.3.400 ECU XX Activation procedure.)
  *
  * If two Latched or Unlatched or Pin Released limit switches fail
  * Perform steps 4.9 and 4.10 (if orbiter is performing attitude control), then notify MCC-H before proceeding.

4.9 Performing Visual Verification Via Cameras
Refer to Figure 5 for bottom view of blanket box.

Figure 5.- Bottom View of Blanket Boxes (BRS Pin Map).

NOTE
The BRS Pin status can be ignored for arrays on the P6 truss. They have already been released.
Verify BRS Pin Release (seven) – Restraint pins released
Verify Latch Position (four of eight) – Unlatched
Refer to Figure 3 in step 2.9.

**CAUTION**

Visual verification of all seven BRS pins is required before performing the 1.3.452 SAW XX Deploy procedure.

ISS ▼ MCC-H, “We confirm, seven BRS Pins released and the right blanket box is unlatched.”

MCC-H ▲ ISS, “We confirm nominal unlatch.”

If orbiter is performing mated attitude control, proceed to step 4.10; otherwise, proceed to step 4.11.

**4.10 Configuring for Nominal Attitude Control**

MCC-H

If ISS is performing attitude control and ISS is in TEA (MCC-H)

Go to step 4.11.

* If ISS is performing attitude control and ISS is not in TEA (MCC-H)
  * Perform {2.405 MODING FREE DRIFT TO CMG TA}, (SODF: MCS: NOMINAL: GNC MODING), then:
  * MCC-H ▲ ISS, Orbiter, “ISS is in Attitude Control.”
  * Go to step 4.11.

* If orbiter is performing mated attitude control
  * Perform rate damping DOCKED CONFIGURATION DAP REFERENCE, (FDF: ORB OPS, REBOOST/DAP), then:
  * Go to step 4.11.
4.11 Determining SABB Relatch Operations

Check with MCC-H.

If latches are to remain unlatched
Exit procedure.

**MCC-H** perform step 4.12 then exit procedure.

If immediately relatching

If orbiter is performing mated attitude control, proceed to step 5.5 and wait for **MCC-H** Go. Otherwise, proceed to step 5.8 and wait for **MCC-H** to latch the right blanket box.

**MCC-H** proceed to step 5.4.

If not immediately relatching
Exit procedure.

**MCC-H** perform step 4.12; then, exit procedure. Perform step 5 when ready to relatch.

4.12 Powering Off Right Blanket Box MDA

PCS

PVM: EPS: SAW XX

```
SAW XX
'RBB'
```

**sel RBB Commands**

```
SAW XX RBB Commands
'MDA'
'Power'
```

**cmd** Off – Off

\[ MDA \text{ Voltage, } V < 10 (\pm 2.8) \]

5. **RELATCHING RIGHT SOLAR ARRAY BLANKET BOX (If Necessary, to Support Operational Loads Until Array is Deployed)**

If orbiter is performing mated attitude control, proceed to step 5.5. Otherwise, proceed to step 5.8 and wait for **MCC-H** to latch the right blanket box.

**MCC-H** proceed to step 5.1.

5.1 **Verifying Temperatures are Within Nominal Ranges Prior to Latch**

PCS

PVM: EPS: SAW XX

```
SAW XX
```

Verify SAW PS Temp, deg C: -33 to 51
Verify BGA PS Temp, deg C: -33 to 51
Verify RBB MDA Temp, deg C: -54 to 48
5.2 Powering on RBB Motor Drive Assembly (MDA)

**NOTE**
MDA Slow Alert will be Nominal until MDA power is applied. Once this is done, the indication is Slow.

<table>
<thead>
<tr>
<th>SAW XX</th>
<th>RBB</th>
</tr>
</thead>
<tbody>
<tr>
<td>sel RBB Commands</td>
<td></td>
</tr>
<tr>
<td>SAW XX RBB Commands</td>
<td></td>
</tr>
<tr>
<td>'MDA' 'Power'</td>
<td></td>
</tr>
<tr>
<td>cmd On – Arm</td>
<td></td>
</tr>
<tr>
<td>cmd On – On</td>
<td></td>
</tr>
<tr>
<td>√ MDA Voltage, V: 120 to 125</td>
<td></td>
</tr>
</tbody>
</table>

5.3 Verifying SAW Right Blanket Box Configuration

| SAW XX RBB Commands |
| Verify parameters in Unlatched column in step 5.7 before executing latch command. |

5.4 Verifying Conditions are Correct for Visual Verification

**CAUTION**
Steps 5.6 and 5.8 are to be performed during insolation to support crew visual cues, use to determine correct SABB latch configuration.

Verify ISS is in insolation.

5.5 Preventing Thruster Firings

**CAUTION**
To minimize the potential for structural damage to hardware while the solar array mechanisms are in motion, nonpropulsive CMG control or Free Drift will be maintained. Anytime the latches are not in motion, thrusters may be enabled.

If ISS is performing attitude control and ISS is in TEA (MCC-H)

| MCC-H |
| MCS: MCS Configuration: Manual CMG Desat |
| Manual CMG Desat |
| \Desat Request – Inh |
| MCC-H \ ISS, Orbiter, “Desats are Inhibited.” |

Go to step 5.6.
If ISS is performing attitude control and ISS is not in TEA (MCC-H)
* Perform \(2.404\) MODIFY CMG TA TO FREE DRIFT\), (SODF:
* MCS: NOMINAL: GNC MODING), then:
* MCC-H \(\searrow\) ISS, Orbiter, “ISS is in Free Drift”
* Go to step 5.6.

C3(A6)
* If orbiter is performing mated attitude control
* Perform rate damping DOCKED CONFIGURATION DAP
  REFERENCE, (FDF: ORB OPS, REBOOST/DAP), then:
* Orbiter \(\Rightarrow\) ISS, MCC-H, “Orbiter is in Free Drift.”
* Go to step 5.8 and wait for MCC-H to latch the right blanket box.
* MCC-H, go to step 5.6.

5.6 Latching SAW Right Blanket Box (Engage High Tension Mode)

**CAUTION**

Confirm no crew exercise or Max EVA loads before proceeding.

Verify ISS is in insolation.

**MCC-H** \(\searrow\) ISS, Orbiter, “Ready to latch the right blanket box.”

**NOTE**

Upon successful Latch commanding, the MDA current will increase (0.2 to 3.0 amps) and the Slow Alert will go to Nominal during transition, then return to Slow. Once power is removed from the MDA, the Slow Alert will indicate Nominal.

PCS

PVM: EPS: SAW XX

\[
\text{SAW XX}
\]

‘RBB’

sel RBB Commands

\[
\text{SAW XX RBB Commands}
\]

‘RBB’
1.3.450 SAW XX SABB INITIAL UNLATCH
(EPS/E12 - ALL/FIN 1) Page 24 of 26 pages

**cmd** Latch – Arm
**cmd** Latch – Latch (Be ready to visually monitor latch motion and check parameters in step 5.7 before sending this command. Latch nominally takes 14 seconds to complete.)

5.7 Monitoring RBB Latch Parameters During Latch (Approximately 14 Seconds)
Refer to Table 5 for RBB parameters.

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Perform a visual verification prior to, during, and at the completion of each blanket box unlatch operation. Monitor for any obvious anomalies and verify blanket box latching operation.</td>
</tr>
<tr>
<td>2. SABB limit switches are sensitive to thermal conditions and may indicate inaccurate values during eclipse and the first 15 minutes of insolation.</td>
</tr>
</tbody>
</table>

### Table 5. RBB Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unlatched→</th>
<th>Transition→ Approximately 14 seconds</th>
<th>Latched</th>
</tr>
</thead>
<tbody>
<tr>
<td>RBB SW 01,02 Pin Released</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>RBB SW 01,02 Latched</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>RBB SW 01,02 Unlatched</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>MDA Slow Alert</td>
<td>Slow</td>
<td>Nominal</td>
<td>Slow</td>
</tr>
<tr>
<td>MDA Voltage, V</td>
<td>120 to 125</td>
<td>120 to 125</td>
<td>120 to 125</td>
</tr>
<tr>
<td>MDA Temp, deg C</td>
<td>-54 to 48</td>
<td>-54 to 48</td>
<td>-54 to 48</td>
</tr>
<tr>
<td>MDA Over Temp Trip</td>
<td>blank</td>
<td>blank</td>
<td>blank</td>
</tr>
<tr>
<td>MDA Current, A</td>
<td>~0.10 (±0.4)</td>
<td>0.20 to 3.00 (±0.4)</td>
<td>~0.10 (±0.4)</td>
</tr>
<tr>
<td>MDA Over Current Trip</td>
<td>blank</td>
<td>blank</td>
<td>blank</td>
</tr>
</tbody>
</table>

******************************************************************************
* If one Latched or Unlatched or Pin Released limit switch fails
* Confirm configuration visually and notify MCC-H before proceeding.
* (SABB limit switch status that would restrict Mast commanding has already been overridden in the 1.3.400 ECU XX Activation procedure.)
* *
* If two Latched or Unlatched or Pin Released limit switches fail
* Perform steps 5.8 and 5.9 (if orbiter is performing attitude control), then notify MCC-H before proceeding.
******************************************************************************
5.8 Performing Visual Verification Via Cameras
Verify Latch Position (four of eight) – Latched (tensioned position)
Refer to Figure 4 in step 3.8.

ISS ↓ MCC-H, “We confirm, the right blanket box is latched.”

MCC-H ↑ ISS, “We confirm nominal latch.”

If orbiter is performing mated attitude control, proceed to step 5.9; otherwise, exit procedure.

MCC-H proceed to step 5.9.

*******************************************************************************
* If Latch sequence is not successful, notify MCC-H before proceeding.
* *
* If MCC-H unavailable
* Perform {3.193 SAW XX FAILURE TO LATCH (TENSION) SABB REMOTELY} (SODF: EPS: MALFUNCTION: PRIMARY POWER), then:
*******************************************************************************

5.9 Configuring for Nominal Attitude Control

MCC-H
If ISS is performing attitude control and ISS is in TEA (MCC-H)
Go to step 5.10.

*******************************************************************************
* If ISS is performing attitude control and ISS is not in TEA (MCC-H)
* Perform {2.405 MODING FREE DRIFT TO CMG TA}, (SODF: MCS: NOMINAL: GNC MODING), then:
* *
* MCC-H ↑ ISS, Orbiter, “ISS is in Attitude Control.”
* *
* Go to step 5.10.
*******************************************************************************

*******************************************************************************
C3(A6)
* If orbiter is performing mated attitude control
* Perform rate damping DOCKED CONFIGURATION DAP REFERENCE, (FDF: ORB OPS, REBOOST/DAP), then:
* *
* Exit procedure.
* *
* MCC-H proceed to step 5.10.
*******************************************************************************
5.10 Powering Off Right Blanket Box MDA

PCS

PVM: EPS: SAW XX

SAW XX

'RBB'

Select RBB Commands

SAW XX RBB Commands

'MDA'

'Power'

cmd Off – Off

√ MDA Voltage, V: < 10 (±2.8)

MCC-H exit procedure.

6. UNLATCHING SABBs AGAIN PRIOR TO SAW XX DEPLOY (If Necessary)

WARNING

Verify EVA crew is clear of SAW XX SABB mechanisms before proceeding.

NOTE

The BRS Pin status can be ignored. The pins have already been released. Any BRS Pin limit switch failures will be overridden in step 9.3 of the 1.3.452 SAW XX Deploy procedure.

Perform steps 2 and 4 of this procedure. >>
OBJECTIVE:
This procedure supports the initial deploy of a single USOS Solar Array Wing (SAW) and it is applicable to all arrays. A unique solar array thermal conditioning attitude is required for initial deploy operations. This procedure also supports redeploy of an array previously retracted to support Sequential Shunt Unit (SSU) Remove and Replace (R&R) activities. Solar array redeployment can be performed in any attitude that supports the visual verification requirements. Redeploy of the P6 arrays after the P6 truss is relocated, should be treated as an initial deploy for this procedure.

NOTE
1. For initial solar array deployments, this procedure assumes that the Solar Array Blanket Boxes (SABBs) are unlatched and the associated Beta Gimbal Assembly (BGA) is locked. If the SABBs are not unlatched, refer to {1.3.450 SAW XX SABB INITIAL UNLATCH}, step 6 (SODF: EPS: ACTIVATION AND CHECKOUT: CHANNEL ACTIVATION). If the BGA is not locked, refer to {2.106 PVM CONFIGURE BGA XX TO SAFE/LOCK MODE}, all (SODF: EPS: NOMINAL: PRIMARY POWER SYSTEM).

2. Crew will be primary for performing steps 12.3, 12.7, 12.9, 13.8, 14.8, 15.3, 15.6 to 15.9, 17.3, 17.6 to 17.7, 17.9, 17.10. MCC-H will be primary for performing all remaining steps.

   Overview of Crew Steps for SAW Deploy
   1. Deploy 1 Bay of Mast, then stop deploy.
   2. Latch Left Blanket Box (LBB) and Right Blanket Box (RBB) for high tension deploy.
   3. Deploy Mast to 49%, then stop deploy.
   4. Thermal condition for 24 to 30 minutes.
   5. Complete Mast deploy.

3. For redeploy of a solar array after an SSU R&R, this procedure assumes the array is fully retracted with the latches in high tension position, the SABBs are physically unlatched, and the associated BGA is locked. It also assumes no orbiter is present. Perform steps 1 to 4, 5.4, 6 to 9.1, 9.3 to 12, 17 to 19, and 20.2.

4. Refer to this procedure for all applicable SAWs. Refer to Table 1 for PVM power channel connectivity.
### Table 1. PVM Connectivity

<table>
<thead>
<tr>
<th>PVM</th>
<th>XX</th>
<th>YY</th>
</tr>
</thead>
<tbody>
<tr>
<td>S4</td>
<td>1A</td>
<td>3A</td>
</tr>
<tr>
<td>S4</td>
<td>3A</td>
<td>1A</td>
</tr>
<tr>
<td>S6</td>
<td>1B</td>
<td>3B</td>
</tr>
<tr>
<td>S6</td>
<td>3B</td>
<td>1B</td>
</tr>
<tr>
<td>P4</td>
<td>2A</td>
<td>4A</td>
</tr>
<tr>
<td>P4</td>
<td>4A</td>
<td>2A</td>
</tr>
<tr>
<td>P6</td>
<td>2B</td>
<td>4B</td>
</tr>
<tr>
<td>P6</td>
<td>4B</td>
<td>2B</td>
</tr>
</tbody>
</table>

---

**CAUTION**

Steps that involve mechanical motion (e.g. Latch, Unlatch, Deploy, Retract) of the SAW hardware, must

1. Be performed during insolation, to support crew visual cues.
2. Be performed with ISS and orbiter thrusters inhibited to avoid damage to solar array mechanisms.

---

1. **VERIFYING SARJ CONFIGURATION**

**CAUTION**

1. If SARJ is not in correct position, there is a risk of P4(S4) solar arrays contacting the P6 SAW 4B(2B) array while P6 is attached to the Z1 truss and the SAW 4B(2B) is deployed. In which case, both the P6 and P4(S4) solar arrays could sustain damage.

2. The SARJ nearest the SAW to be deployed, must be stopped and locked. The SARJ farthest from the SAW to be deployed, can continue to be rotated. These configurations are required to minimize dynamic loading on the array and to support visual verification requirements.

For SARJ nearest the SAW to be deployed

**PCS**

**P4 (S4): EPS: Port (Stbd) SARJ**

Verify Position, deg: 0.0  (200 deg if redeploying 2A or 4B; 20 deg if redeploying 2B or 4A; 160 deg if redeploying 3A or 1B; 340 deg if redeploying 3B or 1A after an SSU R&R, this assumes P6 is on the main truss.)

Verify DLA 1(2) Position – Locked
For SARJ farthest from the SAW to be deployed  
P4 (S4): EPS: Port (Stbd) SARJ  
Port (Stbd) SARJ  
Verify DLA 1(2) Position – Engaged or Locked (No restrictions to SARJ rotation during SAW deploy.)

2. CONFIRMING SSU XX SHUNTED

CAUTION
If SSU has failed, and the SSU shunt plug is not available, do not attempt deploy. The array must remain retracted until the SSU is replaced. During insolation, there is a potential for array damage, if the SSU is not installed and the array is deployed.

PVM: EPS: SSU XX  
SSU XX  
'SSU'  

Verify Integration Counter – incrementing  
Verify Shunt Current 1 (LBB), A: ~0.0  
Verify Shunt Current 2 (RBB), A: ~0.0  

'PVCE'  
'Error Voltage'  
Verify 1: -0.7 to 0.7 V  
Verify 2: -0.7 to 0.7 V  
Verify 3: -0.7 to 0.7 V  

'Output'  
Verify Error Bus Voltage, V: <0.6

* ************************************************************
* If SSU is not shunted, then Shunt SSU at this time  
* PVM: EPS: SSU XX  
* SSU XX  
* sel PVCE  
* SSU XX PVCE  
* 'All PVCEs Off'  
* cmd Arm  
* cmd Off  
* ************************************************************
3. **VERIFYING COMM WITH BGA CONTROLLER**
   
   **PVM: EPS: BGA XX**
   
   **BGA XX**
   
   ‘ECU XX’
   
   Verify ECU/BGA Integ Cnt – incrementing
   
4. **VERIFYING COMM WITH SAW CONTROLLER**
   
   sel SAW XX
   
   **SAW XX**
   
   ‘ECU XX’
   
   Verify ECU/SAW Integ Cnt – incrementing
   
5. **REDUCING LOAD ON SUPPORTING CHANNEL PRIOR TO SAW DEPLOY OPERATIONS**
   
   If redeploying the array after an SSU R&R
   
   Perform step 5.4; then, proceed to step 6.
   
   5.1 Verifying Which Support Channel (ZZ) is Providing Prime Power to ECU XX
   
   **NOTE**
   
   It is possible for both ECUs on a particular PVM to be powered from the same channel. This configuration will determine which channel should be powered down to support the peak power load of 580 watts.
   
   **PVM: EPS: BGA XX**
   
   **BGA XX**
   
   sel RPCM XX A RPC 01
   
   **RPCM XX A RPC 01**
   
   Verify RPC Position – Close (Verify – Cl)
   
   **BGA XX**
   
   sel RPCM YY A RPC 02
   
   **RPCM YY A RPC 02**
   
   Verify RPC Position – Close (Verify – Cl)
If ECU XX is receiving power from one closed RPC, use Table 2 to determine which support channel is affected.

If both RPCs, providing input power to ECU XX, are closed, RPCM XX A and RPCM YY A input current must be used to determine which source is providing prime power to ECU XX. Once this is determined, use Table 2 to determine which support channel is affected.

NOTE
Table 2 provides expected support channel connectivity. A support channel provides initial power to the channel being activated until the SAW is deployed and the batteries are charged (e.g., Ch 4B supports Ch 4A until Ch 4A is fully activated). If redeploying the array after an SSU R&R, confirm support channel with MCC-H.

Table 2. Support Power Channel Connectivity

<table>
<thead>
<tr>
<th>XX</th>
<th>YY</th>
<th>ZZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>3A</td>
<td>4A</td>
</tr>
<tr>
<td>3A</td>
<td>1A</td>
<td>2A</td>
</tr>
<tr>
<td>1B</td>
<td>3B</td>
<td>1A</td>
</tr>
<tr>
<td>3B</td>
<td>1B</td>
<td>3A</td>
</tr>
<tr>
<td>2A</td>
<td>4A</td>
<td>2B</td>
</tr>
<tr>
<td>4A</td>
<td>2A</td>
<td>4B</td>
</tr>
<tr>
<td>2B</td>
<td>4B</td>
<td>2A</td>
</tr>
<tr>
<td>4B</td>
<td>2B</td>
<td>4A</td>
</tr>
</tbody>
</table>

Record
RPCM XX (YY) - A, Providing Prime Power to ECU XX: _________
DDCU XX (YY) Supporting the RPCM: ______________________
Supporting Power Channel ZZ: __________________

5.2 Terminating All Battery Charging/Warming on Channel XX (Same Channel That the SAW is to be Deployed)

NOTE
1. Reducing load on the supporting power channel protects for a peak power load of 580 watts during SAW deployment operations. If unique attitude is required to support SAW thermal conditioning, load reduction also protects for power balance of the supporting channel.

2. BCDU/Battery caution messages are suppressed to prevent nuisance tones, during initial battery charging.
Confirm the following Caution messages are suppressed, where \([Y] = 1,2,3\):

- BCDU XXY Battery SOC Low Failure
- BCDU XXY Trip
- Batt XXY1(XXY2) Undervoltage Condition
- Battery XXY1(XXY2) Trip

If batteries are charging:

- PVM: EPS: Energy Storage XX
- Energy Storage XX
- ‘BCDU XXY’

Perform for BCDU XXY, where \([Y] = 1\ 2\ 3\) (as required):

- sel Conv
  - BCDU XXY Converter FI
    - ‘Converter’
      - cmd Converter Off – Arm
      - cmd Converter Off – Off (Verify – Off)
    - Fault Isolator
      - cmd Open – Arm
      - cmd Open – Open (Verify – Op)
  
- Repeat

If batteries are warming, check with MCC-H for warming status.
PVM: EPS: Energy Storage XX

Energy Storage XX

Perform for BCDU XXY, where \( [Y] = [1 2 3] \) and \( [Z] = [1 2] \) (as required)

‘BCDU XXY’

Verify Htr Sw A(B) – On (green icon)

sel Software Inhibits

BCDU XXY Software

\textbf{cmd} Batt XXYZ Htr Cntl Inhibit – Arm

\textbf{cmd} Batt XXYZ Htr Cntl Inhibit – Inhibit (Verify – Inh)

sel BCDU XXY SoftwareBU

BCDU XXY SoftwareBU

\textbf{cmd} Batt XXYZ Htr Cntl Inhibit – Arm

\textbf{cmd} Batt XXYZ Htr Cntl Inhibit – Inhibit (Verify – Inh)

‘Battery XXYZ’

sel BSCCM

Battery XXY

\textbf{cmd} Battery XXYZ Heater 1,2; Off – Arm

\textbf{cmd} Battery XXYZ Heater 1,2; Off – Off (Verify – Off)

Repeat

5.3 Powering Down ISS (As Necessary)

\begin{center}
\textbf{NOTE}
\end{center}

If a unique attitude is required to support SAW thermal conditioning, loads may be reduced to protect overall ISS energy balance.

Powerdown ISS loads so that energy balance is maintained while in the SAW Deploy attitude.
5.4 Reducing Load on DDCU XX (YY) Prior to SAW Deploy

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power can be supplied to ECU XX from DDCU XX or DDCU YY for the solar array deploy. Therefore, it may be necessary to reduce loads on the appropriate DDCU to support a peak power load of 580 watts during array deployment.</td>
</tr>
</tbody>
</table>

Verify enough margin exist on DDCU XX (YY) to support a potential peak power load of 580 watts during array deployment. Reduce load as necessary to meet this requirement.

6. VERIFYING ECU POWER SUPPLY TEMPERATURES AND VOLTAGE STATUS

PVM: EPS: BGA XX

<table>
<thead>
<tr>
<th>'ECU XX'</th>
</tr>
</thead>
</table>

Verify SAW PS Temp, deg C: -33 to 51
Verify SAW PS Voltage, V: 115 to 125
Verify BGA PS Temp, deg C: -33 to 51
Verify BGA PS Voltage, V: 115 to 125

7. VERIFYING CHANNEL MODE AND BGA MODE

| 'BGA XX' |

Verify PV Ch XX Mode, Primary PVCU – Non-Solar Tracking or Fully Commanded
Verify BGA Mode, Primary PVCU – Safe Lock (Null if BGA is still in launch configuration)

8. VERIFYING BGA STATUS

8.1 Verifying BGA Antirotation Pin Engaged

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prior to deploying the solar array, the BGAs must be prepositioned and locked in order to support thermal conditioning (warming) of the inactive surface of the solar array blankets and visual verification requirements during deployment. Thermal conditioning begins once the array has been deployed to 49%.</td>
</tr>
</tbody>
</table>

| 'BGA XX' |

Verify BGA XX Actual Angle, deg: At Required Position for SAW XX Deploy
NOTE
BGA 4B Latch 2 failed during the 5A.1 mission, this latch is unlatched and no longer used.

‘Latch 1’ or ‘Latch 2’

Verify Pin Status – Latched

Record BGA XX Actual Angle, deg: _________________
Record BGA XX Latch 1 Pin Status: _________________
Record BGA XX Latch 2 Pin Status: _________________

8.2 Inhibiting Motor Velocity Safing

NOTE
1. SCR 19659 - If the array is parked at 0 deg, motor velocity safing may be triggered due to angle oscillations between 0 and 359. Software interprets this as a large angle movement in a short time period. Inhibit motor velocity safing to prevent the RPCs supplying the ECU from being opened.

2. SCR 28128 - The following Caution messages may also be triggered if the array is commanded to 0.
‘BGA XX Observed vs Last Commanded State Discrepancy - PVM’
‘BGA XX Pointing Control Command Response Failed - PVM’

If the BGA at 0.0 (±0.5) degrees
PVM: EPS: BGA XX

BGA XX

sel Motor

BGA XX Motor
‘Velocity Limit Safing, Primary PVCU’

cmd Inhibit – Arm
cmd Inhibit – Inhibit

Verify Primary PVCU – Inh
‘Velocity Limit Safing, Backup PVCU’

cmd Inhibit – Arm
cmd Inhibit – Inhibit

Verify Backup PVCU – Inh
9. VERIFYING SAW STATUS

9.1 Verifying Initial SAW C&W Flags and MDA Data (MCC-H)
Configure for continuous Data Dump of SAW XX. To build dump
command, perform {1.230 CCS BUILD DATA DUMP COMMAND},
all (SODF: GND AVIONICS: C&DH: NOMINAL). For unique start
location addresses, refer to {5.294 EPS MDM BDT/50HZ
ADDRESS}, all (SODF: GND SYSTEMS: EPS: NOMINAL), for
SAW XX with 1 Hz Data Collection, 224 words.
If redeploying the array after an SSU R&R, go to step 9.3.

9.2 Verifying SAW Operational Ranges and Limit Switch Status

| NOTE |
| Disconnects are present in the MDA Over Temp Trip FDIR. The software implements an MDA Over Temp Trip at 77.8° C. The ECU firmware implements an MDA Over Temp Trip at 140° C. These FDIR responses remove power to the MDA. Potential damage to hardware occurs at 120° C. MDA upper limit temperatures indicated in this step are conservative. At a minimum, a 30° C mast MDA temperature increase should be protected for during mast deployment. |

sel SAW XX

SAW XX

`LBB`

| NOTE |
| SABB limit switches are sensitive to thermal conditions and may indicate inaccurate values during eclipse and the first 15 minutes of insolation. |

Verify SW01,02 Pin Released – Yes
Verify SW01,02 Latched – No
Verify SW01,02 Unlatched – Yes
Verify MDA Slow Alert – Nominal
Verify MDA Voltage: 000.0 (±2.8)
Verify MDA Temp, deg C: -54 to 48
Verify MDA Over Temp Trip – blank

`MAST`

| NOTE |
| SAW 2B SW 02 Deployed limit switch failed prior to the 4A mission, No is always indicated. |

Verify SW01,02 Retracted – Yes
Verify SW01,02 Deployed – No
Verify MDA Slow Alert – Nominal
Verify MDA Voltage: 000.0 (±2.8)
Verify MDA Temp, deg C: -54 to 48
Verify MDA Over Temp Trip – blank
'RBB'

NOTE
SABB limit switches are sensitive to thermal conditions and may indicate inaccurate values during eclipse and the first 15 minutes of insolation.

Verify SW01,02 Pin Released – Yes
Verify SW01,02 Latched – No
Verify SW01,02 Unlatched – Yes
Verify MDA Slow Alert – Nominal
Verify MDA Voltage: 000.0 (±2.8)
Verify MDA Temp, deg C: -54 to 48
Verify MDA Over Temp Trip – blank

'ECU XX'

Verify MDA Current, A: 0.00 (±0.4)
Verify MDA Over Current Trip – blank

*************************************************************************
*************************************************************************

If any MDA Temp is out of range, √MCC-H before proceeding.

NOTE
PVCU software implements an MDA Over Temp Trip at 77.8°C which will remove power from the motor.

If MCC-H unavailable and MDA Temp is greater than 48°C, inhibit MDA Over Temp Safing.

‘ECU XX’

sel SAW Software Inhibits

SAW XX Software Inhibits

sel SAW XX Temp Safing

SAW XX Temp Safing

‘LBB (RBB)(Mast) Over Temp Safing’

‘Primary PVCU’

cmd Inhibit – Arm

cmd Inhibit – Inhibit

√Over Temp Safing – Inh

‘Backup PVCU’

cmd Inhibit – Arm

cmd Inhibit – Inhibit

√Over Temp Safing – Inh

*************************************************************************
9.3 Verifying SABB Limit Switch Override

NOTE
The following steps must be performed nominally if the mast will be deployed or retracted while an SABB is in an undetermined state. These steps will also verify the override of a failed Latched, Unlatched, or Pin Released limit switch.

PVM: EPS: SAW XX

SAW XX
‘ECU XX’

sel SAW Software Inhibits

SAW XX Software Inhibits
‘Deploy Reject’

√Deploy Reject – Inh (Allows deploy or retract commands when SABB state is undetermined)

9.4 Verifying Mast Limit Switch Override

NOTE
These steps must be performed nominally if the SABBs are latched or unlatched or if the BGA may be moved while the mast is in an undetermined (partially deployed) state. These steps will also be performed to verify the override of a failed limit switch (e.g., SAW 2B Sw 02 Deployed Limit Switch).

PVM: EPS: SAW XX

SAW XX
‘ECU XX’

sel SAW Software Inhibits

SAW XX Software Inhibits
‘Latch Reject’

√Latch Reject – Inh (Allows SABB unlatch or latch commands when mast state is undetermined)

PVM: EPS: BGA XX

BGA XX

sel BGA Software Inhibits

BGA XX Software Inhibits
‘SAW Deployment’
‘Primary PVCU’
√SAW Deployment – Ena (Allows BGA to be operated when SAW mast is in an undetermined state)

'Backup PVCU'

√SAW Deployment – Ena

10. **VERIFYING MDA HI TEMP REJECT FUNCTION INHIBITED**

PVM: EPS: SAW XX

SAW XX

sel SAW Software Inhibits

SAW XX Software Inhibits

sel SAW XX Temp Safing

SAW XX Temp Safing

'Hi Temp Reject'

√Hi Temp Reject – Inh (Allows unlatch or latch and deploy or retract commands when MDA Temp >30°C)

11. **VERIFYING MDA SAFING CONFIGURATION**

sel SAW Software Inhibits

SAW XX Software Inhibits

√Config Complete MDA Off Safing, Primary PVCU – Ena

√Config Complete MDA Off Safing, Backup PVCU – Ena

(Turns motor off upon limit switch contact, if MDA current above limit.)

√Limit Sw Turnoff Function – Ena

(Stops motor upon limit switch contact but does not turn motor off)

sel SAW XX Motor Stall Safing

SAW XX Motor Stall Safing

√Motor Stall Safing, Primary PVCU – Ena

√Motor Stall Safing, Backup PVCU – Ena

(Turns motor off if Slow is indicated when between limit switches, and if MDA current above limit.)

If deploying both arrays on a PVM the same day
   Perform steps 1 to 11 for both channels before proceeding to step 12.

If redeploying the array after an SSU R&R
   Go to step 17.
12. DEPLOYING FIRST BAY OF SOLAR ARRAY

**WARNING**

All SABB initial unlatch activities (i.e., all BRS pins released and SABBs are unlatched) must be completed prior to performing the following steps. Verify EVA crew is clear of SAW mechanisms before proceeding.

**MCC-H** † ISS, “Steps 1 to 11 of the Solar Array Deploy procedure have been completed. Proceed to step 12.3 and confirm correct camera and RWS configuration for solar array XX deploy.”

**NOTE**

Overview of Crew Steps for SAW Deploy

1. Deploy 1 Bay of Mast, then stop deploy.
2. Latch LBB and RBB for high tension deploy.
3. Deploy Mast to 49%, then stop deploy.
4. Thermal condition for 24 to 30 minutes.
5. Complete Mast deploy.

12.1 Verifying Temperatures are Within Nominal Ranges Prior to SAW Deploy

PVM: EPS: SAW XX

<table>
<thead>
<tr>
<th>SAW XX</th>
</tr>
</thead>
</table>

Verify SAW PS Temp, deg C: -33 to 51
Verify BGA PS Temp, deg C: -33 to 51
Verify Mast MDA Temp, deg C: -54 to 48

12.2 Powering on Mast Motor Drive Assembly (MDA)

**NOTE**

MDA Slow alert will be Nominal until MDA power is applied. Once this is done, the indication is Slow.

<table>
<thead>
<tr>
<th>SAW XX</th>
</tr>
</thead>
</table>

‘Mast’

sel Mast Commands

<table>
<thead>
<tr>
<th>SAW XX Mast Commands</th>
</tr>
</thead>
</table>

‘MDA’

‘Power’

<table>
<thead>
<tr>
<th>cmd</th>
</tr>
</thead>
</table>

On – Arm

<table>
<thead>
<tr>
<th>cmd</th>
</tr>
</thead>
</table>

On – On

\nMDA Voltage, V: 120 to 125
\nMDA Current, A: \(~0.10 \pm0.4\)
\nMDA Slow Alert – Slow
12.3 Verifying Camera Configuration

ISS must be in insolation to perform this verification.

NOTE

Perform a visual verification prior to, during, and at the completion of the mast deploy operation. This ensures all launch restraints have been removed, minimizes the risk of potential collision hazards, and monitor for any obvious anomalies. Total number of visible Mast Bays is 31.5, 1 Bay is rigid batten to rigid batten.

Verify camera configuration correct for solar array deployment before proceeding.

If orbiter is performing mated attitude control, proceed to step 12.6. Otherwise, proceed to step 12.7 and wait for MCC-H GO for 1 Mast Bay deployment.

MCC-H proceed to step 12.4.

12.4 Verifying Initial SAW Mast Configuration

NOTE

SAW 2B SW 02 Deployed limit switch failed prior to the 4A mission, No is always indicated.

SAW XX Mast Commands

√Mast SW01,SW02 Retracted – Yes
√Mast SW01,SW02 Deployed – No

12.5 Verifying Conditions are Correct for Visual Verification

CAUTION

Steps 12.7 and 12.9 are to be performed during insolation to support crew visual cues used to determine when to abort the solar array deployment.

Verify ISS is in insolation.
12.6 Preventing Thruster Firings

**CAUTION**
To minimize the potential for structural damage to hardware while the solar array mechanisms are in motion, nonpropulsive CMG control or Free Drift will be maintained. At any time array deployment is stopped or aborted, thrusters may be enabled.

If ISS is performing attitude control and ISS is in TEA (MCC-H)

**MCC-H**
MCS: MCS Configuration: Manual CMG Desat

√Desat Request – Inh

MCC-H ↑ ISS, Orbiter, “Desats are Inhibited.”

Go to step 12.7.

If ISS is performing attitude control and ISS is not in TEA (MCC-H)

Perform [2.404 MODING CMG TA TO FREE DRIFT], (SODF: MCS: NOMINAL: GNC MODING), then:

MCC-H ↑ ISS, Orbiter, “ISS is in Free Drift.”

Go to step 12.7.

C3(A6) If orbiter is performing mated attitude control

DAP: FREE

Orbiter ⇒ ISS, MCC-H, “Orbiter is in Free Drift.”

Go to step 12.7. Notify MCC-H before sending the Deploy command.

12.7 Deploying First Bay of SAW

**CAUTION**
Confirm no crew exercise or Max EVA loads before proceeding.

**NOTE**
Upon successful deploy commanding, the MDA current will increase (0.2 to 3.0 amps) and the Slow alert will go to Nominal during transition. Once power is removed from the MDA, the Slow alert will indicate Nominal.

MCC-H ↑ ISS, Orbiter, “Crew is GO to Deploy Mast 1 Bay.”
PCS

PVM: EPS: SAW XX

SAW XX

'Mast'

sel Mast Commands

SAW XX Mast Commands

'Mast'

**cmd** Deploy – Arm

**cmd** Deploy – Deploy

* ********************************************************************************************
*   If at any time during the array deploy the blanket box begins to distort
*   'Mast'
*   *
*   **cmd** Abort – Abort
*   *
*   **MCC-H** before proceeding.
* ********************************************************************************************

Wait approximately 20 seconds (~1 Bay).

'Mast'

**cmd** Abort – Abort

If orbiter is performing mated attitude control, proceed to step 12.8. Otherwise, proceed to step 12.9.

**NOTE**

1. The Mast - Abort command removes power from the MDA.
2. SAW 2B SW 02 Deployed limit switch failed prior to the 4A mission, No is always indicated.

√ MDA Voltage, V: <10 (±2.8)
√ Mast SW01,SW02 Retracted – No
√ Mast SW01,SW02 Deployed – No

**MCC-H** proceed to step 12.8.
12.8 Configuring for Nominal Attitude Control

**MCC-H**

If ISS is performing attitude control and ISS is in TEA (**MCC-H**)  
Go to step 12.9.

If ISS is performing attitude control and ISS is not in TEA (**MCC-H**)  
Perform [2.405 MODING FREE DRIFT TO CMG TA] (SODF:  
MCS: NOMINAL: GNC MODING), then:

**MCC-H** ↑ ISS, Orbiter, “ISS is in Attitude Control.”

Go to step 12.9.

**C3(A6)**

If orbiter is performing mated attitude control  
Perform rate damping DOCKED CONFIGURATION DAP  
REFERENCE, (FDF: ORB OPS, REBOOST/DAP), then:

Go to step 12.9.

12.9 Performing Visual Verification Via Cameras

Verify blanket box covers clear of latch hooks (left and right SABB).  
Verify number of visible mast bays ~1.

**ISS** ↓ **MCC-H**, “We confirm 1 mast bay deployed.”

**MCC-H** ↑ **ISS**, “We confirm nominal mast deployment.”

If orbiter is performing mated attitude control, proceed to step 13.5. Otherwise, proceed to step 13.8 and wait for **MCC-H** to latch the left blanket box.

**MCC-H** proceed to step 13.1.

*******************************************************************************
* If deploy sequence is not successful, √**MCC-H** before proceeding.
* If **MCC-H** unavailable, perform {3.191 SAW XX FAILURE TO  
EXPAND MAST REMOTELY}, all (SODF: EPS:  
MALFUNCTION: PRIMARY POWER SYSTEM), then:  
*******************************************************************************
13. LATCHING LEFT SOLAR ARRAY BLANKET BOX (ENGAGING HIGH TENSION MODE)

13.1 Verifying Temperatures are Within Nominal Ranges Prior to SAW Deploy

PCS
PVM: EPS: SAW XX
SAW XX

Verify SAW PS Temp, deg C: -33 to 51
Verify BGA PS Temp, deg C: -33 to 51
Verify LBB MDA Temp, deg C: -54 to 48

13.2 Powering On LBB Motor Drive Assembly (MDA)

NOTE
MDA Slow alert will be Nominal until MDA power is applied. Once this is done, the indication is Slow.

SAW XX
‘LBB’

sel LBB Commands

SAW XX LBB Commands
‘MDA’
‘Power’

cmd On – Arm
cmd On – On

√MDA Voltage, V: 120 to 125

13.3 Verifying SAW Left Blanket Box Configuration
Verify parameters in UNLATCHED column in step 13.7 before executing latch command.

13.4 Verifying Conditions are Correct for Visual Verification

CAUTION
Steps 13.6 and 13.8 are to be performed during insolation, to support crew visual cues use to determine correct SABB latch configuration.

Verify ISS is in insolation.
13.5 Preventing Thruster Firings

**CAUTION**

To minimize the potential for structural damage to hardware while the solar array mechanisms are in motion, nonpropulsive CMG control or Free Drift will be maintained. Anytime the latches are not in motion, thrusters may be enabled.

If ISS is performing attitude control and ISS is in TEA (MCC-H)

MCS: MCS Configuration: Manual CMG Desat

Manual CMG Desat

√ Desat Request – Inh

**MCC-H** \[ ISS, Orbiter, “Desats are Inhibited.” \]

Go to step 13.6.

If ISS is performing attitude control and ISS is not in TEA (MCC-H)

Perform **[2.404 MODING CMG TA TO FREE DRIFT]** (SODF: MCS: NOMINAL: GNC MODING), then:

**MCC-H** \[ ISS, Orbiter, “ISS is in Free Drift.” \]

Go to step 13.6.

C3(A6) If orbiter is performing mated attitude control

DAP: FREE

Orbiter ⇒ ISS, **MCC-H**, “Orbiter is in Free Drift.”

Proceed to step 13.8 and wait for **MCC-H** to latch LBB.

**MCC-H** proceed to step 13.6.

13.6 Latch SAW Left Blanket Box (Engage High Tension Mode)

**CAUTION**

Confirm no crew exercise or max EVA loads before proceeding.
1. Latching the blanket box engages high tension mode (75 lbs) and provides more control over stiction between blanket panels during array deployment.

2. Upon successful Latch commanding, the Slow alert will go to Nominal during transition, then return to Slow. Once power is removed from the MDA, the Slow alert will indicate Nominal.

MCC-H ‡ ISS, Orbiter, “Ready to latch the left blanket box.”

PCS

PVM: EPS: SAW XX

SAW XX

‘LBB’

sel LBB Commands

SAW XX LBB Commands

‘LBB’

cmd Latch – Arm

cmd Latch – Latch (Be ready to visually monitor latch motion and check parameters in step 13.7 before sending this command. Latch nominally takes 14 seconds to complete.)

13.7 Monitoring LBB Latch Parameters During Latch (Approximately 14 Seconds)

Refer to Table 3.

NOTE

1. Perform a visual verification prior to, during, and at the completion of each blanket box unlatch operation. Monitor for any obvious anomalies and verify blanket box latching operation.

2. SABB limit switches are sensitive to thermal conditions and may indicate inaccurate values during eclipse and the first 15 minutes of insolation.
### Table 3. LBB Parameters

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>UNLATCHED→</th>
<th>TRANSITION→</th>
<th>LATCHED</th>
</tr>
</thead>
<tbody>
<tr>
<td>LBB SW01,02 Pin Released</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>LBB SW01,02 Latched</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>LBB SW01,02 Unlatched</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>MDA Slow Alert</td>
<td>Slow</td>
<td>Nominal</td>
<td>Slow</td>
</tr>
<tr>
<td>MDA Voltage, V</td>
<td>120 to 125</td>
<td>120 to 125</td>
<td>120 to 125</td>
</tr>
<tr>
<td>MDA Temp, deg C</td>
<td>-54 to 48</td>
<td>-54 to 48</td>
<td>-54 to 48</td>
</tr>
<tr>
<td>MDA Over Temp Trip</td>
<td>blank</td>
<td>blank</td>
<td>blank</td>
</tr>
<tr>
<td>MDA Current, A</td>
<td>~0.10 (±0.4)</td>
<td>0.20 to 3.00 (±0.4)</td>
<td>~0.10 (±0.4)</td>
</tr>
<tr>
<td>MDA Over Current Trip</td>
<td>blank</td>
<td>blank</td>
<td>blank</td>
</tr>
</tbody>
</table>

**If one Latched, Unlatched, or Pin Released limit switch fails**

* Confirm configuration visually and √MCC-H before proceeding.
* SABB limit switch status that would restrict mast commanding has already been overridden as part of 1.3.400 ECU Activation.
* If two Latched, Unlatched, or Pin Released limit switches fail
* Perform step 13.8 and 13.9 (if orbiter performing attitude control), then √MCC-H before proceeding.

**13.8 Performing Visual Verification Via Cameras**

Verify latch position (four of eight) latched (tensioned position).

ISS ↓ MCC-H, “We confirm the left blanket box is latched.”

MCC-H ↑ ISS, “We confirm nominal Latch.”

If orbiter is performing mated attitude control, proceed to step 13.9. Otherwise, proceed to step 14.8 and wait for MCC-H to latch the right blanket box.

MCC-H proceed to step 13.9.

**If latch sequence is not successful, √MCC-H before proceeding.**

* If MCC-H unavailable, perform SAW XX FAILURE TO
  LATCH (TENSION) SABB REMOTELY, all (SODF: EPS: MALFUNCTION: PRIMARY POWER SYSTEM), then:

**If one Latched, Unlatched, or Pin Released limit switch fails**

* Confirm configuration visually and √MCC-H before proceeding.
* SABB limit switch status that would restrict mast commanding has already been overridden as part of 1.3.400 ECU Activation.
* If two Latched, Unlatched, or Pin Released limit switches fail
  Perform step 13.8 and 13.9 (if orbiter performing attitude control), then √MCC-H before proceeding.

**If latch sequence is not successful, √MCC-H before proceeding.**

* If MCC-H unavailable, perform SAW XX FAILURE TO
  LATCH (TENSION) SABB REMOTELY, all (SODF: EPS: MALFUNCTION: PRIMARY POWER SYSTEM), then:
13.9 Configuring for Nominal Attitude Control

MCC-H

If ISS is performing attitude control and ISS is in TEA (MCC-H)

Go to step 13.10.

If ISS is performing attitude control and ISS is not in TEA (MCC-H)

Perform [2.405 MODING FREE DRIFT TO CMG TA] (SODF: MCS: NOMINAL: GNC MODING), then:

MCC-H ↑ ISS, Orbiter, “ISS is in Attitude Control.”

Go to step 3.10.

C3(A6)

If orbiter is performing mated attitude control

Perform rate damping DOCKED CONFIGURATION DAP REFERENCE, (FDF: ORB OPS, REBOOST/DAP), then:

If orbiter continues to perform mated attitude control, proceed to step 14.5 and wait for MCC-H Go. Otherwise, proceed to step 14.8 and wait for MCC-H to latch the right blanket box.

MCC-H proceed to step 13.10.

13.10 Powering Off Left Blanket Box MDA

PCS

PVM: EPS: SAW XX

SAW XX

‘LBB’

sel LBB Commands

SAW XX LBB Commands

‘MDA’

‘Power’

cmd Off – Off

√ MDA Voltage, V: <10 (±2.8)
14. **LATCHING RIGHT SOLAR ARRAY BLANKET BOX (ENGAGING HIGH TENSION MODE)**

14.1 Verifying Temperatures are Within Nominal Ranges Prior to SAW Deploy

PCS

PVM: EPS: SAW XX

SAW XX

Verify SAW PS Temp, deg C: -33 to 51
Verify BGA PS Temp, deg C: -33 to 51
Verify RBB MDA Temp, deg C: -54 to 48

14.2 Powering On RBB Motor Drive Assembly (MDA)

**NOTE**

MDA Slow alert will be Nominal until MDA power is applied. Once this is done, the indication is Slow.

SAW XX

‘RBB’

sel RBB Commands

SAW XX RBB Commands

‘MDA’

‘Power’

**cmd** On – Arm

**cmd** On – On

√ MDA Voltage, V: 120 to 125

14.3 Verifying SAW Right Blanket Box Configuration

Verify parameters in UNLATCHED column in step 14.7 before executing latch command.

14.4 Verifying Conditions are Correct for Visual Verification

**CAUTION**

Steps 14.6 and 14.8 are to be performed during insolation, to support crew visual cues use to determine correct SABB latch configuration.

Verify ISS is in insolation.
14.5 Preventing Thruster Firings

**CAUTION**

To minimize the potential for structural damage to hardware while the solar array mechanisms are in motion, nonpropulsive CMG control or Free Drift will be maintained. Anytime the latches are not in motion, thrusters may be enabled.

If ISS is performing attitude control and ISS is in TEA (MCC-H)

MCC-H

MCS: MCS Configuration: Manual CMG Desat

| Manual CMG Desat |

√Desat Request – Inh

MCC-H ‡ ISS, Orbiter, “Desats are Inhibited.”

Go to step 14.6.

If ISS is performing attitude control and ISS is not in TEA (MCC-H)

Perform {2.404 MODING CMG TA TO FREE DRIFT} (SODF: MCS: NOMINAL: GNC MODING), then:

MCC-H ‡ ISS, Orbiter, “ISS is in Free Drift.”

Go to step 14.6.

C3(A6) If orbiter is performing mated attitude control

DAP: FREE

Orbiter ⇒ ISS, MCC-H, “Orbiter is in Free Drift.”

Proceed to step 14.8 and wait for MCC-H to latch RBB.

MCC-H proceed to step 14.6.

14.6 Latching SAW Right Blanket Box (Engage High Tension Mode)

**CAUTION**

Confirm no crew exercise or Max EVA loads before proceeding.
1. Latching the blanket box engages high tension mode (75 lbs) and provides more control over stiction between blanket panels during array deployment.

2. Upon successful latch commanding, the Slow alert will go to Nominal during transition, then return to Slow. Once power is removed from the MDA, the Slow alert will indicate Nominal.

MCC-H † ISS, Orbiter, “Ready to latch the right blanket box.”

PCS
PVM: EPS: SAW XX

SAW XX

‘RBB’

sel RBB Commands

SAW XX RBB Commands

‘RBB’

cmd Latch – Arm

cmd Latch – Latch (Be ready to visually monitor latch motion and check parameters in step 14.7 before sending this command. Latch nominally takes 14 seconds to complete.)

14.7 Monitoring RBB latch parameters during latch (approximately 14 seconds)

NOTE

1. Perform a visual verification prior to, during, and at the completion of each blanket box unlatch operation. Monitor for any obvious anomalies and verify blanket box latching operation.

2. SABB limit switches are sensitive to thermal conditions and may indicate inaccurate values during eclipse and the first 15 minutes of insolation.
Table 4. RBB Parameters

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>UNLATCHED→</th>
<th>TRANSITION→</th>
<th>LATCHED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Approximately 14 seconds</td>
<td></td>
</tr>
<tr>
<td>RBB SW01,02 Pin Released</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>RBB SW01,02 Latched</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>RBB SW01,02 Unlatched</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>MDA Slow Alert</td>
<td>Slow</td>
<td>Nominal</td>
<td>Slow</td>
</tr>
<tr>
<td>MDA Voltage, V</td>
<td>120 to 125</td>
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<td>MDA Temp, deg C</td>
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<td>MDA Over Temp Trip</td>
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<td>~0.10 (±0.4)</td>
</tr>
<tr>
<td>MDA Over Current Trip</td>
<td>blank</td>
<td>blank</td>
<td>blank</td>
</tr>
</tbody>
</table>

**************************************************************************
* If one Latched, Unlatched, or Pin Released limit switch fails
  * Confirm configuration visually and \(\sqrt{\text{MCC-H}}\) before proceeding.
  * SABB limit switch status that would restrict mast commanding has already been overridden as part of 1.3.400 ECU Activation.

* If two Latched, Unlatched, or Pin Released limit switches fail
  * Perform step 14.8 and 14.9 (if orbiter performing attitude control), then \(\sqrt{\text{MCC-H}}\) before proceeding.

**************************************************************************

14.8 Performing Visual Verification Via Cameras
Verify latch position (four of eight) latched (tensioned position).

ISS \(\downarrow\) **MCC-H**, “We confirm the right blanket box is latched.”

**MCC-H** \(\uparrow\) ISS, “We confirm nominal latch.”

If orbiter is performing mated attitude control, proceed to step 14.9. Otherwise, proceed to step 15.4.

**MCC-H** proceed to step 14.9.

**************************************************************************
* If latch sequence is not successful, \(\sqrt{\text{MCC-H}}\) before proceeding.

* If **MCC-H** unavailable, perform {3.193 SAW XX FAILURE TO LATCH (TENSION) SABB REMOTELY}, all (SODF: EPS: MALFUNCTION: PRIMARY POWER SYSTEM), then:

**************************************************************************
14.9 Configuring for Nominal Attitude Control

MCC-H

If ISS is performing attitude control and ISS is in TEA (MCC-H)

Go to step 14.10.

If ISS is performing attitude control and ISS is not in TEA (MCC-H)

Perform [2.405 MODING FREE DRIFT TO CMG TA] (SODF: MCS: NOMINAL: GNC MODING), then:

MCC-H ↑ ISS, Orbiter, “ISS is in Attitude Control.”

Go to step 14.10.

C3(A6)

If orbiter is performing mated attitude control

Perform rate damping DOCKED CONFIGURATION DAP REFERENCE, (FDF: ORB OPS, REBOOST/DAP), then:

Proceed to step 15.3.

MCC-H proceed to step 14.10.

14.10 Powering Off Right Blanket Box MDA

PCS

PVM: EPS: SAW XX

SAW XX

‘RBB’

sel RBB Commands

[SAW XX RBB Commands]

‘MDA’

‘Power’

cmd Off – Off

√MDA Voltage, V: <10 (±2.8)

If deploying both arrays on a PVM the same day

Perform steps 12 to 14 for both arrays before proceeding to step 15.

Once both arrays have one bay deployed and both SABBs are in the high tension mode (Latched)

Proceed to step 15.3.

MCC-H proceed to step 15.1.

If deploying only one array

Proceed to step 15.3.

MCC-H proceed to step 15.1.
15. DEPLOYING 49 % OF SOLAR ARRAY

CAUTION

1. If unable to engage high tension mode (latching both LBB and RBB) then complete (100 %), deploy will not be attempted. Blanket stiction force will exceed capability of low tension mode causing a repeat of the 4A mission deployment anomaly. Due to increased storage time for subsequent wings, potentially greater consequences may result. The array may be deployed to 49 % in low tension mode if a SABB MDA failure is at fault, and EVA can later override it. Operations are restricted (as if array is partially deployed) with a fully deployed yet untensioned array.

2. ISS and orbiter attitude control is restricted from the time an array is deployed more than 1 bay (step 15) to when the array is feathered (step 18). The orbiter must maintain attitude control when deploying an array in the aft direction and ISS must maintain attitude control when deploying an array in the forward direction. This is to prevent damaging the array with thruster plumes.

15.1 Verifying Temperatures are Within Nominal Ranges Prior to SAW Deploy

PVM: EPS: SAW XX

Verify SAW PS Temp, deg C: -33 to 51
Verify BGA PS Temp, deg C: -33 to 51
Verify Mast MDA Temp, deg C: -54 to 48

15.2 Powering On Mast Motor Drive Assembly (MDA)

NOTE

1. Mast MDA temperatures may be high due to direct sunlight in deploy configuration. MDA Over Temp Trip occurs at 77.8°C. At a minimum, a 30°C mast MDA temperature increase should be protected for during mast deployment. Delay MDA activation, until just prior to deploy time to minimize temperature increase if necessary.

2. MDA Slow alert will be Nominal until MDA power is applied. Once this is done, the indication is Slow.

SAW XX

‘Mast’

sel Mast Commands

SAW XX Mast Commands

‘MDA’
‘Power’

cmd On – Arm
15.3 Verifying Camera Configuration
ISS must be in insolation to perform this verification.

NOTE
Perform a visual verification prior to, during, and at the completion of the mast deploy operation to minimize the risk of potential collision hazards, monitor for any obvious anomalies, and to verify solar array deployment. Total number of visible Mast Bays is 31.5, 1 Bay is rigid batten to rigid batten.

Verify camera configuration correct for solar array deployment before proceeding.

If orbiter is performing mated attitude control, proceed to step 15.6. Otherwise, proceed to step 15.7 and wait for MCC-H GO to deploy 15.5 (49 %) Mast Bays.

15.4 Verifying Initial SAW Mast Configuration

NOTE
SAW 2B SW 02 Deployed limit switch failed prior to the 4A mission, No is always indicated.

SAW XX Mast Commands

√Mast SW01, SW02 Retracted – No
√Mast SW01, SW02 Deployed – No

15.5 Verifying Conditions are Correct for Visual Verification

CAUTION
Steps 15.7 and 15.9 must be performed during insolation to support crew visual cues used to determine when to abort the solar array deployment.

Verify ISS is in insolation.
15.6 Preventing Thruster Firings

**CAUTION**

To minimize the potential for structural damage to hardware while the solar array mechanisms are in motion, nonpropulsive CMG control or Free Drift will be maintained. At any time array deployment is stopped or aborted, thrusters may be enabled.

If ISS is performing attitude control and ISS is in TEA (MCC-H)

- **MCC-H**
  - MCS: MCS Configuration: Manual CMG Desat
  - Manual CMG Desat

  √Desat Request – Inh

  **MCC-H** \(\uparrow\) ISS, Orbiter, “Desats are Inhibited.”

  Go to step 15.7.

If ISS is performing attitude control and ISS is not in TEA (MCC-H)

Perform [2.404 MODING CMG TA TO FREE DRIFT] (SODF: MCS: NOMINAL: GNC MODING), then:

- **MCC-H** \(\uparrow\) ISS, Orbiter, “ISS is in Free Drift.”

  Go to step 15.7.

C3(A6) If orbiter is performing mated attitude control

- DAP: FREE

  Orbiter \(\Rightarrow\) ISS, **MCC-H**, “Orbiter is in Free Drift.”

  Then go to step 15.7, notify **MCC-H** before sending the deploy command.

15.7 Deploying 49 % of SAW (Approximately 15.5 Bays Visible)

**WARNING**

If deploying a solar array during EVA operations, confirm EVA crew outside of area that could be subject to solar array structural collapse.
CAUTION

1. Confirm no crew exercise or maximum EVA loads before proceeding.

2. If the mast is in motion and the deploy to 49% will not be completed before entering eclipse, the deploy must be stopped using the Mast – Abort command upon entering eclipse due to loss of visual insight. Once the deploy is stopped, the crew will perform step 15.8, if the orbiter is performing attitude control, then contact MCC-H. Otherwise, crew will contact MCC-H before proceeding.

NOTE

Upon successful deploy commanding, the MDA current will increase (0.2 to 3.0 amps) and the Slow alert will go to Nominal during transition. Once power is removed from the MDA, the Slow alert will indicate Nominal.

PCS

PVM: EPS: SAW XX

SAW XX

‘Mast’

sel Mast Commands

SAW XX Mast Commands

‘Mast’

cmd Deploy – Arm

cmd Deploy – Deploy

Monitor RBB and LBB inboard tension mechanisms and tension bars for motion.

* If tension mechanism motion is indicated, immediately abort the deploy.

* While the mast is being deployed, the tension mechanisms may experience small oscillations. This is acceptable and not cause for an abort.

* ‘Mast’

* cmd Abort – Abort

* √MCC-H before proceeding.

CAUTION

* Panel forces are higher than expected and the likelihood of the tension bar rising is increased. Problem may not be due to stiction.
Wait approximately 5 minutes (confirm 15.5 Bays are visible).

‘Mast’

**cmd** Abort – Abort

Record Time Mast – Abort command sent: ___________________ GMT

If orbiter is performing attitude control, proceed to step 15.8.
Otherwise, proceed to step 15.9.

---

**NOTE**

1. The Mast – Abort command removes power from the MDA.

2. SAW 2B SW 02 Deployed limit switch failed prior to the 4A mission, No is always indicated.

\^ MDA Voltage, V: <10 (±2.8)
\^ Mast SW01,SW02 Retracted – No
\^ Mast SW01,SW02 Deployed – No

---

### 15.8 Configuring for Nominal Attitude Control

**MCC-H**

If ISS is performing attitude control and ISS is in TEA (**MCC-H**)  
Go to step 15.9.

If ISS is performing attitude control and ISS is not in TEA (**MCC-H**)  
Perform [2.405 MODING FREE DRIFT TO CMG TA] (SODF: MCS: NOMINAL: GNC MODING), then:

**MCC-H** \^ ISS, Orbiter, “ISS is in Attitude Control.”

Go to step 15.9.

**C3(A6)**

If orbiter is performing mated attitude control  
Perform rate damping DOCKED CONFIGURATION DAP REFERENCE, (FDF: ORB OPS, REBOOST/DAP), then:

Go to step 15.9.

---

### 15.9 Performing Visual Verification Via Cameras

Verify Number of visible mast bays: 15.5

Verify LBB blanket alignment and condition.
Verify LBB inboard tension mechanism visual indicator aligned.
Verify LBB tension bar resting on blanket box sill.

Verify RBB blanket alignment and condition.
Verify RBB inboard tension mechanism visual indicator aligned.
Verify RBB tension bar resting on blanket box sill.
ISS $\downarrow$ MCC-H, “We confirm 15.5 Mast Bays deployed.”

MCC-H $\uparrow$ ISS, “We confirm nominal deploy to 49 %.”

Proceed to step 17.3.

MCC-H proceed to step 16.

******************************************************************************
* If Deploy sequence is not successful, √MCC-H before proceeding.
* * If MCC-H unavailable, perform {3.191 SAW XX FAILURE TO
* EXTEND MAST REMOTELY}, all (SODF: EPS: MALFUNCTION:
* PRIMARY POWER SYSTEM), then:
* *
******************************************************************************

MCC-H 16. DETERMINING WHEN TO CONTINUE SOLAR ARRAY DEPLOYMENT

**CAUTION**

A Sun incidence angle of 90 degrees ($\pm$30), on the inactive surface of the solar array is required to achieve adequate thermal conditioning. This conditioning minimizes sticky panels during the deploy.

**NOTE**

1. If the deployment spans one insolation period, 24 to 30 minutes of thermal condition time is required. If the deployment spans two insolation periods, deployment cannot be resumed until orbital noon of insolation period 2 or after 30 minutes of thermal conditioning.

2. The thermal clock begins once the array is 49 % deployed and a Sun incidence angle of 90 degrees ($\pm$30) to the array is achieved.

If the Sun incidence angle can be maintained at 90 degrees ($\pm$2) throughout the thermal conditioning period

24 minutes of thermal conditioning time is required.

If the Sun incidence angle can be maintained at 90 degrees ($\pm$30) throughout the thermal conditioning period

30 minutes of thermal conditioning time is required.

If the Sun incidence angle cannot be maintained at 90 degrees ($\pm$30) throughout the thermal conditioning period

Do not continue deploy.
OPTION A: 100 % Deploy in 1 Insolation Period

OPTION B: > 49 % Deploy in 1 Insolation Period and 100 % Deploy in 2 Insolation Periods

OPTION C: 49 % Deploy in 1 Insolation Period and 100 % Deploy in 2 Insolation Periods

Figure 1. - Solar Array Deployment.
If the Mast – Abort time recorded in step 15.8 occurred at or before orbital noon of the present (insolation 1) insolation period, Option A or B will be attempted.

Determine deploy times.

Mast – Abort Time (from step 15.8) +24 minutes = Earliest Deploy Time

Record earliest time deploy (step 17.8) can be performed: ______ GMT

Mast – Abort Time (from step 15.8) +30 minutes = Nominal Deploy Time

Record nominal time deploy (step 17.8) can be performed: ______ GMT

Proceed to step 17.

If the Mast – Abort time recorded in step 15.8 occurred after orbital noon of the present (insolation 1) insolation period, Option C will be attempted.

Determine deploy time.

Next Orbital Sunrise +30 Minutes = Contingency Deploy Time

Record contingency time deploy (step 17.8) can be performed: _____ GMT

**NOTE**
Steps 17.1 through 17.6 can be performed early.

17. **COMPLETING SOLAR ARRAY DEPLOYMENT**

17.1 Verifying Temperatures are Within Nominal Ranges Prior to SAW Deploy

PCS

PVM: EPS: SAW XX

SAW XX

Verify SAW PS Temp, deg C: -33 to 51
Verify BGA PS Temp, deg C: -33 to 51
Verify Mast MDA Temp, deg C: -54 to 48
17.2 Powering On Mast Motor Drive Assembly (MDA)

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Mast MDA temperatures may be high due to direct sunlight in deploy configuration. MDA Over Temp Trip occurs at 77.8° C. At a minimum, a 30° C mast MDA temperature increase should be protected for during mast deployment. Delay MDA activation, until just prior to deploy time to minimize temperature increase if necessary.</td>
</tr>
<tr>
<td>2. MDA Slow alert will be Nominal until MDA power is applied. Once this is done, the indication is Slow.</td>
</tr>
</tbody>
</table>

SAW XX
‘Mast’

sel Mast Commands

SAW XX Mast Commands
‘MDA’
‘Power’

**cmd** On – Arm
**cmd** On – On

√ MDA Voltage, V: 120 to 125
√ MDA Current, A: ~0.10 (±0.4)
√ MDA Slow Alert – Slow

17.3 Verifying Camera Configuration

ISS must be in insolation to perform this verification.

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perform a visual verification prior to, during, and at the completion of the mast deploy operation to minimize the risk of potential collision hazards, monitor for any obvious anomalies, and to verify solar array deployment. Total number of visible Mast Bays is 31.5, 1 Bay is rigid batten to rigid batten.</td>
</tr>
</tbody>
</table>

Verify camera configuration is correct for solar array deploy to 100 %, before proceeding.

If orbiter is performing mated attitude control, wait for deploy time from **MCC-H**, then proceed to step 17.6. Otherwise, proceed to step 17.7 and wait for **MCC-H GO** to complete Mast deploy.

**MCC-H** proceed to step 17.4.
17.4 Verifying Initial SAW Mast Configuration

**NOTE**
SAW 2B SW 02 Deployed limit switch failed prior to the 4A mission, No is always indicated.

**SAW XX Mast Commands**

- Mast SW01,SW02 Retracted – No
- Mast SW01,SW02 Deployed – No

17.5 Verifying Conditions are Correct for Visual Verification

**CAUTION**
Steps 17.7 and 17.10 must be performed during insolation to minimize sticky panels during the deploy and support crew visual cues used to determine when to abort the solar array deployment. A Sun incidence angle between 60 degrees and 90 degrees (optimal) on the inactive surface of the solar array is required to achieve an adequate thermal environment throughout the deploy.

Verify ISS is in insolation (orbital noon ±10 minutes is optimal for deploy).

17.6 Preventing Thruster Firings

**CAUTION**
To minimize the potential for structural damage to hardware while the solar array mechanisms are in motion, nonpropulsive CMG control or Free Drift will be maintained. At any time array deployment is stopped or aborted, thrusters may be enabled.

If ISS is performing attitude control and ISS is in TEA *(MCC-H)*

**MCC-H**

MCS: MCS Configuration: Manual CMG Desat

[Manual CMG Desat]

- Desat Request – Inh

**MCC-H** † ISS, Orbiter, “Desats are Inhibited.”

Go to step 17.7.

If ISS is performing attitude control and ISS is not in TEA *(MCC-H)*

Perform [2.404 MODING CMG TA TO FREE DRIFT], all (SODF: MCS: NOMINAL: GNC MODING), then:

**MCC-H** † ISS, Orbiter, “ISS is in Free Drift.”

Go to step 17.7.
1.3.452 SAW XX DEPLOY
(EPS/E12 - ALL/FIN 2) Page 39 of 47 pages

C3(A6) If orbiter is performing mated attitude control

DAP: FREE

Orbiter $\Rightarrow$ ISS, MCC-H, “Orbiter is in Free Drift.”

Go to step 17.8, notify MCC-H before sending the deploy command.

17.7 Deploying 100 % of SAW (Approximately 31.5 Bays Visible)

WARNING
If deploying a solar array during EVA operations, confirm EVA crew outside of area that could be subject to solar array structural collapse.

CAUTION
1. Confirm no crew exercise or maximum EVA loads before proceeding.

2. If the mast is in motion and the deploy will not be completed (100 %) before entering eclipse, the deploy must be stopped using the Mast – Abort command upon entering eclipse due to loss of visual insight. Once deploy is stopped, crew will perform step 17.9, if orbiter is performing attitude control. Otherwise, crew will hold in step 17.7 and wait for MCC-H GO to complete mast deploy. MCC-H return to step 16, then perform steps 17.1 to 17.2 and 17.6.

NOTE
Upon successful deploy commanding, the MDA current will increase (0.2 to 3.0 amps) and the Slow alert will go to Nominal during transition, then return to Slow. Once power is removed from the MDA, the Slow alert will indicate Nominal.

PCS PVM: EPS: SAW XX

SAW XX
‘Mast’

sel Mast Commands

SAW XX Mast Commands
‘Mast’

cmd Deploy – Arm
cmd Deploy – Deploy (Nominal deploy takes ~6 minutes. Tension mechanism monitoring is not required for redeploy after an SSU R&R. Redeploy takes 13 minutes.)
If <24 Bays visible

Monitor RBB and LBB inboard tension mechanisms and tension bars for motion during deployment of the first 24 bays (75 % deployed mast).

*************************************************************************
* If motion (inboard tension mechanism rotates approximately 1/8 turn) is indicated between 49 % (15.5 bays) and 75 % (24 Bays) deployed, immediately abort deploy.
*************************************************************************

NOTE

While the Mast is being deployed, the tension mechanisms may experience small oscillations. This is acceptable and not cause for an abort.

‘Mast’ cmd Abort – Abort

\MCC-H before proceeding.

CAUTION

Panel stiction forces are higher than expected and the likelihood of the tension bar rising is increased. Note that panels will separate from least to greatest stiction force.

If >24 Bays visible

Monitor RBB and LBB inboard tension mechanisms and tension bars for motion until the last Mast Bay begins to deploy.

NOTE

During deployment of the last half Mast Bay (at Mast Bay 31) the tension bars of both blankets will rise off the blanket box sill (~20 inches) and the tension mechanisms will rotate approximately 1.5 turns.
1.3.452 SAW XX DEPLOY
(EPS/E12 - ALL/FIN 2) Page 41 of 47 pages

**If motion (inboard tension mechanism rotates a quarter turn) is indicated between 75\% (24 Bays) and 98\% (31 Bays) deployed, immediately abort the deploy.**

**NOTE**
While the mast is being deployed, the tension mechanisms may experience small oscillations. This is acceptable and not cause for an abort.

'Mast'

**cmd** Abort – Abort

If either tension bar rises up excessively (>3") from the blanket box sill and does not return to the sill after the abort is issued, then immediately

<table>
<thead>
<tr>
<th>SAW XX Mast Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>'MDA'</td>
</tr>
<tr>
<td>'Power'</td>
</tr>
</tbody>
</table>

**cmd** On – Arm
**cmd** On – On

√ MDA Voltage, V: 120 to 125

'Mast'

**cmd** Retract – Arm
**cmd** Retract – Retract

Retract the mast until the tension bar reaches the sill.

'Mast'

**cmd** Abort – Abort

√ MDA Voltage, V: <10 (±2.8)

√ MCC-H before proceeding.

If **MCC-H** unavailable, perform {3.194 SAW XX BLANKET PANEL STICTION DURING DEPLOYMENT}, all (SODF: EPS: MALFUNCTION: PRIMARY POWER SYSTEM), then:

Otherwise, √ **MCC-H** before proceeding.

If **MCC-H** unavailable, perform (3.194 SAW XX BLANKET PANEL STICTION DURING DEPLOYMENT), all (SODF: EPS: MALFUNCTION: PRIMARY POWER SYSTEM), then:
Wait approximately 6 minutes (13 minutes for redeploy post SSU R&R) until 100% deployed (confirm 31.5 bays are visible).

If orbiter is performing mated attitude control, proceed to step 17.9. Otherwise, proceed to step 17.10.

**MCC-H** proceed to step 17.8

### 17.8 Verifying Final SAW Mast Configuration

<table>
<thead>
<tr>
<th>NOTE</th>
<th>SAW 2B SW 02 Deployed limit switch failed prior to the 4A mission, No is always indicated.</th>
</tr>
</thead>
</table>

**SAW XX Mast Commands**

- Mast SW01, SW02 Retracted – No
- Mast SW01, SW02 Deployed – Yes
- MDA Voltage, V: 120 to 125
- MDA Current, A: ~0.10 (±0.4)
- MDA Slow Alert – Slow

***************************************************************************
* If one Deployed or Retracted limit switch fails
* Confirm configuration visually and **MCC-H** before proceeding.
* Mast limit switch status that would restrict SABB and BGA commanding has already been overridden as part of ECU activation.
* If two Deployed or Retracted limit switches fail
* Perform steps 17.9 (if orbiter performing attitude control) and 17.10, then **MCC-H** before proceeding.

***************************************************************************

### 17.9 Configuring for Nominal Attitude Control)

**MCC-H** If ISS is performing attitude control and ISS is in TEA (**MCC-H**) Go to step 17.10.

If ISS is performing attitude control and ISS is not in TEA (**MCC-H**) Perform **2.405 MODING FREE DRIFT TO CMG TA**, (SODF: MCS: NOMINAL: GNC MODING), then:

**MCC-H** → ISS, Orbiter, “ISS is in Attitude Control.”

Go to step 17.10.
C3(A6) If orbiter is performing mated attitude control
Perform rate damping DOCKED CONFIGURATION DAP
REFERENCE, (FDF: ORB OPS, REBOOST/DAP), then:

Go to step 17.10.

17.10 Performing Visual Verification Via Cameras
Verify mast position – Deployed
Verify tension bar – Pulled away from blanket box
~20" (as last mast bay deploys)
Verify number of visible mast bays – 31.5
Verify solar array blanket – Flat

Verify guide rollers on final bay – Visible (final yellow flex batten)
Or
Verify Last Bay barber pole decal – Visible

NOTE
Last Bay barber pole indication can be seen with the cameras only when the array is positioned at or near 180 degrees (Mast MDA side).

ISS ↓ MCC-H, “Solar Array XX deploy complete.”

MCC-H ↑ ISS, “We confirm solar array fully deployed.”

MCC-H proceed to 17.11.

If deploying both arrays on a PVM the same day, return to step 15.3 and reconfigure cameras for deploy of the next array.

If deploying only one array or redeploying the array after an SSU R&R, exit procedure.

********************************************************************
* If deploy sequence is not successful, √MCC-H before proceeding.
* If MCC-H unavailable, perform {3.191 SAW XX FAILURE TO EXTEND MAST REMOTELY}, all (SODF: EPS: MALFUNCTION: PRIMARY POWER SYSTEM), then:
********************************************************************
17.11 Power Off Mast MDA

PCS

PVM: EPS: SAW XX

'SAW XX'

'Mast'

sel Mast Commands

'SAW XX Mast Commands'

'MDA'

'Power'

cmd Off – Off

√ MDA Voltage, V: <10 (±2.8)

18. FEATHERING SOLAR ARRAY TO PROTECT AGAINST ISS/ORBITER PLUME LOADS

[WARNING]

Confirm EVA, SSRMS, and SRMS, clear of solar array rotation path before unlatching and rotating BGA.

[CAUTION]

Once deployed, the solar array must be placed edge-on to ISS and orbiter thruster plume, to minimize array structural loads and contamination. The active surface of the array will be pointed toward the Sun. This requirement is not applicable to P6 arrays, when P6 is located on the Z1 truss.

PVM: EPS: BGA XX

'BGA XX'

Perform {2.110 PVM BGA XX UNLATCH ANTIROTATION LATCH}, all (SODF: EPS: NOMINAL: PRIMARY POWER SYSTEM), then:

Refer to Table 5 for the BGA XX Cmd Angle and perform {2.102 PVM CONFIGURE BGA XX TO DIRECTED POSITION MODE}, steps 5 to 8 (SODF: EPS: NOMINAL: PRIMARY POWER SYSTEM), then:
Table 5. Solar Array Feather Angles

<table>
<thead>
<tr>
<th>PVM</th>
<th>BGA/SA W (XX)</th>
<th>Cmd Angle, deg</th>
</tr>
</thead>
<tbody>
<tr>
<td>S4</td>
<td>1A</td>
<td>90</td>
</tr>
<tr>
<td>S4</td>
<td>3A</td>
<td>270</td>
</tr>
<tr>
<td>S6</td>
<td>1B</td>
<td>270</td>
</tr>
<tr>
<td>S6</td>
<td>3B</td>
<td>90</td>
</tr>
<tr>
<td>P4</td>
<td>2A</td>
<td>90</td>
</tr>
<tr>
<td>P4</td>
<td>4A</td>
<td>270</td>
</tr>
<tr>
<td>P6 on Z1</td>
<td>2B</td>
<td>Not Required</td>
</tr>
<tr>
<td>P6 on Z1</td>
<td>4B</td>
<td>Not Required</td>
</tr>
<tr>
<td>P6</td>
<td>2B</td>
<td>270</td>
</tr>
<tr>
<td>P6</td>
<td>4B</td>
<td>90</td>
</tr>
</tbody>
</table>

If deploying both arrays on a PVM the same day
Perform steps 15 to 18 for both channels before proceeding to step 19.

If deploying only one array or redeploying the array after an SSU R&R, go to step 19.

19. **ENABLING MOTOR VELOCITY SAFING (IF REQUIRED)**

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>If BGA is at 0 degrees, then delay this velocity limit safing - enable step until next time the BGA is reconfigured.</td>
</tr>
</tbody>
</table>

If the BGA is not at 0.0 (±0.5) degrees
PVM: EPS: BGA XX

<table>
<thead>
<tr>
<th>BGA XX Motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘Velocity Limit Safing, Primary PVCU’</td>
</tr>
</tbody>
</table>

**cmd** Enable – Arm

**cmd** Enable – Enable

Verify Primary PVCU – Ena

‘Velocity Limit Safing, Backup PVCU’

**cmd** Enable – Arm

**cmd** Enable – Enable

Verify Backup PVCU – Ena
20. POST SAW DEPLOY RECONFIGURATION

1. Once this procedure is complete, SSU XX is still shunted, and the array is not yet supporting channel XX. Channel XX IEA hardware is still receiving power from a support channel.

2. Table 6 provides support channel connectivity. A support channel, provides initial power to the channel being activated until the SAW is deployed and the batteries are charged (e.g., Ch 4B supports Ch 4A until Ch 4A is fully activated). If redeploying the array after an SSU R&R, confirm support channel with MCC-H.

If the array was redeployed after an SSU R&R, perform step 20.2 then exit procedure.

Table 6. Support Power Channel Connectivity

<table>
<thead>
<tr>
<th>XX</th>
<th>YY</th>
<th>ZZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>3A</td>
<td>4A</td>
</tr>
<tr>
<td>3A</td>
<td>1A</td>
<td>2A</td>
</tr>
<tr>
<td>1B</td>
<td>3B</td>
<td>1A</td>
</tr>
<tr>
<td>3B</td>
<td>1B</td>
<td>3A</td>
</tr>
<tr>
<td>2A</td>
<td>4A</td>
<td>2B</td>
</tr>
<tr>
<td>4A</td>
<td>2A</td>
<td>4B</td>
</tr>
<tr>
<td>2B</td>
<td>4B</td>
<td>2A</td>
</tr>
<tr>
<td>4B</td>
<td>2B</td>
<td>4A</td>
</tr>
</tbody>
</table>

20.1 Powering Up Loads on ISS (As Necessary)

- NOTE
  Loads previously powered down, may be reactivated if no longer in the solar array deploy attitude.

Reactivate those loads previously deactivated for array deployment.

20.2 Recover Loads on DDCU XX (YY) After SAW Deploy

- NOTE
  Power can be supplied to ECU XX from DDCU XX or DDCU YY for the solar array deploy. Therefore, it may have been necessary to reduce loads on the appropriate DDCU to support a peak power load of 580 watts during array deployment.

Reactivate those loads previously deactivated on DDCU XX (YY) for array deployment.
20.3 Configure for Charging Batteries from Channel XX Array (Same Channel the SAW Was Deployed)

Go to {1.3.100 PRIMARY POWER CHANNEL ACTIVATION}, step 72 (SODF: EPS: ACTIVATION AND CHECKOUT: CHANNEL ACTIVATION).
3.190 SAW XX FAILURE TO UNLATCH SABB REMOTELY

1. Notify MCC-H
   Notify MCC-H of visual status.

2. ECU SAW Communicating
   PVM:EPS:SAW XX
   SAW XX
   ‘ECU XX’
   Is Integ Cnt incrementing?

3. ECU BGA Communicating
   PVM:EPS:BGA XX
   BGA XX
   ‘ECU XX’
   Is Integ Cnt incrementing?

4. Go to (3.110 BGA XX LOSS OF COMM), all (SODF: EPS: MALFUNCTION: PRIMARY POWER SYSTEM)

5. Unlatch Sequence Verification
   Has full latch travel been confirmed, visually and by limit switch data?

6. Attempt to Latch
   LBB (RBB) then try to Unlatch again. It may be desirable to wait for a different thermal condition before reattempt.

7. Power on Reset
   sel SAW Firmware
   SAW XX Firmware
   Does Power On Reset = X

8. Go to (3.150 BGA XX 1553/FWC ERRORS), all (SODF: EPS: MALFUNCTION: PRIMARY POWER SYSTEM)

9. LBB (RBB) Latches are not unlatched or latched and are in an undetermined state, in between.

10. Damage to SABB hardware when driving a MDA in the opposite direction from the initial cmded direction.

11. If power was removed from the ECU you must begin again with step 1 of the Deploy/Retract procedure, to reset the F/W inhibits.

12. If Current sensor fails high > 0.78 A RPCs providing power to ECU will be opened. A new PPL with a higher Current limit must be uploaded before the ECU can be recovered. There is no inhibit for SAW MDA Config Complete Persistent Current Safing.
3.190 SAW XX FAILURE TO UNLATCH SABB REMOTELY

10 LBB (RBB) Status
- LBB (RBB) Partially Unlatched
- LBB (RBB) Failed to Unlatch (No Hardware Response)

11 Verify Mast Telemetry
- PVM:EPS:SAW XX
  - ‘Mast’ Verify telemetry (RETRACTED)
    - Mast SW 01,02 Retracted = Yes
    - Mast SW 01,02 Deployed = No
  - Verify telemetry (DEPLOYED)
    - Mast SW 01,02 Retracted = No
    - Mast SW 01,02 Deployed = Yes
- Four good limit switches?

12 Override Switch Indication
- ‘ECU XX’
  - sel SAW Software Inhibits
  - SAW XX Software Inhibits
- ‘Latch Reject’
  - cmd Inhibit - Arm
  - cmd Inhibit - Inhibit
  - Verify Latch Reject - Inh

13 Override SAW Indications
- PVM:EPS:BGA XX
  - BGA XX
    - ‘ECU XX’
      - sel BGA Software Inhibits
      - BGA XX Software Inhibits
  - ‘SAW Deployment’
    - ‘Primary PVCU’
      - cmd Enable - Arm
      - cmd Enable - Enable
      - Verify SAW Deployment - Ena
  - ‘Backup PVCU’
    - cmd Enable - Arm
    - cmd Enable - Enable
    - Verify SAW Deployment - Ena

14 MDA Status
- Is LBB (RBB) (Mast) MDA On?
  - MDA Voltage, V > 10 (+/-2.8)

15 MDA Temp Check
- Is LBB(RBB) MDA Temp > 30 deg C?

16 Hi Temp Reject FI Status
- sel SAW Software Inhibits
  - SAW XX Software Inhibits
- sel SAW XX Temp Safing
  - SAW XX Temp Safing
- Does Hi Temp Reject = Inh?

17 Command Check
- Possible cmd error

18 Temp Limit set too Low
- Command was rejected by the Hi Temp Reject function. Temp limit is set too low for this function.

19 Override Hi Temp Reject
- ‘Hi Temp Reject’
  - cmd Inhibit - Arm
  - cmd Inhibit - Inhibit
  - Verify Hi Temp Reject - Inh

20 Continue SAW Deploy or Retract
- Continue (1.3.452 SAW XX Deploy), (SODF: EPS: ACTIVATION & CHECKOUT: CHANNEL ACTIVATION) OR (1.3.450 SAW XX SABB Initial Unlatch), (SODF: EPS: ACTIVATION & CHECKOUT: CHANNEL ACTIVATION) OR (4.118 P6 SAW Retract (P6 on Z1 Truss)), (SODF: EPS: CORRECTIVE:PRIMARY POWER SYSTEM)
3.190 SAW XX FAILURE TO UNLATCH SABB REMOTELY

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14

21 Override Multiple MDA Reject
MDA Voltage sensor bias high is indicated, inhibit FDIR.
PVM:EPS:SAW XX
SAW XX
ECU XX
sel SAW Software Inhibits
SAW XX Software Inhibits
'Multi MDA On Reject'
cmd Inhibit - Arm
cmd Inhibit - Inhibit
Verify Multi MDA On Reject - Inh
Trend Data indicates MDA Voltage sensor is nominal.

8

42

22 MDA Driving Status
Is LBB (RBB) MDA Driving?
MDA Current, A > 0.3

27 MDA On and may be Driving
If Latches are unlatching:
Possible Latch Binding, or Degraded MDA but not enough to trigger FDIR. Monitor for unlatch completion. Proceed to step 26 if SAW hardware begins to deform. Check with MCC-H if Latches stop moving.

7

9

7

8

The manual MDA override lever is located on the back (inactive side) of the SABB base. (MDA current with no load = 0.3A)

8

There is no overvoltage FDIR for the MDA. The MDA will continue to operate if a Voltage sensor has failed high. Check voltages of all MDAs. The multiple MDA On Reject FDIR will reject an MDA on command if another MDA is already on.

9

If MDA decoupled you may not be able to tell if the MDA is driving based on the current.

23 MDA On and may be Driving
If Latches are not unlatching:
MDA may be de-coupled from mechanism. Visually confirm EVA MDA override lever in the Automatic position.

24 EVA MDA Override Lever Status
Is EVA MDA override lever in automatic position? (Refer to Figure 1)

28 MDA De-Coupled
MDA Decoupled from SABB latch mechanism, SABB must be unlatched by EVA.

25 MDA Fault
MDA may be de-coupled from SABB latch mechanism or the MDA drive capability has failed.

26 Abort SABB Unlatch
Send the Abort cmd if Latches are not moving.
PVM:EPS:SAW XX
SAW XX
'SAW XX'
sel SAW LBB (RBB) Commands
SAW XX LBB (RBB) Commands

cmd LBB (RBB) - Abort

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14800.ppt
3.190 SAW XX FAILURE TO UNLATCH SABB REMOTELY

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10
ECU Firmware
MDA Over Current Trip occurs at 6.2 Amps. S/W Limit (0.78 A) is reached first and it does not set the MDA Over Current Trip Flag.

11
Disconnects are present in the MDA Over Temp FDIR. S/W Trip level = 77.7 deg C. F/W Trip level = 140 deg C. H/W damage occurs at 120 deg C. S/W Temp limit is reached first and it does not set the MDA Over Temp Trip Flag.

12
MDA Power off is a one step command.

29
Possible MDA H/W Failure,
MDA Over Current Trip,
MDA Over Temp Trip,
MDA Stall, Binding,
or sensor failure

30
Over Current Detection
PVM:EPS:SAW XX
SAW XX
'ECU XX'
Does Over Current Trip = X

31
Over Temperature Detection
PVM:EPS:SAW XX
SAW XX
'LBB(RBB) MDA'
Does Over Temp Trip = X

32
MDA Stall Status
MCC Only
Did MDA Slow Alert = Slow prior to removal of MDA Power?

33
Clear MDA Indications
PVM:EPS:SAW XX
SAW XX
LBB(RBB)
sel LBB (RBB) Commands
SAW XX LBB (RBB) Commands
cmd MDA Power - Off
Verify MDA Voltage, V < 10 (+/- 2.8)

34
Possible MDA Over Current
Possible MDA H/W Failure,
MDA Over Current Condition
MDA Stall, Binding,
or sensor failure

35
Possible MDA Over Temp
Possible MDA H/W Failure,
MDA Over Temp Condition
or sensor failure

36
Possible MDA Stall Condition
Possible MDA H/W Failure,
MDA Stall, or Binding

37
Verify S/W Trip Temperature
PVM:EPS:SAW XX
SAW XX
Is LBB, RBB or Mast MDA Temp > 74.4 deg C?

38
MDA Failure Unknown
Unknown MDA Failure. MDA Off, Check with MCC-H

39

44

89

91
3.190 SAW XX FAILURE TO UNLATCH SABB REMOTELY

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38

39 Any C&W Flags Set?

MCC-H Only
Are there any ECU/BGA or SAW C&W flags set?

Yes

43 Dump Additional SAW Data

MCC-H Only
Check with MER for specific Dump Addresses and further action.

No

40 Re-attempt SAW Ops

Re-power MDA and attempt unlatch.

41 Latch Status

Was unlatch successful?

Yes

107

No

21

42 Continue SAW Deploy or Retract

Continue (1.3.452 SAW XX Deploy), (SODF: EPS: ACTIVATION & CHECKOUT: CHANNEL ACTIVATION) OR (1.3.450 SAW XX SABB Initial Unlatch), (SODF: EPS: ACTIVATION & CHECKOUT: CHANNEL ACTIVATION) OR (4.118 P6 SAW Retract (P6 on Z1 Truss)), (SODF: EPS: CORRECTIVE:PRIMARY POWER SYSTEM)

SAW Caution and Warning Flags are available for downlink only during missions that scheduled SAW activities. (e.g 12A) Flags are not available on PCS displays.
3.190 SAW XX FAILURE TO UNLATCH SABB REMOTELY

(1) MDA Power off is a one step command.
(2) PVCU Software MDA Over Current Trip occurs at 0.78 Amps.
(3) If a Stall Condition is indicated, Current > 0.78 A and motor speed is < 25 RPM, power is removed from the MDA.

(4) Re-latch SABB to protect blanket from external loads.

Clear MDA Indications

PVM:EPS:SAW XX
SAW XX
LBB(RBB) sel SAW LBB(RBB) Commands

MDA Over Current Trip occurs at 0.78 Amps.

Possible short or fault in MDA.

Check MDA Trend Data for Increase in Current

MCC-H Only
Does trend data for MDA Current indicate an overcurrent condition before MDA Power was removed?

Yes

No

PVCU Software
MDA Over Current Trip occurs at 0.78 Amps.

Possible MDA fault, MDA Stall, or Binding

Check RPCM Trend Data for Increase in Current

MCC-H Only
Does trend data for RPCM XX A indicate a high current condition before MDA power was removed?

Yes

No

Possible MDA fault, MDA Stall, or Binding

MCC Stall Status

MCC Only
Did MDA Slow Alert = Slow prior to removal of MDA Power?

Yes

No

MDA Stall indicated, binding.

Possible short or fault in MDA.

Deploying

BRSP Status

Are BRS Pins Released for both SABBs?

Yes

No

Continued SABB Unlatch Ops

Proceed with initial unlatch of unaffected SABB. Re-latch SABB once BRS Pins are confirmed released.

Retracting

SABB Operations

DO NOT unlatch unaffected SABB at this time, wait until just prior to EVA unlatch of affected SABB. If already unlatched, re-latch the unaffected SABB.
If Current sensor fails high > 0.78 A RPCs providing power to ECU will be opened. A new PPL with a higher current limit must be uploaded before the ECU can be recovered. There is no inhibit for SAW MDA Motor Stall Persistent Current Safing. Refer to block 3.

Nominal SABB unlatch, takes approximately 14 seconds to complete. However, all MDAs use the same current sensor. A new PPL 69 must be uplinked prior to SAW operations or Inhibit the RPC Open Command to avoid power cycling the ECU.
3.190 SAW XX FAILURE TO UNLATCH SABB REMOTELY

53

65 Attempt to Unlatch LBB (RBB) again. It may be desirable to wait for a different thermal condition before reattempt.

67 Set SAW LBB(RBB) Abort
PVM:EPS:SAW XX
SAW XX
LBB(RBB)
sel LBB(RBB) Commands
SAW XX LBB(RBB) Commands
cmd LBB(RBB) - Abort

68 Re-attempt SAW Ops
Re-power MDA and attempt Unlatch per the Nominal procedure.

69 Latch Status
Was unlatch successful?

70 Attempt to Latch LBB (RBB) then try to Unlatch again. It may be desirable to wait for a different thermal condition before reattempt.

71 Clear CW Flag Indications
PVM:EPS:EPS, Software
EPS Software
sel PVCU Software
PV SW
sel Cmd Resp Clear
PV Cmd Response Clear
'SAW Command Response Clear'
cmd Arm
cmd Clear

72 Continue SAW Deploy or Retract
Continue (1.3.452 SAW XX Deploy), (SODF: EPS: ACTIVATION & CHECKOUT: CHANNEL ACTIVATION) OR (1.3.450 SAW XX SABB Initial Unlatch), (SODF: EPS: ACTIVATION & CHECKOUT: CHANNEL ACTIVATION) OR (4.118 P6 SAW Retract (P6 on Z1 Truss)), (SODF: EPS: CORRECTIVE:PRIMARY POWER SYSTEM)

19 There is a very limited partially unlatched range in which a re-latch can be attempted without damaging the hardware. This must be confirmed visually by MCC-H. CAUTION Re-latch cannot be attempted if BRSP are not released. Damage to hardware can occur.

20 Damage to SABB hardware when driving a MDA in the opposite direction from the initial cmded direction.

21 Re-attempt will be made at the end of insolation or end of eclipse, which ever case is opposite initial attempt.
3.190 SAW XX FAILURE TO UNLATCH SABB REMOTELY

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71

Set SAW LBB(RBB) Abort

73

PVM:EPP:SAW XX

SAW XX

'SBB(RBB)' sel LBB(RBB) Commands

SAW XX LBB(RBB) Commands

cmd LBB(RBB) - Abort

74

Turn MDA On

cmd MDA Power - On Arm

MDA Abort must be sent to prevent MDA from driving once power is reapplied. This is a single step command.

75

Latch LBB (RBB)

Monitor LBB(RBB) Latch with cameras

cmd LBB(RBB) - Latch Arm

cmd LBB(RBB) - Latch

Verify telemetry

LBB(RBB) SW 01,02 Pin Released = Yes
LBB(RBB) SW 01,02 Latched = Yes
LBB(RBB) SW 01,02 Unlatched = No

Verify visually

Latch Position (four of eight) - Latched

76

Unlatch LBB(RBB)

Monitor LBB(RBB) Unlatch with cameras

cmd LBB(RBB) - Unlatch Arm

cmd LBB(RBB) - Unlatch

Verify telemetry

LBB(RBB) SW 01,02 Pin Released = Yes
LBB(RBB) SW 01,02 Latched = No
LBB(RBB) SW 01,02 Unlatched = Yes

Verify visually

BRS Pin Release (seven) - restraint pins released
Latch Position (four of eight) - Unlatched

Separation of BB top and bottom - Uniform

Was Unlatch successful?

77

Is this the first attempt to Unlatch the LBB (RBB) using this sequence?

78

LBB (RBB) Hardware Binding

Wait for better thermal conditions and re-attempt LBB(RBB) Unlatch.

79

BRSP Status

Are BRS Pins Released?

80

Continue SAW Ops

Continue (1.3.450 SAW XX SABB Initial Unlatch),(SODF: EPS: ACTIVATION & CHECKOUT: CHANNEL ACTIVATION)

81

Continue SAW Ops

Continue (4.118 P6 SAW Retract (P6 on Z1 Truss)), (SODF: EPS: CORRECTIVE:PRIMARY POWER)

20

Damage to SABB hardware when driving a MDA in the opposite direction from the initial cmded direction.

22

MDA Abort must be sent to prevent MDA from driving once power is reapplied. This is a single step command.

23

There is a very limited partially unlatched range in which a re-latch can be attempted without damaging the hardware. This must be confirmed visually by MCC-H before block 75 can be executed. If block 75 cannot be performed continue in block 76.

24

Confirm that ISS Thrusters are inhibited or ISS/Orbiter in Free Drift and no crew exercise or max EVA loads prior to sending the Unlatch or Latch command. If at any time the array mechanical movement is stopped or aborted, attitude control may be resumed.

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137
3.190 SAW XX FAILURE TO UNLATCH SABB REMOTELY

Identify Stuck BRS Pins

Record which BRS Pin(s) are stuck, and corresponding BGA position and Latch number, required for EVA access. Refer to procedure (Manual Release of SABB Restraint Pins) (EVA C/L, Generic Reference) for this data.

BRS Pin  Angle, deg  Latch
1        _________       ______
2        _________       ______
3        _________       ______
4        _________       ______
5        _________       ______
6        _________       ______
7        _________       ______

Copy values into the next step.

Position SAW for Mast Deploy via EVA

Perform (2.101 PVM BGA XX Engage Antirotation Latch) (SODF: EPS: NOMINAL: PRIMARY POWER)

Copy the following values from previous step into Step 4 of the Latch procedure:
Cmded Angle = _________ deg
Latch Select = _________

BRS Pin Status

Did BRS Pins release during BGA rotation?

Yes

Clear CW Flag Indications

PVM:EPS:EPS Software
EPS Software
sel PVCU Software
PV SW
sel Cmd Resp Clear
PV Cmd Response Clear
'SAW Command Response Clear'
cmd Arm
cmd Clear

Set SAW LBB(RBB) Abort

PVM:EPS:SAW XX
SAW XX
' LBB(RBB) '
sel LBB(RBB) Commands
SAW XX LBB(RBB) Commands

LBB(RBB) - Abort

Turn MDA On

cmd MDA Power - On Arm
cmd MDA Power - On
Verify MDA Voltage, V = 120 --- 125

Release BRS Pins via EVA

On MCC-H Go

Perform Manual Release of SABB Restraint Pins (EVA C/L, Generic Reference)

Clear CW Flag Indications

PVM:EPS:EPS Software
EPS Software
sel PVCU Software
PV SW
sel Cmd Resp Clear
PV Cmd Response Clear
'SAW Command Response Clear'
cmd Arm
cmd Clear

Set SAW LBB(RBB) Abort

PVM:EPS:SAW XX
SAW XX
' LBB(RBB) '
sel LBB(RBB) Commands
SAW XX LBB(RBB) Commands

LBB(RBB) - Abort

Turn MDA On

cmd MDA Power - On Arm
cmd MDA Power - On
Verify MDA Voltage, V = 120 --- 125

MDA Abort must be sent to prevent MDA from driving once power is re-applied. This is a single step cmd.
3.190 SAW XX FAILURE TO UNLATCH SABB REMOTELY

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Disconnects are present in the MDA Over Temp FDIR. S/W Trip level = 77.7 deg C. F/W Trip level = 140 deg C. H/W damage occurs at 120 deg C.

Since S/W Temp limit is reached first and it does not set the MDA Over Temp Trip flag, a MDA Abort must be sent to prevent MDA from driving, once power is reapplied. This is a single step cmd.

Per Flight Rule B9-207, MDA operations can proceed even if MDA temp is high in order to meet critical mission objectives. SABB unlatch takes approximately 14 seconds. Measurement Out of Range will be indicated if MDA temp >72.2 deg C.
3.190 SAW XX FAILURE TO UNLATCH SABB REMOTELY

**PVM:EPS:SAW XX**

'SAW XX'

'SAW XX Software Inhibits'

'SAW XX Temp Safing'

'LBB(RBB) MDA'

'Primary PVCU'

'Over Temp Safing'

'SW Trip level = 77.7 deg C. F/W Trip level = 140 deg C. H/W damage occurs at 120 deg C.'

Let MDA Cool to < 44.4 deg C and re-attempt Unlatch or Unlatch via EVA.

Unlatch Via EVA?

Yes

No

105 Let MDA Cool

Let MDA cool to < 44.4 deg C and re-attempt Unlatch.

106 Continue SAW Deploy or Retract

Continue {1.3.452 SAW XX Deploy}, (SODF: EPS: ACTIVATION & CHECKOUT: CHANNEL ACTIVATION)

**OR** {1.3.450 SAW XX SABB Initial Unlatch}, (SODF: EPS: ACTIVATION & CHECKOUT: CHANNEL ACTIVATION)

**OR** {4.118 P6 SAW Retract (P6 on Z1 Truss)}, (SODF: EPS: CORRECTIVE:PRIMARY POWER SYSTEM)

Disconnects are present in the MDA Over Temp FDIR.

Retry temperatures can be higher for SABBs since they are only operated a few seconds.
3.190 SAW XX FAILURE TO UNLATCH SABB REMOTELY

LBB (RBB) MDA Failed or De-coupled
LBB (RBB) Unlatch and Latch must be accomplished by EVA.

PVM:EPS:SAW XX
SAW XX
LBB(RBB)
sel LBB(RBB) Commands
SAW XX LBB(RBB) Commands

MDA Power - Off
Verify MDA Voltage, V < 10 (+/- 2.8)

Position SAW for LBB (RBB) Unlatch via EVA
Perform [2.101 PVM BGA XX Engage Antirotation Latch], (SODF: EPS: NOMINAL: PRIMARY POWER)

Copy the following values into Step 4:
For LBB
Cmded Angle = 270 deg
Latch Select = 1
For RBB
Cmded Angle = 90 deg
Latch Select = 1

LBB (RBB) Unlatch via EVA
On MCC-H Go
Perform (Manual Override to Unlatch/Latch SABB) (EVA C/L, FS Reference)

Is LBB (RBB) Fully Unlatched?
Yes

EVA Unlatch Attempts
Is this the first attempt to Unlatch the LBB (RBB) via EVA?
Yes
No

MDA Power off is a one step command.

Retracting

Deploying

107 LBB(RBB) MDA Failed or De-coupled
LBB (RBB) Unlatch and Latch must be accomplished by EVA.

108 LBB (RBB) Hardware Binding
LBB(RBB) Unlatch and Latch must be attempted via EVA.

Remove LBB(RBB) MDA Power

PVM:EPS:SAW XX
SAW XX
LBB(RBB)
sel LBB(RBB) Commands
SAW XX LBB(RBB) Commands

cmd MDA Power - Off
Verify MDA Voltage, V < 10 (+/- 2.8)

This step can take up to 1 hr to complete. The latch cmd can be sent when the BGA Actual Angle is within 1 deg of the commanded value in order to save time.

This step may be omitted if EVA crew can free float and drive the MDA.
3.190 SAW XX FAILURE TO UNLATCH SABB REMOTELY

On MCC-H Go
Perform Manual Override to Unlatch/Latch SABB (EVA C/L, FS Reference)

Verify LBB(RBB) Latched
Verify telemetry
LBB(RBB) SW 01,02 Latched = Yes
LBB(RBB) SW 01,02 Unlatched = No
Verify visually
Latch Position (four of eight) - Latched

Is LBB(RBB) Latched?

Return to Nominal Procedure
Continue {1.3.452 SAW XX Deploy}, Step 12, then step 13(14), (SODF: EPS: ACTIVATION & CHECKOUT: CHANNEL ACTIVATION)

Wait for better thermal conditions and re-attempt LBB(RBB) Latch via EVA.

LBB(RBB) Failed to Unlatch
Unable to Deploy SAW

Unable to deploy the solar array, mast is 0% deployed. Primary power channel XX is unable to support itself.

Both SABBs must be Latched (Hi Tension Mode) before the SAW can be deployed, to protect H/W against damage due to high stiction forces.

Re-attempt will be made at the end of insolation or end of eclipse, which ever case is opposite initial attempt.

Assumes that one or more mast bays have already been deployed.
3.190 SAW XX FAILURE TO UNLATCH SABB REMOTELY

ECU SAW Failure
Possible ECU SAW Firmware Power Supply, or RT Failure. Possible fault on ECU SAW power string below ECU input power selector circuit breaker.

Verify ECU Power
MCC-H Only
Does trend data for RPCM XX A Input Current indicate that half of the ECU housekeeping power was lost?
Yes
No

Verify MDA Power
MCC-H Only
Does trend data for RPCM XX A Input Current indicate MDA is on?
Yes
No

Verify MDA State
MCC-H Only
Does trend data for RPCM XX A Input Current indicate MDA is driving?
Yes
No

ECU SAW PS & MDA Powered
ECU SAW Power Supply remains powered & MDA is driving but communication is lost. Possible fault in SAW Firmware controller. BGA operations are unaffected.

ECU SAW PS Powered & MDA off
ECU SAW Power Supply is on and MDA is off. Possible ECU SAW Power Supply output failure or fault downstream of ECU SAW PS. BGA operations are unaffected.

Total ECU housekeeping power is 115W (0.93A) at initialization and before BGA mtr or MDAs are turned on. Half of the ECU housekeeping power is 57.5W (0.47A).

It only takes 14 sec to unlatch SABBs. When the MDA is on it draws about 0.22A. When the MDA is driving it can draw as high as 3.0A. MDA over current trip occurs at 0.78A. The MDA will stop driving but will remain on if one of the two "Unlatched" limit switches have contacted.
3.190 SAW XX FAILURE TO UNLATCH SABB REMOTELY

Removes Power from MDA. When power is re-applied to the ECU the MDA will be off.

MCC-H must build and perform this step from command inventory.

Expect Caution message BGA XX Loss of Comm - PVM when RPC 01 is cmded open.

131 132

133 Reset ECU SAW Remote Terminal

MCC-H Only
Perform ECU SAW RT Reset from Ground:

For P6 Solar Arrays
  CI PUI=PEPW96L/M0042K
  SPI=USPZ21MD0702
  SAW 2B = 33804
  SAW 4B = 17420
For P4 Solar Arrays
  CI PUI=PEPW95SM0042K
  SPI=USPZ21MD0702
  SAW 2A = 17164
  SAW 4A = 33548

For S6 Solar Arrays
  CI PUI=SEPW96L/M0484K
  SPI=USPZ21MD0702
  SAW 1B = 33292
  SAW 3B = 16908
For S4 Solar Arrays
  CI PUI=SEPW95SM0042K
  SPI=USPZ21MD0702
  SAW 1A = 16652
  SAW 3A = 33036

134 ECU SAW Communicating

PVM:EPS:SAW XX
SAW XX
"ECU XX"
Is Integ Cnt incrementing?

135 Remove ECU Power

PVM:EPS:SAW XX
SAW XX
  sel RPCM YY A RPC 02
RPCM YY A RPC 02
   cmd RPC Position - Open (Verify - Op)
SAW XX
  sel RPCM XX A RPC 01
RPCM XX A RPC 01
   cmd RPC Position - Open (Verify - Op)

136 Communication Restored
Communication with the SAW has been restored.

137 Continue SAW Deploy or Retract
Continue {1.3.452 SAW XX Deploy}, (SODF: EPS: ACTIVATION & CHECKOUT: CHANNEL ACTIVATION) OR
{1.3.450 SAW XX SABB Initial Unlatch}, (SODF: EPS: ACTIVATION & CHECKOUT: CHANNEL ACTIVATION) OR
{4.118 P6 SAW Retract (P6 on Z1 Truss)}, (SODF: EPS: CORRECTIVE:PRIMARY POWER SYSTEM)
3.190 SAW XX FAILURE TO UNLATCH SABB REMOTELY

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135

136 Apply Power to ECU

Attempt to recover SAW capability by activating ECU on Redundant power source.
PVM:EPS:SAW XX
SAW XX
sel RPCM YY (XX) A RPC 02 (01)
RPCM YY (XX) A RPC 02 (01)
cmd RPC Position - Close (Verify - Cl)

139 ECU SAW Communication

PVM:EPS:SAW XX
SAW XX
"ECU XX"
Is Integ Cnt incrementing?

Yes

140 Communication Lost with SAW Firmware

Possible SAW RT or Firmware Controller failure. Mast Deploy, LBB and RBB Unlatching and Tensioning must be accomplished by EVA.
BGA operations are unaffected.

No

141 Unlatch Opposite SAW

If opposite SAW SABBs have not been unlatched. Reconfigure cameras and unlatch them now.

142 ECU BGA Communication

PVM:EPS:BGA XX
BGA XX
"ECU XX"
Is Integ Cnt incrementing?

Yes

143 BGA Common Clear

BGA XX
"ECU XX"
sel BGA Firmware
BGA XX Firmware
‘Clear Commands’
cmd Common Clear
Verify Power On Reset - < blank>

No

144 Continue SAW Deploy or Retract

Continue (1.3.452 SAW XX Deploy), (SODF: EPS: ACTIVATION & CHECKOUT: CHANNEL ACTIVATION)
OR (1.3.450 SAW XX SABB Initial Unlatch), (SODF: EPS: ACTIVATION & CHECKOUT: CHANNEL ACTIVATION)
OR (4.118 P6 SAW Retract (P6 on Z1 Truss)), (SODF: EPS: CORRECTIVE:PRIMARY POWER SYSTEM)

145 ECU Power Lost

Possible ECU SAW Power Supply Failure or fault on ECU SAW power string below ECU input power selector circuit breaker. BGA operations are unaffected.

146 Override SAW Indications

BGA XX
"ECU XX"
sel BGA Software Inhibits
BGA XX Software Inhibits
‘SAW Deployment’
‘Primary PVCU’
cmd Enable - Arm
cmd Enable - Enable
Verify SAW Deployment - Ena

‘Backup PVCU’
cmd Enable - Arm
cmd Enable - Enable
Verify SAW Deployment - Ena

127

39

40

38

Caution message BGA XX 1553/ FWC Errors- PVM may be received after RPC 01 is closed.

ECU power is supplied by the opposite deck channel (YY) for SAW Retraction Operations and Channel (XX) for Deploy Operations

If power was removed from the ECU you must begin again with step 1 of the Deploy/Retract procedure, to reset the F/W inhibits.
3.190 SAW XX FAILURE TO UNLATCH SABB REMOTELY

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147 SAW PS, FWC or RT Lost
LBB and RBB Unlatch/Latch, Mast Deploy/Retract, must be accomplished by EVA.

Retracting
Deploying

149 One or Both SABBs Affected?
Is LBB Unlatched?

No
Yes

150
155

148 Retract Configuration
Leave Mast 1 bay deployed and both SABBs unlatched. Check with MCC-H
3.190 SAW XX FAILURE TO UNLATCH SABB REMOTELY

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149 150 151 152 153 154 155 156 157 158 159 160

Position SAW for LBB Unlatch via EVA
Perform (2.101 PVM BGA XX Engage Antirotation Latch) (SODF: EPS, NOMINAL PRIMARY POWER SYSTEM)
Use:
Cmded Angle = 270 deg
Latch Select = 1

LBB Unlatch via EVA
On MCC-H Go
Perform (Manual Override to Latch/Unlatch SABB) (EVA C/L, FS Reference)

Verify LBB Fully Unlatched
Verify visually
BRS Pin Release (seven) - restraint pins released
Latch Position (four of eight) - Unlatched Separation of BB top and bottom - Uniform

Is LBB Fully Unlatched?
No
Yes

EVA Unlatch Attempts
Is this the first attempt to Unlatch the LBB via EVA?
No
Yes

LBB Hardware Binding
Wait for better thermal conditions and re-attempt LBB Unlatch via EVA.

Position SAW for RBB Unlatch via EVA
Perform (2.101 PVM BGA XX Engage Antirotation Latch) (SODF: EPS, NOMINAL PRIMARY POWER SYSTEM)
Use:
Cmded Angle = 90 deg
Latch Select = 1

RBB Unlatch via EVA
On MCC-H Go
Perform (Manual Override to Latch/Unlatch SABB) (EVA C/L, FS Reference)

Verify RBB Fully Unlatched
Verify visually
BRS Pin Release (seven) - restraint pins released
Latch Position (four of eight) - Unlatched Separation of BB top and bottom - Uniform

Is RBB Fully Unlatched?
No
Yes

EVA Unlatch Attempts
Is this the first attempt to Unlatch the RBB via EVA?
No
Yes

RBB Hardware Binding
Wait for better thermal conditions and re-attempt RBB Unlatch via EVA.

Re-attempt will be made at the end of insolation or end of eclipse, which ever case is opposite initial attempt.

This step can take up to 1 hr to complete. The latch cmd can be sent when the BGA Actual Angle is within 1 deg of the commanded value in order to save time.

This step may be omitted if EVA crew can free float and drive the MDA.

Go to (3.191  SAW XX FAILURE TO EXTEND MAST REMOTELY), EVA Support Steps Only (SODF:EPS: MALFUNCTION:PRIMARY POWER)
3.190 SAW XX FAILURE TO UNLATCH SABB REMOTELY

1. Mast Bay visible

1 mast bay is visible. SABB still latched but troubleshooting can be performed without damage to SABB cover.

2. Unlatch Unaffected SABB (if not already unlatched)

Perform [4.118 P6 SAW XX Retract (P6 on Z1 TRUSS)], Step 14 or 15 (SODF: EPS: CORRECTIVE: PRIMARY POWER)

3. Perform EVA to Unlatch Affected SABB

EVA must unlatch failed SABB, IVA will Complete retract then EVA must Re-latch failed SABB

4. Position SAW for SABB Unlatch via EVA


Use:
For LBB
Cmded Angle = 270 deg
Latch Select = 1

For RBB
Cmded Angle = 90 deg
Latch Select = 1

5. SABB Unlatch via EVA

On MCC-H Go
Perform [Manual Override to Latch/Unlatch SABB] (EVA C/L, FS Reference)

6. Verify SABB Fully Unlatched

PVM:EPS:SAW XX
SAW XX
LBB(RBB)
Verify telemetry
LBB(RBB) SW 01,02 Pin Released = Yes
LBB(RBB) SW 01,02 Latched = No
LBB(RBB) SW 01,02 Unlatched = Yes

Verify visually
Latch Position (four of eight) - Unlatched

Is SABB Fully Unlatched?

No

1. 167 EVA Unlatch Attempts

Is this the first attempt to Unlatch the SABB via EVA?

Yes

2. 168 SABB Hardware Binding

Wait for better thermal conditions and re-attempt SABB Unlatch via EVA.

No

21

3. 169 SABB Failed to Unlatch

LBB (RBB) Failed to Unlatch

170 Unable Complete Mast Retract

Unable to retract the last mast bay or latch the SABBs. Partially deployed SAW constraints apply. Potential exists for damaging the SAW during the P6 re-location.

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3.190 SAW XX FAILURE TO UNLATCH SABB REMOTELY

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Perform (4.118 P6 SAW XX RETRACT (P6 on Z1 TRUSS)), step 17 (SODF:EPS: CORRECTIVE: PRIMARY POWER)

Retract Last Mast Bay

EVA Confirmation
EVA to Confirm SAW Containment within SABBs

Latch Unaffected SABB

EVA Confirmation
EVA to Confirm SAW Containment within SABBs

Latch Failed SABB via EVA

On MCC-H Go
Perform Manual Override to Latch/Unlatch SABB (EVA C/L, FS Reference)

Verify SABB Fully Latched

Verify telemetry
LBB(RBB) SW 01,02 Pin Released = Yes
LBB(RBB) SW 01,02 Latched = Yes
LBB(RBB) SW 01,02 Unlatched = No

Verify visually
Latch Position (four of eight) - Latched

Is SABB Fully Latched?

176 EVA Latch Attempts
Is this the first attempt to Latch the SABB via EVA?

Yes

177 SABB Hardware Binding
Wait for better thermal conditions and re-attempt SABB Latch via EVA.

No

Failed

EVA Latch Attempts

174

Unable to Deploy SAW

Unable to deploy the solar array, mast is 0% deployed. Primary power channel XX is unable to support itself.

180

SABB Failed to Unlatch

LBB (RBB) Failed to Unlatch

Unable to Deploy SAW

180

SABB Failed to Unlatch

LBB (RBB) Failed to Unlatch

Unable to deploy the solar array, mast is 0% deployed. Primary power channel XX is unable to support itself.

180

On MCC-H Go
Perform Manual Override to Latch/Unlatch SABB (EVA C/L, FS Reference)

Verify SABB Fully Latched

Verify telemetry
LBB(RBB) SW 01,02 Pin Released = Yes
LBB(RBB) SW 01,02 Latched = Yes
LBB(RBB) SW 01,02 Unlatched = No

Verify visually
Latch Position (four of eight) - Latched

Is SABB Fully Latched?

181 EVA Confirmation
EVA to Confirm SAW Containment within SABBs

182 SABB Failed to Latch

LBB (RBB) Failed to Latch

183 One SABB Remains Unlatched

Unable to Latch one SABB. Unlatched SABB but fully retracted SAW constraints apply. Potential exists for damaging the SAW during the P6 re-location.

184 Install SABB Restraint

A long duration tether restraint may be used in place of latching once the array is fully retracted. This will avoid all operational constraints for an unlatched SABB.

14 AUG 06

149
3.191 SAW XX FAILURE TO EXTEND MAST REMOTELY

1. ECU SAW Communicating
   - PVM:EPS:SAW XX
   - SAW XX
   - ECU XX
   Is Integ Cnt incrementing?
   Yes
   5. Power on Reset
      - sel SAW Firmware
      - SAW XX Firmware
      Does Power On Reset = X
      Yes
      6. Go to [3.150 BGA XX 1553/FWC ERRORS], all (SODF:EPS: MALFUNCTION: PRIMARYPOWER SYSTEM)
      No
   12

2. SAW Deploy Status
   - Is SAW XX Mast in Motion? (Visual Confirmation Required)
   No
   11

3. ECU BGA Communicating
   - PVM:EPS:BGA XX
   - BGA XX
   - ECU XX
   Is Integ Cnt incrementing?
   No
   2

4. Go to [3.110 BGA XX LOSS OF COMM], all (SODF: EPS: MALFUNCTION: PRIMARYPOWER SYSTEM)

5. Power on Reset
   - sel SAW Firmware
   - SAW XX Firmware
   Does Power On Reset = X
   Yes
   6. Go to [3.150 BGA XX 1553/FWC ERRORS], all (SODF:EPS: MALFUNCTION: PRIMARYPOWER SYSTEM)
   No

7. ECU SAW PS Powered
   - ECU SAW Power Supply remains powered but communication is lost.
   - Possible fault in SAW Firmware Controller or RT Failure.

8. SAW Power Must be Removed
   - If # of visible mast bays > 15 ½ OR
   - If SABBs are still in low tension mode.
   - Remove power to ECU immediately to prevent possible damage due to panel stiction.
   - If # of visible mast bays < 15 ½
   - Wait until the # of visible mast bays = 15 ½. Then remove power to ECU.

9

CAUTION
ALARM

BGA XX Loss of Comm - PVM

No C&W messages are available for SAW hardware

Power Channel Connectivity

<table>
<thead>
<tr>
<th>PVM</th>
<th>XX</th>
<th>YY</th>
<th>S4</th>
<th>1A</th>
<th>3A</th>
</tr>
</thead>
<tbody>
<tr>
<td>S4</td>
<td>3A</td>
<td>1A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S6</td>
<td>3B</td>
<td>1B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P4</td>
<td>2A</td>
<td>4A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P6</td>
<td>2B</td>
<td>4B</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Nominal Config:
ECU SAW XX:
RPCM XX A
RPC 1 - C1
RPCM YY A
RPC 2 - C1

14 AUG 06
3.191 SAW XX FAILURE TO EXTEND MAST REMOTELY

(PVMEPS:SAW XX)

Remove ECU/Mast MDA Power

PVM:EPS:SAW XX
SAW XX
sel RPCM YY A RPC 02
RPCM YY A RPC 02
cmd RPC Position - Open (Verify – Op)
SAW XX
sel RPCM XX A RPC 01
RPCM XX A RPC 01
cmd RPC Position - Open (Verify - Op)

Recover ECU

Go to procedure {1.3.400 ECU XX ACTIVATION}, (SODF: EPS: ACTIVATION AND CHECKOUT: CHANNEL ACTIVATION)

ECU Status

Was BGA Portion of ECU XX Activation successful?

No

3

Yes

4

ECU Status

Was SAW Portion of ECU XX Activation successful?

No

1

Yes

13 Continue SAW Deploy

MCC-H

Perform {1.3.452 SAW XX Deploy}, Steps 4-11 (SODF: EPS: ACTIVATION & CHECKOUT: CHANNEL ACTIVATION). Then re-power MDA and continue deploy.

Communication with the BGA is not required in order to complete SAW deploy/retract. This assumes that the BGA is already locked and at the SAW deployment position. BGA trouble-shooting can wait until after the array is deployed.

Remove the ECU power to remove power from the MDA. Note the ECU may attempt a power on reset after the first RPC is opened depending on which channel is supplying prime power to the ECU. Expect Caution message BGA XX Loss of Comm - PVM when RPC 01 is cmded open.
3.191 SAW XX FAILURE TO EXTEND MAST REMOTELY

---

5

14 Mast Status

- Mast Partially Extended
- Mast Failed to Extend

15 Verify LBB Telemetry

<table>
<thead>
<tr>
<th>PVM:EPS:SAW XX</th>
<th>SAW XX</th>
<th>‘SAW XX’</th>
</tr>
</thead>
</table>

Verify telemetry:
- LBB SW 01,02 Pin Released = Yes
- LBB SW 01,02 Latched = No
- LBB SW 01,02 Unlatched = Yes

Six good limit switches?

16 Verify RBB Telemetry

<table>
<thead>
<tr>
<th>PVM:EPS:SAW XX</th>
<th>SAW XX</th>
<th>‘SAW XX’</th>
</tr>
</thead>
</table>

Verify telemetry:
- RBB SW 01,02 Pin Released = Yes
- RBB SW 01,02 Latched = No
- RBB SW 01,02 Unlatched = Yes

Six good limit switches?

17 SABB Status

- Have SABBs been re-latched? (SABBs in Hi Tension Mode)

No
- Yes

18 Verify LBB Telemetry

<table>
<thead>
<tr>
<th>PVM:EPS:SAW XX</th>
<th>SAW XX</th>
<th>‘SAW XX’</th>
</tr>
</thead>
</table>

Verify telemetry:
- LBB SW 01,02 Pin Released = Yes
- LBB SW 01,02 Latched = Yes
- LBB SW 01,02 Unlatched = No

Six good limit switches?

19 Verify RBB Telemetry

<table>
<thead>
<tr>
<th>PVM:EPS:SAW XX</th>
<th>SAW XX</th>
<th>‘SAW XX’</th>
</tr>
</thead>
</table>

Verify telemetry:
- RBB SW 01,02 Pin Released = Yes
- RBB SW 01,02 Latched = Yes
- RBB SW 01,02 Unlatched = No

Six good limit switches?

20 Override Switch Indication

- sel SAW Software Inhibits
- SAW XX Software Inhibits

‘Deploy Reject’
- cmd Inhibit - Arm
- cmd Inhibit - Inhibit
- Verify Deploy Reject - Inh

21 Continue SAW Deploy

Continue (1.3.452 SAW XX Deploy), (SODF: EPS: ACTIVATION & CHECKOUT: CHANNEL ACTIVATION)

22 Yes

---

6

SABBs are latched after the mast has been deployed 1 mast bay in order to clear the latch mechanisms. Hi tension mode is used to reduce the potential for damage due to panel stiction problems.
3.191 SAW XX FAILURE TO EXTEND MAST REMOTELY

(MDA Temp Check)

Is Mast MDA Temp > 30 deg C?

No

Yes

(MDA Status)

Is Mast MDA On?

MDA Voltage, V > 10 (+/-2.8)

No

MDA Voltage, V > 10 (+/-2.8)

Yes

(MDA Temp Check)

Is Mast MDA Temp > 30 deg C?

No

Yes

(Override Hi Temp Reject)

'Hi Temp Reject'

cmd Inhibit - Arm

cmd Inhibit - Inhibit

Verify Hi Temp Reject - Inh

No

Yes

(Temp Limit set to Low)

Command was rejected by the Hi Temp Reject function. Temp limit is set to low for this function.

(Command Check)

Possible cmd error

(Continue SAW Deploy)

Continue (1.3.452 SAW XX Deploy), (SODF: EPS: ACTIVATION & CHECKOUT: CHANNEL ACTIVATION)

MDA operating temperature range is -54 to 48 deg C.
3.191 SAW XX FAILURE TO EXTEND MAST REMOTELY

(EPS/12A – ALL/EIN 1) Page 5 of 19

### MDA On and may be Driving

If Mast is deploying:
- Possible Mast Binding, or
- Degraded MDA but not enough to trigger FDIR. Monitor for Mast Deploy completion. Proceed to block 34 if SAW hardware begins to deform. Check with MCC-H if Mast stop moving.

- The manual MDA override lever is located on the back (inactive side) of the mast canister. (MDA current with no load = 0.3A)

### There is no overvoltage FDIR for the MDA. The MDA will continue to operate if a Voltage sensor has failed high. Check voltages of all MDAs. The multiple MDA On Reject FDIR will reject an MDA on command if another MDA is already on.

### Possible overdrive of MDA brake during retract of P6 arrays.

---

### MDA De-Coupled

MDA Decoupled from mast mechanism, mast must be deployed by EVA.

---

### Abort Mast Deploy

Send the Abort cmd if Mast is not moving.

- PVM:EWS:SAW XX
- SAW XX
- ‘Mast’
- sel SAW Mast Commands
- SAW XX Mast Commands
- **cmd** Mast - Abort

---

### Override Multiple MDA Reject

MDA Voltage sensor bias high is indicated, inhibit FDIR.

- PVM:EWS:SAW XX
- SAW XX
- ECU XX
- sel SAW Software Inhibits
- SAW XX Software Inhibits
- ‘Multi MDA On Reject’
- **cmd** Inhibit - Arm
- **cmd** Inhibit - Inhibit
- Verify Multi MDA On Reject - Inh

- Trend Data indicates MDA Voltage sensor is nominal.

---

### MDA On and may be Driving

If Mast is not deploying:
- MDA may be de-coupled from mechanism. Visually confirm EVA MDA override lever in the Automatic position.

---

### EVA MDA Override Lever Status

Is EVA MDA override lever in automatic position? (Refer to Figure 1)

---

### MDA Fault

MDA may be de-coupled from mast mechanism or the MDA drive capability has failed.

---

### Figure 1

![Image of a control panel labeled 'Automatic MDA Override Lever Status']
3.191 SAW XX FAILURE TO EXTEND MAST REMOTELY

ECU Firmware
MDA Over Current Trip occurs at 6.2 Amps. S/W Limit (0.78 A) is reached first and it does not set the MDA Over Current Trip Flag.

Disconnects are present in the MDA Over Temp FDIR. S/W Trip level = 77.7 deg C. F/W Trip level = 140 deg C. H/W damage occurs at 120 deg C. S/W Temp limit is reached first and it does not set the MDA Over Temp Trip Flag.

MDA Power off is a one step command.

Possible MDA H/W Failure, MDA Over Temp Trip or sensor failure

MDA Stall, Binding, or sensor failure

Possible MDA Over Current Trip

Possible MDA Over Temp Trip or sensor failure

Possible MDA Stall Condition

Possible MDA H/W Failure, MDA Stall, Binding, or sensor failure

MDA Stall Status

MCC Only
Did MDA Slow Alert = Slow prior to removal of MDA Power?

Clear MDA Indications

Verify S/W Trip Temperature

Is LBB, RBB or Mast MDA Temp > 74.4 deg C?

MDA Failure Unknown

Unknown MDA Failure. MDA Off, Check with MCC-H

MDA Power - Off
Verify MDA Voltage, V < 10 (+/- 2.8)
3.191 SAW XX FAILURE TO EXTEND MAST REMOTELY

(MCC-H Only)
Are there any ECU/BGA or SAW C&W flags set?

No

15

Yes

47

Any C&W Flags Set?

46

51

Dump Additional SAW Data

MCC-H Only
Check with MER for specific Dump Addresses and further action.

48

Re-attempt SAW Deploy

Re-power MDA and attempt Deploy.

49

Mast Deploy Status

Was deployment successful?

Yes

No

101

29

50

Continue SAW Deploy

Continue (1.3.452 SAW Deploy), (SODF: EPS: ACTIVATION AND CHECKOUT: CHANNEL ACTIVATION)

15

SAW Caution and Warning Flags are available for downlink only during missions that scheduled SAW activities. (e.g 12A) Flags are not available on PCS displays.
3.191 SAW XX FAILURE TO EXTEND MAST REMOTELY

- Check MDA Trend Data for Increase in Current
  - MCC-H Only
    - Does trend data for MDA Current indicate an overcurrent condition before MDA Power was removed?
  - No
    - Possible Data transient
  - Yes
    - Check RPCM Trend Data for Increase in Current
      - MCC-H Only
        - Does trend data for RPCM XX A indicate a high current condition before MDA power was removed?
      - No
        - Binding Position
          - Record # of mast bays visible at stall position.
      - Yes
        - MDA Stall indicated. Mast binding. Attempt to retract array a short distance then try to deploy again. It may be desirable to wait for a different thermal condition before reattempt.
- MDA Stall Status
  - MCC Only
    - Did MDA Slow Alert = Slow prior to removal of MDA Power?
  - No
    - Possible short or fault in MDA.
  - Yes
    - Confirm MDA Fault
      - PVM:EPS:SAW XX
        - 'Mast'
          - sel SAW Mast Commands
        - SAW XX Mast Commands
        - cmd MDA Power - On Arm
          - Verify MDA Voltage, V = 120 --- 125
          - Verify MDA Current, A < 0.2

- PVCU Software
  - MDA Over Current Trip occurs at 0.78 Amps.
  - If a Stall Condition is indicated, Current > 0.78 A and motor speed is < 25 RPM, power is removed from the MDA.
3.191 SAW XX FAILURE TO EXTEND MAST REMOTELY

**EPS**

14 AUG 06

---

**3.191 SAW XX FAILURE TO EXTEND MAST REMOTELY**

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---

**MDA Current Sensor Bias or Data Transient**

- **Check MDA Indications**
- **PVM:EPS:SAW XX**
- **SAW XX**
- **‘ECU XX’**
  
  Does MDA Current, A = 0.00 (+/- 0.4)

---

**Inhibit SAW MDA Motor Stall Safing**

- **sel SAW Software Inhibits**
- **SAW XX Software Inhibits**
- **sel SAW XX Motor Stall Safing**
- **SAW XX Motor Stall Safing**

---

**Inhibit Over Current Trip FI**

- **sel SAW Software Inhibits**
- **SAW XX Software Inhibits**
- **sel SAW XX Motor Stall Safing**
- **SAW XX Motor Stall Safing**

---

**Apply RPC Open Command Inhibit to prevent ECU Power Cycle**

- **Apply RPC Close Command Inhibit on prime ECU Power supply to prevent ECU Power Cycle.**
- **PVM:EPS:SAW XX**
- **SAW XX**
- **sel RPCM YY (XX) A RPC 01**
- **RPCM YY (XX) A RPC 01**

---

**IF** Current sensor fails high > 0.78 A RPCs providing power to ECU will be opened. A new PPL with a higher current limit must be uploaded before the ECU can be recovered. There is no inhibit for SAW MDA Motor Stall Persistent Current Safing. Refer to block 3.

---

**However, all MDAs use the same current sensor. A new PPL 69 must be uplinked prior to SAW operations or Inhibit the RPC Open Command to avoid power cycling the ECU.**

---

**Continue SAW Deploy**

- **Continue (1.3.452 SAW XX Deploy), (SODF: EPS: ACTIVATION AND CHECKOUT: CHANNEL ACTIVATION)**

---

**18**

**19**

---

159
3.191 SAW XX FAILURE TO EXTEND MAST REMOTELY

51 Clear CW Flag Indications

PVM:EPS:EPS Software
EPS Software
PV SW
PV Cmd Resp Clear
‘SAW Command Response Clear’
cmd Arm
cmd Clear

61 Set SAW Mast Abort

PVM:EPS:SAW XX
SAW XX
‘SAW XX’
sel SAW Mast Commands
SAW XX Mast Commands

cmd Mast - Abort

71 Clear MDA Indications

PVM:EPS:SAW XX
SAW XX
‘SAW XX’
sel SAW Mast Commands
SAW XX Mast Commands

cmd MDA Power - Off
Verify MDA Voltage, V < 10 (+/- 2.8)

77 Turn MDA On

cmd MDA Power - On Arm
cmd MDA Power - On
Verify MDA Voltage, V = 120 --- 125

78 Deploy Mast

Monitor mast deploy with cameras.
Continue (1.3.452 SAW XX Deploy), (SODF: EPS: ACTIVATION & CHECKOUT: CHANNEL ACTIVATION)

79 Mast Deploy Status

Was deployment successful?

Yes

No

102 Continue SAW Deploy

Continue (1.3.452 SAW XX Deploy), (SODF: EPS: ACTIVATION & CHECKOUT: CHANNEL ACTIVATION)

81 Mast Retract Status

Was retraction successful?

Yes

No

76 Mast Binding. Mast in partially deployed state and cannot be extended or retracted. It may be desirable to wait for a different thermal condition before reattempt.

75 Retract Mast and Abort

Monitor mast retract with cameras.
cmd Mast - Retract Arm
cmd Mast - Retract
Retract at least 1 bay then Abort
cmd Mast - Abort

74 Mast Retract Status

Was retraction successful?

Yes

No

150 Deploy Opposite SAW

If opposite SAW has not been deployed, reconfigure cameras and deploy now.

20 MDA Abort must be sent to prevent MDA from driving once power is re-applied. This is a single step cmd

21 Confirm that ISS Thrusters are inhibited or ISS/Orbiter in Free Drift and no crew un-isolated exercise or max EVA loads prior to sending the Deploy or Retract command. If at any time mechanical movement is stopped or aborted, attitude control may be resumed.
3.191 SAW XX FAILURE TO EXTEND MAST REMOTELY

EPS

(PV:EPS:SAW XX)

'Saw' sel SAW Mast Commands

 cmd MDA Power - Off
 Verify MDA Voltage, V < 10 (+/- 2.8)

83 Clear MDA Indications

PVM:EPS:SAW XX

SAW XX

'Mast' sel SAW Mast Commands

SAW XX Mast Commands

84 Verify S/W Trip Temperature

PVM:EPS:SAW XX

SAW XX

Is LBB, RBB or Mast MDA Temp > 74.4 deg C?

85 Check MDA Trend Data for Increase in Temperature

MCC-H Only

Is a steady MDA Temp increase over time indicated in trend data just before MDA power was removed?

86 MDA Temp Sensor Failure

87 Set SAW Mast Abort

PVM:EPS:SAW XX

SAW XX

'Mast' sel SAW Mast Commands

SAW XX Mast Commands

 cmd MDA Power - Off
 Verify MDA Voltage, V < 10 (+/- 2.8)

88 Clear MDA Indications

 cmd MDA Power - Off
 Verify MDA Voltage, V < 10 (+/- 2.8)

89 Assess Inhibit

MCC-H Only

Assess use of MDA based on last good Temp value.

90 Data Transient

91 MDA Over Temp Condition

92 Set SAW Mast Abort

PVM:EPS:SAW XX

SAW XX

'Mast' sel SAW Mast Commands

SAW XX Mast Commands

 cmd Mast - Abort

93 Clear MDA Indications

 cmd MDA Power - Off
 Verify MDA Voltage, V < 10 (+/- 2.8)

94 Assess Inhibit

Check with MCC-H to determine if inhibiting the MDA Over Temp Safing FI is appropriate.

95 No

96 MDA Power off is a one step command.

97 MCC-H Only

Assess use of MDA based on last good Temp value.

98 Measurement Out of Range will be indicated if MDA temp >72.2 deg C.

99 Per Flight Rule B9-207, MDA operations can proceed even if MDA temp is high in order to meet critical mission objectives.

100

MDA Power off is a one step command.

Disconnects are present in the MDA Over Temp FDIR. S/W Trip level = 77.7 deg C. F/W Trip level = 140 deg C. H/W damage occurs at 120 deg C. At a minimum a 30 deg C Mast MDA Temp increase should be protected for during mast deploy/retract.

Since S/W Temp limit is reached first and it does not set the MDA Over Temp Trip flag, a MDA Abort must sent to prevent MDA from driving, once power is re-applied. This is a single step cmd.

Per Flight Rule B9-207, MDA operations can proceed even if MDA temp is high in order to meet critical mission objectives. Measurement Out of Range will be indicated if MDA temp >72.2 deg C.

14 AUG 06
3.191 SAW XX FAILURE TO EXTEND MAST REMOTELY

(P/M:EPS:SAW XX
'SAW XX Software Inhibits
'SAW XX Temp Safing
'Mast MDA'
'Over Temp Safing' 
Primary PVCU 

Inhibit Over Temp Safing
PVM:EPS:SAW XX
'SAW XX Software Inhibits
'SAW XX Temp Safing

Inhibit Over Temp Trip Function
If necessary
'SAW XX Temp Safing

Let MDA Cool or Deploy Via EVA
Let MDA cool to < 44.4 deg C and re-attempt deploy or Deploy via EVA

Deploy Via EVA?
Yes
No

Let MDA Cool
Let MDA cool to < 44.4 deg C and re-attempt deploy.

Continue SAW Deploy
Continue {1.3.452 SAW XX Deploy},
(SODF: EPS: ACTIVATION AND CHECKOUT: CHANNEL ACTIVATION)

Disconnects are present in the MDA Over Temp FDIR. S/W Trip level = 77.7 deg C. F/W Trip level = 140 deg C. H/W damage occurs at 120 deg C. At a minimum a 30 deg C Mast MDA Temp increase should be protected for during mast deploy/retract.
3.191 SAW XX FAILURE TO EXTEND MAST REMOTELY

Mast MDA Failed
Mast deploy must be accomplished by EVA.

Mast Hardware Binding
Mast deploy must be attempted via EVA.

Remove Mast MDA Power
PVM/EPS: SAW XX
SAW XX
Mast
set SAW Mast Commands
SAW XX Mast Commands
cmd MDA Power - Off
Verify MDA Voltage, V < 10 (+/- 2.8)

Deploy Opposite SAW
If opposite SAW has not been deployed, reconfigure cameras and deploy now.

Mast Status
Is the # of visible mast bays = 1 or more?

SABB Status
Have SABBs been re-latched? (SABBs in Hi Tension Mode)

Latch SABBs
Perform (1.3.452 SAW XX Deploy), Steps 13, 14 (SODF: EPS: ACTIVATION AND CHECKOUT: CHANNEL ACTIVATION)

Deploy Mast & Latch SABBs
Deploy mast 1 bay and latch SABBs

Position SAW for Mast Deploy via EVA
Perform (2.101 PVM BGA XX Engage Antirotation Latch) (SODF: EPS: NOMINAL: PRIMARY POWER SYSTEM)
Use:
Cmded Angle = 180 deg
Latch Select = 1

Deploy 1 Mast Bay via EVA
On MCC-H Go
Perform (Manual Override to Extend/Retract Mast) (EVA C/L, FS Reference)

This step can take up to 1 hr to complete. The latch cmd can be sent when the BGA Actual Angle is within 1 deg of the commanded value in order to save time.

This step may be omitted if EVA crew can free float and drive the Mast MDA.
3.191 SAW XX FAILURE TO EXTEND MAST REMOTELY

3.191 SAW XX FAILURE TO EXTEND MAST REMOTELY

111 Position SAW for Mast Deploy via EVA


Use:
Cmded Angle = 180 deg
Latch Select = 1

This step can take up to 1 hr to complete. The latch cmd can be sent when the BGA Actual Angle is within 1 deg of the commanded value in order to save time.

112 Complete Mast Deploy via EVA

On MCC-H Go
Perform [Manual Override to Extend/Retract Mast] (EVA C/L, FS Reference)

Verify Mast Fully Deployed

PVM:EPS:SAW XX

"SAW XX"

Verify telemetry
Mast SW 01,02 Retracted = No
Mast SW 01,02 Deployed = Yes

Verify visually
Tension Bar - Pulled away from blanket box (as last mast bay deploys)
Number of visible mast bays = 31.5
Guide rollers on final bay - visible (yellow flex batten)

Is Mast Fully Deployed?

Yes

Return to Nominal Procedure

Continue [1.3.452 SAW XX Deploy], (SODF: EPS: ACTIVATION AND CHECKOUT: CHANNEL ACTIVATION)

No

113 Verify Mast Fully Deployed

Is this the first attempt to deploy the mast via EVA?

No

115 EVA Deploy Attempts

116 Mast Hardware Binding

Wait for better thermal conditions and re-attempt Mast deploy via EVA.

Yes

114 Return to Nominal Procedure

No

112 Complete Mast Deploy via EVA

On MCC-H Go
Perform [Manual Override to Extend/Retract Mast] (EVA C/L, FS Reference)

Verify Mast Fully Deployed

PVM:EPS:SAW XX

"SAW XX"

Verify telemetry
Mast SW 01,02 Retracted = No
Mast SW 01,02 Deployed = Yes

Verify visually
Tension Bar - Pulled away from blanket box (as last mast bay deploys)
Number of visible mast bays = 31.5
Guide rollers on final bay - visible (yellow flex batten)

Is Mast Fully Deployed?

Yes

Return to Nominal Procedure

Continue [1.3.452 SAW XX Deploy], (SODF: EPS: ACTIVATION AND CHECKOUT: CHANNEL ACTIVATION)

No

115 EVA Deploy Attempts

116 Mast Hardware Binding

Wait for better thermal conditions and re-attempt Mast deploy via EVA.

Yes

112 Complete Mast Deploy via EVA

On MCC-H Go
Perform [Manual Override to Extend/Retract Mast] (EVA C/L, FS Reference)

Verify Mast Fully Deployed

PVM:EPS:SAW XX

"SAW XX"

Verify telemetry
Mast SW 01,02 Retracted = No
Mast SW 01,02 Deployed = Yes

Verify visually
Tension Bar - Pulled away from blanket box (as last mast bay deploys)
Number of visible mast bays = 31.5
Guide rollers on final bay - visible (yellow flex batten)

Is Mast Fully Deployed?

Yes

Return to Nominal Procedure

Continue [1.3.452 SAW XX Deploy], (SODF: EPS: ACTIVATION AND CHECKOUT: CHANNEL ACTIVATION)

No

115 EVA Deploy Attempts

116 Mast Hardware Binding

Wait for better thermal conditions and re-attempt Mast deploy via EVA.

Yes

112 Complete Mast Deploy via EVA

On MCC-H Go
Perform [Manual Override to Extend/Retract Mast] (EVA C/L, FS Reference)

Verify Mast Fully Deployed

PVM:EPS:SAW XX

"SAW XX"

Verify telemetry
Mast SW 01,02 Retracted = No
Mast SW 01,02 Deployed = Yes

Verify visually
Tension Bar - Pulled away from blanket box (as last mast bay deploys)
Number of visible mast bays = 31.5
Guide rollers on final bay - visible (yellow flex batten)

Is Mast Fully Deployed?

Yes

Return to Nominal Procedure

Continue [1.3.452 SAW XX Deploy], (SODF: EPS: ACTIVATION AND CHECKOUT: CHANNEL ACTIVATION)

No

115 EVA Deploy Attempts

116 Mast Hardware Binding

Wait for better thermal conditions and re-attempt Mast deploy via EVA.

Yes

112 Complete Mast Deploy via EVA

On MCC-H Go
Perform [Manual Override to Extend/Retract Mast] (EVA C/L, FS Reference)

Verify Mast Fully Deployed

PVM:EPS:SAW XX

"SAW XX"

Verify telemetry
Mast SW 01,02 Retracted = No
Mast SW 01,02 Deployed = Yes

Verify visually
Tension Bar - Pulled away from blanket box (as last mast bay deploys)
Number of visible mast bays = 31.5
Guide rollers on final bay - visible (yellow flex batten)

Is Mast Fully Deployed?

Yes

Return to Nominal Procedure

Continue [1.3.452 SAW XX Deploy], (SODF: EPS: ACTIVATION AND CHECKOUT: CHANNEL ACTIVATION)

No

115 EVA Deploy Attempts

116 Mast Hardware Binding

Wait for better thermal conditions and re-attempt Mast deploy via EVA.

Yes

112 Complete Mast Deploy via EVA

On MCC-H Go
Perform [Manual Override to Extend/Retract Mast] (EVA C/L, FS Reference)

Verify Mast Fully Deployed

PVM:EPS:SAW XX

"SAW XX"

Verify telemetry
Mast SW 01,02 Retracted = No
Mast SW 01,02 Deployed = Yes

Verify visually
Tension Bar - Pulled away from blanket box (as last mast bay deploys)
Number of visible mast bays = 31.5
Guide rollers on final bay - visible (yellow flex batten)

Is Mast Fully Deployed?

Yes

Return to Nominal Procedure

Continue [1.3.452 SAW XX Deploy], (SODF: EPS: ACTIVATION AND CHECKOUT: CHANNEL ACTIVATION)

No

115 EVA Deploy Attempts

116 Mast Hardware Binding

Wait for better thermal conditions and re-attempt Mast deploy via EVA.

Yes

112 Complete Mast Deploy via EVA

On MCC-H Go
Perform [Manual Override to Extend/Retract Mast] (EVA C/L, FS Reference)

Verify Mast Fully Deployed

PVM:EPS:SAW XX

"SAW XX"

Verify telemetry
Mast SW 01,02 Retracted = No
Mast SW 01,02 Deployed = Yes

Verify visually
Tension Bar - Pulled away from blanket box (as last mast bay deploys)
Number of visible mast bays = 31.5
Guide rollers on final bay - visible (yellow flex batten)

Is Mast Fully Deployed?
117. ECU SAW Failure
Possible ECU SAW Firmware Power Supply, or RT Failure. Possible fault on ECU SAW power string below ECU input power selector circuit breaker.

118. Verify ECU Power
MCC-H Only
Does trend data for RPCM XX A Input Current indicate that half of the ECU housekeeping power was lost?

119. Verify MDA Power
MCC-H Only
Does trend data for RPCM XX A Input Current indicate MDA is on?

120. Verify MDA State
MCC-H Only
Does trend data for RPCM XX A Input Current indicate MDA is driving?

121. ECU SAW PS Powered & MDA Driving
ECU SAW Power Supply remains powered & MDA is driving but communication is lost. Possible fault in SAW Firmware controller. BGA operations are unaffected.

122. ECU SAW PS Powered & MDA off
ECU SAW Power Supply is on and MDA is off. Possible ECU SAW Power Supply output failure or fault downstream of ECU SAW PS. BGA operations are unaffected.

123. Deploy Opposite SAW
If opposite SAW has not been deployed, reconfigure cameras and deploy now.

124. ECU SAW PS & MDA Powered
ECU SAW Power Supply and MDA remain powered but communication is lost. Possible fault in SAW Firmware controller or SAW RT Failure. BGA operations are unaffected.

125. ECU SAW PS Powered & MDA off
ECU SAW Power Supply is on and MDA is off. Possible ECU SAW Power Supply output failure or fault downstream of ECU SAW PS. BGA operations are unaffected.

28. Total ECU housekeeping power is 115W (0.93A) at initialization and before BGA mtr or MDAs are turned on. Half of the ECU housekeeping power is 57.5W (0.47A)

29. When the MDA is on it draws about 0.22A. When the MDA is driving it can draw as high as 3.0A. MDA over current trip occurs at 0.78A. The MDA will stop driving but will remain on if one of the two “Deployed” limit switches have contacted.
3.191 SAW XX FAILURE TO EXTEND MAST REMOTELY

125 Reset ECU SAW Remote Terminal

MCC-H Only
Perform ECU SAW RT Reset from Ground:
For P6 Solar Arrays
CI PUI=P6PW96IM0042K
SPUI=USPZ21MD0702
SAW 2B = 33804
SAW 4B = 17420
For P4 Solar Arrays
CI PUI=P4PW95SM0042K
SPUI=USPZ21MD0702
SAW 2A = 17164
SAW 4A = 33548
For S6 Solar Arrays
CI PUI=S6PX96IM0484K
SPUI=USPZ21MD0702
SAW 1B = 33292
SAW 3B = 16908
For S4 Solar Arrays
CI PUI=S4PW95SM0042K
SPUI=USPZ21MD0702
SAW 1A = 16652
SAW 3A = 33036

126 ECU SAW Communicating
PVM:EPS:SAW XX
SAW XX
"ECU XX"
Is Integ Cnt incrementing?

127 Remove ECU Power
PVM:EPS:SAW XX
SAW XX
sel RPCM YY A RPC 02
RPCM YY A RPC 02
cmd RPC Position - Open (Verify - Op)
SAW XX
sel RPCM XX A RPC 01
RPCM XX A RPC 01
cmd RPC Position - Open (Verify - Op)

128 Communication Restored
Communication with the SAW has been restored. Confirm SAW and BGA configurations are as expected before continuing nominal procedure.

129 Continue SAW Deploy
Continue (1.3.452 SAW XX Deploy), (SODF: EPS: ACTIVATION AND CHECKOUT: CHANNEL ACTIVATION)

30 Removes Power from MDA. When power is re-applied to the ECU the MDA will be off.
31 MCC-H must build and perform this step from command inventory.
32 Expect Caution message BGA XX Loss of Comm - PVM when RPC 01 is cmded open.
3.191 SAW XX FAILURE TO EXTEND MAST REMOTELY

(EPS/12A – ALL/FIN 1) Page 17 of 19

130 Apply Power to ECU

Attempt to recover SAW capability by activating ECU on Redundant power source.
PVM/EPS:SAW XX
SAW XX
sel RPCM YY A RPC 02

RPCM YY A RPC 02

cmd RPC Position - Close (Verify - Cl)

131 ECU SAW Communication

PVM/EPS:SAW XX
SAW XX
ECU XX

Is Integ Cnt incrementing?

Yes

136 Continue SAW Deploy

Continue (1.3.452 SAW XX Deploy).
(SODF: EPS: ACTIVATION AND CHECKOUT: CHANNEL ACTIVATION)

No

Communication Lost with SAW Firmware

Possible SAW RT or Firmware Controller failure. Mast Deploy, LBB and RBB Unlatching and Tensioning must be accomplished by EVA.
BGA operations are unaffected.

132 Deploy Opposite SAW

If opposite SAW has not been deployed. Reconfigure cameras and deploy it now.

133 ECU BGA Communication

PVM/EPS:BGA XX
BGA XX
ECU XX

Is Integ Cnt incrementing?

Yes

135 BGA Common Clear

BGA XX
ECU XX
sel BGA Software Inhibits
BGA XX Software Inhibits

Clear Commands

cmd Common Clear
Verify Power On Reset - < blank>

No

137 ECU SAW Power Lost

Possible ECU SAW Power Supply Failure or fault on ECU SAW power string below ECU input power selector circuit breaker. BGA operations are unaffected.

138 Override SAW Indications

BGA XX
ECU XX
sel BGA Software Inhibits
BGA XX Software Inhibits

'SAW Deployment'
'SPrimary PVCU'

cmd Enable - Arm
cmd Enable - Enable
Verify SAW Deployment - Ena

'SBackup PVCU'

cmd Enable - Arm
cmd Enable - Enable
Verify SAW Deployment - Ena

33 Caution message BGA XX 1553/ FWC Errors- PVM may be received after RPC 01 is closed.

34 ECU power is supplied by channel (XX) for SAW Deployment operations.

36 If power was removed from the ECU you must begin again with step 1 of the Deploy/Retract procedure, to reset the F/W inhibits.

14 AUG 06
3.191 SAW XX FAILURE TO EXTEND MAST REMOTELY

**Mission Manifestation:**

- **Failure Type:** SAW PS, FWC or RT Lost
- **Action Required:** Mast deploy, LBB and RBB
- **Note:** Latch must be accomplished by EVA.

**Flowchart Description:**

1. **Mast Status**
   - Is the # of visible mast bays = 1 or more?
     - **Yes:** Deploy mast 1 bay and latch SABBs.
     - **No:** Others.

2. **SABB Status**
   - Have SABBs been re-latched? (SABBs in Hi Tension Mode)
     - **Yes:** Deploy mast 1 bay and latch SABBs.
     - **No:** Others.

3. **Position SAW for Mast Deploy via EVA**
   - Perform (2.101 PVM BGA XX Engage Antirotation Latch) (SODF: EPS NOMINAL: PRIMARY POWER SYSTEM)
     - Use:
       - Cmded Angle = 180 deg
       - Latch Select = 1

4. **Mast Deploy via EVA**
   - On MCC-H Go
     - Perform (Manual Override to Extend/Retract Mast) (EVA C/L, FS Reference)
     - Verify visually:
       - Tension Bar - Pulled away from blanket box (as last mast bay deploys)
       - Number of visible mast bays = 31.5
       - Guide rollers on final bay - visible (yellow flex batten)

5. **Verify Mast Fully Deployed**
   - Is Mast Fully Deployed?
     - **Yes:** Deploy mast 1 bay and latch SABBs.
     - **No:** Others.

6. **EVA Deploy Attempts**
   - Is this the first attempt to deploy the mast via EVA?
     - **Yes:** Wait for better thermal conditions and re-attempt Mast deploy via EVA.
     - **No:** Others.

7. **Mast Hardware Binding**
   - No thermal conditioning of the SAW is required if manually deploying, due to fact that it takes longer to deploy and it is warming throughout the manual deploy, also the crew can respond faster to stop the deploy.

**Additional Notes:**

- **This step may be omitted if EVA crew can free float and drive the Mast MDA.**
- **This step can take up to 1 hr to complete.**
- The latch cmd can be sent when the BGA Actual Angle is within 1 deg of the commanded value in order to save time.

---

138 134 138

139 138

140 147

141 147

142 149

143 27

144 149

145 147

146 26

147 147

148 150

149 147
Mast Failed to Extend

Is Mast partially deployed?

No

Mast is 0% Deployed
Primary Power Channel Lost

Yes

Percent Mast is Deployed

Record number of visible mast bays:

# of Bays | % Deployed
--- | ---
31.5 | 100
28 | 90
25 | 80
22 | 70
19 | 60
16 | 50
13 | 40
9 | 30
6 | 20
3 | 10
0 | 0

Record Percent Deployed:

% Mast is Partially Deployed

Primary power generation capability degraded for affected channel.

Assess short term impacts:
1. Attitude control restrictions
2. Power generation capability
3. Departure restrictions
4. Crew exercise constraints

Assess long term impacts to:
1. Future rendezvous ops
2. SAW retract capability

Return to Nominal Procedure

Continue (3.452 SAW Deploy), Steps 18-20 (SODF: EPS: ACTIVATION AND CHECKOUT: CHANNEL ACTIVATION)

Mast is 0% Deployed

Primary Power Channel Lost

Tensioning the SAW is ineffective if < 31.5 bays are visible.

Remove MDA Power (Mast MDA-Off) if you have not already done so.

Go to (3.193 SAW XX FAILURE TO LATCH (TENSION) SABB REMOTELY), EVA support steps only (SODF:EPS: MALFUNCTION:PRIMARY POWER)
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3.192 SAW XX FAILURE TO RETRACT MAST REMOTELY

Go to procedure {1.3.400 ECU XX ACTIVATION}, (SODF: EPS: ACTIVATION AND CHECKOUT: CHANNEL ACTIVATION)

Remove the ECU power to remove power from the MDA. ECU power is supplied by the opposite deck channel (YY) for SAW Retraction operations. Expect Caution message BGA XX Loss of Comm - PVM when RPC 01 is cmded open.
3.192 SAW XX FAILURE TO RETRACT MAST REMOTELY

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5

14 Mast Status
Mast Partially Extended
Mast Failed to Retract

15 Verify LBB Telemetry
PVM:EPS:SAW XX
SAW XX
'SAW XX'
Verify telemetry
LBB SW 01,02 Pin Released = Yes
LBB SW 01,02 Latched = No
LBB SW 01,02 Unlatched = Yes
Six good limit switches?

16 Verify RBB Telemetry
PVM:EPS:SAW XX
SAW XX
'SAW XX'
Verify telemetry
RBB SW 01,02 Pin Released = Yes
RBB SW 01,02 Latched = No
RBB SW 01,02 Unlatched = Yes
Six good limit switches?

17 SABB Status
Have SABBs been unlatched?

No

18 Verify LBB Telemetry
PVM:EPS:SAW XX
SAW XX
'SAW XX'
Verify telemetry
LBB SW 01,02 Pin Released = Yes
LBB SW 01,02 Latched = Yes
LBB SW 01,02 Unlatched = No
Six good limit switches?

19 Verify RBB Telemetry
PVM:EPS:SAW XX
SAW XX
'SAW XX'
Verify telemetry
RBB SW 01,02 Pin Released = Yes
RBB SW 01,02 Latched = Yes
RBB SW 01,02 Unlatched = No
Six good limit switches?

20 Override Switch Indication
sel SAW Software Inhibits
SAW XX Software Inhibits
'Deploy Reject'
 cmd Inhibit - Arm
 cmd Inhibit - Inhibit
 Verify Deploy Reject - Inh

21 Continue SAW Retract
Continue (4.118 P6 SAW XX Retract (P6 ON Z1 TRUSS)), (SODF: EPS: CORRECTIVE:PRIMARY POWER).

6

SABBs are unlatched after the mast has been retracted until only 1 mast bay is visible so the SABB cover is clear of the latch operations.
3.192 SAW XX FAILURE TO RETRACT MAST REMOTELY

(Pg 4 of 20)

16 19

22 MDA Temp Check
Is Mast MDA Temp > 30 deg C?

23 Hi Temp Reject FI Status
- sel SAW Software Inhibits
- SAW XX Software Inhibits
- sel SAW XX Temp Safing
- SAW XX Temp Safing

Hi Temp Reject = Inh?

24 Command Check
Possible cmd error

25 Temp Limit set to Low
Command was rejected by the Hi Temp Reject function. Temp limit is set to low for this function.

26 Override Hi Temp Reject
- ‘Hi Temp Reject’ cmd Inhibit - Arm
- cmd Inhibit - Inhibit
- Verify Hi Temp Reject - Inh

27 Continue SAW Retract

Continue (4.118 P6 SAW XX Retract P6 ON Z1 TRUSS), (SODF: EPS: CORRECTIVE:PRIMARY POWER)

28 MDA Status
Is Mast MDA On?
MDA Voltage, V > 10 (+/-2.8)

29

MDA operating temperature range is -54 to 48 deg C.
3.192 SAW XX FAILURE TO RETRACT MAST REMOTELY
(EPS/12A – ALL/FIN) Page 5 of 20

31. MDA On and may be Driving

If Mast is not retracting:
MDA may be de-coupled from mechanism. Visually confirm EVA MDA override lever in the Automatic position.

32. EVA MDA Override Lever Status

Is EVA MDA override lever in automatic position? (Refer to Figure 1)

33. MDA Fault

MDA may be de-coupled from mast mechanism or the MDA drive capability has failed.

34. Abort Mast Retract

Send the Abort cmd if Mast is not moving.
PVM:EPM:SOW XX
SAW XX
‘Mast’
Sel SAW Mast Commands
SAW XX Mast Commands
cmd Mast - Abort

35. MDA On and may be Driving

If Mast is retracting:
Possible Mast Binding, or Degraded MDA but not enough to trigger FDIR. Monitor for Mast Retract completion. Proceed to block 34 if SAW hardware begins to deform. Check with MCC-H if Mast stop moving

36. MDA De-Coupled

MDA Decoupled from mast mechanism, mast must be retracted by EVA.

8. The manual MDA override lever is located on the back (inactive side) of the mast canister. (MDA current with no load = 0.3A)

9. There is no overvoltage FDIR for the MDA. The MDA will continue to operate if a Voltage sensor has failed high. Check voltages of all MDAs. The multiple MDA On Reject FDIR will reject an MDA on command if another MDA is already on.

10. If MDA de-coupled you may not be able to tell if the MDA is driving based on the current.

Figure 1
3.192 SAW XX FAILURE TO RETRACT MAST REMOTELY

ECU Firmware
MDA Over Current Trip occurs at 6.2 Amps. S/W Limit (0.78 A) is reached first and it does not set the MDA Over Current Trip Flag.

Disconnects are present in the MDA Over Temp FDIR. S/W Trip level = 77.7 deg C. F/W Trip level = 140 deg C. H/W damage occurs at 120 deg C. S/W Temp limit is reached first and it does not set the MDA Over Temp Trip Flag.

MDA Power off is a one step command.

MDA Stall Status
Did MDA Slow Alert = Slow prior to removal of MDA Power?

Clear MDA Indications
Verify MDA Voltage, V < 10 (+/- 2.8)

MDA Off
Possible MDA H/W Failure, MDA Over Current Trip, MDA Over Temp Trip, MDA Stall, Binding, or sensor failure

Over Current Detection
PVM:EPS:SAW XX
SAW XX
‘ECU XX’
Does Over Current Trip = X

Over Temperature Detection
PVM:EPS:SAW XX
SAW XX
‘LBB(RBB) MDA’
Does Over Temp Trip = X

Possible MDA Over Current
Possible MDA H/W Failure, MDA Over Current Condition MDA Stall, Binding, or sensor failure

Possible MDA Over Temp
Possible MDA H/W Failure, MDA Over Temp Condition or sensor failure

Possible MDA Stall Condition
Possible MDA H/W Failure, MDA Stall, or Binding

Verify S/W Trip Temperature
PVM:EPS:SAW XX
SAW XX
Is LBB, RBB or Mast MDA Temp > 74.4 deg C?

MDA Failure Unknown
Unknown MDA Failure. MDA Off, Check with MCC-H

MCC Only
Did MDA Slow Alert = Slow prior to removal of MDA Power?
3.192 SAW XX FAILURE TO RETRACT MAST REMOTELY

MCC-H Only
Are there any ECU/BGA or SAW C&W flags set?

Yes

Dump Additional SAW Data

MCC-H Only
Check with MER for specific Dump Addresses and further action.

No

Re-attempt SAW Retract
Re-power MDA and attempt Retract.

Mast Retract Status
Was retraction successful?

Yes

No

Continue SAW Retract
Continue (4.118 P6 SAW XX Retract (P6 ON Z1 TRUSS)), (SODF: EPS: CORRECTIVE:PRIMARY POWER)

SAW Caution and Warning Flags are available for downlink only during missions that scheduled SAW activities. (e.g 12A) Flags are not available on PCS displays.
3.192 SAW XX FAILURE TO RETRACT MAST REMOTELY

14 AUG 06

13
MDA Power off is a one step command.

15
PVCU Software MDA Over Current Trip occurs at 0.78 Amps.

16
If a Stall Condition is indicated, Current > 0.78 A and motor speed is < 25 RPM, power is removed from the MDA

52
Possible MDA fault, MDA Stall, or Binding

53
Clear MDA Indications

54
Verify MDA Voltage, V < 10 (+/- 2.8)

55
Check MDA Trend Data for Increase in Current

56
MDA Stall Status

57
Possible short or fault in MDA.

58
Confirm MDA Fault

60
MCC-H Only
Does trend data for RPCM XX A indicate a high current condition before MDA power was removed?

61
Check RPCM Trend Data for Increase in Current

62
MDA Stall indicated. Mast binding. Attempt to deploy array a short distance then try to retract again. It may be desirable to wait for a different thermal condition before reattempt.

63
Record # of mast bays visible at stall position.

64
Possible Data transient

65
Yes

66
No

67
MCC-H Only
Does trend data for MDA Current indicate an overcurrent condition before MDA Power was removed?

68
No

69
Yes

70
MCC-H Only
Does trend data for RPCM XX A indicate a high current condition before MDA power was removed?

71
Check MDA Trend Data for Increase in Current

72
Confirm MDA Fault

73
Verify MDA Voltage, V = 120 --- 125

74
Verify MDA Current, A < 0.2

75
MCC-H Only
Does trend data for RPCM XX A indicate a high current condition before MDA power was removed?

76
MDA Stall Status

77
Possible MDA fault, MDA Stall, or Binding

78
Clear MDA Indications

79
Verify MDA Voltage, V < 10 (+/- 2.8)

80
Check MDA Trend Data for Increase in Current

81
MDA Stall Status

82
Possible short or fault in MDA.

83
Confirm MDA Fault

84
Verify MDA Voltage, V = 120 --- 125

85
Verify MDA Current, A < 0.2

86
Is a short indicated?

87
Yes

88
No

89
MCC-H Only
Does trend data for RPCM XX A indicate a high current condition before MDA power was removed?
3.192 SAW XX FAILURE TO RETRACT MAST REMOTELY

(EPS/12A – ALL/FIN) Page 9 of 20

If Current sensor fails high > 0.78 A RPCs providing power to ECU will be opened. A new PPL with a higher current limit must be uploaded before the ECU can be recovered. There is no inhibit for SAW MDA Motor Stall Persistent Current Safing. Refer to block 3.

However, all MDAs use the same current sensor. A new PPL must be uplinked prior to SAW operations or Inhibit the RPC Open Command to avoid power cycling the ECU.
3.192 SAW XX FAILURE TO RETRACT MAST REMOTELY

(MPS/2A – ALL/FN) Page 10 of 20

1. Clear CW Flag Indications
   - PVM/EP: SAW XX
   - EPS Software
   - PVM SW: Sel Cmd Resp Clear
   - PV Cmd Response Clear
   - 'SAW Command Response Clear'
   - cmd Arm
   - cmd Clear

2. Set SAW Mast Abort
   - PVM/EP: SAW XX
   - SAW XX
   - 'SAW XX'
   - Sel SAW Mast Commands
   - SAW XX Mast Commands
   - cmd Mast - Abort

3. Turn MDA On
   - cmd MDA Power - On
   - Verify MDA Voltage, V = 120 --- 125

4. Deploy Mast and Abort
   - Monitor mast retract with cameras.
   - cmd Mast - Deploy Arm
   - cmd Mast - Deploy
   - Deploy at least 1 bay then Abort
   - cmd Mast - Abort

5. Mast Deploy Status
   - Was deployment successful?
   - No

6. Mast Binding. Mast in partially deployed state and cannot be extended or retracted. It may be desirable to wait for a different thermal condition before reattempt.

7. Clear MDA Indications
   - PVM/EP: SAW XX
   - SAW XX
   - Sel SAW Mast Commands
   - SAW XX Mast Commands
   - cmd MDA Power - Off
   - Verify MDA Voltage, V < 10 (+/- 2.8)

8. Turn MDA On
   - cmd MDA Power - On
   - Verify MDA Voltage, V = 120 --- 125

9. Retract Mast
   - Monitor mast retract with cameras.
   - Continue {4.118 P6 SAW XX Retract (P6 ON Z1 TRUSS)}, (SODF: EPS: CORRECTIVE: PRIMARY POWER)

10. Mast Retract Status
    - Was retraction successful?
    - Yes
    - No

11. Continue SAW Retract
    - Continue {4.118 P6 SAW XX Retract (P6 ON Z1 TRUSS)}, (SODF: EPS: CORRECTIVE: PRIMARY POWER)

MDA Abort must be sent to prevent MDA from driving once power is reapplied. This is a single step cmd.

Confirm that ISS Thrusters are inhibited or ISS/Orbiter in Free Drift and no crew un-isolated exercise or max EVA loads prior to sending the Deploy or Retract command. If at anytime mechanical movement is stopped or aborted, attitude control may be resumed.

Step 82 Deleted
3.192 SAW XX FAILURE TO RETRACT MAST REMOTELY

Disconnects are present in the MDA Over Temp FDIR.
S/W Trip level = 77.7 deg C. F/W Trip level = 140 deg C. H/W damage occurs at 120 deg C. At a minimum a 30 deg C Mast MDA Temp increase should be protected for during mast deploy/retract.

Since S/W Temp limit is reached first and it does not set the MDA Over Temp Trip flag, a MDA Abort must sent to prevent MDA from driving, once power is reapplied. This is a single step cmd.

Per Flight Rule B9-207, MDA operations can proceed even if MDA temp is high in order to meet critical mission objectives.
Measurement Out of Range will be indicated if MDA temp >72.2 deg C.
3.192 SAW XX FAILURE TO RETRACT MAST REMOTELY

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95 Inhibit Over Temp Safing

PVM:EPS:SAW XX
SAW XX ‘ECU XX’

sel SAW Software Inhibits
SAW XX Software Inhibits

sel SAW XX Temp Safing
SAW XX Temp Safing

‘Mast MDA’
‘Over Temp Safing’
‘Primary PVCU’

cmd Inhibit - Arm
cmd Inhibit - Inhibit
Verify Over Temp Safing = Inh
‘Backup PVCU’

cmd Inhibit - Arm
cmd Inhibit - Inhibit
Verify Over Temp Safing = Inh

96 Inhibit Over Temp Trip Function

If necessary

SAW XX Temp Safing

‘Over Temp Trip Function’

cmd Inhibit - Arm
cmd Inhibit - Inhibit
Verify Over Temp Trip Function = Inh

94

97 Let MDA Cool or Retract Via EVA

Let MDA cool to < 44.4 deg C and re-attempt retract or Retract via EVA

98 Retract Via EVA?

Yes

101

No

99 Let MDA Cool

Let MDA cool to < 44.4 deg C and re-attempt retract.

100 Continue SAW Retract

Continue {4.118 P6 SAW XX Retract (P6 ON Z1 TRUSS)}, (SODF: EPS:
CORRECTIVE:PRIMARY POWER)

21 Disconnects are present in the MDA
Over Temp FDIR.
S/W Trip level = 77.7 deg C. F/W
Trip level = 140 deg C. H/W
damage occurs at 120 deg C. At
a minimum a 30
deg C Mast MDA
Temp increase
should be
protected for
during mast
deploy/retract
3.192 SAW XX FAILURE TO RETRACT MAST REMOTELY

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101 Mast MDA Failed
Mast retract must be accomplished by EVA.

102 Mast Hardware Binding
Mast retract must be attempted via EVA.

103 Remove Mast MDA Power
PVM/EPS: SAW XX
SAW XX
SAW XX Mast Commands
SAW XX Mast Commands
cmd MDA Power - Off
Verify MDA Voltage, V < 10 (+/- 2.8)

104 Mast Status
Is the # of visible mast bays more than 1 bay

105 SABB Status
Have SABBs been unlatched?

106 Unlatch SABBs
Perform (4.118 P6 SAW XX Retract P6 ON Z1 TRUSS),
Steps 14 and 15 (SODF: EPS CORRECTIVE: PRIMARY POWER)

107 Retract Mast & Unlatch SABBs
Retract mast until only 1 bay is visible and unlatch SABBs

108 Position SAW for Mast Retract via EVA
Perform (2.101 PVM BGA XX Engage Antirotation Latch) (SODF: EPS: NOMINAL: PRIMARY POWER SYSTEM)
Use:
Cmded Angle = 180 deg
Latch Select = 1

109 Retract Until Only 1 Mast Bay is Visible
On MCC-H Go
Perform (Manual Override to Extend/Retract Mast) (EVA C/L, FS Reference)

24 This step can take up to 1 hr to complete. The latch cmd can be sent when the BGA Actual Angle is within 1 deg of the commanded value in order to save time.

25 This step may be omitted if EVA crew can free float and drive the Mast MDA.

26 SABBs can be unlatched anytime the Mast is less than 13.5 or greater than 1 bay. May consider unlatching prior to BGA positioning to support EVA, if there will be no attempt to redeploy.
Camera config. is still available to view unlatch, prior to BGA rotation, and unlatching early will reduce EVA time.

27 When the BGA is repositioned, the thermal environment of the Mast is changed. Consider another attempt to retract if binding was the problem.
3.192 SAW XX FAILURE TO RETRACT MAST REMOTELY

**SAW Status**
Mast at 1 bay or less and both SABBs are unlatched. Mast MDA Failed or Hardware is binding.

**Position SAW for Mast Retract via EVA**
Use:
Cmded Angle = 180 deg
Latch Select = 1
This step is not required, if already performed in block 109.

**Complete Mast Retraction**
On MCC-H Go
Perform [Manual Override to Extend/Retract Mast] (EVA C/L, FS Reference)

**Verify Mast/Blankets Contained**
Verify visually
Blankets contained within the SABBs?
Yes  No

**Return to Nominal Procedure**
Continue [4.118 P6 SAW XX Retract (P6 ON Z1 TRUSS)],
(SODF: EPS: CORRECTIVE:PRIMARY POWER)

**Verify Mast Fully Retracted**
PVM-EPS:SAW XX
'SAW XX'
Verify telemetry
Mast SW 01,02 Retracted = Yes
Mast SW 01,02 Deployed = No
Verify visually
Blankets contained within the SABBs and latch pins are within reach of the latch hooks.
Is Mast Fully Retracted?
Yes  No

**EVA Retract Attempts**
Is this the first attempt to Retract the mast via EVA?
Yes  No

**Mast Hardware Binding**
Wait for better thermal conditions and re-attempt Mast Retract via EVA.

---

24
This step can take up to 1 hr to complete. The latch cmd can be sent when the BGA Actual Angle is within 1 deg of the commanded value in order to save time.

25
This step may be omitted if EVA crew can free float and drive the Mast MDA.
ECU SAW Failure
Possible ECU SAW Firmware Power Supply, or RT Failure. Possible fault on ECU SAW power string below ECU input power selector circuit breaker.

Verify ECU Power
MCC-H Only
Does trend data for RPCM XX A Input Current indicate that half of the ECU housekeeping power was lost?

Verify MDA Power
MCC-H Only
Does trend data for RPCM XX A Input Current indicate MDA is on?

Verify MDA State
MCC-H Only
Does trend data for RPCM XX A Input Current indicate MDA is driving?

ECU SAW PS Powered & MDA Driving
ECU SAW Power Supply remains powered & MDA is driving but communication is lost. Possible fault in SAW Firmware controller. BGA operations are unaffected.

ECU SAW PS & MDA Powered
ECU SAW Power Supply and MDA remain powered but communication is lost. Possible fault in SAW Firmware controller or SAW RT Failure. BGA operations are unaffected.

ECU SAW PS Powered & MDA off
ECU SAW Power Supply is on and MDA is off. Possible ECU SAW Power Supply output failure or fault downstream of ECU SAW PS. BGA operations are unaffected.

Total ECU housekeeping power is 115W (0.93A) at initialization and before BGA mtr or MDAs are turned on. Half of the ECU housekeeping power is 57.5W (0.47A).

When the MDA is on it draws about 0.22A. When the MDA is driving it can draw as high as 3.0A. MDA over current trip occurs at 0.78A. The MDA will stop driving but will remain on if one of the two "Retracted" limit switches have contacted.
3.192 SAW XX FAILURE TO RETRACT MAST REMOTELY

Removes Power from MDA. When power is re-applied to the ECU the MDA will be off.

MCC-H Only

Perform ECU SAW RT Reset from Ground:

For P6 Solar Arrays
CI PUI=P6PW96IM0042K
SPUI=USPZ21MD0702
SAW 2B = 33804
SAW 4B = 17420

For S6 Solar Arrays
CI PUI=S6PW96IM0484K
SPUI=USPZ21MD0702
SAW 1B = 33292
SAW 3B = 16908

For P4 Solar Arrays
CI PUI=P4PW95SM0042K
SPUI=USPZ21MD0702
SAW 2A = 17164
SAW 4A = 33548

For S4 Solar Arrays
CI PUI=S4PW95SM0042K
SPUI=USPZ21MD0702
SAW 1A = 16652
SAW 3A = 33036

ECU SAW Communicating

PVM:EPS:SAW XX
SAW XX
"ECU XX"

Is Integ Cnt incrementing?

Yes

Communication Restored

Communication with the SAW has been restored. Confirm SAW and BGA configurations are as expected before continuing nominal procedure.

No

Remove ECU Power

PVM:EPS:SAW XX
SAW XX
sel RPCM XX A RPC 01
RPCM XX A RPC 01
cmd RPC Position - Open (Verify - Op)
SAW XX
sel RPCM YY A RPC 02
RPCM YY A RPC 02
cmd RPC Position - Open (Verify - Op)

Continue SAW Retract

Continue (4.118 P6 SAW XX Retract (P6 ON Z1 TRUSS)), (SODF: EPS: CORRECTIVE:PRIMARY POWER)
**3.192 SAW XX FAILURE TO RETRACT MAST REMOTELY**

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- **Mast Status**
  - Is the # of visible mast bays more than 1 bay
    - No
    - Yes

- **SABB Status**
  - Have SABBs been unlatched?
    - No
    - Yes

- **Unlatch SABBs**
  - Perform (3.190 SAW XX FAILURE TO UNLATCH SABB REMOTELY), EVA Support Steps Only (SODF: EPS: MALFUNCTION: PRIMARY POWER)

- **Retract Mast & Unlatch SABBs**
  - Retract mast until only 1 bay is visible and unlatch SABBs

- **Position SAW for Mast Retract via EVA**
    - Use:
      - Cmded Angle = 180 deg
      - Latch Select = 1

- **Retract Until Only 1 Mast Bay is Visible**

- **On MCC-H Go**
  - Perform [Manual Override to Extend/Retract Mast] (EVA C/L, FS Reference)

---

- **This step can take up to 1 hr to complete. The latch cmd can be sent when the BGA Actual Angle is within 1 deg of the commanded value in order to save time.**

- **This step may be omitted if EVA crew can free float and drive the Mast MDA.**

- **Retracting while still latched, allows for early SARJ positioning, or improved power generation, while the crew is still working on the rest of the SAW EVA tasks.**
3.192 SAW XX FAILURE TO RETRACT MAST REMOTELY
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146 SAW Status
Mast at 1 bay or less and both SABBs are unlatched. SAW PS, FWC or RT lost

147 Verify Mast/Blankets Contained
Verify visually
Blankets contained within the SABBs?
Yes
No

148 Position SAW for Mast Retract via EVA
Use:
Cmded Angle = 180 deg
Latch Select = 1
This step is not required, if already performed in step 109.

149 Complete Mast Retraction
On MCC-H Go
Perform [Manual Override to Extend/Retract Mast] (EVA C/L, FS Reference)

150 Verify Mast Fully Retracted
PVM-EPS: SAW XX
‘SAW XX’
Verify telemetry
Mast SW 01.02 Retracted = Yes
Mast SW 01.02 Deployed = No
Verify visually
Blankets contained within the SABBs and latch pins are within reach of the latch hooks.
Is Mast Fully Retracted?
Yes
No

151 Unable to contain SABB, however, mast is able to take operational loads. Check with MCC-H for further action.

24 This step can take up to 1 hr to complete. The latch cmd can be sent when the BGA Actual Angle is within 1 deg of the commanded value in order to save time.

25 This step may be omitted if EVA crew can free float and drive the Mast MDA.

152 Latch SABBs
Perform [3.193 SAW XX FAILURE TO LATCH SABB REMOTELY], EVA Support Steps Only (SODF: EPS: MALFUNCTION: PRIMARY POWER)

153 Continue SAW Retract
Continue [4.118 P6 SAW XX Retract P6 ON Z1 TRUSS], Steps 20-22 (SODF: EPS: CORRECTIVE: PRIMARY POWER)

154 EVA Retract Attempts
Is this the first attempt to Retract the mast via EVA?
Yes
No

156 Mast Hardware Binding
Wait for better thermal conditions and re-attempt Mast Retract via EVA.
3.192 SAW XX FAILURE TO RETRACT MAST REMOTELY

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76 117 154

157 Mast Failed to Retract
Is Mast partially deployed?

Yes

160 Mast is 100% Deployed
Primary Power Channel can be operated nominally.

No

158 Percent Mast is Deployed

Record number of visible mast bays: ____________

# of Bays  %Deployed
31.5 100
28 90
25 80
22 70
19 60
16 50
13 40
9 30
6 20
3 10
0 0

Record Percent Deployed: ____________

159 Mast is Partially Deployed

Primary power generation capability degraded for affected channel.

Assess short term impacts:
1. Attitude control restrictions
2. Power generation capability
3. Departure restrictions
4. Crew exercise constraints

Assess long term impacts to:
1. Future rendezvous ops
2. SAW retract capability

161 Mast is < 100% Deployed

If Mast deployed more than 1 bay, consider re-deploying the solar array to 100% to support on-orbit loads, until the problem can be investigated further.

Note stiction is not a problem for re-deployments so no thermal conditioning is required.

162 Redeploy SAW

Refer to {1.3.452 SAW XX Deploy}, (SODF: EPS: ACTIVATION AND CHECKOUT: CHANNEL ACTIVATION)

38 SAW is untensioned if < 31.5 bays are visible.

39 Analysis indicates that the Mast must be deployed > 60% before adequate power generation can be achieved.

40 Remove MDA Power (Mast MDA-Off) if you have not already done so.
3.193 SAW XX FAILURE TO LATCH (TENSION) SABB REMOTELY

EPS

1. Notify MCC-H
   Notify MCC-H of visual status.

2. ECU SAW Communicating
   PVM:EPS:SAW XX
   SAW XX
   'ECU XX'
   Is Integ Cnt incrementing?

3. ECU BGA Communicating
   PVM:EPS:BGA XX
   BGA XX
   'ECU XX'
   Is Integ Cnt incrementing?

4. Go to (3.110 BGA XX LOSS OF COMM), all (SODF: EPS: MALFUNCTION: PRIMARY POWER SYSTEM)

5. Power on Reset
   sel SAW Firmware
   SAW XX Firmware
   Does Power On Reset = X

6. Go to (3.150 BGA XX 1553/FWC ERRORS), all (SODF: EPS: MALFUNCTION: PRIMARY POWER SYSTEM)

7. Caution message BGA XX 1553/FWC Errors- PVM may also be received if a Power on Reset has occurred.

This procedure assumes the SABBs will be latched at specific times during the mission. For Deployments: 1) Re-latch after Initial SABB Unlatch, 2) Re-latch SABBs when Mast at 1 Bay. For Retractions: 1) Latch when 100% retracted.

If power was removed from the ECU you must begin again with step 1 of the Deploy/Retract procedure, to reset the F/W inhibits.

If Current sensor fails high > 0.78 A RPCs providing power to ECU will be opened. A new PPL with a higher Current limit must be uploaded before the ECU can be recovered. There is no inhibit for SAW MDA Config Complete Persistent Current Safing.

Nominal Config:
ECU SAW XX:
RPCM XX A
RPC 1 - Cl
RPCM YY A
RPC 2 - Cl

Power Channel Connectivity

PVM XX YY
S4 1A 3A
S4 3A 1A
S6 1B 3B
S6 3B 1B
P4 2A 4A
P4 4A 2A
P6 2B 4B
P6 4B 2B

No C&W messages are available for SAW hardware.

14 AUG 06
3.193 SAW XX FAILURE TO LATCH (TENSION) SABB REMOTELY

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5

MDA operating temperature range is -54 to 48 deg C.

7
LBB (RBB) Status

LBB (RBB) Partially Latched

LBB (RBB) Failed to Latch (No Hardware Response)

8
Verify Mast Telemetry

PVM:EPS:SAW XX

'Saw XX'

'Mast'
Verify telemetry (RETRACTED)
Mast SW 01,02 Retracted = Yes
Mast SW 01,02 Deployed = No

Verify telemetry (DEPLOYED)
Mast SW 01,02 Retracted = No
Mast SW 01,02 Deployed = Yes

Four good limit switches?

9
Override Switch Indication

'ECU XX'

sel SAW Software Inhibits

SAW XX Software Inhibits

'Saw XX'

'Latch Reject'

cmd Inhibit - Arm

cmd Inhibit - Inhibit

Verify Latch Reject - Inh

10
Override SAW Indications

PVM:EPS:BGA XX

'BGA XX'

'ECU XX'

sel BGA Software Inhibits

BGA XX Software Inhibits

'SAW Deployment'

'Primary PVCU'

cmd Enable - Arm

cmd Enable - Enable

Verify SAW Deployment - Ena

'Saw Deployment'

'Backup PVCU'

cmd Enable - Arm

cmd Enable - Enable

Verify SAW Deployment - Ena

11
MDA Status

Is LBB (RBB) (Mast) MDA On?

MDA Voltage, V > 10 (+/-2.8)

12
MDA Temp Check

Is LBB(RBB) MDA Temp > 30 deg C?

13
Hi Temp Reject FI Status

sel SAW Software Inhibits

SAW XX Software Inhibits

sel SAW XX Temp Safing

SAW XX Temp Safing

Does Hi Temp Reject = Inh?

14
Command Check

Possible cmd error

15
Temp Limit set too Low

Command was rejected by the Hi Temp Reject function.
Temp limit is set to low for this function.

16
Override Hi Temp Reject

'Hi Temp Reject'

cmd Inhibit - Arm

cmd Inhibit - Inhibit

Verify Low Temp Reject - Inh

17
Continue SAW Deploy or Retract

Continue (1.3.452 SAW XX Deploy), (SODF: EPS: ACTIVATION & CHECKOUT: CHANNEL ACTIVATION)
OR (1.3.450 SAW XX SABB Initial Unlatch), (SODF: EPS: ACTIVATION & CHECKOUT: CHANNEL ACTIVATION)
OR (4.118 P6 SAW Retract (P6 on Z1 Truss)), (SODF: EPS: CORRECTIVE:PRIMARY POWER SYSTEM)
3.193 SAW XX FAILURE TO LATCH (TENSION) SABB REMOTELY

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11. Override Multiple MDA Reject

MDA Voltage sensor bias high is indicated, inhibit FDIR.
PVM:EPS:SAW XX
SAW XX
ECU XX
sel SAW Software Inhibits
SAW XX Software Inhibits
'Multi MDA On Reject'
cmd Inhibit - Arm
cmd Inhibit - Inhibit
Verify Multi MDA On Reject - Inh

Trend Data indicates MDA Voltage sensor is nominal.

18. MDA Driving Status

Is LBB (RBB) MDA Driving?
MDA Current, A > 0.3

Yes

20. MDA On and may be Driving

If Latches are not latching:
MDA may be de-coupled from mechanism. Visually confirm EVA MDA override lever in the Automatic position.

No

19. EVA MDA Override Lever Status

Is EVA MDA override lever in automatic position? (Refer to Figure 1)

Yes

21. MDA Fault

MDA may be de-coupled from SABB latch mechanism or the MDA drive capability has failed.

22. Abort SABB latch

Send the Abort cmd if Latches are not moving.
PVM:EPS:SAW XX
SAW XX
'SAW XX'
sel SAW LBB (RBB) Commands
SAW XX LBB (RBB) Commands
cmd LBB (RBB) - Abort

24. MDA On and may be Driving

If Latches are latching:
Possible Latch Binding, or Degraded MDA but not enough to trigger FDIR. Monitor for latch completion. Proceed to step 23 if SAW hardware begins to deform. Check with MCC-H if Latches stop moving.

25. MDA De-Coupled

MDA Decoupled from SABB latch mechanism, SABB must be latched by EVA.

26. MDA On and may be Driving

If Latches are not latching:
MDA may be de-coupled from mechanism. Visually confirm EVA MDA override lever in the Automatic position.

27. EVA MDA Override Lever Status

Is EVA MDA override lever in automatic position? (Refer to Figure 1)

Yes

28. MDA Fault

MDA may be de-coupled from SABB latch mechanism or the MDA drive capability has failed.

29. Abort SABB latch

Send the Abort cmd if Latches are not moving.
PVM:EPS:SAW XX
SAW XX
'SAW XX'
sel SAW LBB (RBB) Commands
SAW XX LBB (RBB) Commands
cmd LBB (RBB) - Abort

30. MDA On and may be Driving

If Latches are latching:
Possible Latch Binding, or Degraded MDA but not enough to trigger FDIR. Monitor for latch completion. Proceed to step 23 if SAW hardware begins to deform. Check with MCC-H if Latches stop moving.

31. MDA De-Coupled

MDA Decoupled from SABB latch mechanism, SABB must be latched by EVA.

32. MDA On and may be Driving

If Latches are not latching:
MDA may be de-coupled from mechanism. Visually confirm EVA MDA override lever in the Automatic position.

33. EVA MDA Override Lever Status

Is EVA MDA override lever in automatic position? (Refer to Figure 1)

Yes

34. MDA Fault

MDA may be de-coupled from SABB latch mechanism or the MDA drive capability has failed.

35. Abort SABB latch

Send the Abort cmd if Latches are not moving.
PVM:EPS:SAW XX
SAW XX
'SAW XX'
sel SAW LBB (RBB) Commands
SAW XX LBB (RBB) Commands
cmd LBB (RBB) - Abort

36. MDA On and may be Driving

If Latches are latching:
Possible Latch Binding, or Degraded MDA but not enough to trigger FDIR. Monitor for latch completion. Proceed to step 23 if SAW hardware begins to deform. Check with MCC-H if Latches stop moving.

6. The manual MDA override lever is located on the back (inactive side) of the SABB base. (MDA current with no load = 0.3A)

7. There is no overvoltage FDIR for the MDA. The MDA will continue to operate if a Voltage sensor has failed high. Check voltages of all MDAs. The multiple MDA On Reject FDIR will reject an MDA on command if another MDA is already on.

8. If MDA de-coupled you may not be able to tell if the MDA is driving based on the current.

Figure 1
3.193 SAW XX FAILURE TO LATCH (TENSION) SABB REMOTELY

**Possible MDA H/W Failure, MDA Over Current Trip, MDA Over Temp Trip, MDA Stall, Binding, or sensor failure**

**Over Current Detection**

PVM:EPS:SAW XX
SAW XX
'ECU XX'

Does Over Current Trip = X

**Over Temperature Detection**

PVM:EPS:SAW XX
SAW XX
'LBB(RBB) MDA'

Does Over Temp Trip = X

**MDA Stall Status**

MCC Only
Did MDA Slow Alert = Slow prior to removal of MDA Power?

**Clear MDA Indications**

PVM:EPS:SAW XX
SAW XX
LBB(RBB)

set LBB (RBB) Commands
SAW XX LBB (RBB) Commands:

**cmd** MDA Power - Off
Verify MDA Voltage, V < 10 (+/- 2.8)

**MDA Failure Unknown**

Unknown MDA Failure. MDA Off, Check with MCC-H

**MDA Over Current Trip**

ECU Firmware MDA Over Current Trip occurs at 6.2 Amps. S/W Limit (0.78 A) is reached first and it does not set the MDA Over Current Trip Flag.

**MDA Over Temp Trip**

Disconects are present in the MDA Over Temp FDIR. S/W Trip level = 77.7 deg C. F/W Trip level = 140 deg C. H/W damage occurs at 120 deg C. S/W Temp limit is reached first and it does not set the MDA Over Temp Trip Flag.

**MDA Power off is a one step command.**
3.193 SAW XX FAILURE TO LATCH (TENSION) SABB REMOTELY

14 AUG 06

14802.ppt

MCC-H Only
Are there any ECU/BGA or SAW C&W flags set?

No

37 Re-attempt SAW Ops
Re-power MDA and attempt latch.

38 Latch Status
Was latch successful?

Yes

No

39 Continue SAW Deploy or Retract
Continue {1.3.452 SAW XX Deploy}, (SODF: EPS: ACTIVATION & CHECKOUT: CHANNEL ACTIVATION)
**OR** {1.3.450 SAW XX SABB Initial Unlatch}, (SODF: EPS: ACTIVATION & CHECKOUT: CHANNEL ACTIVATION)
**OR** {4.118 P6 SAW Retract (P6 on Z1 Truss)}, (SODF: EPS: CORRECTIVE: PRIMARY POWER SYSTEM)

12 SAW Caution and Warning Flags are available for downlink only during missions that scheduled SAW activities. (e.g 12A) Flags are not available on PCS displays.
3.193 SAW XX FAILURE TO LATCH (TENSION) SABB REMOTELY

11 MDA Power off is a one step command.

13 PVCU Software MDA Over Current Trip occurs at 0.78 Amps.

If a Stall Condition is indicated, Current > 0.78 A and motor speed is < 25 RPM, power is removed from the MDA.

41 Clear MDA Indications

PVM:EPS:SAW XX
SAW XX
\text{LBB(RBB)}\searrow\text{SAW LBB(RBB) Commands}
\text{SAW XX LBB(RBB) Command}

\text{cmd MDA Power - Off}
Verify MDA Voltage, V < 10 (+/- 2.8)

42 Check MDA Trend Data for Increase in Current

MCC-H Only
Does trend data for MDA Current indicate an overcurrent condition before MDA Power was removed?

No \rightarrow 47 Possible Data transient

Yes \rightarrow

43 Check RPCM Trend Data for Increase in Current

MCC-H Only
Does trend data for RPCM XX A indicate a high current condition before MDA power was removed?

No \rightarrow

49

Yes \rightarrow

44 Possible MDA fault, MDA Stall, or Binding

45 MDA Stall Status

MCC Only
Did MDA Slow Alert = Slow prior to removal of MDA Power?

Yes \rightarrow 48 MDA Stall indicated, binding.

No \rightarrow

46 Possible short or fault in MDA.

47 Possible Data transient

57

93
3.193 SAW XX FAILURE TO LATCH (TENSION) SABB REMOTELY

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If Current sensor fails high > 0.78 A
RPCs providing power to ECU
will be opened.
A new PPL with a higher current
limit must be uploaded before
the ECU can be recovered. There
is no inhibit for SAW MDA Motor
Stall Persistent
Current Safing. Refer to block 3.

Nominal SABB latch, takes
approximately 14 seconds to
complete. However, all
MDAs use the same current
sensor. A new
PPL 69 must
be uplinked
prior to SAW
operations or
Inhibit the RPC
Open
Command to
avoid power
cycling the
ECU.

If Current sensor
fails high > 0.78 A
RPCs providing
power to ECU
will be opened.
A new PPL with a higher current
limit must be uploaded before
the ECU can be recovered. There
is no inhibit for SAW MDA Motor
Stall Persistent
Current Safing. Refer to block 3.

If Current sensor
fails high > 0.78 A
RPCs providing
power to ECU
will be opened.
A new PPL with a higher current
limit must be uploaded before
the ECU can be recovered. There
is no inhibit for SAW MDA Motor
Stall Persistent
Current Safing. Refer to block 3.

If Current sensor
fails high > 0.78 A
RPCs providing
power to ECU
will be opened.
A new PPL with a higher current
limit must be uploaded before
the ECU can be recovered. There
is no inhibit for SAW MDA Motor
Stall Persistent
Current Safing. Refer to block 3.

If Current sensor
fails high > 0.78 A
RPCs providing
power to ECU
will be opened.
A new PPL with a higher current
limit must be uploaded before
the ECU can be recovered. There
is no inhibit for SAW MDA Motor
Stall Persistent
Current Safing. Refer to block 3.

If Current sensor
fails high > 0.78 A
RPCs providing
power to ECU
will be opened.
A new PPL with a higher current
limit must be uploaded before
the ECU can be recovered. There
is no inhibit for SAW MDA Motor
Stall Persistent
Current Safing. Refer to block 3.

If Current sensor
fails high > 0.78 A
RPCs providing
power to ECU
will be opened.
A new PPL with a higher current
limit must be uploaded before
the ECU can be recovered. There
is no inhibit for SAW MDA Motor
Stall Persistent
Current Safing. Refer to block 3.

If Current sensor
fails high > 0.78 A
RPCs providing
power to ECU
will be opened.
A new PPL with a higher current
limit must be uploaded before
the ECU can be recovered. There
is no inhibit for SAW MDA Motor
Stall Persistent
Current Safing. Refer to block 3.

If Current sensor
fails high > 0.78 A
RPCs providing
power to ECU
will be opened.
A new PPL with a higher current
limit must be uploaded before
the ECU can be recovered. There
is no inhibit for SAW MDA Motor
Stall Persistent
Current Safing. Refer to block 3.

If Current sensor
fails high > 0.78 A
RPCs providing
power to ECU
will be opened.
A new PPL with a higher current
limit must be uploaded before
the ECU can be recovered. There
is no inhibit for SAW MDA Motor
Stall Persistent
Current Safing. Refer to block 3.

If Current sensor
fails high > 0.78 A
RPCs providing
power to ECU
will be opened.
A new PPL with a higher current
limit must be uploaded before
the ECU can be recovered. There
is no inhibit for SAW MDA Motor
Stall Persistent
Current Safing. Refer to block 3.

If Current sensor
fails high > 0.78 A
RPCs providing
power to ECU
will be opened.
A new PPL with a higher current
limit must be uploaded before
the ECU can be recovered. There
is no inhibit for SAW MDA Motor
Stall Persistent
Current Safing. Refer to block 3.

If Current sensor
fails high > 0.78 A
RPCs providing
power to ECU
will be opened.
A new PPL with a higher current
limit must be uploaded before
the ECU can be recovered. There
is no inhibit for SAW MDA Motor
Stall Persistent
Current Safing. Refer to block 3.

If Current sensor
fails high > 0.78 A
RPCs providing
power to ECU
will be opened.
A new PPL with a higher current
limit must be uploaded before
the ECU can be recovered. There
is no inhibit for SAW MDA Motor
Stall Persistent
Current Safing. Refer to block 3.

If Current sensor
fails high > 0.78 A
RPCs providing
power to ECU
will be opened.
A new PPL with a higher current
limit must be uploaded before
the ECU can be recovered. There
is no inhibit for SAW MDA Motor
Stall Persistent
Current Safing. Refer to block 3.

If Current sensor
fails high > 0.78 A
RPCs providing
power to ECU
will be opened.
A new PPL with a higher current
limit must be uploaded before
the ECU can be recovered. There
is no inhibit for SAW MDA Motor
Stall Persistent
Current Safing. Refer to block 3.
3.193 SAW XX FAILURE TO LATCH (TENSION) SABB REMOTELY

Re-attempt SAW Ops

Re-power MDA and attempt latch per the Nominal procedure.

Latch Status

Was latch successful?

No

Attempt to Unlatch LBB (RBB) then try to latch again. It may be desirable to wait for a different thermal condition before reattempt.

Clear CW Flag Indications

PVM: EPS: EPS Software
EPS Software
sel PVCU Software
PV SW
sel Cmd Resp Clear
PV Cmd Response Clear
'SAW Command Response Clear'
cmd Arm
cmd Clear

There is a very limited partially unlatched range in which a unlatch can be attempted without damaging the hardware. This must be confirmed visually by MCC-H.

Damage to SABB hardware when driving a MDA in the opposite direction from the initial cmded direction.

Re-attempt will be made at the end of insolation or end of eclipse, which ever case is opposite initial attempt.
3.193 SAW XX FAILURE TO LATCH (TENSION) SABB REMOTELY

62 Set SAW LBB(RBB) Abort

64 PVM:EPS:SAW XX
SAW XX LBB(RBB) Commands
SAW XX LBB(RBB) Commands
cmd LBB(RBB) - Abort

65 Turn MDA On

cmd MDA Power - On Arm
cmd MDA Power - On
Verify MDA Voltage, V = 120 --- 125

66 Unlatch LBB (RBB)

Monitor LBB(RBB) Unlatch with cameras
cmd LBB(RBB) - Unlatch Arm
cmd LBB(RBB) - Unlatch

Verify telemetry
LBB(RBB) SW 01,02 Pin Released = Yes
LBB(RBB) SW 01,02 Latched = No
LBB(RBB) SW 01,02 Unlatched = Yes

Verify visually
Latch Position (four of eight) - Unlatched

68 Latch Attempts
Is this the first attempt to Latch the LBB (RBB) using this sequence?

No

69 LBB (RBB) Hardware Binding
Wait for better thermal conditions and re-attempt LBB(RBB) Latch.

Yes

67 Latch LBB(RBB)

Crew Only
Monitor LBB(RBB) Latch with cameras.
cmd LBB(RBB) - Latch Arm
cmd LBB(RBB) - Latch

Verify telemetry
LBB(RBB) SW 01,02 Pin Released = Yes
LBB(RBB) SW 01,02 Latched = Yes
LBB(RBB) SW 01,02 Unlatched = No

Verify visually
Latch Position (four of eight) - Latched

Was Latch successful?

70 Continue SAW Ops
Continue (1.3.452 SAW XX Deploy), (SODF: EPS: ACTIVATION & CHECKOUT: CHANNEL ACTIVATION) OR (1.3.450 SAW XX SABB Initial Unlatch), (SODF: EPS: ACTIVATION & CHECKOUT: CHANNEL ACTIVATION)

71 Continue SAW Ops
Continue (4.118 P6 SAW XX Retract (P6 on Z1)), (SODF: EPS: CORRECTIVE: PRIMARY POWER)

Damage to SABB hardware when driving a MDA in the opposite direction from the initial cmded direction.

MDA Abort must sent to prevent MDA from driving once power is re-applied. This is a single step cmd.

There is a very limited partially unlatched range in which a unlatch can be attempted without damaging the hardware. This must be confirmed visually by MCC-H before step 66 can be executed. If step 66 cannot be performed continue in step 67.

Confirm that ISS Thrusters are inhibited or ISS/Orbiter in Free Drift and no crew un-isolated exercise or max EVA loads prior to sending the Unlatch or Latch command. If at any time the array mechanical movement is stopped or aborted, attitude control may be resumed.
3.193 SAW XX FAILURE TO LATCH (TENSION) SABB REMOTELY

1. MDA Power off is a one step command.

2. Disconnects are present in the MDA Over Temp FDIR. S/W Trip level = 77.7 deg C. F/W Trip level = 140 deg C. H/W damage occurs at 120 deg C.

3. Since SW Temp limit is reached first and it does not set the MDA Over Temp Trip flag, a MDA Abort must be sent to prevent MDA from driving, once power is re-applied. This is a single step cmd.

4. Per Flight Rule B9-207, MDA operations can proceed even if MDA temp is high in order to meet critical mission objectives. SABB latch takes approximately 14 seconds. Measurement Out of Range will be indicated if MDA temp > 72.2 deg C.
3.193 SAW XX FAILURE TO LATCH (TENSION) SABB REMOTELY

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84 Inhibit Over Temp Safing

PVM:EPS:SAW XX
SAW XX
'ECU XX'

sel SAW Software Inhibits
SAW XX Software Inhibits

sel SAW XX Temp Safing
SAW XX Temp Safing

'LBB(RBB) MDA'
'Over Temp Safing'
'Primary PVCU'

.cmd Inhibit - Arm
.cmd Inhibit - Inhibit

Verify Over Temp Safing = Inh

'Backup PVCU'
.cmd Inhibit - Arm
.cmd Inhibit - Inhibit

Verify Over Temp Safing = Inh

85 Inhibit Over Temp Trip Function

If necessary

SAW XX Temp Safing

'Over Temp Trip Function'
.cmd Inhibit - Arm
.cmd Inhibit - Inhibit

Verify Over Temp Trip Function = Inh

86 Let MDA Cool or Deploy Via EVA

Let MDA cool to < 44.4 deg C and re-attempt Latch or Latch via EVA.

87 Latch Via EVA?

Yes

90

No

88 Let MDA Cool

Let MDA cool to < 44.4 deg C and re-attempt Latch.

89 Continue SAW Deploy or Retract

Continue {1.3.452 SAW XX Deploy}, (SODF: EPS: ACTIVATION & CHECKOUT: CHANNEL ACTIVATION)
OR {1.3.450 SAW XX SABB Initial Unlatch}, (SODF: EPS: ACTIVATION & CHECKOUT: CHANNEL ACTIVATION)
OR {4.118 P6 SAW Retract (P6 on Z1 Truss)}, (SODF: EPS: CORRECTIVE:PRIMARY POWER SYSTEM)

23

Disconnects are present in the MDA Over Temp FDIR. S/W Trip level = 77.7 deg C. F/W Trip level = 140 deg C. H/W damage occurs at 120 deg C.

26

Retry temperatures can be higher for SABBs since they are only operated a few seconds.
3.193 SAW XX FAILURE TO LATCH (TENSION) SABB REMOTELY

1. **LBB (RBB) MDA Failed**
   - LBB (RBB) Unlatch and Latch must be accomplished by EVA.

2. **LBB (RBB) Hardware Binding**
   - LBB (RBB) Unlatch and Latch must be attempted via EVA.

3. **Remove LBB (RBB) MDA Power**
   - MDA Power off is a one step command.

4. **Re-attempt will be made at the end of insolation or end of eclipse, which ever case is opposite initial attempt.**

5. **LBB (RBB) Latch via EVA**
   - Position SAW for LBB (RBB) Latch via EVA.

6. **LBB (RBB) Latch via EVA**
   - Perform (2.101 PVM BGA XX Engage Antirotation Latch), (SODF: EPS: NOMINAL: PRIMARY POWER)

7. **Copy the following values into Step 4:**
   - For LBB
     - Cmded Angle = 270 deg
     - Latch Select = 1
   - For RBB
     - Cmded Angle = 90 deg
     - Latch Select = 1

8. **LBB (RBB) Latch via EVA**
   - Verify MDA Voltage, V < 10 (+/- 2.8)

9. **Deploy Opposite SAW**
   - On MCC-H Go
     - Perform (Manual Override to Unlatch/Latch SABB) (EVA C/L, FS Reference)

10. **Verify LBB (RBB) (Fully Latched**
    - Verify telemetry
      - LBB (RBB) SW 01.02 Pin Released = Yes
      - LBB (RBB) SW 01.02 Latched = Yes
      - LBB (RBB) SW 01.02 Unlatched = No
    - Verify visually
      - Latch Position (four of eight) - Latched

11. **Is LBB (RBB) Fully Latched?**
    - Return to Nominal Procedure
      - Continue (1.3.452 SAW XX Deploy), (SODF: EPS: ACTIVATION AND CHECKOUT: CHANNEL ACTIVATION)

12. **EVA Latch Attempts**
    - Is this the first attempt to Latch the LBB (RBB) via EVA?
      - Is present activity Re-Latching SABBs temporarily to support on-orbit loads such as Crew Exercise, etc. until the SAW can be deployed?

13. **Operational Status**
    - If opposite SAW has not been deployed. Reconfigure cameras and deploy it now.

14. **If present activity Re-Latching SABBs temporarily to support on-orbit loads such as Crew Exercise, etc. until the SAW can be deployed?**
    - No
    - Yes

15. **Is LBB (RBB) Fully Latched?**
    - Assumes that one or more mast bays have already been deployed, to allow latches to clear SABB Structure
    - Both SABBs must be Latched (Hi Tension Mode) before the SAW can be deployed, to protect H/W against damage due to high stiction forces.

16. **Deploy Opposite SAW**
    - This step may be omitted if EVA crew can free float and drive the MDA.

17. **Position SAW for LBB (RBB) Latch via EVA**
    - This step can take up to 1 hr to complete.
    - The latch cmd can be sent when the BGA Actual Angle is within 1 deg of the commanded value in order to save time.
3.193 SAW XX FAILURE TO LATCH (TENSION) SABB REMOTELY

1. Unlatch unaffected SABB
   If the unaffected SABB is not unlatched, unlatch it now.

2. Deploy Affected SAW 1 bay
   Deploy Mast 1 bay to reduce Operational load constraints. Schedule EVA to latch affected SABB prior to Remaining SAW deployment.

3. Return to Nominal Procedure
   Perform {1.3.452 SAW XX Deploy}, Steps 1-12, then step 13 (14) (SODF: EPS: ACTIVATION AND CHECKOUT: CHANNEL ACTIVATION)
3.193 SAW XX FAILURE TO LATCH (TENSION) SABB REMOTELY

Unable to Deploy SAW
Mast is deployed 1 bay, one SABB is latched and the other SABB has failed unlatched. Unable to complete solar array deploy. Primary power channel XX is unable to support itself.

SAW Structurally Limited
SAW structural load capability limited.
Assess short term impacts:
1. Attitude control restrictions
2. Departure restrictions
3. Crew exercise constraints
Assess long term impacts to:
1. Future rendezvous ops

Further Attempts
Will further attempts be made to Latch affected SABB in the next 2 weeks?

Leave SAW in Present Config.
Mast is deployed 1 bay, one SABB is latched and the other SABB has failed unlatched. Unable to complete solar array deploy until both SABB are Latched.

Unlatch Unaffected SABB
Perform (1.3.450 SAW XX SABB Initial Unlatch), Step 2(4) (SODF: EPS: ACTIVATION & CHECKOUT: CHANNEL ACTIVATION)

Turn Mast MDA On
PVM:EPS:SAW XX
'SAW XX'
sel SAW Mast Commands
SAW XX Mast Commands
cmd MDA Power - On Arm
cmd MDA Power - On
Verify MDA Voltage, V = 120 --- 125

Retract Mast
Monitor mast retract with cameras.
cmd Mast - Retract Arm
cmd Mast - Retract
Verify telemetry
Mast SW 01,02 Retracted = Yes
Mast SW 01,02 Deployed = No

EVA Install PRD
EVA Install PRD on affected SABB to prevent damage to blanket.

Re-Latch Unaffected SABB
Perform (1.3.452 SAW Deploy), Step 13(14), (SODF: EPS: ACTIVATION AND CHECKOUT: CHANNEL ACTIVATION)

Unable to Deploy SAW
Unable to deploy the solar array, mast is 0% deployed. Primary power channel XX is unable to support itself.

Confirm that ISS Thrusters are inhibited or ISS/Orbiter in Free Drift and no crew un-isolated exercise or max EVA loads prior to sending the Deploy or Retract command. If at any time mechanical movement is stopped or aborted, attitude control may be resumed.

Both SABBs must be latched before deployment can continue. If the SABB is not latched, the blanket will not be tensioned when the array is at 100% deployed, and subject to damage from thrusters and external loads. The array can handle most loads in the 1 bay deployed configuration.

If unable to latch one of the SABBs, and PRD is not available, it is better to remain deployed to 1 mast bay than retract. Blanket is subject to damage when mast is fully retracted and the SABB is unlatched.
ECU SAW Failure
Possible ECU SAW Firmware Power Supply, or RT Failure. Possible fault on ECU SAW power string below ECU input power selector circuit breaker.

Verify ECU Power
MCC-H Only
Does trend data for RPCM XX A Input Current indicate that half of the ECU housekeeping power was lost?

Verify MDA Power
MCC-H Only
Does trend data for RPCM XX A Input Current indicate MDA is on?

Verify MDA State
MCC-H Only
Does trend data for RPCM XX A Input Current indicate MDA is driving?

ECU SAW PS Powered & MDA Driving
ECU SAW Power Supply remains powered & MDA is driving but communication is lost. Possible fault in SAW Firmware controller. BGA operations are unaffected.

ECU SAW PS Powered & MDA off
ECU SAW Power Supply is on and MDA is off. Possible ECU SAW Power Supply output failure or fault downstream of ECU SAW PS. BGA operations are unaffected.

ECU SAW PS & MDA Powered
ECU SAW Power Supply and MDA remain powered but communication is lost. Possible fault in SAW Firmware controller or SAW RT Failure. BGA operations are unaffected.
3.193 SAW XX FAILURE TO LATCH (TENSION) SABB REMOTELY

MCC-H Only

Perform ECU SAW Reset from Ground:

For P6 Solar Arrays
- CI PUI=P6PW96IM0042K
- SAW 2B = 33804
- SAW 4B = 17420

For P4 Solar Arrays
- CI PUI=P4PW95SM0042K
- SAW 2A = 17164
- SAW 4A = 33548

For S6 Solar Arrays
- CI PUI=S6PX96IM0484K
- SAW 1B = 33292
- SAW 3B = 16908

For S4 Solar Arrays
- CI PUI=S4PW95SM0042K
- SAW 1A = 16652
- SAW 3A = 33036

ECU SAW Communicating

PVM:EPS:SAW XX
SAW XX
‘ECU XX’

Is Integ Cnt incrementing?

No

Remove ECU Power

PVM:EPS:SAW XX
SAW XX
sel RPCM YY A RPC 02

RPCM YY A RPC 02

cmd RPC Position - Open (Verify - Op)

SAW XX
sel RPCM XX A RPC 01

RPCM XX A RPC 01

cmd RPC Position - Open (Verify - Op)

Communication Restored

Communication with the SAW has been restored.

Continue SAW Deploy or Retract

Continue (1.3.452 SAW XX Deploy), (SODF: EPS: ACTIVATION & CHECKOUT: CHANNEL ACTIVATION) OR (1.3.450 SAW XX SABB Initial Unlatch), (SODF: EPS: ACTIVATION & CHECKOUT: CHANNEL ACTIVATION) OR (4.118 P6 SAW Retract (P6 on Z1 Truss)), (SODF: EPS: CORRECTIVE:PRIMARY POWER SYSTEM)
3.193 SAW XX FAILURE TO LATCH (TENSION) SABB REMOTELY

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123

126. Apply Power to ECU

Attempt to recover SAW capability by activating ECU on Redundant power source.

PVM:EPS:SAW XX
SAW XX
sel RPCM YY (XX) A RPC 02 (01)

RPCM YY (XX) A RPC 02 (01)

cmd RPC Position - Close (Verify - Cl)

127. ECU SAW Communication

PVM:EPS:SAW XX
SAW XX
‘ECU XX’

Is Integ Cnt incrementing?

Yes

No

128. Communication Lost with SAW Firmware

Possible SAW RT or Firmware Controller failure. Mast Deploy, LBB and RBB Unlatching and Tensioning must be accomplished by EVA.

BGA operations are unaffected.

129. Deploy Opposite SAW

If opposite SAW has not been deployed. Reconfigure cameras and deploy it now.

130. ECU BGA Communication

PVM:EPS:BGA XX
BGA XX
‘ECU XX’

Is Integ Cnt incrementing?

Yes

No

131. BGA Common Clear

BGA XX
‘ECU XX’

sel BGA Firmware

BGA XX Firmware

‘Clear Commands’

cmd Common Clear

Verify Power On Reset - < blank>

132. Continue SAW Deploy or Retract

Continue (1.3.452 SAW XX Deploy). (SODF: EPS: ACTIVATION & CHECKOUT: CHANNEL ACTIVATION)

OR (1.3.450 SAW XX SABB Initial Unlatch). (SODF: EPS: ACTIVATION & CHECKOUT: CHANNEL ACTIVATION)

OR (4.118 P6 SAW Retract (P6 on Z1 Truss)). (SODF: EPS: CORRECTIVE: PRIMARY POWER SYSTEM)

133. ECU SAW Power Lost

Possible ECU SAW Power Supply Failure or fault on ECU SAW power string below ECU input power selector circuit breaker. BGA operations are unaffected.

134. Override SAW Indications

BGA XX
‘ECU XX’

sel BGA Software Inhibits

BGA XX Software Inhibits

’Saw Deployment’

‘Primary PVCU’

cmd Enable - Arm

cmd Enable - Enable

Verify SAW Deployment - Ena

‘Backup PVCU’

cmd Enable - Arm

cmd Enable - Enable

Verify SAW Deployment - Ena

135. Continue {1.3.452 SAW XX Deploy}, (SODF: EPS: ACTIVATION & CHECKOUT: CHANNEL ACTIVATION)

OR {1.3.450 SAW XX SABB Initial Unlatch}, (SODF: EPS: ACTIVATION & CHECKOUT: CHANNEL ACTIVATION)

OR {4.118 P6 SAW Retract (P6 on Z1 Truss)}. (SODF: EPS: CORRECTIVE: PRIMARY POWER SYSTEM)
3.193 SAW XX FAILURE TO LATCH (TENSION) SABB REMOTELY

LBB and RBB Unlatch/Latch, Mast Deploy/Retract, must be accomplished by EVA.

One or Both SABBs Affected?

Is LBB Latched?

No
Yes

No thermal conditioning of the SAW is required if manually deploying due to fact that it takes longer to deploy and it is warming throughout the manual deploy, also the crew can respond faster to stop the deploy.

Assumes 1 bay has been deployed and one (both) SABBs are unlatched.
3.193 SAW XX FAILURE TO LATCH (TENSION) SABB REMOTELY

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136

Position SAW for LBB Latch via EVA

Perform (2.101 PVM BGA XX Engage Antirotation Latch) (SODF: EPS, NOMINAL PRIMARY POWER)

Use:
Cmded Angle = 270 deg
Latch Select = 1

137

LBB Latch via EVA

On MCC-H Go
Perform (Manual Override to Latch/Unlatch SABB) (EVA C/L, FS Reference)

138

Verify LBB Fully Latched

Verify visually
Latch Position (four of eight) - Latched

Is LBB Fully Latched?

No
Yes

139

EVA Latch Attempts

Is this the first attempt to Latch the LBB via EVA?

No
Yes

140

LBB Hardware Binding

Wait for better thermal conditions and re-attempt LBB Latch via EVA.

141

Re-attempt will be made at the end of insolation or end of eclipse, which ever case is opposite initial attempt.

27

This step can take up to 1 hr to complete. The latch cmd can be sent when the BGA Actual Angle is within 1 deg of the commanded value in order to save time.

28

This step may be omitted if EVA crew can free float and drive the MDA.

142

Position SAW for RBB Latch via EVA

Perform (2.101 PVM BGA XX Engage Antirotation Latch) (SODF: EPS, NOMINAL PRIMARY POWER)

Use:
Cmded Angle = 90 deg
Latch Select = 1

143

RBB Latch via EVA

On MCC-H Go
Perform (Manual Override to Latch/Unlatch SABB) (EVA C/L, FS Reference)

144

Verify RBB Fully Latched

Verify visually
Latch Position (four of eight) - Latched

Is RBB Fully Latched?

No
Yes

145

Go to (3.191 SAW XX FAILURE TO EXTEND MAST REMOTELY), EVA Support Steps Only (SODF:EPS:MALFUNCTION:PRIMARYPOWER)
Re-attempt will be made at the end of insolation or end of eclipse, which ever case is opposite initial attempt.
All displays in this procedure are on the PCS.

This procedure assumes that the abort cmd has already been issued to stop the deploy.

Visual confirmation of hardware status is required throughout this procedure. Do not attempt to perform this procedure during eclipse. Stiction forces increase as the blanket cools during eclipse.

MDA Abort must be sent to prevent MDA from driving once power is re-applied. This is a single step cmd.

---

### Table 1. Power Channel Connectivity

<table>
<thead>
<tr>
<th>PVM</th>
<th>XX</th>
<th>YY</th>
</tr>
</thead>
<tbody>
<tr>
<td>S4</td>
<td>1A</td>
<td>3A</td>
</tr>
<tr>
<td>S4</td>
<td>3A</td>
<td>1A</td>
</tr>
<tr>
<td>S6</td>
<td>1B</td>
<td>3B</td>
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<tr>
<td>S6</td>
<td>3B</td>
<td>1B</td>
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<td>P6</td>
<td>2B</td>
<td>4B</td>
</tr>
<tr>
<td>P6</td>
<td>4B</td>
<td>2B</td>
</tr>
</tbody>
</table>

---

### Nominal Config:
- ECU SAW [XX]:
- RPCM [XX] 1A
- RPC [YY] 1A
- RPC 2 – CI

SABBs in High Tension Mode

No C&W messages are available for SAW hardware.

---

1. **Tension Mechanism Status**
   - Visually confirm.
   - Is tension mechanism rotated off initial position?
   - **Yes**: Proceed to next step.
   - **No**: Return to initial position and retry.

2. **Retract Mast a Short Distance**
   - Confirm that ISS Thrusters are inhibited or ISS/Orbiter in Free Drift and no crew exercise prior to sending the Deploy or Retract command. If at any time the array deployment or retraction is stopped or aborted, attitude control may be resumed.

3. **SAW Deployment Status**
   - Number of visible mast bays < 15 ½ (49%)
   - Number of visible mast bays greater than 15 ½ (49%) but less than 24 (75%)
   - Number of visible mast bays > 24 (75%)

4. **Stiction Status**
   - Is the blanket flat and are the panels stuck together?
   - **Yes**: Proceed to next step.
   - **No**: Visual confirmation of hardware status is required throughout this procedure. Do not attempt to perform this procedure during eclipse. Stiction forces increase as the blanket cools during eclipse.

5. **Possible mechanism binding. Problem will not be due to stiction.**

6. **MCC-H**
Despite the deployment of the last half mast bay (at Mast Bay #31) the tension bars of both blankets will rise off the blanket box sill (~20 inches) and the tension mechanisms will rotate approximately 1½ turns.

**Panel Release Status**

Did panel pair(s) release?

- **Yes**
- **No**

**Tension Mechanism Status**

Is inboard tension mechanism rotated 1/4 turn or greater?

- **Yes**
- **No**

**Deploy Status**

Visually Confirm.

- **Is mast deployed 31 bays?**
  - **Yes**
  - **No**

**Complete Mast Deploy**

Confirm that ISS Thrusters are inhibited or ISS/Orbiter in Free Drift and no crew exercise prior to sending the Deploy or Retract command. If at any time the array deployment or retraction is stopped or aborted, attitude control may be resumed.

**Panel Release Status**

- **Yes**
- **No**

**Deploy Mast a Short Distance**

Confirm that ISS Thrusters are inhibited or ISS/Orbiter in Free Drift and no crew exercise prior to sending the Deploy or Retract command. If at any time the array deployment or retraction is stopped or aborted, attitude control may be resumed.

**Deploy Status**

- **Visually Confirm.**
- **Is mast deployed 31 bays?**
  - **Yes**
  - **No**

**Deploy Mast a Short Distance**

Confirm that ISS Thrusters are inhibited or ISS/Orbiter in Free Drift and no crew exercise prior to sending the Deploy or Retract command. If at any time the array deployment or retraction is stopped or aborted, attitude control may be resumed.
If unable to complete array deployment in a single insolation pass, deploy the mast until the array is flat and tension mechanism motion is indicated. Leave the array in this configuration during the eclipse period. Continue deploy attempts at sunrise + 5 minutes. If a panel pair released during eclipse, deploy attempts can resume at sunrise.

“Creep Release” attempts to reduce stiction by placing the problematic panel under tension, (blanket should be flat) then warming the array for 5 minutes. The warmer the array, the lower the stiction force.
Avoid pluming a partially deployed array with ISS or Orbiter thrusters. Refer to Flight Rule B9-207 Section B paragraph 5. For the stiction case, you must complete the deployment of this array first before attempting to deploy another array.

If unable to complete array deployment in a single insolation pass, then deploy the mast until the array is flat and tension mechanism motion is indicated. Leave the array in this configuration during the eclipse period. Continue deploy attempts at sunrise + 5 minutes. If a panel pair released during eclipse, deploy attempts can resume at sunrise.
ASSEMBLY
OBJECTIVE:
Verify correct activation of Capture Latch Assembly (CLA) heaters and Umbilical Mating Assembly (UMA) heaters on the four S3 Payload Attach Systems (PAS).

LOCATION:
S3 Truss

DURATION:
45 minutes

REFERENCED PROCEDURE(S):
None

NOTE
All of the PAS heaters are Resistive Temperature Device (RTD) controlled and should be enabled automatically upon activation of control software in the S3 MDMs. The following steps verify correct heater activation required to keep the PAS hardware above the operational limit of -42.8 °C (-45 °F) post S3-1 and S3-2 MDM activation.

1. **VERIFYING PAS 1 HEATER ACTIVATION**

PCS
S3: SNM
S3 SNM Overlay
‘PAS 1’

sel Latch Htr

PAS 1 Latch Htr
‘Htr Availability’

√Availability – Ena
√Control Mode State – Closed Loop

‘Temperature’

Verify Temp: -26.1 to 50 deg C
Verify Invalid – no X

‘RPC Status’

Verify RPC Trip – no X

sel RPCM S31A A RPC 14

RPCM S31A A RPC 14

Verify Integration Counter – incrementing
Verify Tripped – no X
2. VERIFYING PAS 2 HEATER ACTIVATION

Sel Latch Htr

‘Htr Availability’

‘Availability’ – Ena
‘Control Mode State’ – Closed Loop

‘Temperature’

Verify Temp: -22.2 to 50 deg C
Verify Invalid – no X

‘RPC Status’

Verify RPC Trip – no X

Sel RPCM S31A A RPC 9

‘RPCM S31A A RPC 9’

Verify Integration Counter – incrementing
Verify Tripped – no X
Verify RPC Trip – no X

sel RPCM S32B A RPC 14

RPCM S32B A RPC 14

Verify Integration Counter – incrementing
Verify Tripped – no X

√Close Cmd – Ena

S3 SNM Overlay
‘PAS 2’

sel UMA Htr

PAS 2 UMA Htr
‘Htr Availability’

√Htr Availability – Ena
√Control Mode State – Closed Loop

‘Temperature’

Verify Temp: -36.7 to 52.8 deg C
Verify Invalid – no X

‘RPC Status’

Verify RPC Trip – no X

sel RPCM S32B A RPC 9

RPCM S32B A RPC 9

Verify Integration Counter – incrementing
Verify Tripped – no X

√Close Cmd – Ena

3. **VERIFYING PAS 3 HEATER ACTIVATION**

S3 SNM Overlay
‘PAS 3’

sel Latch Htr

PAS 3 Latch Htr
‘Htr Availability’
Availability – Ena
Control Mode State – Closed Loop

‘Temperature’
Verify Temp: -22.2 to 50 deg C
Verify Invalid – no X

‘RPC Status’
Verify RPC Trip – no X

sel RPCM S32B A RPC 05

RPCM S32B A RPC 05

Verify Integration Counter – incrementing
Verify Tripped – no X

Close Cmd – Ena

S3 SNM Overlay
‘PAS 3’

sel UMA Htr

PAS 3 UMA Htr
‘Htr Availability’

Htr Availability – Ena
Control Mode State – Closed Loop

‘Temperature’
Verify Temp: -36.7 to 52.8 deg C
Verify Invalid – no X

‘RPC Status’
Verify RPC Trip – no X

sel RPCM S32B A RPC 07

RPCM S32B A RPC 07

Verify Integration Counter – incrementing
Verify Tripped – no X

Close Cmd – Ena
4. **VERIFYING PAS 4 HEATER ACTIVATION**

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<thead>
<tr>
<th>S3 SNM Overlay</th>
<th>‘PAS 4’</th>
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<tr>
<th>PAS 4 Latch Htr</th>
<th>‘Htr Availability’</th>
</tr>
</thead>
<tbody>
<tr>
<td>√Availability – Ena</td>
<td></td>
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<tr>
<td>√Control Mode State – Closed Loop</td>
<td></td>
</tr>
<tr>
<td>‘Temperature’</td>
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</tr>
<tr>
<td>Verify Temp: -26.1 to 50 deg C</td>
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<tr>
<td>Verify Invalid – no X</td>
<td></td>
</tr>
<tr>
<td>‘RPC Status’</td>
<td></td>
</tr>
<tr>
<td>Verify RPC Trip – no X</td>
<td></td>
</tr>
<tr>
<td>sel RPCM S31A A RPC 05</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RPCM S31A A RPC 05</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verify Integration Counter – incrementing</td>
</tr>
<tr>
<td>Verify Tripped – no X</td>
</tr>
<tr>
<td>√Close Cmd – Ena</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>S3 SNM Overlay</th>
<th>‘PAS 4’</th>
</tr>
</thead>
<tbody>
<tr>
<td>sel UMA Htr</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PAS 4 UMA Htr</th>
<th>‘Htr Availability’</th>
</tr>
</thead>
<tbody>
<tr>
<td>√Htr Availability – Ena</td>
<td></td>
</tr>
<tr>
<td>√Control Mode State – Closed Loop</td>
<td></td>
</tr>
<tr>
<td>‘Temperature’</td>
<td></td>
</tr>
<tr>
<td>Verify Temp: -36.7 to 52.8 deg C</td>
<td></td>
</tr>
<tr>
<td>Verify Invalid – no X</td>
<td></td>
</tr>
<tr>
<td>‘RPC Status’</td>
<td></td>
</tr>
<tr>
<td>Verify RPC Trip – no X</td>
<td></td>
</tr>
</tbody>
</table>
sel RPCM S31A A RPC 07

RPCM S31A A RPC 07

Verify Integration Counter – incrementing
Verify Tripped – no X

√ Close Cmd – Ena
OBJECTIVE:
Activate the S1S3 Segment to Segment Attachment System (SSAS) by powering on and checking communication with both Integrated Motor Controller Actuators (IMCAs) and by powering each Bolt Bus Controller (BBC), one at a time, which will then be used to checkout the Motorized Bolt Assemblies (MBAs) in preparation for the mating event.

LOCATION:
Starboard side of S1 Truss

DURATION:
2 hours

REFERENCED PROCEDURE(S):
1.231 CCS BUILD DATA LOAD COMMAND
1.232 CCS BUILD FILE UPLINK COMMAND

NOTE
1. Step titles followed by the notation “(AOS/M)” indicate that AOS during the execution of that step is mandatory. If current LOS or expecting LOS prior to completion of an AOS/M step, wait for the next AOS to perform.

2. Step titles followed by the notation “(AOS/HD)” indicate that AOS during the execution of that step is highly desired. If communication will be regained within 10 minutes of reaching such a step, wait for AOS to perform.

3. For any off-nominal steps or any attention symbols that appear, refer to {2.903 SSAS MALFUNCTION} (SODF: S&M: MALFUNCTION: TRUSS SYSTEMS).

4. Ignore all attention symbols, switch indications, cautions and advisories prior to activation of SSAS software, path selection and devices being powered.

5. To stop mechanism actuation the following commands may be sent:
   in Manual State: `cmd Stop Execute`
   in Normal State: `cmd Pause Execute`
   in any SSAS state: `cmd Abort Execute` (device power will be cut with Abort command)

6. In order to prevent erroneous autosafing, the IMCA Inadvertent Motion and BBC Inadvertent Power autosafing capabilities will be inhibited during use of IMCAs and BBC.

7. Caution events for the IMCA Inadvertent Motion and BBC Inadvertent Power should be inhibited (event codes: 10331, 10332, 10315, and 10316).

8. If crew performing procedure steps, Advisories on PCS should be turned on.

9. IMCA and BBC activation/deactivation and bolt drive tests will be performed by MCC-H using command scripts, with script information contained in Table 1.
Table 1. S1S3 SSAS Command Script Information

<table>
<thead>
<tr>
<th>Command Script</th>
<th>Script Function</th>
<th>Procedure Step(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1S3_SSAS_IMCA_1_Activate</td>
<td>Activate S1S3 SSAS IMCA 1</td>
<td>6</td>
</tr>
<tr>
<td>S1S3_SSAS_IMCA_2_Activate</td>
<td>Activate S1S3 SSAS IMCA 2</td>
<td>7</td>
</tr>
<tr>
<td>S1S3_SSAS_BBC_2_Activate</td>
<td>Activate S1S3 SSAS BBC 2</td>
<td>8</td>
</tr>
<tr>
<td>SSAS_Bolt_1_Forward_Drive_Test</td>
<td>Drive MBA 1 forward 35 seconds</td>
<td>13</td>
</tr>
<tr>
<td>SSAS_Bolt_2_Forward_Drive_Test</td>
<td>Drive MBA 2 forward 35 seconds</td>
<td>13</td>
</tr>
<tr>
<td>SSAS_Bolt_3_Forward_Drive_Test</td>
<td>Drive MBA 3 forward 35 seconds</td>
<td>13</td>
</tr>
<tr>
<td>SSAS_Bolt_4_Forward_Drive_Test</td>
<td>Drive MBA 4 forward 35 seconds</td>
<td>13</td>
</tr>
<tr>
<td>S1S3_SSAS_BBC_2_Deactivate</td>
<td>Deactivate S1S3 SSAS BBC 2</td>
<td>16</td>
</tr>
<tr>
<td>S1S3_SSAS_BBC_1_Activate</td>
<td>Activate S1S3 SSAS BBC 1</td>
<td>18</td>
</tr>
<tr>
<td>SSAS_Bolt_1.Reverse_Drive_Test</td>
<td>Drive MBA 1 reverse 38 seconds</td>
<td>23</td>
</tr>
<tr>
<td>SSAS_Bolt_2.Reverse_Drive_Test</td>
<td>Drive MBA 2 reverse 38 seconds</td>
<td>23</td>
</tr>
<tr>
<td>SSAS_Bolt_3.Reverse_Drive_Test</td>
<td>Drive MBA 3 reverse 38 seconds</td>
<td>23</td>
</tr>
<tr>
<td>SSAS_Bolt_4.Reverse_Drive_Test</td>
<td>Drive MBA 4 reverse 38 seconds</td>
<td>23</td>
</tr>
</tbody>
</table>

1. **VERIFYING RPCM STATUS**

PCS

S1: S&M: SSAS S1/S3

S1S3 SSAS Overview

‘BBC-1 Pwr’

sel S14B G RPC 01

RPCM S14B G RPC 01

\sqrt{Integration Counter – incrementing}

S1S3 SSAS Overview

‘BBC-2 Pwr’

sel S13A G RPC 01

RPCM S13A G RPC 01

\sqrt{Integration Counter – incrementing}

S1S3 SSAS Overview

‘IMCA-1 Pwr’

sel S14B G RPC 15

RPCM S14B G RPC 15

\sqrt{Integration Counter – incrementing}

S1S3 SSAS Overview

‘IMCA-2 Pwr’
sel S13A G RPC 15

RPCM S13A G RPC 15

√ Integration Counter – incrementing

2. RECORDING CDH CONFIGURATION

S1S3 SSAS Overview

Record Primary MDM: EXT: ________
Record Backup MDM: EXT: ________

√ LB MECH S1 Ch – A
√ LB MECH S2 Ch – A

sel Primary EXT MDM

Primary Ext MDM

sel LB Mech S 1

LB MECH S1

sel RT Status

LB MECH S1 RT Status

‘12 SSAS S1/S3 L1’

√ RT Status – Inh
√ RT FDIR Status – Inh

Verify RT Comm Failed Status – blank

‘13 SSAS S1/S3 B1’

√ RT Status – Inh
√ RT FDIR Status – Inh

Verify RT Comm Failed Status – blank

Primary Ext MDM

sel LB Mech S 2

LB MECH S2

sel RT Status
LB MECH S2 RT Status
‘12 SSAS S1/S3 L2’

√RT Status – Inh
√RT FDIR Status – Inh

Verify RT Comm Failed Status – blank

‘13 SSAS S1/S3 B2’

√RT Status – Inh
√RT FDIR Status – Inh

Verify RT Comm Failed Status – blank

3. ACTIVATING SSAS SOFTWARE APPLICATION

NOTE
Before SSAS software activation, a nominal SSAS State indication of 'Idle' will be displayed.

S1S3 SSAS Overview
‘SSAS Application’

sel Application Commands

SSAS Application

cmd SSAS Application S/W Status – Activate Execute

Verify SSAS Application S/W Status – Activated

√SSAS IMCA S/W Status – Activated
√SSAS BBC S/W Status – Activated

4. TRANSITIONING SSAS STATE TO STANDBY

S1S3 SSAS Overview
‘SSAS State’

sel State Commands

SSAS State Commands

cmd Standby Execute

Verify SSAS State – Standby
5. **SELECTING SSAS PATH**

**S1S3 SSAS Overview**
‘S1S3 Path Selection’

sel Path Commands

**S1S3 SSAS Path Commands**
‘Nominal Commands’

**cmd IMCA 2 and BBC 2 Execute**

Verify SSAS Selected – S1S3
Verify IMCA Selected – IMCA 2
 Verify BBC Selected – BBC 2
Verify SSAS Path – S1S3 IMCA 2 BBC 2

**NOTE**
1. IMCA-1 and IMCA-2 telemetry fields on Latching graphical display update at 0.1 Hz rate. Data on Latching command displays update at 1.0 Hz rate and should be used first for data verification.
2. Each IMCA will take 6 seconds to complete Power On Self Test (POST) and mode to Standby after power has been applied.

6. **ACTIVATING S1S3 SSAS IMCA-1**

**NOTE**
The following commands to Inhibit Inadvertent Motion Autosafing and their associated telemetry do not exist on PCS and, thus, can only be sent and verified by **MCC-H**.

6.1 Inhibiting IMCA-1 Inadvertent Motion Autosafing

**MCC-H**

**cmd Prim_EXT_Arm_Inh_ECZ_Function_Tmplt Execute**

<Cmd PUI: S0DD96IM1665K>
<Template IMCA_SAS_S1S3_L1_INADVERT_MOTION _AUTOSAFING_9A>

input – 3 9

**S1S3 SSAS Latching MSKVIEW**
‘Latching Cautions & Advisories’

Verify IMCA-1 Inadvertent Motion – Arm

**cmd Prim_EXT_Inh_ECZ_Function_Tmplt Execute**
NOTE
The RPC powering IMCA-1 was closed to allow IMCA to be continuously powered in order to prevent loss of heating should the Capture Latch heaters fail similar to the P1P3 SSAS. Thus in order to clear the IMCA Watchdog Timer, the IMCA RPC is opened prior to its reactivation and enabling of the Remote Terminal communication.

6.2 Opening IMCA-1 RPC

sel S14B G RPC 15

RPCM S14B G RPC 15

cmd RPC Position – Open (Verify – Op)

6.3 Enabling IMCA-1 RT I/O

sel Primary EXT MDM

Primary Ext MDM

sel LB Mech S 1

LB MECH S1

sel RT Status

LB MECH S1 RT Status
‘12 SSAS S1/S3 L1’

√RT FDIR Status – Inh

cmd RT Status – Enable Execute

Verify RT Status – Ena
6.4 Activating IMCA-1

S1S3 SSAS Overview

'Operations'

Sel Latching

S1S3 SSAS Latching

'Latching Graphical Representation'

'IMCA-1 Pwr'

Sel S14B G RPC 15

RPCM S14B G RPC 15

Cmd RPC Position – Close (Verify – Cl)

Verify Open Cmd – Ena

S1S3 SSAS Latching

'IMCA-1'

Verify Built In Test Errors – no attention symbol

'Mode'

Verify Standby – green

'Motor Status'

Verify RTD Voltage ≤ 1251mV

Verify RTD Voltage – changed at least once over a 30 second period

'Latch Status'

Verify Latch Status – Stopped

'Latching Graphical Representation'

Verify IMCA-1 icon – no attention symbol

Verify Closed – gray

Verify Open – green

Verify RTL 1 – gray

Verify RTL 2 – gray

Verify RTL 3 – gray
6.5 Enabling IMCA-1 RT FDIR

**S1S3 SSAS Latching**

sel Primary EXT MDM

**Primary Ext MDM**

sel LB Mech S 1

**LB MECH S1**

sel RT Status

**LB MECH S1 RT Status**

‘12 SSAS S1/S3 L1’

√RT Status – Ena

cmd RT FDIR Status – Enable FDIR  **Execute**

Verify RT FDIR Status – Ena
Verify RT Comm Failed Status – blank

7. **ACTIVATING S1S3 SSAS IMCA-2**

**NOTE**

The following commands to Inhibit Inadvertent Motion Autosafing and their associated telemetry do not exist on PCS and, thus, can only be sent and verified by **MCC-H**.

7.1 Inhibiting IMCA-2 Inadvertent Motion Autosafing

**MCC-H**

**cmd** Prim_EXT_Arm_Inh_ECZ_Function_Tmplt  **Execute**

<Cmd PUI: S0DD96IM1665K>
<Template IMCA_SAS_S1S3_L2_INADVERT_MOTION_AUTOSAFING_9A>

input – 4 0

**S1S3 SSAS Latching MSKVIEW**

‘Latching Cautions & Advisories’

Verify IMCA-2 Inadvertent Motion – Arm

**cmd** Prim_EXT_Inh_ECZ_Function_Tmplt  **Execute**

<Cmd PUI: S0DD96IM1672K>
<Template IMCA_SAS_S1S3_L2_INADVERT_MOTION_AUTOSAFING_9A>
input – 4 0

[S1S3 SSAS Latching MSKVIEW]
‘Latching Cautions & Advisories’

Verify IMCA-2 Inadvertent Motion – Inh

7.2 Opening IMCA-2 RPC

NOTE
The RPC powering IMCA-2 was closed to allow IMCA to be continuously powered in order to prevent loss of heating should the Capture Latch heaters fail similar to the P1P3 SSAS. Thus in order to clear the IMCA Watchdog Timer, the IMCA RPC is opened prior to its reactivation and Enabling of the Remote Terminal communication.

[S1S3 SSAS Overview]
‘IMCA-2 Pwr’

sel S13A G RPC 15

RPCM S13A G RPC 15

cmd RPC Position – Open (Verify – Op)

7.3 Enabling IMCA-2 RT I/O

[S1S3 SSAS Latching]

sel Primary EXT MDM

Primary Ext MDM

sel LB Mech S 2

LB MECH S2

sel RT Status

LB MECH S2 RT Status
‘12 SSAS S1/S3 L2’

√RT FDIR Status – Inh

cmd RT Status – Enable Execute

Verify RT Status – Ena
7.4 Activating IMCA-2

**S1S3 SSAS Latching**

'Latching Graphical Representation'

'IMCA-2 Pwr'

sel S13A G RPC 15

**RPCM S13A G RPC 15**

**cmd** RPC Position – Close (Verify – Cl)

Verify Open Cmd – Ena

**S1S3 SSAS Latching**

'IMCA-2'

Verify Built In Test Errors – no attention symbol

'Mode'

Verify Standby – green

'Motor Status'

Verify RTD Voltage \( \leq 1251 \text{ mV} \)

Verify RTD Voltage – changed at least once over a 30 second period

'Latch Status'

Verify Latch Status – Stopped

'Latching Graphical Representation'

Verify IMCA-2 icon – no attention symbol

Verify Closed – gray

Verify Open – green

Verify RTL 1 – gray

Verify RTL 2 – gray

Verify RTL 3 – gray

'Command Validation'

Verify IMCA Cmd and Data Status – no attention symbol
7.5 Enabling IMCA-2 RT FDIR

S1S3 SSAS Latching

sel Primary EXT MDM

Primary Ext MDM

sel LB Mech S 2

LB MECH S2

sel RT Status

LB MECH S2 RT Status

'12 SSAS S1/S3 L2'

√RT Status – Ena

cmd RT FDIR Status – Enable FDIR  Execute

Verify RT FDIR Status – Ena
Verify RT Comm Failed Status – blank

8. ACTIVATING S1S3 SSAS BBC-2

NOTE

The following commands to Inhibit Inadvertent Power Autosafing and their associated telemetry do not exist on PCS and, thus, can only be sent and verified by MCC-H.

8.1 Inhibiting BBC-2 Inadvertent Power Autosafing

MCC-H

cmd Prim_EXT_Arm_Inh_ECZ_Function_Tmplt  Execute

<Cmd PUI: S0DD96IM1665K>
<Template BBC_SAS_S1S3_B2_INADVERT_POWER_AUTOSAFING_9A>

input – 6 4

S1S3 SSAS Bolting MSKVIEW

'Bolting Cautions & Advisories'

Verify BBC-2 Inadvertent Power – Arm

cmd Prim_EXT_Inh_ECZ_Function_Tmplt  Execute

<Cmd PUI: S0DD96IM1672K>
<Template BBC_SAS_S1S3_B2_INADVERT_POWER_AUTOSAFING_9A>

input – 6 4
8.2 Activating BBC-2

**CAUTION**
Only one Bolt Bus Controller (BBC) may be powered at a given time to avoid short circuits between BBC-1 and BBC-2.

8.3 Enabling BBC-2 RT I/O

```cmd
Close Cmd – Enable (Verify – Ena)
RPC Position – Close (Verify – Cl)
```
Verify BBC Cmd and Data Status – no attention symbol

'BBC Status'

Verify BBC Selected – BBC 2

Verify MBA Current: 0 to 16 mA

Verify Bolt Direction – FWD
Verify Limit Sw Cutoff Flag – gray
Verify Current Cutoff Flag – gray
Verify Limit Sw Cutoff Override – gray

'Bolting Graphical Representation'

Verify Limit Switch Return Num 2 – Closed
Verify BBS (all) – green
Verify BTS (all) – gray
Verify BBC-1 icon – gray
Verify BBC-1 & BBC-2 icon – no attention symbol

8.4 Enabling BBC-2 RT FDIR

S1S3 SSAS Bolting

sel Primary EXT MDM

Primary Ext MDM

sel LB MECH S 2

LB MECH S2

sel RT Status

LB MECH S2 RT Status

‘13 SSAS S1/S3 B2’

√RT Status – Ena

cmd RT FDIR Status – Enable FDIR Execute

Verify RT FDIR Status – Ena
Verify RT Comm Failed Status – blank

9. TRANSITIONING SSAS STATE TO MANUAL

S1S3 SSAS Overview

‘SSAS State’

sel State Commands

SSAS State Commands
cmd Manual  Execute

Verify SSAS State – Manual

10. **PERFORMING ACTIVE BIT TEST ON IMCA-2 (AOS/HD)**

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The IMCA will stop communicating with the MDM momentarily during performance of the Active Built In Test (BIT), which should cause a single 1553 channel swap to the alternate channel for the affected IMCA.</td>
</tr>
<tr>
<td>2. Likewise, during performance of the Active BIT the attention symbol next to the IMCA Cmd and Data Status nav button may momentarily appear for approximately 4 to 5 seconds. This is caused by the IMCA Status Measurement Data Stale indication being set during performance of the BIT, which is a known software feature.</td>
</tr>
</tbody>
</table>

**S1S3 SSAS Latching**

sel Contingency Latching

**SSAS Contingency Latching Commands**

‘Contingency Commands’

**cmd Active BIT  Execute**

**S1S3 SSAS Latching**

‘IMCA-2’

Verify Built-In Test Errors – no attention symbol

‘Latching Graphical Representation’

Verify LB MECH S2 Ch – B

sel Primary EXT MDM

**Primary Ext MDM**

sel LB Mech S 2

**LB MECH S2**

sel RT Status

**LB MECH S2 RT Status**

‘12 SSAS S1/S3 L2’
Verifying RT Status – Ena
Verify RT FDIR Status – Ena
Verify RT Comm Failed Status – blank

‘13 SSAS S1/S3 B2’
Verify RT Status – Ena
Verify RT FDIR Status – Ena
Verify RT Comm Failed Status – blank

******************************************************************************
* If LB MECH S2 bus is not on channel B
* 
* LB MECH S2
* sel Bus Status
* 
* LB MECH S2 Bus Status
* 
* cmd Select Ch B Execute
* 
* Verify Channel Selected – B
******************************************************************************

11. **VERIFYING IMCA-2, BBC-2 COMMUNICATION ON ALTERNATE 1553 CHANNEL**

S1S3 SSAS Overview
‘Operations’

sel Latching

S1S3 SSAS Latching
‘Command Validation’

Verify IMCA Cmd and Data Status – no attention symbol

‘Latching Graphical Representation’

Verify IMCA-1 & IMCA-2 icons – no attention symbols
Verify IMCA-1 Closed – gray
Verify IMCA-2 Closed – gray
Verify IMCA-1 Open – green
Verify IMCA-2 Open – green
Verify RTL 1 (two) – gray
Verify RTL 2 (two) – gray
Verify RTL 3 (two) – gray

S1S3 SSAS Overview
‘Operations’

sel Bolting
S1S3 SSAS PREP FOR MATE

12. SETUP CONFIGURATION FOR S1S3 SSAS BOLT DRIVE TEST

12. SETUP CONFIGURATION FOR S1S3 SSAS BOLT DRIVE TEST

(AOS/M)

S1S3 SSAS Overview

‘Operations’

sel Bolting

S1S3 SSAS Bolting

sel Common Power Relay Cmds

SSAS BBC Common Power Relay

‘SSAS MANUAL MODE - Relay Position’

cmd Close Execute

Verify Commanded Relay Position – Cl
Verify Actual Relay Position – Cl

S1S3 SSAS Bolting

sel Manual Bolting Commands

SSAS Manual Bolting Commands

Verify Bolt Direction – Forward
Verify Common Power Relay – Closed
Verify Limit Switch Return – Closed
CAUTION
To prevent Bolt from extending beyond the fine alignment cone, MBA on time should not exceed 35 seconds.

NOTE
1. This Bolt Drive test will use BBC-2 to drive each SSAS Bolt forward in Manual State (one at a time) to open the Bolt Back Switch (BBS), and then power will be cut to the MBA. Upon completion of driving all four Bolts forward, BBC-2 will be deactivated and BBC-1 will be activated and used to drive all four Bolts in reverse in Manual State (one at a time), until the BBS closes.

2. When sending bolting commands, SSAS command validation S/W will momentarily cause an attention symbol next to the BBC Command and Data Status, but will self-clear.

3. When performing the bolt forward drive test from Ground, MCC-H will build time tag commands to drive the Bolts forward one at a time for a total of 35 seconds. This is done by sending Bolt [Z] power on command, followed by the Bolt power-off command sent 35 seconds later.
13. **S1S3 SSAS BOLT [Z] FORWARD DRIVE TEST (AOS/M)**

 SSAS Manual Bolting Commands

 ‘Drive Bolt’

```
cmd Bolt [Z] Execute  where [Z] = [1, 2, 3, 4]
```

***********************************************************
*
* If MBA Current exceeds 300 mA just after Drive
* Bolt command is sent, immediately
* cmd Stop Execute
***********************************************************

Verify Bolt Selected – Bolt [Z]
Verify MBA Current: 100 to 175 mA
Verify Pwr On – X
Verify MBA Posn, On – incrementing

***********************************************************
*
* If MBA Current exceeds 175 mA at anytime
* before MBA On of 480 seconds, immediately
* cmd Stop Execute
***********************************************************

When BBS – blank or MBA On: 35 seconds
```
cmd Bolt Power – Off Execute
```

Verify Bolt Selected – None
Verify MBA Current – Current < 16 mA
Verify Pwr On – blank
Verify MBA Posn, On – not incrementing

Repeat

14. **OPENING COMMON POWER RELAY**

 SSAS Bolting

 sel Common Power Relay Cmds

```
SSAS BBC Common Power Relay
‘SSAS MANUAL MODE - Relay Position’
```

```
cmd Open Execute
```

Verify Commanded Relay Position – Op
Verify Actual Relay Position – Op
15. **TRANSITIONING SSAS STATE TO STANDBY**

   **S1S3 SSAS Overview**
   
   ‘SSAS State’

   sel State Commands

   **SSAS State Commands**

   **cmd** Standby **Execute**

   Verify SSAS State – Standby

16. **DEACTIVATING S1S3 SSAS BBC-2**

   16.1 **Inhibiting BBC-2 RT FDIR**

   **S1S3 SSAS Overview**

   sel Primary EXT MDM

   **Primary Ext MDM**

   sel LB Mech S 2

   **LB MECH S2**

   sel RT Status

   **LB MECH S2 RT Status**

   ‘13 SSAS S1/S3 B2’

   √RT Status – Ena

   **cmd** RT FDIR Status – Inhibit FDIR **Execute**

   Verify RT FDIR Status – Inh

   16.2 **Inhibiting BBC-2 RT I/O**

   **LB MECH S2 RT Status**

   ‘13 SSAS S1/S3 B2’

   **cmd** RT Status – Inhibit **Execute**

   Verify RT Status – Inh

   16.3 **Deactivating BBC-2**

   **S1S3 SSAS Overview**

   ‘BBC-2 Pwr’

   sel S13A G RPC 01
16.4 Enabling BBC-2 Inadvertent Power Autosafing

NOTE
The following command to Enable Inadvertent Power Autosafing and its associated telemetry does not exist on PCS and, thus, can only be sent by MCC-H.

MCC-H cmd Prim_EXT_Ena_ECZ_Function_Tmplt Execute

<Scmd PUI: S0DD96IM1658K>
<Template BBC_SAS_S1S3_B1_INADVERT_POWER_AUTOSAFING_9A>

input – 6

S1S3 SSAS Bolting MSKVIEW
‘Bolting Cautions & Advisories’

Verify BBC-2 Inadvertent Power – Ena

17. SELECTING SSAS PATH

S1S3 SSAS Overview
‘S1S3 Path Selection’

sel Path Commands

S1S3 SSAS Path Commands
‘Nominal Commands’

cmd IMCA 1 and BBC 1 Execute

S1S3 SSAS Overview
‘S1S3 Path Selection’

Verify SSAS Selected – S1S3
Verify IMCA Selected – IMCA 1
Verify BBC Selected – BBC 1
Verify SSAS Path – S1S3 IMCA 1 BBC 1

18. ACTIVATING S1S3 SSAS BBC-1

NOTE
The following commands to Inhibit Inadvertent Power Autosafing and their associated telemetry do not exist on PCS and, thus, can only be sent by MCC-H.
18.1 Inhibiting BBC-1 Inadvertent Power Autosafing

**MCC-H**

**cmd** Prim_EXT_Arm_Inh_Ena_ECZ_Function_Tmplt **Execute**

<Cmd PUI: S0DD96IIM1665K>
<Template BBC_SAS_S1S3_B1_INADVERT_POWER_AUTOSAFING_9A>

input – 63

[S1S3 SSAS Bolting MSKVIEW]
‘Bolting Cautions & Advisories’

Verify BBC-1 Inadvertent Power – Arm

**cmd** Prim_EXT_Inh_ECZ_Function_Tmplt **Execute**

<Cmd PUI: S0DD96IIM1672K>
<Template BBC_SAS_S1S3_B1_INADVERT_POWER_AUTOSAFING_9A>

input – 63

[S1S3 SSAS Bolting MSKVIEW]
‘Bolting Cautions & Advisories’

Verify BBC-1 Inadvertent Power – Inh

18.2 Activating BBC-1

**CAUTION**

Only one Bolt Bus Controller (BBC) may be powered at a given time to avoid short circuits between BBC-1 and BBC-2.

[S1S3 SSAS Overview]
‘Operations’

sel Bolting

[S1S3 SSAS Bolting]
‘Bolting Graphical Representation’
‘BBC-1 Pwr’

sel S14B G RPC 01

[RPCM S14B G RPC 01]

**cmd** Close Cmd – Enable (Verify – Ena)
**cmd** RPC Position – Close (Verify – Cl)
18.3 Enabling BBC-1 RT I/O

sel Primary EXT MDM

sel LB Mech S 1

sel RT Status

√ RT FDIR Status – Inh

cmd RT Status – Enable Execute

Verify RT Status – Ena

Verify BBC Cmd and Data Status – no attention symbol

‘BBC Status’

Verify BBC Selected – BBC 1

Verify MBA Current: 0 to 16 mA

Verify Bolt Direction – FWD
Verify Limit Sw Cutoff Flag – gray
Verify Current Cutoff Flag – gray
Verify Limit Sw Cutoff Override – gray

‘Bolting Graphical Representation’

Verify Limit Switch Return Num 1 – Closed
Verify BBS (all) – gray
Verify BTS (all) – gray
Verify BBC-2 icon – gray
Verify BBC-1 & BBC-2 icon – no attention symbol

18.4 Enabling BBC-1 RT FDIR
sel Primary EXT MDM

Primary Ext MDM

sel LB Mech S 1

LB MECH S1

sel RT Status

LB MECH S1 RT Status

‘13 SSAS S1/S3 B1’

√RT Status – Ena

cmd RT FDIR Status – Enable FDIR Execute

Verify RT FDIR Status – Ena

19. TRANSITIONING SSAS STATE TO MANUAL

SSAS State Commands

SSAS State Commands

cmd Manual Execute

Verify SSAS State – Manual

20. PERFORMING ACTIVE BIT TEST ON IMCA-1 (AOS/HD)

NOTE

1. The IMCA will stop communicating with the MDM momentarily during performance of the Active Built In Test (BIT), which should cause a single 1553 channel swap to the alternate channel for the affected IMCA.

2. Likewise, during performance of the Active BIT the attention symbol next to the IMCA Cmd and Data Status nav button may momentarily appear for approximately 4 to 5 seconds. This is caused by the IMCA Status Measurement Data Stale indication being set during performance of the BIT, which is a known software feature.

S1S3 SSAS Latching

sel Contingency Latching
SSAS Contingency Latching Commands
‘Contingency Commands’

**cmd** Active BIT  **Execute**

S1S3 SSAS Latching
‘IMCA-1’

Verify Built-In Test Errors – no attention symbol

‘Latching Graphical Representation’

Verify LB MECH S1 Ch – B
sel Primary EXT MDM

Primary Ext MDM

sel LB Mech S 1

**LB MECH S1**

sel RT Status

**LB MECH S1 RT Status**
‘12 SSAS S1/S3 L1’

Verify RT Status – Ena
Verify RT FDIR Status – Ena
Verify RT Comm Failed Status – blank

‘13 SSAS S1/S3 B1’

Verify RT Status – Ena
Verify RT FDIR Status – Ena
Verify RT Comm Failed Status – blank

*******************************************************************************

* If LB MECH S1 bus is not on channel B
  *
  *
  **LB MECH S1**
  *
  * sel Bus Status
  *
  **LB MECH S1 Bus Status**
  *
  **cmd** Select Ch B  **Execute**
  *
  *
  * Verify Channel Selected – B
  *******************************************************************************
21. **VERIFYING IMCA-1, BBC-1 COMMUNICATION ON ALTERNATE 1553 CHANNELS**

S1S3 SSAS Overview

'Sel Latching'

S1S3 SSAS Latching

'Command Validation'

Verify IMCA Cmd and Data Status – no attention symbol

'Latching Graphical Representation'

Verify IMCA-1 & IMCA-2 icons – no attention symbols
Verify IMCA-1 Closed – gray
Verify IMCA-2 Closed – gray
Verify IMCA-1 Open – green
Verify IMCA-2 Open – green
Verify RTL 1 (two) – gray
Verify RTL 2 (two) – gray
Verify RTL 3 (two) – gray

S1S3 SSAS Overview

'Sel Bolting'

S1S3 SSAS Bolting

'Command Validation'

Verify BBC Cmd and Data Status – no attention symbol

'BBC Status'

Verify Bolt Direction – FWD

'Bolting Graphical Representation'

Verify BBC-1 & BBC-2 icons – no attention symbols
Verify Limit Switch Return Num 1 – Closed
Verify BBS (all) – gray
Verify BTS (all) – gray
Verify BBC-2 icon – gray
22. **SETUP CONFIGURATION FOR S1S3 SSAS BOLT REVERSE DRIVE TEST (AOS/M)**

**NOTE**
The following step will use BBC-1 to drive each Bolt in reverse (one at a time) in manual state until the BBS closes and MBA Position and On Time equal zero. At this time, the Bolt is powered off.

**S1S3 SSAS Overview**

*Operations*

**sel Bolting**

**S1S3 SSAS Bolting**

**sel Common Power Relay Cmds**

**SSAS BBC Common Power Relay**

*SSAS MANUAL MODE - Relay Position*

**cmd Close Execute**

Verify Commanded Relay Position – CI
Verify Actual Relay Position – CI

**S1S3 SSAS Bolting**

**sel Bolt Direction Commands**

**SSAS BBC Set Bolt Direction**

*Select Bolt Direction (Manual Mode)*

**cmd Reverse Execute**

Verify Commanded Bolt Direction – Reverse
Verify Actual Bolt Direction – Reverse

**NOTE**

1. When sending bolting commands, SSAS command validation S/W will momentarily cause an attention symbol next to the BBC Command and Data Status but will self-clear.

2. When performing the bolt reverse drive test from Ground, **MCC-H** will build time tag commands to drive the Bolts in reverse one at a time for a total of 38 seconds. This is done by sending Bolt [Z] power on command, followed by the Bolt power-off command sent 38 seconds later.

3. Bolts are driven for 38 seconds to ensure that MBA Posn and MBA On telemetry is reset back to zero for each bolt prior to the mating event.
23. **S1S3 SSAS BOLT [Z] REVERSE DRIVE TEST (AOS/M)**

Sel Manual Bolting Commands

**SSAS Manual Bolting Commands**

'SDrive Bolt'

**cmd** Bolt [Z] **Execute** where \([Z] = 1 \ 2 \ 3 \ 4\)

*********************************************************
* If MBA Current exceeds 300 mA just after Drive
* Bolt command is sent, immediately
* **cmd** Stop **Execute**
***********************************************************

Verify Bolt Selected – Bolt [Z]
Verify MBA Current: 100 to 175 mA
Verify Pwr On – X
Verify MBA Posn, On – decrementing

*********************************************************
* If MBA Current exceeds 175 mA at anytime
* before MBA On of 480 seconds, immediately
* **cmd** Stop **Execute**
***********************************************************

When BBS – X and MBA Posn, On: 0

'Bolt Power'

**cmd** Bolt Power – Off **Execute**

Verify Bolt Selected – None
Verify MBA Current – Current < 16 mA
Verify Pwr On – blank

Verify MBA Posn: 0.0
Verify MBA On: 0

Repeat

Sel Bolt Direction Commands

**SSAS BBC Set Bolt Direction**

'Select Bolt Direction (Manual Mode)'

**cmd** Forward **Execute**

Verify Commanded Bolt Direction – Forward
Verify Actual Bolt Direction – Forward
24. **OPENING COMMON POWER RELAY**

   **S1S3 SSAS Bolting**

   sel Common Power Relay Cmds

   **SSAS BBC Common Power Relay**

   ‘SSAS MANUAL MODE - Relay Position’

   **cmd** Open  **Execute**

   Verify Commanded Relay Position – Op
   Verify Actual Relay Position – Op

25. **TRANSITIONING SSAS STATE TO STANDBY AND VERIFYING LB MECH BUS ON CHANNEL A**

   **S1S3 SSAS OVERVIEW**

   ‘SSAS State’

   sel State Commands

   **SSAS State Commands**

   **cmd** Standby  **Execute**

   Verify SSAS State – Standby

   **NOTE**
   The S3 Activation procedure requires the LB Mech S1 and S2 busses to be on channel A in preparation for the EVA Nadir tray connections.

   **S1S3 SSAS OVERVIEW**

   ‘Overview Graphical Representation’

   sel Primary EXT MDM

   **Primary Ext MDM**

   sel LB Mech S 1

   **LB MECH S1**

   sel Bus Status

   **LB MECH S1 Bus Status**

   **cmd** Select Ch A  **Execute**

   Verify Channel Selected – A
Primary Ext MDM

sel LB Mech S 2

LB MECH S2

sel Bus Status

LB MECH S2 Bus Status

**cmd** Select Ch A  **Execute**

Verify Channel Selected – A

---

**MCC-H 26. PERFORMING FILE UPLINK AND DATA LOAD COMMANDS FOR MECHANISM AUTOSAFING PPLs**

**26.1 Building RDF 207 PPL Uplink to Primary C&C MDM (OSO)**

Using the following, perform {1.232  CCS BUILD FILE UPLINK COMMAND}, all (SODF: GND AVIONICS: C&DH: NOMINAL), then:

- **Ops Name** = YYYY_DDD_HH_CC_Hot_Mech_Safing_207_PPL_1
- **Source Device** = Ground
- **Storage Type** = RAM
- **Select Destination Filename** = /mcc/fsw/\{ISS Flight ID\}/ppl/ccsr4_460/ccs_ppl_0207_4_a_04012.lif
- **Verify Source Filename** = /mcc/fsw/\{ISS Flight ID\}/ppl/ccsr4_460/ccs_ppl_0207_4_a_04012.lif
- **Destination Device** = C&C HOT
- **Priority** = High
- **Uplink after** = S1S3 SSAS Prep for Mate procedure
- **Uplink by** = prior to S1S3 SSAS Nominal Mate procedure
- **Remarks** = uplink required by OCAD #s 19418, and 19427

**26.2 Building RDF 207 PPL Uplink to Backup C&C MDM (OSO)**

Using the following, perform {1.231  CCS BUILD DATA LOAD COMMAND}, all (SODF: GND AVIONICS: C&DH: NOMINAL), then:

- **Ops Name** = YYYY_DDD_HH_CC_Warm_Mech_Safing_207_PPL_1
- **Select Load File** = /mcc/fsw/\{ISS Flight ID\}/ppl/ccsr4_460/ccs_ppl_0207_4_a_04012.lif
- **Memory Type** = RAM
- **Destination Device** = C&C WARM
- **Priority** = High
- **Uplink after** = S1S3 SSAS Prep for Mate procedure
- **Uplink by** = prior to S1S3 SSAS Nominal Mate procedure
- **Remarks** = uplink required by OCAD #s 19418, and 19427
26.3  **Building RDF 243 PPL Uplink to Backup C&C MDM (OSO)**
Using the following, perform `{1.231 CCS BUILD DATA LOAD COMMAND}`, all (SODF: GND AVIONICS: C&DH: NOMINAL), then:

**Ops Name** = YYYY_DDD_HH_CC_Warm_Mech_Safing_243_PPL_2
**Select Load File** = /mcc/fsw/[ISS Flight ID]/ppl/ccsr4_460/ccs_ppl_0243_4_a_04002.lif
**Memory Type** = RAM
**Destination Device** = C&C WARM
**Priority** = High
**Uplink after** = S1S3 SSAS Prep for Mate procedure
**Uplink by** = prior to S1S3 SSAS Nominal Mate procedure

26.4  **Performing PPL FILE Uplink and Data Loads (ODIN)**
To uplink RDF 207 PPL to the Primary C&C MDM, perform `{1.232 CCS BUILD FILE UPLINK COMMAND}`, all (SODF: GND AVIONICS: C&DH: NOMINAL), then:

To uplink RDF 207 PPL to the Backup C&C MDM, perform `{1.231 CCS BUILD DATA LOAD COMMAND}`, all (SODF: GND AVIONICS: C&DH: NOMINAL), then:

To uplink RDF 243 PPL to the Backup C&C MDM, perform `{1.231 CCS BUILD DATA LOAD COMMAND}`, all (SODF: GND AVIONICS: C&DH: NOMINAL), then:

26.5  **Verifying PPL Version IDs (OSO)**

**S1S3 SSAS Overview**

‘Operations’

sel Latching

**S1S3 SSAS Latching**

sel Manual Latching

**SSAS Manual Latching Commands**

‘Capture Autosafing’

sel Mechanism Autosafing

**Mechanism Autosafing**

‘Autosafing PPL Version IDs - Safing Cmds’

Verify Primary C&C: 04012
Verify Backup C&C: 04012

‘Autosafing PPL Version IDs - Safing Default’

Verify Backup C&C: 04002
**OBJECTIVE:**
In Manual State operation, capture the S3 Integrated Truss Segments (ITS) using S1S3 Segment to Segment Attachment System (SSAS) Capture Latch driven by Integrated Motor Controller Actuators (IMCAs). Switch to Normal State to permanently attach the S1 and S3 Trusses together using Bolt Bus Controllers (BBCs) and Motorized Bolt Assemblies (MBAs).

**LOCATION:**
Starboard side of S1 Truss

**DURATION:**
1 hour, 40 minutes

**REFERRED PROCEDURE(S):**
1.231 CCS BUILD DATA LOAD COMMAND
1.232 CCS BUILD FILE UPLINK COMMAND

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Step titles followed by the notation “(AOS/M)” indicate that AOS during the execution of that step is mandatory. If current LOS or expecting LOS prior to completion of an AOS/M step, wait for the next AOS to perform.</td>
</tr>
<tr>
<td>2. Step titles followed by the notation “(AOS/HD)” indicate that AOS during the execution of that step is highly desired. If communication will be regained within 10 minutes of reaching such a step, wait for AOS to perform.</td>
</tr>
<tr>
<td>3. For any off-nominal steps or any attention symbols that appear, refer to {2.903 SSAS MALFUNCTION} (SODF: S&amp;M: MALFUNCTION: TRUSS SYSTEMS).</td>
</tr>
<tr>
<td>4. To stop mechanism actuation, the following commands may be sent: in Manual State: <strong>cmd Stop Execute</strong> in Normal State: <strong>cmd Pause Execute</strong> in any SSAS State: <strong>cmd Abort Execute</strong> (device power will be cut with Abort command)</td>
</tr>
<tr>
<td>5. In order to prevent erroneous autosafing, the IMCA Inadvertent Motion and BBC Inadvertent Power autosafing capabilities are inhibited during the mating event and reenabled once mating is complete.</td>
</tr>
<tr>
<td>6. If crew performing procedure steps, then Advisories on PCS should be turned ON.</td>
</tr>
<tr>
<td>7. Upon completion of mating event, IMCAs are permanently unpowered and, as such, will no longer serve function as contingency survival heater replacement, since the Capture Latch has fulfilled its expected usage.</td>
</tr>
<tr>
<td>8. IMCA and BBC deactivation will nominally be performed by <strong>MCC-H</strong> using command scripts, with script information contained in Table 1.</td>
</tr>
</tbody>
</table>
Table 1. S1S3 SSAS Command Script Information

<table>
<thead>
<tr>
<th>Command Script</th>
<th>Script Function</th>
<th>Procedure Step(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1S3_SSAS_IMCA_2_Deactivate</td>
<td>Deactivates S1S3 SSAS IMCA 2</td>
<td>20</td>
</tr>
<tr>
<td>S1S3_SSAS_IMCA_1_Deactivate</td>
<td>Deactivates S1S3 SSAS IMCA 1</td>
<td>26</td>
</tr>
<tr>
<td>S1S3_SSAS_BBC_1_Deactivate</td>
<td>Deactivates S1S3 SSAS BBC 1</td>
<td>27</td>
</tr>
</tbody>
</table>

1. **VERIFYING RPCM STATUS**

PCS

S1: S&M: SSAS S1/S3

S1S3 SSAS Overview

‘SSAS Graphical Representation’

‘BBC-1 Pwr’

\&S14B G RPC 01 Icon – blue with green corners

‘BBC-2 Pwr’

\&S13A G RPC 01 Icon – gray with black corners

‘IMCA-1 Pwr’

\&S14B G RPC 15 Icon – blue with green corners

‘IMCA-2 Pwr’

\&S13A G RPC 15 Icon – blue with green corners

2. **SSAS STATUS VERIFICATION**

S1S3 SSAS Overview

‘SSAS Application’

\&SSAS App On – green

‘SSAS State’

\&SSAS State – Standby

‘S1S3 Path Selection’

\&SSAS Path – S1S3 IMCA 1 BBC 1

‘SSAS Graphical Representation’

Record Primary MDM: EXT: ________
Record Backup MDM: EXT: ________
Record LB MECH S1 Ch: ________
Record LB MECH S2 Ch: ________
‘Operations’

sel Latching

S1S3 SSAS Latching

sel Manual Latching

SSAS Manual Latching Commands

‘Capture Autosafing’

sel Mechanism Autosafing

Mechanism Autosafing

‘Autosafing PPL Version IDs - Safing Cmds’

Verify Primary C&C: 04012
Verify Backup C&C: 04012

‘Autosafing PPL Version IDs - Safing Default’

Verify Backup C&C: 04002

3. TRANSITIONING SSAS TO MANUAL STATE

S1S3 SSAS Overview

‘SSAS State’

sel State Commands

SSAS State Commands

cmd Manual Execute

Verify SSAS State – Manual

S1S3 SSAS Overview

‘SSAS Graphical Representation’

Verify IMCA-1 Open – green
Verify IMCA-2 Open – green
Verify RTL 1 (two) – gray
Verify RTL 2 (two) – gray
Verify RTL 3 (two) – gray
4. **INITIALIZING IMCA-1 WITH SAFING INITFRAME AND MODING TO ON (AOS/HD)**

S1S3 SSAS Overview

‘Operations’

sel Latching

S1S3 SSAS Latching

sel Manual Latching

SSAS Manual Latching Commands

‘Select IMCA Initframe’

**cmd Safing Execute**

Verify Initframe Selected – Safing

---

**CAUTION**

From preinstall until RTLs are acquired, in the very unlikely event of IMCA inadvertent actuation (uncommanded motion), the operator should stop or abort latch actuation.

---

* Upon detection of inadvertent IMCA motion, SSAS operator should immediately send the following commands
* cmd Latch Operations – Stop Execute
* or
* cmd Latch Operations – Abort Execute (device power will be cut with this command)

---

‘IMCA Mode’

Verify Standby – √

‘Mode Cmds’

**cmd On Execute**

‘IMCA Mode’

Verify On – √

Verify IMCA Turns: 0 ± 2 Rev

Verify Accum IMCA Turns: 0 ± 2 Rev
5. **BUILDING AND UPLINKING MODIFIED FIRST STAGE CAPTURE INITFRAME (AOS/HD)**

**S1S3 SSAS Latching**

sel Contingency Latching

**SSAS Contingency Latching Commands**

‘Contingency Commands’

sel Modify Previous Initframe Template

**SSAS Modify Previous Initframe Template**

input parameters into template window shown in Figure 1

**NOTE**

When selecting Yes/No values in the template, right-click on the data input field to open the picklist and allow selection.

<table>
<thead>
<tr>
<th>SSAS Modify Previous Initframe Template</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stop On</strong></td>
</tr>
<tr>
<td>Latch Closed</td>
</tr>
<tr>
<td>Latch Open</td>
</tr>
<tr>
<td>RTL 1 Closed</td>
</tr>
<tr>
<td>RTL 2 Closed</td>
</tr>
<tr>
<td>RTL 3 Closed</td>
</tr>
<tr>
<td>Torque Limit</td>
</tr>
<tr>
<td>Rate Error Limit</td>
</tr>
<tr>
<td>Position Change</td>
</tr>
<tr>
<td>Inverter Temp</td>
</tr>
<tr>
<td>Card Temp</td>
</tr>
<tr>
<td>Monitor Limit Switches</td>
</tr>
<tr>
<td>Enable Clutch</td>
</tr>
<tr>
<td>Perform Overspeed Reverse Test</td>
</tr>
</tbody>
</table>

Figure 1.- SSAS IMCA Initframe Template Modified First Stage Capture Parameters.

**cmd Set Execute**

**NOTE**

At this point the SSAS is ready for the SSRMS to maneuver to the Ready to Latch position.
6. **GIVING A GO FOR MODIFIED FIRST STAGE CAPTURE POST MANEUVER TO RTL**
   Robotics operator ⇒ SSAS operator, “Maneuver to RTL complete - go for Modified First Stage Capture.”

7. **VERIFYING POSITIVE READY-TO-LATCH (RTL) INDICATIONS AND LOADING FIRST STAGE CAPTURE INITFRAME INTO IMCA (AOS/HD)**

   **S1: S&M: SSAS S1/S3**

   **S1S3 SSAS Overview**

   **sel Latching**

   **S1S3 SSAS Latching**
   ‘Latching Graphical Representation’

   Verify RTL 1 (at least one of two) – green
   Verify RTL 2 (at least one of two) – green
   Verify RTL 3 (at least one of two) – green

   **sel Contingency Latching**

   **SSAS Contingency Latching Commands**
   ‘Contingency Commands’

   **cmd Select Mod Previous Initframe**  **Execute**

   Verify Initframe Selected – Wildcard Initframe

   **S1S3 SSAS Latching**
   ‘IMCA-1’

   **sel Initframe Details**

   **S1S3 SSAS IMCA 1 Initframe Details**
   ‘Limits’

   Verify Position Change: 1033.92 ± 1 Rev
   Verify Shaft Speed: 449.99 ± 1 rpm
   Verify RTD Voltage: 1500.00 mV
   Verify Torque: 0.76 ± 0.04 N-m
   Verify Power: 472.97 ± 1.0 N-m Rad/s (Watts)
   Verify Accel/Decel Time: 1.98 ± 0.5 s

   ‘Stop On’
Verify Position Change – X
Verify RTD Voltage – X
Verify Torque – blank
Verify Latch Closed – blank
Verify Latch Open – blank
Verify RTL 1 Closed – blank
Verify RTL 2 Closed – blank
Verify RTL 3 Closed – blank
Verify Inverter Temp – X
Verify Rate Error – blank

‘Clutch and Switch Settings’

Verify Monitor Limit Switches – blank
Verify Enable Clutch – X
Verify Perform Overspeed Reverse Speed Test – X

8. PERFORMING MODIFIED FIRST STAGE CAPTURE LATCH CLOSURE (AOS/HD)

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. To prevent damage to active SSAS, CMG TA (with Desat Request inhibited), or Free Drift (DAP: FREE if shuttle in control of attitude) is required from initiation of SSAS Capture Latch operation until a minimum of two bolts (with one being bolt three); have completed loading (both Bolt Tight Switches closed). SSRMS shall nominally remain grappled to truss until any three Bolts have completed loading.</td>
</tr>
<tr>
<td>2. To prevent potential damage to SSRMS or element grapple fixture due to overloading by SSAS mechanism if SSRMS safes during capture, the Mechanism Autosafing software must be Enabled prior to initiation of Capture Latch actuation.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desat Request will nominally be Inhibited prior to SSRMS maneuvering element to within 5 feet and remain inhibited until minimum structural integrity is achieved for the SSAS (two bolts with one bolt being three). Desat Request Enable may be performed as early as Capture Latch fully closed as long as Progress jets are inhibited from firing.</td>
</tr>
</tbody>
</table>

S1S3 SSAS Latching

sel Manual Latching

SSAS Manual Latching Commands

‘Capture Autosafing’

sel Mechanism Autosafing
Mechanism Autosafing
‘Enable’

**cmd** Enable **Execute**

Verify Mechanism Autosafing – Enabled

SSAS Manual Latching Commands
‘Mode Cmds’

**cmd** Enabled **Execute**

‘IMCA Mode’

Verify Enabled – √
Verify IMCA Turns – incrementing
Verify Accum IMCA Turns – incrementing

Wait approximately 3 minutes for completion of Modified First Stage Capture.

******************************************************************************
* If SSAS powered off due to SSRMS Safing Event
* `\MCC-H` for SSAS and SSRMS reconfiguration
* per Flight rule 13A_C10-7
******************************************************************************

9. **VERIFYING IMCA-1 STOP CONDITIONS AT END OF MODIFIED FIRST STAGE CAPTURE (AOS/HD)**

SSAS Manual Latching Commands
‘IMCA Mode’

Verify On – √

‘IMCA Data’

Verify IMCA Turns: 1034 ± 2 Rev
Verify Accum IMCA Turns: 1034 ± 2 Rev

S1S3 SSAS Latching
‘IMCA-1’

Verify Latch Status – Stopped

‘Latching Graphical Representation’

Verify IMCA-1 Open – gray
Verify IMCA-2 Open – gray
10. **GIVING A GO FOR SSRMS LIMP POST FIRST STAGE CAPTURE**
   SSAS operator ⇒ Robotics operator, “Modified First Stage Capture complete – go to limp SSRMS.”

11. **BUILDING AND UPLINKING MODIFIED THIRD STAGE CAPTURE INITFRAME (AOS/HD)**
   11.1 Building and Uplinking Template
       Wait for Robotics Operator message, “Go for Modified Third Stage Capture - All joints limped.”

   **NOTE**
   1. The latch will be driven fully closed from the topological capture position in one stage, called the Modified Third Stage Capture, since the speed of the IMCA needs to be lowered in order to prevent potential loads buildup in SSRMS.
   2. When selecting Yes/No values in the template, right click on the data input field to open the picklist and allow selection.

   **S1S3 SSAS Latching**
   sel Contingency Latching

   **SSAS Contingency Latching Commands**
   ‘Contingency Commands’

   sel Modify Previous Initframe Template

   **SSAS Modify Previous Initframe Template**

   input parameters into template window shown in Figure 2
Figure 2.- SSAS IMCA Initframe Template Modified Third Stage Capture Parameters.

<table>
<thead>
<tr>
<th>Stop On</th>
<th>Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latch Closed</td>
<td>Torque</td>
</tr>
<tr>
<td>Latch Open</td>
<td>Shaft Speed</td>
</tr>
<tr>
<td>RTL 1 Closed</td>
<td>Accel/Decel Time</td>
</tr>
<tr>
<td>RTL 2 Closed</td>
<td>Position Change High</td>
</tr>
<tr>
<td>RTL 3 Closed</td>
<td>Position Change Low</td>
</tr>
<tr>
<td>Torque Limit</td>
<td>RTD Voltage</td>
</tr>
<tr>
<td>Rate Error Limit</td>
<td></td>
</tr>
<tr>
<td>Position Change</td>
<td>Yes</td>
</tr>
<tr>
<td>Inverter Temp</td>
<td>Yes</td>
</tr>
<tr>
<td>Card Temp</td>
<td>Yes</td>
</tr>
<tr>
<td>Monitor Limit Switches</td>
<td>No</td>
</tr>
<tr>
<td>Enable Clutch</td>
<td>Yes</td>
</tr>
<tr>
<td>Perform Overspeed Reverse Test</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**cmd Set Execute**

SSAS Contingency Latching Commands
‘Contingency Commands’

**cmd Select Mod Previous Initframe Execute**

Verify Initframe Selected – Wildcard Initframe

11.2 Verifying Template Parameters

**S1S3 SSAS Latching**
‘IMCA-1’

sel Initframe Details

**S1S3 SSAS IMCA 1 Initframe Details**
‘Limits’
Verify Position Change: 3110.02 ± 1 Rev
Verify Shaft Speed: 350.00 ± 1 rpm
Verify RTD Voltage: 1500.00 mV
Verify Torque: 0.76 ± 0.04 N-m
Verify Power: 472.97 ± 1.0 N-m Rad/s (Watts)
Verify Accel/Decel Time: 1.98 ± 0.5 s

‘Stop On’
Verify Position Change – X
Verify RTD Voltage – X
Verify Torque – blank
Verify Latch Closed – blank
Verify Latch Open – blank
Verify RTL 1 Closed – blank
Verify RTL 2 Closed – blank
Verify RTL 3 Closed – blank
Verify Inverter Temp – X
Verify Rate Error – blank

‘Clutch and Switch Settings’
Verify Monitor Limit Switches – blank
Verify Enable Clutch – X
Verify Perform Overspeed Reverse Speed Test – X

12. **PERFORMING MODIFIED THIRD STAGE CAPTURE (AOS/HD)**

<table>
<thead>
<tr>
<th>SSAS Manual Latching Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘IMCA Mode’</td>
</tr>
</tbody>
</table>

Verify On – ✓

‘Mode Cmds’

**cmd** Enabled **Execute**

‘IMCA Mode’

Verify Enabled – ✓
Verify IMCA Turns – incrementing
Verify Accum IMCA Turns – incrementing

Wait approximately 6 minutes for completion of Modified Third Stage Capture.

******************************************************************************
* If SSAS powered off due to SSRMS Safing Event
* \~MCC-H for SSAS and SSRMS reconfiguration
* per Flight rule 13A_C10-7
******************************************************************************
13. **VERIFYING IMCA-1 STOP CONDITIONS AT END OF MODIFIED THIRD STAGE CAPTURE (AOS/HD)**

<table>
<thead>
<tr>
<th>SSAS Manual Latching Commands</th>
<th>‘IMCA Mode’</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verify On – ✓</td>
<td></td>
</tr>
<tr>
<td>Verify IMCA Turns: 3110 ± 2 Rev</td>
<td></td>
</tr>
<tr>
<td>Verify Accum IMCA Turns: 3110 ± 2 Rev</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>S1S3 SSAS Latching</strong></th>
<th>‘IMCA-1’</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verify Latch Status – Stopped</td>
<td></td>
</tr>
<tr>
<td>‘Latching Graphical Representation’</td>
<td></td>
</tr>
<tr>
<td>Verify IMCA-1 Closed – green</td>
<td></td>
</tr>
<tr>
<td>Verify IMCA-2 Closed – green</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SSAS Manual Latching Commands</th>
<th>‘Mode Cmds’</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>cmd Standby Execute</strong></td>
<td>‘IMCA Mode’</td>
</tr>
<tr>
<td>Verify Standby – ✓</td>
<td></td>
</tr>
</tbody>
</table>

14. **INHIBITING MECHANISM AUTOSAFING SOFTWARE**

**NOTE**
To prevent undesirable removal of power from the SSAS IMCAs when SSRMS transitions to Safed, the Mechanism Autosafing software is Inhibited.

<table>
<thead>
<tr>
<th><strong>SSAS Manual Latching Command</strong></th>
<th>‘Capture Autosafing’</th>
</tr>
</thead>
<tbody>
<tr>
<td>sel Mechanism Autosafing</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Mechanism Autosafing</strong></th>
<th>‘Inhibit’</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>cmd Arm Execute</strong></td>
<td></td>
</tr>
<tr>
<td>Verify Arm – ✓</td>
<td></td>
</tr>
</tbody>
</table>

| **cmd Inhibit Execute** |   |
| Verify Mechanism Autosafing – Inhibited |   |
15. **GIVING A GO FOR SSRMS SAFING POST CAPTURE COMPLETE**
SSAS operator ⇒ Robotics operator, “Third Stage Capture complete – go for SSRMS Safing.”

16. **VERIFYING CONFIGURATION TO BEGIN BOLTING OPERATIONS**

   - **S1S3 SSAS Overview**
     - ‘SSAS State’

     sel State Commands

     - **SSAS State Commands**
     
     cmd Standby  **Execute**

     Verify SSAS State – Standby

     cmd Normal  **Execute**

     Verify SSAS State – Normal

   - **S1S3 SSAS Overview**
     - ‘SSAS Graphical Representation’
     - ‘BBC-1 Pwr’

    √S14B G RPC 01 icon – blue with green corners

    ‘BBC-2 Pwr’

    √S13A G RPC 01 icon – gray with black corners

    ‘Operations’

     sel Bolting

     - **S1S3 SSAS Bolting**
     
     ‘BBC Status’

     Verify Bolt Direction – FWD

17. **CLOSING BBC COMMON POWER RELAY (AOS/HD)**

   - **S1S3 SSAS Bolting**

     sel Common Power Relay Cmds

     - **SSAS BBC Common Power Relay**
      
      ‘SSAS NORMAL MODE - Relay Position’

     cmd Close  **Execute**
Verify Commanded Relay Position – Cl
Verify Actual Relay Position – Cl

S1S3 SSAS Bolting

sel Normal Bolting Commands

SSAS Normal Bolting Commands
‘Common Power Relay and Limit Switch Return Status’

Verify Limit Switch Return – Closed

**CAUTION**

To prevent damage to bolt hardware, operator should be prepared to send cmd Pause **Execute** if the MBA Current exceeds the specified limits during Bolt tightening.

**NOTE**

1. Each SSAS Bolt takes approximately 8.5 minutes to complete its tightening. During the tightening of each Bolt, when both Bolt Tight Switches (BTS) close, the Limit Sw Cutoff Flag will momentarily turn green for approximately 1 second. This is an indication that the Bolt tightened nominally.

2. If unexpected LOS with **MCC-H** during bolt actuation and bolt current > 175 mA and MBA On Time > 480 seconds, do not stop bolt motion. Continue to let bolt drive until fully tight. Wait for AOS before driving next bolt.
18. **TIGHTENING S1S3 SSAS BOLT - BOLTS 3,1,2 (AOS/M)**

SSAS Normal Bolting Commands

'Select'

**cmd Bolt [Z] Execute** where [Z] = 3 1 2

Verify Bolt Selected – Bolt [Z]
Verify BBS – X

**cmd Bolt Actuation – Drive Bolt Execute**

******************************************************************************************
* If MBA Current exceeds 300 mA just after Drive
* Bolt command is sent, immediately
* **cmd Pause Execute**
******************************************************************************************

Verify MBA Current (steady state): 100 to 175 mA

Verify Pwr On – X
Verify MBA Posn, Rev – incrementing
Verify MBA On, s – incrementing
Verify Bolt Controller Sequence Step: Bolt Motion – In Progress

******************************************************************************************
* If MBA Current exceeds 175 mA at anytime
* before MBA On of 480 seconds, immediately
* **cmd Pause Execute**
******************************************************************************************

Wait approximately 8.5 minutes for Bolt to tighten.

Verify BBS – blank
Verify BTS 1 – X
Verify BTS 2 – X
Verify Bolt Controller Sequence Step – No Motion
Verify Common Power Relay – Closed
Verify Limit Switch Return – Closed
Verify Bolt Direction – Forward

**S1S3 SSAS Bolting**

'BBC Status'

Limit Sw Cutoff Flag – green (momentary)

Repeat
19. **CONFIGURING ATTITUDE CONTROL**

\(\text{MCC-H}\) for required MCS Configuration

**NOTE**

At this point in the operation, \(\text{MCC-H}\) is nominally expected to take over control and complete remaining steps of SSAS mate to allow crew to support SSRMS ungrapple and subsequent EVA RMS support.

20. **DEACTIVATING S1S3 SSAS IMCA-2**

20.1 **Inhibiting IMCA-2 RT FDIR**

S1S3 SSAS Overview

sel Primary EXT MDM

Primary Ext MDM

sel LB Mech S 2

LB MECH S2

sel RT Status

LB MECH S2 RT Status

‘12 SSAS S1/S3 L2’

\(\sqrt{\text{RT Status – Ena}}\)

**cmd** RT FDIR Status – Inhibit FDIR **Execute**

\(\sqrt{\text{RT FDIR Status – Inh}}\)

20.2 **Deactivating IMCA-2**

S1S3 SSAS Overview

‘SSAS Graphical Representation’

‘IMCA-2 Pwr’

sel S13A G RPC 15

RPCM S13A G RPC 15

**cmd** RPC Position – Open (Verify – Op)

**cmd** Close Cmd – Inhibit (Verify – Inh)

20.3 **Inhibiting IMCA-2 RT I/O**

S1S3 SSAS Overview

sel Primary EXT MDM
Primary Ext MDM

sel LB Mech S 2

LB MECH S2

sel RT Status

LB MECH S2 RT Status

‘12 SSAS S1/S3 L2’

√RT FDIR Status – Inh

cmd RT Status – Inhibit Execute

√RT Status – Inh

20.4 Enabling IMCA-2 Inadvertent Motion Autosafing

NOTE

The following command to Enable Inadvertent Motion Autosafing and its associated telemetry does not exist on PCS and, thus, can only be sent and verified by MCC-H.

MCC-H
cmd Prim_EXT_Ena_ECZ_Function_Tmplt Execute

<Cmd PUI: S0DD96IM1658K>
<Template IMCA_SAS_S1S3_L2_INADVERT_MOTION_AUTOSAFING_9A>

input – 4 0

S1S3 SSAS Latching MSKVIEW

‘Latching Cautions & Advisories’

Verify IMCA-2 Inadvertent Motion – Ena

CAUTION

To prevent damage to bolt hardware, operator should be prepared to send cmd Pause Execute if the MBA Current exceeds the specified limits during Bolt tightening.

NOTE

Each SSAS Bolt takes approximately 8.5 minutes to complete its tightening. During the tightening of each Bolt, when both Bolt Tight Switches (BTS) close, the Limit Sw Cutoff Flag will momentarily turn green for approximately 1 second. This is an indication that the Bolt tightened nominally.
21. **TIGHTENING S1S3 SSAS BOLT - BOLT 4 (AOS/M)**

   **SSAS Normal Bolting Commands**
   
   ‘Select’

   **cmd Bolt 4  Execute**

   Verify Bolt Selected – Bolt 4
   Verify BBS – X

   **cmd Bolt Actuation – Drive Bolt  Execute**

   ****************************
   *
   * If MBA Current exceeds 300 mA just after Drive
   * Bolt command is sent, immediately
   * **cmd Pause  Execute**
   ****************************

   Verify MBA Current (steady state): 100 to 175 mA

   Verify Pwr On – X
   Verify MBA Posn, Rev – incrementing
   Verify MBA On, s – incrementing
   Verify Bolt Controller Sequence Step: Bolt Motion – In Progress

   ****************************
   *
   * If MBA Current exceeds 175 mA at anytime
   * before MBA On of 480 seconds, immediately
   * **cmd Pause  Execute**
   ****************************

   Wait approximately 8.5 minutes for Bolt to tighten.

   Verify BBS – blank
   Verify BTS 1 – X
   Verify BTS 2 – X
   Verify Bolt Controller Sequence Step – No Motion
   Verify Common Power Relay – Closed
   Verify Limit Switch Return – Closed
   Verify Bolt Direction – Forward

   **S1S3 SSAS Bolting**
   ‘BBC Status’

   Limit Sw Cutoff Flag – green (momentary)

22. **OPENING COMMON POWER RELAY (AOS/HD)**

   **S1S3 SSAS Bolting**

   sel Common Power Relay Cmds
**SSAS BBC Common Power Relay**  
'SSAS NORMAL MODE - Relay Position'

**cmd** Open  **Execute**

Verify Commanded Relay Position – Op  
Verify Actual Relay Position – Op

### 23. TRANSITIONING SSAS TO STANDBY STATE

SSAS State Commands

**cmd Standby**  **Execute**

Verify SSAS State – Standby

### 24. DEACTIVATING S1S3 SSAS IMCA-1

#### 24.1 Inhibiting IMCA-1 RT FDIR

Primary Ext MDM  

RT Status – Ena  

**cmd** RT FDIR Status – Inhibit FDIR  **Execute**

#### 24.2 Deactivating IMCA-1
sel S14B G RPC 15

RPCM S14B G RPC 15

**cmd** RPC Position – Open (Verify – Op)
**cmd** Close Cmd – Inhibit (Verify – Inh)

### 24.3 Inhibiting IMCA-1 RT I/O

S1S3 SSAS Overview

sel Primary EXT MDM

Primary Ext MDM

sel LB Mech S 1

LB MECH S1

sel RT Status

LB MECH S1 RT Status

‘12 SSAS S1/S3 L1’

√RT FDIR Status – Inh

**cmd** RT Status – Inhibit **Execute**

√RT Status – Inh

### 24.4 Enabling IMCA-1 Inadvertent Motion Autosafing

**NOTE**
The following command to Enable Inadvertent Motion Autosafing and its associated telemetry does not exist on PCS and, thus, can only be sent and verified by MCC-H.

**cmd** Prim_EXT_Ena_ECZ_Function_Tmplt **Execute**

<Cmd PUI: S0DD96IM1658K>
<Template IMCA_SAS_S1S3_L1_INADVERT_MOTION_AUTOSAFING_9A>

input – 3 9

S1S3 SSAS Latching MSKVIEW

‘Latching Cautions & Advisories’

Verify IMCA-1 Inadvertent Motion – Ena
25. **DEACTIVATING S1S3 SSAS BBC-1**

25.1 **Inhibiting BBC-1 RT FDIR**

S1S3 SSAS Overview

sel Primary EXT MDM

Primary Ext MDM

sel LB Mech S 1

LB MECH S1

sel RT Status

LB MECH S1 RT Status

‘13 SSAS S1/S3 B1’

√RT Status – Ena

**cmd** RT FDIR Status – Inhibit FDIR **Execute**

√RT FDIR Status – Inh

25.2 **Inhibiting BBC-1 RT I/O**

LB MECH S1 RT Status

‘13 SSAS S1/S3 B1’

**cmd** RT Status – Inhibit **Execute**

√RT Status – Inh

25.3 **Deactivating BBC-1**

S1S3 SSAS Overview

‘BBC-1 Pwr’

sel S14B G RPC 01

RPCM S14B G RPC 01

**cmd** RPC Position – Open (Verify – Op)

**cmd** Close Cmd – Inhibit (Verify – Inh)

25.4 **Enabling BBC-1 Inadvertent Power Autosafing**

**NOTE**

The following command to Enable Inadvertent Power Autosafing and its associated telemetry does not exist on PCS and, thus, can only be sent and verified by **MCC-H**.
cmd Prim_EXT_Ena_ECZ_Function_Tmplt Execute

<Cmd PUI: S0DD96IIM1658K>
<Template BBC_SAS_S1S3_B1_INADVERT_POWER_AUTOSAFING_9A>

input – 6

S1S3 SSAS Bolting MSKVIEW
‘Bolting Cautions & Advisories’

Verify BBC-1 Inadvertent Power – Ena

26. TRANSITIONING SSAS TO IDLE STATE AND DEACTIVATING SSAS APPLICATION

S1S3 SSAS Overview
‘SSAS State’

sel State Commands

SSAS State Commands

cmd Idle Execute

Verify SSAS State – Idle

S1S3 SSAS Overview
‘SSAS Application’

sel Application Commands

SSAS Application

cmd SSAS Application S/W Status – Deactivate Execute

√SSAS Application S/W Status – Deactivated
√SSAS IMCA S/W Status – Activated
√SSAS BBC S/W Status – Activated

NOTE
As a non-time critical clean-up step after completion of the mating event, the default Mechanism Autosafing PPLs are reloaded into the Primary and Backup C&C MDMs to return to the default configuration.
27. PERFORMING FILE UPLINK AND DATA LOAD COMMANDS FOR MECHANISM AUTOSAFING PPLs

27.1 Building RDF 207 PPL Uplink to Primary C&C MDM (OSO)
Using the following, perform \{1.232 CCS BUILD FILE UPLINK COMMAND\}, all (SODF: GND AVIONICS: C&DH: NOMINAL), then:

Ops Name = YYYY_DDD_HH_CC_Hot_Mech_Safing_207_PPL_1
Source Device = Ground
Storage Type = RAM
Select Destination Filename = /mcc/fsw/{ISS Flight ID}/ppl/ccsr4_460/ccs_ppl_0207_4_a_04001.lif
Verify Source Filename = /mcc/fsw/{ISS Flight ID}/ppl/ccsr4_460/ccs_ppl_0207_4_a_04001.lif
Destination Device = C&C HOT
Priority = High
Uplink after = completion of S1S3 SSAS Nominal Mate
Remarks = re-engages default PPL after mate is completed

27.2 Building RDF 207 PPL Uplink to Backup C&C MDM (OSO)
Using the following, perform \{1.231 CCS BUILD DATA LOAD COMMAND\}, all (SODF: GND AVIONICS: C&DH: NOMINAL), then:

Ops Name = YYYY_DDD_HH_CC_Warm_Mech_Safing_207_PPL_1
Select Load File = /mcc/fsw/{ISS Flight ID}/ppl/ccsr4_460/ccs_ppl_0207_4_a_04001.lif
Memory Type = RAM
Select Destination Filename = /mcc/fsw/{ISS Flight ID}/ppl/ccsr4_460/ccs_ppl_0207_4_a_04001.lif
Destination Device = C&C WARM
Priority = High
Uplink after = completion of S1S3 SSAS Nominal Mate
Remarks = re-engages default PPL after mate is completed

27.3 Building RDF 243 PPL Uplink to Backup C&C MDM (OSO)
Using the following, perform \{1.231 CCS BUILD DATA LOAD COMMAND\}, all (SODF: GND AVIONICS: C&DH: NOMINAL), then:

Ops Name = YYYY_DDD_HH_CC_Warm_Mech_Safing_243_PPL_2
Select Load File = /mcc/fsw/{ISS Flight ID}/ppl/ccsr4_460/ccs_ppl_0243_4_a_04001.lif
Memory Type = RAM
Destination Device = C&C WARM
Priority = High
Uplink after = completion of S1S3 SSAS Nominal Mate
Remarks = re-engages default PPL after mate is completed
27.4 Performing PPL File Uplink and Data Loads (ODIN)
To uplink RDF 207 PPL to the Primary C&C MDM, perform {1.232 CCS BUILD FILE UPLINK COMMAND}, all (SODF: GND AVIONICS: C&DH: NOMINAL), then:
To uplink RDF 207 PPL to the Backup C&C MDM, perform {1.231 CCS BUILD DATA LOAD COMMAND}, all (SODF: GND AVIONICS: C&DH: NOMINAL), then:
To uplink RDF 243 PPL to the Backup C&C MDM, perform {1.231 CCS BUILD DATA LOAD COMMAND}, all (SODF: GND AVIONICS: C&DH: NOMINAL), then:

27.5 Verifying PPL Version IDs (OSO)
S1S3 SSAS Overview
'Selections'
'Selections Latching'
'Selections Manual Latching'
'SSAS Manual Latching Commands
'Selections Mechanism Autosafing'
'Mechanism Autosafing
'Selections Autosafing PPL Version IDs - Safing Cmds'
Verify Primary C&C: 04001
Verify Backup C&C: 04001
'Selections Autosafing PPL Version IDs - Safing Default'
Verify Backup C&C: 04001
OBJECTIVE:
In Manual State operation, capture the S3 Integrated Truss Segments (ITS) using S1S3 Segment to Segment Attachment System (SSAS) Capture Latch driven by Integrated Motor Controller Actuators (IMCAs). Bolting is then performed in Manual State to permanently attach the S1 and S3 Trusses together using Bolt Bus Controllers (BBCs) and Motorized Bolt Assemblies (MBAs). This procedure is for contingency purposes since bolting will nominally be performed utilizing the Nominal Mate procedure.

LOCATION:
Starboard side of S1 Truss

DURATION:
1 hour, 40 minutes

REFERENCED PROCEDURE(S):
1.231 CCS BUILD DATA LOAD COMMAND
1.232 CCS BUILD FILE UPLINK COMMAND

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Step titles followed by the notation “(AOS/M)” indicate that AOS during the execution of that step is mandatory. If current LOS or expecting LOS prior to completion of an AOS/M step, wait for the next AOS to perform.</td>
</tr>
<tr>
<td>2. Step titles followed by the notation “(AOS/HD)” indicate that AOS during the execution of that step is highly desired. If communication will be regained within 10 minutes of reaching such a step, wait for AOS to perform.</td>
</tr>
<tr>
<td>3. For any off-nominal steps or any attention symbols that appear, refer to [2.903 SSAS MALFUNCTION] (SODF: S&amp;M: MALFUNCTION: TRUSS SYSTEMS).</td>
</tr>
<tr>
<td>4. To stop mechanism actuation, the following commands may be sent:</td>
</tr>
<tr>
<td>in Manual State: cmd Stop Execute</td>
</tr>
<tr>
<td>in Normal State: cmd Pause Execute</td>
</tr>
<tr>
<td>in any SSAS State: cmd Abort Execute (device power will be cut with Abort command)</td>
</tr>
<tr>
<td>5. In order to prevent erroneous autosafing, the IMCA Inadvertent Motion and BBC Inadvertent Power autosafing capabilities are inhibited during the mating event and reenabled once mating is complete.</td>
</tr>
<tr>
<td>6. If crew performing procedure steps, then Advisories on PCS should be turned ON.</td>
</tr>
<tr>
<td>7. Upon completion of mating event, IMCAs are permanently unpowered and, as such, will no longer serve function as contingency survival heater replacement because the Capture Latch has fulfilled its expected usage.</td>
</tr>
<tr>
<td>8. IMCA and BBC deactivation will nominally be performed by MCC-H using command scripts, with script information contained in Table 1.</td>
</tr>
</tbody>
</table>
1. **VERIFYING RPCM STATUS**

   S1: S&M: SSAS S1/S3

   **S1S3 SSAS Overview**

   ‘SSAS Graphical Representation’

   ‘BBC-1 Pwr’

   √S14B G RPC 01 Icon – blue with green corners

   ‘BBC-2 Pwr’

   √S13A G RPC 01 Icon – gray with black corners

   ‘IMCA-1 Pwr’

   √S14B G RPC 15 Icon – blue with green corners

   ‘IMCA-2 Pwr’

   √S13A G RPC 15 Icon – blue with green corners

2. **SSAS STATUS VERIFICATION**

   **S1S3 SSAS Overview**

   ‘SSAS Application’

   √SSAS App On – green

   ‘SSAS State’

   √SSAS State – Standby

   ‘S1S3 Path Selection’

   √SSAS Path – S1S3 IMCA 1 BBC 1

   ‘SSAS Graphical Representation’

   Record Primary MDM: EXT ________

   Record Backup MDM: EXT ________

   Record Active LB MECH S1 Ch ________

   Record Active LB MECH S2 Ch ________

---

### Table 1. S1S3 SSAS Command Script Information

<table>
<thead>
<tr>
<th>Command Script</th>
<th>Script Function</th>
<th>Procedure Step(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1S3_SSAS_IMCA_2_Deactivate</td>
<td>Deactivates S1S3 SSAS IMCA 2</td>
<td>20</td>
</tr>
<tr>
<td>S1S3_SSAS_IMCA_1_Deactivate</td>
<td>Deactivates S1S3 SSAS IMCA 1</td>
<td>27</td>
</tr>
<tr>
<td>S1S3_SSAS_BBC_1_Deactivate</td>
<td>Deactivates S1S3 SSAS BBC 1</td>
<td>28</td>
</tr>
</tbody>
</table>
‘Operations’

sel Latching

S1S3 SSAS Latching

sel Manual Latching

SSAS Manual Latching Commands

‘Capture Autosafing’

sel Mechanism Autosafing

Mechanism Autosafing

‘Autosafing PPL Version IDs - Safing Cmds’

Verify Primary C&C: 04012
Verify Backup C&C: 04012

‘Autosafing PPL Version IDs - Safing Default’

Verify Backup C&C: 04002

3. **TRANSITIONING SSAS TO MANUAL STATE**

S1S3 SSAS Overview

‘SSAS State’

sel State Commands

SSAS State Commands

**cmd Manual**  **Execute**

Verify SSAS State – Manual

S1S3 SSAS Overview

‘SSAS Graphical Representation’

Verify IMCA-1 Open – green
Verify IMCA-2 Open – green
Verify RTL 1 (two) – gray
Verify RTL 2 (two) – gray
Verify RTL 3 (two) – gray
4. **INITIALIZING IMCA-1 WITH SAFING INITFRAME AND MODING TO ON (AOS/HD)**

S1S3 SSAS Overview

‘Operations’

sel Latching

S1S3 SSAS Latching

sel Manual Latching

SSAS Manual Latching Commands

‘Select IMCA Initframe’

**cmd Safing Execute**

Verify Initframe Selected – Safing

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>From preinstall until RTLs are acquired, in the very unlikely event of IMCA inadvertent actuation (uncommanded motion), the operator should stop or abort latch actuation.</td>
</tr>
</tbody>
</table>

**********************************************************************
* Upon detection of inadvertent IMCA motion, SSAS operator should immediately send the following commands
* *
* **cmd Latch Operations – Stop Execute**
* or
* **cmd Latch Operations – Abort Execute** (device power will be cut with this command)
**********************************************************************

‘IMCA Mode’

Verify Standby – √

‘Mode Cmds’

**cmd On Execute**

‘IMCA Mode’

Verify On – √

Verify IMCA Turns: 0 ± 2 Rev
Verify Accum IMCA Turns: 0 ± 2 Rev
5. BUILDING AND UPLINKING MODIFIED FIRST STAGE CAPTURE INITFRAME (AOS/HD)

S1S3 SSAS Latching

sel Contingency Latching

SSAS Contingency Latching Commands

'Selection Commands'

sel Modify Previous Initframe Template

SSAS Modify Previous Initframe Template

input parameters into template window shown in Figure 1

NOTE

When selecting Yes/No values in the template, right-click on the data input field to open the picklist and allow selection.

<table>
<thead>
<tr>
<th>SSAS Modify Previous Initframe Template</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stop On</td>
</tr>
<tr>
<td>Latch Closed</td>
</tr>
<tr>
<td>Latch Open</td>
</tr>
<tr>
<td>RTL 1 Closed</td>
</tr>
<tr>
<td>RTL 2 Closed</td>
</tr>
<tr>
<td>RTL 3 Closed</td>
</tr>
<tr>
<td>Torque Limit</td>
</tr>
<tr>
<td>Rate Error Limit</td>
</tr>
<tr>
<td>Position Change</td>
</tr>
<tr>
<td>Inverter Temp</td>
</tr>
<tr>
<td>Card Temp</td>
</tr>
<tr>
<td>Monitor Limit Switches</td>
</tr>
<tr>
<td>Enable Clutch</td>
</tr>
<tr>
<td>Perform Overspeed Reverse Test</td>
</tr>
</tbody>
</table>

Figure 1.- SSAS IMCA Initframe Template Modified First Stage Capture Parameters.

**cmd Set Execute**
NOTE
At this point the SSAS is ready for the SSRMS to maneuver to the Ready to Latch position.

6. **GIVING A GO FOR MODIFIED FIRST STAGE CAPTURE POST MANEUVER TO RTL**
   Robotics operator ⇒ SSAS operator, “Maneuver to RTL complete - go for Modified First Stage Capture.”

7. **VERIFYING POSITIVE READY-TO-LATCH (RTL) INDICATIONS AND LOADING FIRST STAGE CAPTURE INITFRAME INTO IMCA (AOS/HD)**
   S1: S&M: SSAS S1/S3
   
   **S1S3 SSAS Overview**

   sel Latching

   **S1S3 SSAS Latching**
   ‘Latching Graphical Representation’
   
   Verify RTL 1 (at least one of two) – green
   Verify RTL 2 (at least one of two) – green
   Verify RTL 3 (at least one of two) – green

   sel Contingency Latching

   **SSAS Contingency Latching Commands**
   ‘Contingency Commands’

   **cmd Select Mod Previous Initframe Execute**
   
   Verify Initframe Selected – Wildcard Initframe

   **S1S3 SSAS Latching**
   ‘IMCA-1’

   sel Initframe Details

   **S1S3 SSAS IMCA 1 Initframe Details**
   ‘Limits’
   
   Verify Position Change: 1033.92 ± 1 Rev
   Verify Shaft Speed: 449.99 ± 1 rpm
   Verify RTD Voltage: 1500.00mV
   Verify Torque: 0.76 ± 0.04 N-m
   Verify Power: 472.97 ± 1.0 N-m Rad/s (Watts)
   Verify Accel/Decel Time: 1.98 ± 0.5 s

   ‘Stop On’
Verify Position Change – X
Verify RTD Voltage – X
Verify Torque – blank
Verify Latch Closed – blank
Verify Latch Open – blank
Verify RTL 1 Closed – blank
Verify RTL 2 Closed – blank
Verify RTL 3 Closed – blank
Verify Inverter Temp – X
Verify Rate Error – blank

‘Clutch and Switch Settings’

Verify Monitor Limit Switches – blank
Verify Enable Clutch – X
Verify Perform Overspeed Reverse Speed Test – X

8. **PERFORMING MODIFIED FIRST STAGE CAPTURE LATCH CLOSURE (AOS/HD)**

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. To prevent damage to active SSAS, CMG TA (with Desat Request inhibited), or Free Drift (DAP: FREE for shuttle control) is required from initiation of SSAS Capture Latch operation until a minimum of two bolts (with one being bolt three); have completed loading (both Bolt Tight Switches closed). SSRMS shall nominally remain grappled to truss until any three Bolts have completed loading.</td>
</tr>
<tr>
<td>2. To prevent potential damage to SSRMS or element grapple fixture due to overloading by SSAS mechanism if SSRMS safes during capture, the Mechanism Autosafing software must be Enabled prior to initiation of Capture Latch actuation.</td>
</tr>
</tbody>
</table>

**NOTE**

Desat Request will nominally be Inhibited prior to SSRMS maneuvering element to within 5 feet and remain inhibited until minimum structural integrity is achieved for the SSAS (two bolts with one bolt being three). Desat Request Enable may be performed as early as Capture Latch fully closed as long as Progress jets are inhibited from firing.

S1S3 SSAS Latching

sel Manual Latching

SSAS Manual Latching Commands

‘Capture Autosafing’

sel Mechanism Autosafing
**Mechanism Autosafing**

cmd Enable Execute

Verify Mechanism Autosafing – Enabled

**SSAS Manual Latching Commands**

'Mode Cmds'

cmd Enabled Execute

‘IMCA Mode’

Verify Enabled – √
Verify IMCA Turns – incrementing
Verify Accum IMCA Turns – incrementing

Wait approximately 3 minutes for completion of Modified First Stage Capture.

*********************************************************
* If SSAS powered off due to SSRMS Safing Event
* `MCC-H` for SSAS and SSRMS reconfiguration
* per Flight rule 13A_C10-7
*********************************************************

9. **VERIFYING IMCA-1 STOP CONDITIONS AT END OF MODIFIED FIRST STAGE CAPTURE (AOS/HD)**

**SSAS Manual Latching Commands**

'IMCA Mode'

Verify On – √

Verify IMCA Turns: 1034 ± 2 Rev
Verify Accum IMCA Turns: 1034 ± 2 Rev

**S1S3 SSAS Latching**

‘IMCA-1’

Verify Latch Status – Stopped

‘Latching Graphical Representation’

Verify IMCA-1 Open – gray
Verify IMCA-2 Open – gray

10. **GIVING A GO FOR SSRMS LIMP POST FIRST STAGE CAPTURE**

SSAS operator ⇒ Robotics operator, “Modified First Stage Capture complete – go to limp SSRMS.”
11. BUILDING AND UPLINKING MODIFIED THIRD STAGE CAPTURE INITFRAME (AOS/HD)

11.1 Building and Uplinking Template

Wait for Robotics Operator message, “Go for Modified Third Stage Capture - All joints limped.”

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The latch will be driven fully closed from the topological capture position in one stage, called the Modified Third Stage Capture, since the speed of the IMCA needs to be lowered in order to prevent potential loads buildup in SSRMS.</td>
</tr>
<tr>
<td>2. When selecting Yes/No values in the template, right-click on the data input field to open the picklist and allow selection.</td>
</tr>
</tbody>
</table>

S1S3 SSAS Latching

sel Contingency Latching

SSAS Contingency Latching Commands

‘Contingency Commands’

sel Modify Previous Initframe Template

SSAS Modify Previous Initframe Template

input parameters into template window shown in Figure 2
### SSAS Modify Previous Initframe Template

<table>
<thead>
<tr>
<th>Stop On</th>
<th>Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latch Closed</td>
<td>Torque</td>
</tr>
<tr>
<td>Latch Open</td>
<td>Shaft Speed</td>
</tr>
<tr>
<td>RTL 1 Closed</td>
<td>Accel/Decel Time</td>
</tr>
<tr>
<td>RTL 2 Closed</td>
<td>Position Change High</td>
</tr>
<tr>
<td>RTL 3 Closed</td>
<td>Position Change Low</td>
</tr>
<tr>
<td>Torque Limit</td>
<td>RTD Voltage</td>
</tr>
<tr>
<td>Rate Error Limit</td>
<td>No</td>
</tr>
<tr>
<td>Position Change</td>
<td>Yes</td>
</tr>
<tr>
<td>Inverter Temp</td>
<td>Yes</td>
</tr>
<tr>
<td>Card Temp</td>
<td>Yes</td>
</tr>
<tr>
<td>Monitor Limit Switches</td>
<td>No</td>
</tr>
<tr>
<td>Enable Clutch</td>
<td>Yes</td>
</tr>
<tr>
<td>Perform Overspeed Reverse Test</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Figure 2.- SSAS IMCA Initframe Template Modified Third Stage Capture Parameters.

**cmd** Set  **Execute**

**SSAS Contingency Latching Commands**

‘Contingency Commands’

**cmd** Select Mod Previous Initframe  **Execute**

Verify Initframe Selected – Wildcard Initframe

11.2 **Verifying Template Parameters**

**S1S3 SSAS Latching**

‘IMCA-1’

sel Initframe Details

**S1S3 SSAS IMCA 1 Initframe Details**

‘Limits’
Verify Position Change: 3109.92 ± 1 Rev
Verify Shaft Speed: 349.99 ± 1 rpm
Verify RTD Voltage: 1500.00mV
Verify Torque: 0.76 ± 0.04 N-m
Verify Power: 472.97 ± 1.0 N-m Rad/s (Watts)
Verify Accel/Decel Time: 1.98 ± 0.5 s

‘Stop On’

Verify Position Change – X
Verify RTD Voltage – X
Verify Torque – blank
Verify Latch Closed – blank
Verify Latch Open – blank
Verify RTL 1 Closed – blank
Verify RTL 2 Closed – blank
Verify RTL 3 Closed – blank
Verify Inverter Temp – X
Verify Rate Error – blank

‘Clutch and Switch Settings’

Verify Monitor Limit Switches – blank
Verify Enable Clutch – X
Verify Perform Overspeed Reverse Speed Test – X

12. PERFORMING MODIFIED THIRD STAGE CAPTURE (AOS/HD)

SSAS Manual Latching Commands

‘IMCA Mode’

Verify On – √

‘Mode Cmds’

cmd Enabled Execute

‘IMCA Mode’

Verify Enabled – √
Verify IMCA Turns – incrementing
Verify Accum IMCA Turns – incrementing

Wait approximately 6 minutes for completion of Modified Third Stage Capture.

******************************************************************************
* If SSAS powered off due to SSRMS Safing Event
* √MCC-H for SSAS and SSRMS reconfiguration per Flight rule 13A_C10-7
******************************************************************************
13. **VERIFYING IMCA-1 STOP CONDITIONS AT END OF MODIFIED THIRD STAGE CAPTURE (AOS/HD)**

SSAS Manual Latching Commands

‘IMCA Mode’

Verify On – √

Verify IMCA Turns: 3110 ± 2 Rev
Verify Accum IMCA Turns: 3110 ± 2 Rev

S1S3 SSAS Latching

‘IMCA-1’

Verify Latch Status – Stopped

‘Latching Graphical Representation’

Verify IMCA-1 Closed – green
Verify IMCA-2 Closed – green

SSAS Manual Latching Commands

‘Mode Cmds’

**cmd** Standby **Execute**

‘IMCA Mode’

Verify Standby – √

14. **INHIBITING MECHANISM AUTOSAFING SOFTWARE**

**NOTE**

To prevent undesirable removal of power from the SSAS IMCAs when SSRMS transitions to Safed, the Mechanism Autosafing software is Inhibited.

SSAS Manual Latching Command

‘Capture Autosafing’

**sel** Mechanism Autosafing

Mechanism Autosafing

‘Inhibit’

**cmd** Arm **Execute**

Verify Arm – √

**cmd** Inhibit **Execute**

Verify Mechanism Autosafing – Inhibited
15. **GIVING A GO FOR SSRMS SAFING POST CAPTURE COMPLETE**
SSAS operator ⇒ Robotics operator, “Third Stage Capture complete – go for SSRMS Safing.”

16. **VERIFYING CONFIGURATION TO BEGIN BOLTING OPERATIONS**

- **S1S3 SSAS Overview**
  - ‘SSAS Graphical Representation’
  - ‘BBC-1 Pwr’

  √ S14B G RPC 01 icon – blue with green corners

  ‘BBC-2 Pwr’

  √ S13A G RPC 01 icon – gray with black corners

  ‘Operations’

  sel Bolting

- **S1S3 SSAS Bolting**
  - ‘BBC Status’

  Verify Bolt Direction – FWD

17. **CLOSING BBC COMMON POWER RELAY (AOS/HD)**

- **S1S3 SSAS Bolting**

  sel Common Power Relay Cmds

- **SSAS BBC Common Power Relay**
  - ‘SSAS MANUAL MODE - Relay Position’

  **cmd** Close **Execute**

  Verify Commanded Relay Position – Cl
  Verify Actual Relay Position – Cl

- **S1S3 SSAS Bolting**

  sel Manual Bolting Commands

- **SSAS Manual Bolting Commands**
  - ‘Common Power Relay and Limit Switch Return Status’

  Verify Limit Switch Return – Closed
CAUTION

1. To prevent overtightening of Bolts and possible hardware damage in Manual State, it is imperative that the operator send the Bolt Power Off command immediately upon detection of the first Bolt Tight Switch (BTS) closing, which is represented by an “X” on command displays and a green status light on the bolting graphical display.

2. To prevent damage to bolt hardware, operator should be prepared to send a cmd Bolt Power – Off Execute if the MBA Current exceeds the specified limits during Bolt tightening.

NOTE

1. Each SSAS Bolt takes approximately 8.5 minutes to complete its tightening. During the tightening of each Bolt, when both Bolt Tight Switches (BTS) close, the Limit Sw Cutoff Flag will turn green and will go gray when the Bolt Power – Off or Reset Stop Flags – step 1 command is sent. This is an indication that the Bolt tightened nominally.

2. If unexpected LOS with MCC-H during bolt actuation and bolt current > 175mA AND MBA On Time > 480 seconds, do not stop bolt motion. Continue to let bolt drive until fully tight. Wait for AOS before driving next bolt.

*****************************************************************
* If a Latching malfunction led to performance of Manual *
* Latching steps (refer to previous Caution box), then *
* Do not perform the following manual bolting steps. *
* Perform bolting steps from nominal mate procedure. *
******************************************************************
18. **TIGHTENING S1S3 SSAS BOLT - BOLTS 3,1,2 (AOS/M)**

**SSAS Manual Bolting Commands**

'Drive Bolt'

```plaintext
cmd Bolt [Z] Execute  where [Z] = [3][1][2]
```

*********************************************************
* If MBA Current exceeds 300 mA just after Drive
* Bolt command is sent, immediately
* cmd Stop  Execute
***********************************************************

Verify Bolt Selected – Bolt [Z]

Verify MBA Current (steady state): 100 to 175 mA

Verify Pwr On – X
Verify BBS – blank
Verify MBA Posn, Rev – incrementing
Verify MBA On, s – incrementing

*********************************************************

* If MBA Current exceeds 175 mA at anytime
* before MBA On of 480 seconds, immediately
* cmd Stop  Execute
***********************************************************

When BTS 1 or BTS 2 – X, immediately

```plaintext
cmd Bolt Power – Off  Execute
```

Verify MBA Current <15 mA

Verify Pwr On – blank
Verify BBS – blank
Verify BTS 1 – X
Verify BTS 2 – X
Verify Common Power Relay – Closed
Verify Limit Switch Return – Closed

sel Reset Stop Flags Cmds

`SSAS BBC Reset Stop Flags`

'Reset Stop Flags’

```plaintext
cmd Step 1  Execute
```

Verify Limit Switch Cutoff Flag – Not Set

```plaintext
cmd Step 2  Execute
```

Verify Limit Switch Cutoff Flag – Not Set

`SSAS Manual Bolting Commands`
19. **CONFIGURING ATTITUDE CONTROL**

\[\text{MCC-H} \] for required MCS Configuration

**NOTE**

At this point in the operation, \text{MCC-H} is nominally expected to take over control and complete remaining steps of SSAS mate to allow crew to support SSRMS ungrapple and subsequent EVA RMS support.

20. **DEACTIVATING S1S3 SSAS IMCA-2**

20.1 **Inhibiting IMCA-2 RT FDIR**

\[\text{S1S3 SSAS Overview}\]

sel Primary EXT MDM

\[\text{Primary Ext MDM}\]

sel LB Mech S 2

\[\text{LB MECH S2}\]

sel RT Status

\[\text{LB MECH S2 RT Status}\]

‘12 SSAS S1/S3 L2’

\[\text{RT Status – Ena}\]

\[\text{cmd RT FDIR Status – Inhibit FDIR Execute}\]

\[\text{RT FDIR Status – Inh}\]

20.2 **Deactivating IMCA-2**

\[\text{S1S3 SSAS Overview}\]

‘SSAS Graphical Representation’

‘IMCA-2 Pwr’

sel S13A G RPC 15

\[\text{RPCM S13A G RPC 15}\]

\[\text{cmd RPC Position – Open (Verify – Op)}\]

\[\text{cmd Close Cmd – Inhibit (Verify – Inh)}\]

20.3 **Inhibiting IMCA-2 RT I/O**

\[\text{S1S3 SSAS Overview}\]

sel Primary EXT MDM
2.04 Enabling IMCA-2 Inadvertent Motion Autosafing

NOTE
The following command to Enable Inadvertent Motion Autosafing and its associated telemetry does not exist on PCS and, thus, can only be sent and verified by MCC-H.

**MCC-H**

**cmd** Prim_EXT_Ena_ECZ_Function_Tmplt **Execute**

<Cmd PUI: S0DD96LM1658K>
<Template IMCA_SAS_S1S3_L2_INADVERT_MOTION_AUTOSAFING_9A>

input – 4 0

S1S3 SSAS Latching MSKVIEW
‘Latching Cautions & Advisories’

Verify IMCA-2 Inadvertent Motion – Ena

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. To prevent overtightening of Bolts and possible hardware damage in Manual State, it is imperative that the operator send the Bolt Power – Off command immediately upon detection of the first Bolt Tight Switch (BTS) closing (represented by an “X” on command displays and a green status light on the bolting graphical display).</td>
</tr>
<tr>
<td>2. To prevent damage to bolt hardware, operator should be prepared to send <strong>cmd</strong> Bolt Power – Off <strong>Execute</strong> if the MBA Current exceeds the specified limits during Bolt tightening.</td>
</tr>
</tbody>
</table>
NOTE
Each SSAS Bolt takes approximately 8.5 minutes to complete its tightening. During the tightening of each Bolt, when both Bolt Tight Switches (BTS) close, the Limit Sw Cutoff Flag will turn green and will go gray when the Bolt Power – Off or Reset Stop Flags – step 1 command is sent. This is an indication that the Bolt tightened nominally.

******************************************************************
* If a Latching malfunction led to performance of Manual
* Latching steps (refer to previous Caution box), then
* Do not perform the following manual bolting steps.
* Perform bolting steps from nominal mate procedure.
******************************************************************

21. **TIGHTENING S1S3 SSAS BOLT - BOLT 4 (AOS/M)**

   SSAS Manual Bolting Commands

   ‘Drive Bolt’

   **cmd Bolt 4 Execute**

   ********************************************************************************
   * If MBA Current exceeds 300 mA just after Drive
   * Bolt command is sent, immediately
   * **cmd Stop Execute**
   ********************************************************************************

   Verify Bolt Selected – Bolt 4

   Verify MBA Current (steady state): 100 to 175 mA
   Verify Pwr On – X
   Verify BBS – blank
   Verify MBA Posn, Rev – incrementing
   Verify MBA On, seconds – incrementing

   ********************************************************************************
   * If MBA Current exceeds 175 mA at anytime
   * before MBA On of 480 seconds, immediately
   * **cmd Stop Execute**
   ********************************************************************************

   Wait approximately 8.5 minutes for Bolt to tighten.
When BTS 1 or BTS 2 – X, immediately

**cmd Bolt Power – Off Execute**

Verify MBA Current < 16 mA
Verify Pwr On – blank
Verify BBS – blank
Verify BTS 1 – X
Verify BTS 2 – X
Verify Common Power Relay – Closed
Verify Limit Switch Return – Closed

sel Reset Stop Flags Cmds

**SSAS BBC Reset Stop Flags**
‘Reset Stop Flags’

**cmd Step 1 Execute**

Verify Limit Switch Cutoff Flag – Not Set

**cmd Step 2 Execute**

Verify Limit Switch Cutoff Flag – Not Set

---

22. **OPENING COMMON POWER RELAY (AOS/HD)**

**S1S3 SSAS Bolting**

sel Common Power Relay Cmds

**SSAS BBC Common Power Relay**
‘SSAS MANUAL MODE - Relay Position’

**cmd Open Execute**

Verify Commanded Relay Position – Op
Verify Actual Relay Position – Op
If a Latching malfunction led to performance of Manual Latching steps then:
* Do not perform the following manual latching steps to deploy the latch immediately following the tightening of the fourth bolt, but perform the steps to deactivate the SSAS because deploying the latch after the bolt tightening may interfere with S3/S4 Activation.
* At a later date, after S3/S4 Activation is complete, perform necessary steps from S1S3 SSAS Prep for Mate procedure to activate both IMCAs, one BBC, and transition SSAS to Manual State before performing the following steps.

23. **INITIALIZING IMCA-1 WITH SAFING INITFRAME AND MODE TO ON (AOS/HD)**

**S1S3 SSAS Overview**

'Selections'

**Latching**

**S1S3 SSAS Latching**

'Sel Manual Latching'

**SSAS Manual Latching Commands**

'Select IMCA Initframe'

**cmd** Safing **Execute**

Verify Initframe Selected – Safing

'IMCA Mode'

Verify Standby – √

'Mode Cmds'

**cmd** On **Execute**

'IMCA Mode'

Verify On – √

Verify IMCA Turns: 0 ± 2 Rev
Verify Accum IMCA Turns: 3110 ± 2 Rev
24. **INITIATING FIRST STAGE DEPLOY OF CAPTURE LATCH (AOS/HD)**

SSAS Manual Latching Commands

'Select IMCA Initframe'

**cmd** First Stage Deploy  **Execute**

Verify Initframe Selected – First Stage Deploy

'Mode Cmds'

**cmd** Enabled  **Execute**

‘IMCA Mode’

Verify Enabled  

Verify IMCA Turns – decrementing
Verify Accum IMCA Turns – decrementing

Wait approximately 4 minutes for completion of First Stage Deploy.

25. **VERIFYING IMCA-1 STOP CONDITIONS AT REMOVE PRELOAD POSITION (AOS/HD)**

SSAS Manual Latching Commands

‘IMCA Mode’

Verify On  

Verify IMCA Turns: -1500 ± 2 Rev
Verify Accum IMCA Turns: 1610 ± 2 Rev

S1S3 SSAS Latching

‘IMCA-1’

Verify Latch Status – Stopped

‘SSAS Graphical Representation’

Verify IMCA-1 Closed – gray

SSAS Manual Latching Commands

‘Mode Cmds’

**cmd** Standby  **Execute**

‘IMCA Mode’

Verify Standby  

26. **TRANSITIONING SSAS TO STANDBY STATE**

<table>
<thead>
<tr>
<th>S1S3 SSAS Overview</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘SSAS State’</td>
</tr>
</tbody>
</table>

sel State Commands

<table>
<thead>
<tr>
<th>SSAS State Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>cmd Standby Execute</td>
</tr>
</tbody>
</table>

Verify SSAS State – Standby

27. **DEACTIVATING S1S3 SSAS IMCA-1**

27.1 **Inhibiting IMCA-1 RT FDIR**

<table>
<thead>
<tr>
<th>S1S3 SSAS Overview</th>
</tr>
</thead>
<tbody>
<tr>
<td>sel Primary EXT MDM</td>
</tr>
<tr>
<td>Primary Ext MDM</td>
</tr>
</tbody>
</table>

sel LB Mech S 1

<table>
<thead>
<tr>
<th>LB MECH S1</th>
</tr>
</thead>
</table>

sel RT Status

<table>
<thead>
<tr>
<th>LB MECH S1 RT Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘12 SSAS S1/S3 L1’</td>
</tr>
</tbody>
</table>

√RT Status – Ena

<table>
<thead>
<tr>
<th>cmd RT FDIR Status – Inhibit FDIR Execute</th>
</tr>
</thead>
<tbody>
<tr>
<td>RT FDIR Status – Inh</td>
</tr>
</tbody>
</table>

27.2 **Deactivating IMCA-1**

<table>
<thead>
<tr>
<th>S1S3 SSAS Overview</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘SSAS Graphical Representation’</td>
</tr>
<tr>
<td>‘IMCA-1 Pwr’</td>
</tr>
</tbody>
</table>

sel S14B G RPC 15

<table>
<thead>
<tr>
<th>RPCM S14B G RPC 15</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>cmd RPC Position – Open (Verify – Op)</th>
</tr>
</thead>
<tbody>
<tr>
<td>cmd Close Cmd – Inhibit (Verify – Inh)</td>
</tr>
</tbody>
</table>
27.3  Inhibiting IMCA-1 RT I/O

S1S3 SSAS Overview

sel Primary EXT MDM

Primary Ext MDM

sel LB Mech S 1

LB MECH S1

sel RT Status

LB MECH S1 RT Status

‘12 SSAS S1/S3 L1’

√ RT FDIR Status – Inh

cmd RT Status – Inhibit  Execute

√ RT Status – Inh

27.4  Enabling IMCA-1 Inadvertent Motion Autosafing

NOTE

The following command to Enable Inadvertent Motion Autosafing and its associated telemetry does not exist on PCS and, thus, can only be sent and verified by MCC-H.

MCC-H  cmd  Prim_EXT_Ena_ECZ_Function_Tmplt  Execute

<Cmd PUI: S0DD96lM1658K>

<Template IMCA_SAS_S1S3_L1_INADVERT_MOTION_AUTOSAFING_9A>

input – 3 9

S1S3 SSAS Latching MSKVIEW

‘Latching Cautions & Advisories’

Verify IMCA-1 Inadvertent Motion – Ena

28.  DEACTIVATING S1S3 SSAS BBC-1

28.1  Inhibiting BBC-1 RT FDIR

S1S3 SSAS Overview

sel Primary EXT MDM

Primary Ext MDM
sel LB Mech S 1

SEL LB Mech S 1

sel RT Status

SEL LB MECH S1 RT Status
‘13 SSAS S1/S3 B1’

√RT Status – Ena

cmd RT FDIR Status – Inhibit FDIR Execute

√RT FDIR Status – Inh

28.2 Inhibiting BBC-1 RT I/O

SEL LB MECH S1 RT Status
‘13 SSAS S1/S3 B1’

cmd RT Status – Inhibit Execute

√RT Status – Inh

28.3 Deactivating BBC-1

S1S3 SSAS Overview
‘BBC-1 Pwr’

sel S14B G RPC 01

RPCM S14B G RPC 01

cmd RPC Position – Open (Verify – Op)
cmd Close Cmd – Inhibit (Verify – Inh)

28.4 Enabling BBC-1 Inadvertent Power Autosafing

NOTE
The following command to Enable Inadvertent Power Autosafing and its associated telemetry does not exist on PCS and, thus, can only be sent and verified by MCC-H

MCC-H cmd Prim_EXT_Ena_ECZ_Function_Tmplt Execute

<Cmd PUI: S0DD96IM1658K>
<Template BBC_SAS_S1S3_B1_INADVERT_POWER
_AUTOSAFING_9A>

input – 6 3
S1S3 SSAS Bolting MSKVIEW
‘Bolting Cautions & Advisories’

Verify BBC-1 Inadvertent Power – Ena

29. TRANSITIONING SSAS TO IDLE STATE, AND DEACTIVATING SSAS APPLICATION

S1S3 SSAS Overview
‘SSAS State’

sel State Commands

SSAS State Commands

cmd Idle Execute

Verify SSAS State – Idle

S1S3 SSAS Overview
‘SSAS Application’

sel Application Commands

SSAS Application

cmd SSAS Application S/W Status – Deactivate Execute

✓SSAS Application S/W Status – Deactivated
✓SSAS IMCA S/W Status – Activated
✓SSAS BBC S/W Status – Activated

NOTE
As a non-time critical clean-up step after completion of the mating event, the default Mechanism Autosafing PPLs are reloaded into the Primary and Backup C&C MDMs to return to the default configuration.

MCC-H 30. PERFORMING FILE UPLINK AND DATA LOAD COMMANDS FOR MECHANISM AUTOSAFING PPLs

30.1 Building RDF 207 PPL Uplink to Primary C&C MDM (OSO)
Using the following, perform {1.232 CCS BUILD FILE UPLINK COMMAND} (SODF: GND AVIONICS: C&DH: NOMINAL), then:

Ops Name = YYYY_DDD_HH_CC_Hot_Mech_Safing_207_PPL_3
Source Device = Ground
Storage Type = RAM
Select Destination Filename = /mcc/fsw/{ISS Flight ID}/ppl/ccsr4_460/ccs_ppl_0207_4_a_04001.lif
Verify Source Filename = /mcc/fsw/{ISS Flight ID}/ppl/ccsr4_460/ccs_ppl_0207_4_a_04001.lif
Storage Type = RAM
Destination Device = C&C HOT
Priority = High
Uplink after = completion of S1S3 SSAS Nominal Mate
Remarks = re-engages default PPL after mate is completed

30.2 Building RDF 207 PPL Uplink to Backup C&C MDM (OSO)
Using the following, perform {1.231 CCS BUILD DATA LOAD COMMAND}, all (SODF: GND AVIONICS: C&DH: NOMINAL), then:

Ops Name = YYYY_DDD_HH_CC_Warm_Mech_Safing_207_PPL_4
Select Load File = /mcc/fsw/{ISS Flight ID}/ppl/ccsr4_460/ccs_ppl_0207_4_a_04001.lif
Memory Type = RAM
Destination Device = C&C WARM
Priority = High
Uplink after = completion of S1S3 SSAS Nominal Mate
Remarks = re-engages default PPL after mate is completed

30.3 Building RDF 243 PPL Uplink to Backup C&C MDM (OSO)
Using the following, perform {1.231 CCS BUILD DATA LOAD COMMAND}, all (SODF: GND AVIONICS: C&DH: NOMINAL), then:

Ops Name = YYYY_DDD_HH_CC_Warm_Mech_Safing_243_PPL_5
Select Load File = /mcc/fsw/{ISS Flight ID}/ppl/ccsr4_460/ccs_ppl_0243_4_a_04001.lif
Memory Type = RAM
Destination Device = C&C WARM
Priority = High
Uplink after = completion of S1S3 SSAS Nominal Mate
Remarks = re-engages default PPL after mate is completed

30.4 Performing PPL File Uplink and Data Loads (ODIN)
To uplink RDF 207 PPL to the Primary C&C MDM, perform {1.232 CCS BUILD FILE UPLINK COMMAND}, all (SODF: GND AVIONICS: C&DH: NOMINAL), then:

To uplink RDF 207 PPL to the Backup C&C MDM, perform {1.231 CCS BUILD DATA LOAD COMMAND}, all (SODF: GND AVIONICS: C&DH: NOMINAL), then:

To uplink RDF 243 PPL to the Backup C&C MDM, perform {1.231 CCS BUILD DATA LOAD COMMAND}, all (SODF: GND AVIONICS: C&DH: NOMINAL), then:
30.5 Verifying PPL Version IDS (OSO)

S1S3 SSAS Overview

‘Operations’

Sel Latching

S1S3 SSAS Latching

Sel Manual Latching

SSAS Manual Latching Commands

‘Capture Autosafing’

Sel Mechanism Autosafing

Mechanism Autosafing

‘Autosafing PPL Version IDs - Safing Cmds’

Verify Primary C&C: 04001
Verify Backup C&C: 04001

‘Autosafing PPL Version IDs - Safing Default’

Verify Backup C&C: 04001
OBJECTIVE:
Activate the S1S3 Segment to Segment Attachment System (SSAS) by powering on both Integrated Motor Controller Actuators (IMCAs) and powering one of the Bolt Bus Controllers (BBC) in order to complete the partial deployment of the Capture Latch in Normal State. The deployment which removes pre-load from the latch is to be performed anytime after S3/S4 Activation is complete. This procedure also performs a check of the Bolt Tight Switches (BTS) subsequent to the mating event.

LOCATION:
Starboard side of S1 Truss

DURATION:
1 hour

REFERENCED PROCEDURE(S):
None

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Step titles followed by the notation &quot;(AOS/M)&quot; indicate that AOS during the execution of that step is mandatory. If current LOS or expecting LOS prior to completion of an AOS/M step, wait for the next AOS to perform.</td>
</tr>
<tr>
<td>2. Step titles followed by the notation &quot;(AOS/HD)&quot; indicate that AOS during the execution of that step is highly desired. If communication will be regained within 10 minutes of reaching such a step, wait for AOS to perform.</td>
</tr>
<tr>
<td>3. For any off-nominal steps or any attention symbols that appear, refer to [2.903 SSAS MALFUNCTION] (SODF: S&amp;M: MALFUNCTION: TRUSS SYSTEMS).</td>
</tr>
<tr>
<td>4. Ignore all attention symbols, switch indications, cautions and advisories prior to activation of SSAS software, path selection and devices being powered.</td>
</tr>
<tr>
<td>5. To stop mechanism actuation the following commands may be sent: in Manual State: cmd Stop Execute in Normal State: cmd Pause Execute in any SSAS state: cmd Abort Execute (device power will be cut with Abort command)</td>
</tr>
<tr>
<td>6. In order to prevent erroneous autosafing, the IMCA Inadvertent Motion and BBC Inadvertent Power autosafing capabilities will be inhibited during use of IMCAs and BBC.</td>
</tr>
<tr>
<td>7. Caution events for the IMCA Inadvertent Motion and BBC Inadvertent Power should be inhibited (event codes: 10331, 10332, 10315, and 10316).</td>
</tr>
<tr>
<td>8. If crew performing procedure steps, Advisories on PCS should be turned on.</td>
</tr>
<tr>
<td>9. IMCA and BBC activation, deactivation, and bolt drive tests will be performed by MCC-H using command scripts, with script information contained in Table 1.</td>
</tr>
</tbody>
</table>
Table 1. S1S3 SSAS Command Script Information

<table>
<thead>
<tr>
<th>Command Script</th>
<th>Script Function</th>
<th>Procedure Step(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1S3_SSAS_IMCA_1_Activate</td>
<td>Activate S1S3 SSAS IMCA 1</td>
<td>6</td>
</tr>
<tr>
<td>S1S3_SSAS_IMCA_2_Activate</td>
<td>Activate S1S3 SSAS IMCA 2</td>
<td>7</td>
</tr>
<tr>
<td>S1S3_SSAS_BBC_2_Activate</td>
<td>Activate S1S3 SSAS BBC 2</td>
<td>8</td>
</tr>
<tr>
<td>S1S3_SSAS_BBC_2_Deactivate</td>
<td>Deactivate S1S3 SSAS BBC 2</td>
<td>14</td>
</tr>
<tr>
<td>S1S3_SSAS_IMCA_1_Deactivate</td>
<td>Deactivates S1S3 SSAS IMCA 1</td>
<td>15</td>
</tr>
<tr>
<td>S1S3_SSAS_IMCA_2_Deactivate</td>
<td>Deactivates S1S3 SSAS IMCA 2</td>
<td>16</td>
</tr>
</tbody>
</table>

1. **VERIFYING RPCM STATUS**

PCS

S1: S&M: SSAS S1/S3

<table>
<thead>
<tr>
<th>S1S3 SSAS Overview</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘BBC-2 Pwr’</td>
</tr>
</tbody>
</table>

Sel S13A G RPC 01

RPCM S13A G RPC 01

√Integration Counter – incrementing

S1S3 SSAS Overview

| ‘IMCA-1 Pwr’         |

Sel S14B G RPC 15

RPCM S14B G RPC 15

√Integration Counter – incrementing

S1S3 SSAS Overview

| ‘IMCA-2 Pwr’         |

Sel S13A G RPC 15

RPCM S13A G RPC 15

√Integration Counter – incrementing

2. **RECORDING CDH CONFIGURATION**

S1S3 SSAS Overview

Record Primary MDM: EXT ________
Record Backup MDM: EXT ________
Record LB MECH S1 Ch ________
Record LB MECH S2 Ch ________

Sel Primary EXT MDM
Primary Ext MDM

sel LB Mech S 1

LB MECH S1

sel RT Status

LB MECH S1 RT Status
‘12 SSAS S1/S3 L1’

√RT Status – Inh
√RT FDIR Status – Inh
Verify RT Comm Failed Status – blank

Primary Ext MDM

sel LB Mech S 2

LB MECH S2

sel RT Status

LB MECH S2 RT Status
‘12 SSAS S1/S3 L2’

√RT Status – Inh
√RT FDIR Status – Inh
Verify RT Comm Failed Status – blank
‘13 SSAS S1/S3 B2’

√RT Status – Inh
√RT FDIR Status – Inh
Verify RT Comm Failed Status – blank

3. **ACTIVATING SSAS SOFTWARE APPLICATION**

NOTE
Before SSAS software activation, a nominal SSAS State indication of ‘Idle’ will be displayed.

S1S3 SSAS Overview
‘SSAS Application’

sel Application Commands
SSAS Application

**cmd** SSAS Application S/W Status – Activate  **Execute**

Verify SSAS Application S/W Status – Activated

√ SSAS IMCA S/W Status – Activated
√ SSAS BBC S/W Status – Activated

4.  **TRANSITIONING SSAS STATE TO STANDBY**

**S1S3 SSAS Overview**

'SSAS State'

**cmd** State Commands

**SSAS State Commands**

**cmd** Standby  **Execute**

Verify SSAS State – Standby

5.  **SELECTING SSAS PATH**

**S1S3 SSAS Overview**

'S1S3 Path Selection'

**cmd** IMCA-2 and BBC-2  **Execute**

**S1S3 SSAS Overview**

'S1S3 Path Selection'

Verify SSAS Selected – S1S3
Verify IMCA Selected – IMCA 2
Verify BBC Selected – BBC 2
Verify SSAS Path – S1S3 IMCA 2 BBC 2
NOTE
1. IMCA-1 and IMCA-2 telemetry fields on Latching graphical display update at 0.1 Hz rate. Data on Latching command displays update at 1.0 Hz rate and should be used first for data verification.

2. Each IMCA will take 6 seconds to complete Power On Self Test (POST) and mode to Standby after power has been applied.

6. ACTIVATING S1S3 SSAS IMCA-1

**NOTE**
The following commands to Inhibit Inadvertent Motion Autosafing and their associated telemetry do not exist on PCS and, thus, can only be sent and verified by MCC-H.

6.1 Inhibiting IMCA-1 Inadvertent Motion Autosafing

**MCC-H**

**cmd** Prim_EXT_Arm_Inh_ECZ_Function_Tmplt **Execute**

```
<Cmd PUI: S0DD96IM1665K>
<Template IMCA_SAS_S1S3_L1_INADVERT_MOTION_AUTOSAFING_9A>
```

Input – 3 9

[S1S3 SSAS Latching MSKVIEW]
‘Latching Cautions & Advisories’

Verify IMCA-1 Inadvertent Motion – Arm

**cmd** Prim_EXT_Inh_ECZ_Function_Tmplt **Execute**

```
<Cmd PUI: S0DD96IM1672K>
<Template IMCA_SAS_S1S3_L1_INADVERT_MOTION_AUTOSAFING_9A>
```

Input – 3 9

[S1S3 SSAS Latching MSKVIEW]
‘Latching Cautions & Advisories’

Verify IMCA-1 Inadvertent Motion – Inh
6.2 Opening IMCA-1 RPC

**NOTE**
The RPC powering IMCA-1 was closed to allow IMCA to be continuously powered in order to prevent loss of heating should the Capture Latch heaters fail similar to the S1S3 SSAS. Thus, in order to clear the IMCA Watchdog Timer, the IMCA RPC is opened prior to its reactivation and Enabling of the Remote Terminal communication.

<table>
<thead>
<tr>
<th>S1S3 SSAS Overview</th>
</tr>
</thead>
<tbody>
<tr>
<td>'IMCA-1 Pwr'</td>
</tr>
</tbody>
</table>

sel S14B G RPC 15

<table>
<thead>
<tr>
<th>RPCM S14B G RPC 15</th>
</tr>
</thead>
<tbody>
<tr>
<td>cmd</td>
</tr>
<tr>
<td>RPC Position – Open (Verify – Op)</td>
</tr>
</tbody>
</table>

6.3 Enabling IMCA-1 RT I/O

<table>
<thead>
<tr>
<th>S1S3 SSAS Overview</th>
</tr>
</thead>
<tbody>
<tr>
<td>sel Primary EXT MDM</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Primary Ext MDM</th>
</tr>
</thead>
<tbody>
<tr>
<td>sel LB Mech S 1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LB MECH S1</th>
</tr>
</thead>
<tbody>
<tr>
<td>sel RT Status</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LB MECH S1 RT Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>'12 SSAS S1/S3 L1'</td>
</tr>
</tbody>
</table>

\√ RT FDIR Status – Inh

<table>
<thead>
<tr>
<th>cmd</th>
</tr>
</thead>
<tbody>
<tr>
<td>RT Status – Enable <strong>Execute</strong></td>
</tr>
</tbody>
</table>

Verify RT Status – Ena

6.4 Activating IMCA-1

<table>
<thead>
<tr>
<th>S1S3 SSAS Overview</th>
</tr>
</thead>
<tbody>
<tr>
<td>'Operations'</td>
</tr>
</tbody>
</table>

sel Latching

<table>
<thead>
<tr>
<th>S1S3 SSAS Latching</th>
</tr>
</thead>
<tbody>
<tr>
<td>'Latching Graphical Representation'</td>
</tr>
<tr>
<td>'IMCA-1 Pwr'</td>
</tr>
</tbody>
</table>
sel S14B G RPC 15

**RPCM S14B G RPC 15**

**cmd** RPC Position – Close (Verify – Cl)

Verify Open Cmd – Ena

**S1S3 SSAS Latching**

‘IMCA-1’

Verify Built In Test Errors – no attention symbol

‘Mode’

Verify Standby – green

**NOTE**

The next check verifies RTD Voltage changes after IMCA activation. The RTD Voltage should change at least once within a 30 second period. If RTD Voltage does not change, __√MCC__.

‘Motor Status’

Verify RTD Voltage ≤ 1251mV

‘Latch Status’

Verify Latch Status – Stopped

‘Latching Graphical Representation’

Verify IMCA-1 icon – no attention symbol
Verify Closed – gray
Verify Open – green
Verify RTL 1 – gray
Verify RTL 2 – gray
Verify RTL 3 – gray

6.5 **Enabling IMCA-1 RT FDIR**

**S1S3 SSAS Latching**

sel Primary EXT MDM

**Primary Ext MDM**

sel LB Mech S 1
7. ACTIVATING S1S3 SSAS IMCA-2

NOTE
The following commands to Inhibit Inadvertent Motion Autosafing and their associated telemetry do not exist on PCS and, thus, can only be sent and verified by MCC-H.

7.1 Inhibiting IMCA-2 Inadvertent Motion Autosafing

MCC-H

**cmd** Prim_EXT_Arm_Inh_ECZ_Function_Tmplt **Execute**

<Cmd PUI: S0DD96IM1665K>
<Template IMCA_SAS_S1S3_L2_INADVERT_MOTION_AUTOSAFING_9A>

input – **4 0**

[S1S3 SSAS Latching MSKVIEW]
‘Latching Cautions & Advisories’

Verify IMCA-2 Inadvertent Motion – Arm

**cmd** Prim_EXT_Inh_ECZ_Function_Tmplt **Execute**

<Cmd PUI: S0DD96IM1672K>
<Template IMCA_SAS_S1S3_L2_INADVERT_MOTION_AUTOSAFING_9A>

input – **4 0**

[S1S3 SSAS Latching MSKVIEW]
‘Latching Cautions & Advisories’

Verify IMCA-2 Inadvertent Motion – Inh
7.2 Opening IMCA-2 RPC

NOTE
The RPC powering IMCA-2 was closed to allow IMCA to be continuously powered in order to prevent loss of heating should the Capture Latch heaters fail similar to the S1S3 SSAS. Thus in order to clear the IMCA Watchdog Timer, the IMCA RPC is opened prior to its reactivation and Enabling of the Remote Terminal communication.

S1S3 SSAS Overview
IMCA-2 Pwr

sel S13A G RPC 15
RPCM S13A G RPC 15

**cmd** RPC Position – Open (Verify – Op)

7.3 Enabling IMCA-2 RT I/O

S1S3 SSAS Latching

sel Primary EXT MDM

Primary Ext MDM

sel LB Mech S 2

LB MECH S2

sel RT Status

LB MECH S2 RT Status
12 SSAS S1/S3 L2

\RT FDIR Status – Inh

**cmd** RT Status – Enable **Execute**

Verify RT Status – Ena

7.4 Activating IMCA-2

S1S3 SSAS Latching
Latching Graphical Representation
IMCA-2 Pwr

sel S13A G RPC 15
RPCM S13A G RPC 15
cmd RPC Position – Close (Verify – Cl)

Verify Open Cmd – Ena

S1S3 SSAS Latching

‘IMCA-2’

Verify Built In Test Errors – no attention symbol

‘Mode’

Verify Standby – green

NOTE
The next check verifies RTD Voltage changes after IMCA activation. The RTD Voltage should change at least once within a 30 second period. If RTD Voltage does not change, √MCC.

‘Motor Status’

Verify RTD Voltage ≤ 1251mV

‘Latch Status’

Verify Latch Status – Stopped

‘Latching Graphical Representation’

Verify IMCA-2 icon – no attention symbol
Verify Closed – gray
Verify Open – green
Verify RTL 1 – gray
Verify RTL 2 – gray
Verify RTL 3 – gray

‘Command Validation’

Verify IMCA Cmd and Data Status – no attention symbol

7.5 Enabling IMCA-2 RT FDIR

S1S3 SSAS Latching

sel Primary EXT MDM

Primary Ext MDM

sel LB Mech S 2

LB MECH S2
sel RT Status

| LB MECH S2 RT Status | '12 SSAS S1/S3 L2' |

√ RT Status – Ena

cmd RT FDIR Status – Enable FDIR Execute

Verify RT FDIR Status – Ena
Verify RT Comm Failed Status – blank

8. ACTIVATING S1S3 SSAS BBC-2

NOTE
The following commands to Inhibit Inadvertent Power Autosafing and their associated telemetry do not exist on PCS and, thus, can only be sent and verified by MCC-H.

8.1 Inhibiting BBC-2 Inadvertent Power Autosafing

MCC-H cmd Prim_EXT_Arm_Inh_ECZ_Function_Tmplt Execute

<Cmd PUI: S0DD96IM1665K> <Template BBC_SAS_S1S3_B2_INADVERT_POWER_AUTOSAFING_9A>

input – 6 4

S1S3 SSAS Bolting MSKVIEW ‘Bolting Cautions & Advisories’

Verify BBC-2 Inadvertent Power – Arm

MCC-H cmd Prim_EXT_Inh_ECZ_Function_Tmplt Execute

<Cmd PUI: S0DD96IM1672K> <Template BBC_SAS_S1S3_B2_INADVERT_POWER_AUTOSAFING_9A>

input – 6 4

S1S3 SSAS Bolting MSKVIEW ‘Bolting Cautions & Advisories’

Verify BBC-2 Inadvertent Power – Inh

8.2 Activating BBC-2

CAUTION
Only one Bolt Bus Controller (BBC) may be powered at a given time to avoid short circuits between BBC-1 and BBC-2.
S1S3 SSAS Overview

‘Operations’

sel Bolting

S1S3 SSAS Bolting

‘Bolting Graphical Representation’

‘BBC-2 Pwr’

sel S13A G RPC 01

RPCM S13A G RPC 01

cmd Close Cmd – Enable (Verify – Ena)

cmd RPC Position – Close (Verify – Cl)

8.3 Enabling BBC-2 RT I/O

S1S3 SSAS Bolting

sel Primary EXT MDM

Primary Ext MDM

sel LB Mech S 2

LB MECH S2

sel RT Status

LB MECH S2 RT Status

‘13 SSAS S1/S3 B2’

√RT FDIR Status – Inh

cmd RT Status – Enable Execute

Verify RT Status – Ena

S1S3 SSAS Bolting

‘Command Validation’

Verify BBC Cmd and Data Status – no attention symbol

‘BBC Status’

Verify BBC Selected – BBC 2

Verify MBA Current: 0 to 16 mA
Verify Bolt Direction – FWD
Verify Limit Sw Cutoff Flag – gray
Verify Current Cutoff Flag – gray
Verify Limit Sw Cutoff Override – gray

‘Bolting Graphical Representation’

Verify Limit Switch Return Num 2 – Closed
Verify BBS (all) – green
Verify BTS (all) – gray
Verify BBC-1 icon – gray
Verify BBC-1 & BBC-2 icon – no attention symbol

8.4 Enabling BBC-2 RT FDIR

S1S3 SSAS Bolting

sel Primary EXT MDM

Primary Ext MDM

sel LB MECH S2

LB MECH S2

sel RT Status

LB MECH S2 RT Status

‘13 SSAS S1/S3 B2’

√RT Status – Ena

cmd RT FDIR Status – Enable FDIR Execute

Verify RT FDIR Status – Ena
Verify RT Comm Failed Status – blank

9. TRANSITIONING SSAS STATE TO NORMAL

S1S3 SSAS Overview

‘SSAS State’

sel State Commands

SSAS State Commands

cmd Normal Execute

Verify SSAS State – Normal

NOTE

The partial deployment of the Capture Latch that removes the preload from the latch will be delayed until after the S3/S4 Activation procedure is completed. This will ensure no interference with EVA Nadir/Zenith Tray connection preparations.
10. **INITIATING REMOVE PRELOAD PHASE OF CAPTURE LATCH (AOS/HD)**

**S1S3 SSAS Overview**

‘Operations’

sel Latching

**S1S3 SSAS Latching**

sel Normal Latching

**SSAS Normal Latching Commands**

‘IMCA Mode’

Verify Standby – √

‘Deploy Commands’

**cmd Initialize First Phase Deploy Execute**

Verify Initframe Selected – Initialize First Phase (momentary)

‘IMCA Mode’

Verify On – √

Verify Latch Cntrlr Seq Step – First Phase Deploy - Initialize

‘Deploy Commands’

**cmd First Phase Deploy Execute**

Verify Initframe Selected – First Phase Deploy

‘IMCA Mode’

Verify Enabled – √

‘IMCA Data’

Verify IMCA Turns – decrementing
Verify Accum IMCA Turns – decrementing
Verify Latch Cntrlr Seq Step: First Phase Deploy – Enabled
Verify IMCA Phase Time – incrementing

Wait approximately 4 minutes for completion of First Phase Deploy.
11. **VERIFYING IMCA-1 STOP CONDITIONS AT REMOVE PRELOAD POSITION (AOS/HD)**

SSAS Normal Latching Commands

‘IMCA Mode’

Verify Standby – √

‘IMCA Data’

Verify IMCA Turns: -1500 ± 2 Rev (momentary)

Verify Accum IMCA Turns: 1610 ± 2 Rev

Verify Latch Cntrlr Seq Step – None

Verify IMCA Phase Time ≤ 207 s

*S1S3 SSAS Latching ‘IMCA-1’*

Verify Latch Status – Stopped

‘Latching Graphical Representation’

Verify IMCA-1 Closed – gray
Verify IMCA-2 Closed – gray

12. **BOLT TIGHT SWITCH CHECK**

*S1S3 SSAS Latching ‘SSAS Graphical Representation’*

sel S1S3 SSAS Overview

*S1S3 SSAS Overview ‘Operations’*

sel Bolting

*P1P3 SSAS Bolting ‘Bolting Graphical Representation’*

Verify BTS 1 (four) – green
Verify BTS 2 (four) – green
13. **TRANSITIONING SSAS TO STANDBY STATE**

S1S3 SSAS Overview

'SSAS State'

Sel State Commands

**SSAS State Commands**

**cmd** Standby **Execute**

Verify SSAS State – Standby

14. **DEACTIVATING S1S3 SSAS BBC-2**

14.1 **Inhibiting BBC-2 RT FDIR**

S1S3 SSAS Overview

Sel Primary EXT MDM

**Primary Ext MDM**

Sel LB Mech S 2

**LB MECH S2**

Sel RT Status

**LB MECH S2 RT Status**

'13 SSAS S1/S3 B2'

√RT Status – Ena

**cmd** RT FDIR Status – Inhibit FDIR **Execute**

Verify RT FDIR Status – Inh

14.2 **Inhibiting BBC-2 RT I/O**

**LB MECH S2 RT Status**

'13 SSAS S1/S3 B2'

**cmd** RT Status – Inhibit **Execute**

Verify RT Status – Inh

14.3 **Deactivating BBC-2**

S1S3 SSAS Overview

'BBC-2 Pwr'

Sel S13A G RPC 01
14.4 Enabling BBC-2 Inadvertent Power Autosafing

**NOTE**
The following command to Enable Inadvertent Power Autosafing and its associated telemetry does not exist on PCS and, thus, can only be sent by **MCC-H**.

**MCC-H**

**cmd** Prim_EXT_Ena_ECZ_Function_Tmplt  **Execute**

<Cmd PUI: S0DD96IIM1658K>
<Template BBC_SAS_S1S3_B1_INADVERT_POWER_AUTOSAFING_9A>

input – 6

[S1S3 SSAS Bolting MSKVIEW]
‘Bolting Cautions & Advisories’

Verify BBC-2 Inadvertent Power – Ena

15. **DEACTIVATING S1S3 SSAS IMCA-1**

15.1 **Inhibiting IMCA-1 RT FDIR**

[S1S3 SSAS Overview]

sel Primary EXT MDM

[Primary Ext MDM]

sel LB Mech S 1

[LB MECH S1]

sel RT Status

[LB MECH S1 RT Status]
‘12 SSAS S1/S3 L1’

√RT Status – Ena

**cmd** RT FDIR Status – Inhibit FDIR  **Execute**

√RT FDIR Status – Inh
15.2 Deactivating IMCA-1

S1S3 SSAS Overview
’SAS Graphical Representation’
‘IMCA-1 Pwr’

sel S14B G RPC 15

RPCM S14B G RPC 15

cmd RPC Position – Open (Verify – Op)

cmd Close Cmd – Inhibit (Verify – Inh)

15.3 Inhibiting IMCA-1 RT I/O

S1S3 SSAS Overview

sel Primary EXT MDM

Primary Ext MDM

sel LB Mech S 1

LB MECH S1

sel RT Status

LB MECH S1 RT Status

‘12 SSAS S1/S3 L1’

√RT FDIR Status – Inh

**cmd** RT Status – Inhibit  **Execute**

√RT Status – Inh

15.4 Enabling IMCA-1 Inadvertent Motion Autosafing

**NOTE**
The following command to Enable Inadvertent Motion Autosafing and its associated telemetry does not exist on PCS and, thus, can only be sent and verified by **MCC-H**.

**MCC-H**

**cmd** Prim_EXT_Ena_ECZ_Function_Tmplt  **Execute**

<Cmd PUI: S0DD96IM1658K>
<Template IMCA_SAS_S1S3_L1_INADVERT_MOTION_AUTOSAFING_9A>

input – 3 9
Verify IMCA-1 Inadvertent Motion – Ena

16. **DEACTIVATING S1S3 SSAS IMCA-2**

16.1 Inhibiting IMCA-2 RT FDIR

S1S3 SSAS Overview

sel Primary EXT MDM

Primary Ext MDM

sel LB Mech S 2

LB MECH S2

sel RT Status

LB MECH S2 RT Status

‘12 SSAS S1/S3 L2’

√ RT Status – Ena

**cmd** RT FDIR Status – Inhibit FDIR **Execute**

√ RT FDIR Status – Inh

16.2 Deactivating IMCA-2

S1S3 SSAS Overview

‘SSAS Graphical Representation’

‘IMCA-2 Pwr’

sel S13A G RPC 15

RPCM S13A G RPC 15

**cmd** RPC Position – Open (Verify – Op)

**cmd** Close Cmd – Inhibit (Verify – Inh)

16.3 Inhibiting IMCA-2 RT I/O

S1S3 SSAS Overview

sel Primary EXT MDM

Primary Ext MDM

sel LB Mech S 2
16.4 Enabling IMCA-2 Inadvertent Motion Autosafing

**NOTE**
The following command to Enable Inadvertent Motion Autosafing and its associated telemetry does not exist on PCS and, thus, can only be sent and verified by **MCC-H**.

**MCC-H**

**cmd** Prim_EXT_Ena_ECZ_Function_Tmplt  **Execute**

<Cmd PUI: S0DD96IM1658K>
<Template IMCA_SAS_S1S3_L2_INADVERT_MOTION_AUTOSAFING_9A>

input – 4 0

**S1S3 SSAS Latching MSKVIEW**
‘Latching Cautions & Advisories’

Verify IMCA-2 Inadvertent Motion – Ena

17. TRANSITIONING SSAS TO IDLE STATE AND DEACTIVATING SSAS APPLICATION

**S1S3 SSAS Overview**
‘SSAS State’

sel State Commands

**SSAS State Commands**

**cmd** Idle  **Execute**

Verify SSAS State – Idle

**S1S3 SSAS Overview**
‘SSAS Application’

sel Application Commands
SSAS Application

**cmd** SSAS Application S/W Status – Deactivate  **Execute**

√ SSAS Application S/W Status – Deactivated
√ SSAS IMCA S/W Status – Activated
√ SSAS BBC S/W Status – Activated
NOTE
The APCUs are in a parallel configuration. When either APCU converter is turned ON, both APCU CONV talkbacks will be gray [tb APCU 1,2 CONV (two) – gray].

1. **VERIFYING ORBITER PAYLOAD BUS CONFIGURATION**
   - R1
     - √ tb PL PRI MNC – ON
     - √ PL CAB – MNA(MNB)
     - √ PL AUX – ON

2. **VERIFYING SWITCH POWER**
   - SSP 1
     - √ cb SW PWR 1 – cl

3. **CLOSING APCU 1 OUTPUT RELAY**
   - √ tb APCU 1,2 CONV – bp
     - APCU 1 OUTPUT RLY – cl

4. **TURNING APCU CONVERTER(S) ON**
   - APCU 1(2) CONV – ON
     - √ tb APCU 1,2 CONV – gray
     - √ tb APCU 1 OUTPUT RLY – gray

   CRT
   - SM 200 APCU Status

   √ APCU 1(2) OUT VOLTS RES HIGH: 122 to 126.5 V
NOTE
1. Expect ‘**S200 APCU 1(2) VOLT LMT**’ message when APCU Converters are powered OFF.

2. The APCUs are in a parallel configuration. When either APCU converter is turned ON, both APCU CONV talkbacks will be gray [tb APCU 1,2 CONV (two) – gray].

---

**CRT SM 200 APCU Status**

1. **TURNING APCU CONVERTER(S) OFF**
   - APCU 1(2) CONV – OFF
   - √ tb APCU 1,2 CONV – bp
   - √ tb APCU 1 OUTPUT RLY – bp

2. **OPENING APCU 1 OUTPUT RELAY**
   - APCU 1 OUTPUT RELAY – OP
| L12U | 1. cb SW PWR 1 – op |
|      | PDIP 1 PWR 2/KuBAND RLY – op |
|      | X1/X2 SW – op |
|      | X1/X2 SW PDIP 1 PWR 1 – op |
| L12L | 2. cb PDIP 2 PWR 2 – op |
|      | PDIP 2 PWR 1 – op |
| L12  | 3. Ku BAND RATE – OFF |
| R1   | 4. PL CAB – OFF |
| ML86B:E | 5. cb MNB MAR 2 – op |
PAYLOAD ENTRY SWITCH LIST/VERIFICATION

TIG-1:55  **PAYLOAD PWR CONFIG**

R1  
1. √ PL CAB – OFF
   √ PRI MNC – ctr (tb-OFF)
   √ MNB – ctr (tb-OFF)
   √ FC3 – ctr (tb-OFF)
   √ AUX – ON
   √ AFT MNB – OFF
   √ MNC – OFF

L12U  
2. √ APCU 1 CONV – OFF (tb-bp)
   √ OUTPUT RLY – OPEN (tb-bp)
   √ APCU 2 CONV – OFF (tb-bp)
   √ cb SW PWR 1 – op
   √ cb PDIP 1 PWR 2/KuBAND RLY – op
   √ tb OIU PWR – bp
   √ TCS PWR – OFF (tb-bp)
   √ cb X1/X2 SW – op
   √ cb X1/X2 SW PDIP1 PWR1 – op
   √ ODS CONN MATE X1 TLM PWR – OFF
   √ X2 TLM PWR – OFF
   √ OIU PWR – OFF

L12L  
3. √ cb PDIP 2 PWR 2 – op
   √ C/L CAM PWR – OFF
   √ cb PDIP 2 PWR 1 – op

L12  
4. √ Ku BAND RATE – OFF
   √ DC PWR 1 CAB PL – OFF
   √ 2 CAB PL – OFF

L11  
5. √ DC PWR 1 CAB PL – OFF
   √ 2 CAB PL – OFF

ML86B:E  
6. √ cb MNB MAR 1 – cl
   √ 2 – op

ML85E  
7. √ DC 10 AMP MNB S2 – OFF
   √ S3 – ON
   √ S4 – OFF
   √ S5 – OFF

8. √ cb DC 10 AMP MNB CB2 – op
   √ CB3 – cl
   √ CB4 – op
   √ CB5 – op
PAYLOAD REACTIVATION
(ASSY OPS/13A/FIN)  Page 1 of 1 page

N/A
MALFUNCTION
The APCU and the Primary Payload Bus will be deactivated in LCH DEACT.

MCC will determine between a transducer shift and a real single converter failure.

Total output for each APCU must be maintained less than 14.7 amps and each CONV output must be maintained less than 8.5 amps.
1. Loss of APCU 1 output results in loss of orbiter 120 V power to LCS/IDC.

2. MCC will determine between a transducer shift and a real circuitry failure.

APCU TEMP ↓↑
(ASSY OPS/13A/FIN)

APCU Status

1. Determine which of the following conditions will occur.
   - APCU 1(2) TRIP > -4.40
   - Any APCU 1(2) CONV A(B) AMPS > 8.5
   - APCU 1(2) VOLTS RES HIGH < 122 or > 126.5


5. Orbiter cooling problem.

6. All APCU Power OFF (L12/SSP 1)
   - APCU 1,2 CONV (two) – OFF (tb-bp)
   - APCU 1 OUTPUT RLY – OPEN (tb-bp)

7. CONV A and CONV B TEMPS in a single operating APCU ≥ 130 and rising or ≤ 20?
   - Yes
   - Single APCU cooling problem or circuit failure.
   - To activate other APCU
     - APCU 2(1) CONV – ON (tb-gray)

8. Single CONV TEMP ≥ 130 or ≤ 20?
   - Yes
   - Temp transducer shift or converter circuit failure.
   - MCC

9. No
   - Transient temperature shift or transducer shift.

10. Continue nominal operations.

11. Continue nominal operations.

12. No
   - All APCU 1,2 CONV A,B TEMPS (four) ≥ 130 or rising or ≤ 20?

13. Yes
   - Continue nominal operations.

14. Affected APCU
   - APCU 1(2) CONV – OFF (tb-gray)

15. (L12/SSP 1)

16. (L12/SSP 1)

Nominal Config:
(R1)
PRI PL MNC – ON (tb-ON)
PL CAB – MNA(MNB)
PL AUX – ON
L12 (SSP 1) cb SW PWR 1 (CB2) – Close

Nominal Single APCU Config:
L12 (SSP 1)
APCU 1(2) CONV – ON (tb-gray)
APCU 1 OUTPUT RLY – CLOSE (tb-gray)
APCU 2(1) CONV – OFF (tb-gray)

The APCUs are in a parallel configuration. When either APCU converter is turned ON, both APCU CONV talkbacks will be gray [tb APCU 1,2 CONV (two) – gray]
MCC will determine cause of interruption of power or signal to the APCUs.

---

1. APCU Status
   - Determine the following:
   - (L12/SSP 1) APCU 1,2 CONV (two) tb-bp
   - APCU 1 OUTPUT RLY - CLOSE (tb-bp-gray)
   - SM 200 APCU STATUS
   - Both APCU 1 TRIP and APCU 2 TRIP approx = 0

2. ORB R1
   - PRI PL tbs
   - All tbs OFF?
   - Yes
     - Possible PRI PL short.
   - No

3. PRI PL bus disconnection.
   - Yes
     - MCC
   - No

4. PRI PL Bus disconnection.
   - No

5. APCU TRIP STATUS TABLE
   - (L12/SSP 1)
   - Affected APCU 1(2) CONV OFF (tb-bp-gray)
   - Affected APCU 1 OUTPUT RLY OPEN (tb-bp-gray)

6. Both APCUs tripped.
   - Yes
     - False trip indicator.
   - No

7. The APCUs are in a parallel configuration.
   - When either APCU converter is turned ON, both APCU CONV talkbacks will be gray [tb APCU 1,2 CONV (two) - gray].

8. Both APCUs tripped.
   - No

9. Transient trip indication.
   - Yes
     - Continue nominal operations.
   - No

10. Affected APCU CONV amps
    - Both A and B amps = 0.3L?
    - Yes
      - MCC
    - No

11. Both A and B converters tripped.
    - Yes
      - MCC
    - No

12. Affected APCU CONV amps
    - CONV A amps = 0.3L or CONV B amps = 0.3L?
    - Yes
      - MCC
    - No

13. Verify APCU configuration.
    - Both APCU 1 and 2 activated at time of failure?
    - Yes
      - MCC
    - No

14. Deactivate affected APCU.
    - Affected APCU 1(2) CONV - OFF (tb-bp-gray)

15. Record TRIP Status:
    - APCU 1 TRIP STATUS TABLE
    - APCU 1 OUTPUT RLY - OPEN (tb-bp)

16. APCU TEMP \( \uparrow \downarrow \), block 2 (SODF: ASSY OPS: MALFUNCTION: APCU)
    - APCU VOLTS \( \uparrow \downarrow \), block 2 (SODF: ASSY OPS: MALFUNCTION: APCU)
    - APCU AMPS \( \uparrow \), block 2 (SODF: ASSY OPS: MALFUNCTION: APCU)
MCC will coordinate recovery of the PRI PL bus and equipment.

Loss of APCU 1 output results in loss of orbiter 120V power LCS.

MCC will consider recovery actions. May activate downstream loads one at a time to find shorted load.
Loss of APCU 1 output results in loss of orbiter 120V power LCS.

1. Record TRIP Status:

2. APCU TRIP STATUS TABLE

3. Verify APCU 2

4. Reconfigure to APCU 2.

5. APCU 2 TRIP > -4.40 or APCU 2 CONV A amps + CONV B amps > 14.7 or Single CONV amps > 8.5?

6. APCU 1 TRIP > -4.40 or APCU 1 CONV A amps + CONV B amps > 14.7 or Single CONV amps > 8.5?

7. Unisolatable short in wiring between APCU 1 and 2.

8. Unisolatable short in APCU 1 or trip circuitry failure.

9. Reconfigure to APCU 2.
Verify APCU 2 Status
(L12/SSP 1)
• APCU 1 CONV – OFF (tb-bp)
• APCU 2 CONV – ON (tb-gray)

(APCU 2 CONV amps and TRIP STATUS)
APCU-2 TRIP > -4.40 or
APCU-2 CONV A amps +
CONV B amps > 14.7
or
Single CONV amps > 8.5?

Yes
(APCU VOLTS ↑↓), block 35 (SODF: ASSY OPS:
MALFUNCTION: APCU)

Unisolatable short in
APCU 2 or trip circuitry
failure.

No
Obss data required?

Yes
Reconfigure to
APCU 1
(L12/SSP 1)
• APCU 2 CONV – OFF (tb-bp)
• APCU 1 OUTPUT RLY –
CLOSE (tb-bp)
• APCU 1 CONV – ON (tb-gray)
• APCU 1 OUTPUT RLY
(tb-gray)

No
Unpower APCU 2
(L12/SSP 1)
• APCU 2 CONV – OFF (tb-bp)

Inadvertent trip or
short downstream of
APCU.

Unpower APCU 2
(L12/SSP 1)
• APCU 2 CONV – OFF (tb-bp)

Single converter
tripped.

SM 200 APCU STATUS
• Record Trip Status:
• APCU TRIP STATUS
TABLE
• Manage remaining
converter so that CONV
amps ≤ 8.5.
### Table 1. APCU Trip Status

<table>
<thead>
<tr>
<th>TRIP (STATUS VOLTAGE)</th>
<th>OV</th>
<th>OUV</th>
<th>OC</th>
<th>IUV</th>
</tr>
</thead>
<tbody>
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<td>+4.88</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td>+4.23</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td>+3.59</td>
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<td>+2.95</td>
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<td>+1.62</td>
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<tr>
<td>+0.98</td>
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<td>+0.34</td>
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<td>-0.30</td>
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<td>-4.20</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>-4.86 (no trip)</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**NOTE**

OV: Output Overvoltage  
OUV: Output Undervoltage  
OC: Output Overcurrent  
IUV: Input Undervoltage  

Tolerance for all reported voltages is ± 0.20V
SPEC voltage for APCU in the 120 volts mode is 122 to 126.5 volts. If APCU volts are outside this range but stable and usable, consideration will be given to continuing APCU operation.
APCU tripped but failed to set trip indicator (possible for a short circuit directly at the APCU output).

1. APCU Switches to OFF
   - APCU 1,2 CONV (two) – OFF (tb-bp)
   - APCU 1 OUTPUT RLY – OPEN (tb-bp)

2. APCU tripped but failed to set trip indicator (possible for a short circuit directly at the APCU output).

3. Yes
   - APCU-1 CONV – ON (tb-gray)
   - APCU 1,2 CONV (two)
   - APCU 1 OUTPUT RLY – OPEN (tb-bp)

4. No
   - APCU-1 TRIP > -4.40 or
   - APCU-1 CONV A amps + CONV B amps > 14.7
   - Single CONV amps > 8.5?

5. Yes
   - APCU 1,2 OUT VOLTS (four) – OSL?

6. No
   - Unannunciated trip.

7. Yes
   - MCC

8. No
   - APCU 1,2 CONV (two) – OFF (tb-bp)
   - APCU 1 OUTPUT RLY – OPEN (tb-bp)
3 Loss of APCU 1 output results in loss of orbiter 120 V power to LCS/IDC.

4 MCC will determine cause of the power interruption.

Loss of APCU 1 output results in loss of orbiter 120 V power to LCS/IDC.

MCC will determine cause of the power interruption.
APCU tripped but failed to set trip indicator (possible for a short circuit directly at the APCU output).

Loss of APCU 1 output results in loss of orbiter 120 V power to LCS/IDC.

There is a single point failure that will cause both the HIGH and LOW RES VOLTS to read low (broken wire).
Loss of APCU 1 output results in loss of 120 V orbiter power to LCS/IDC. Loss of APCU 2 output is no impact.

43 Are both APCU converters on?
   No

44 (L12/SSP 1)
   • APCU-1 CONV – OFF (tb-gray)
   • √ APCU 1,2 CONV volts STATUS
   All APCU 1,2 OUT VOLTS (four) > 121 and < 127?
   Yes
   • Continue nominal operations.
   No

46 (L12/SSP 1)
   • APCU-1 CONV – ON (tb-gray)
   • APCU-2 CONV – OFF (tb-gray)
   • √ APCU 1,2 CONV volts STATUS
   All APCU 1,2 OUT VOLTS (four) > 121 and < 127?
   Yes
   • Continue nominal operations.
   No

48 Powerdown APCU
   (L12/SSP 1)
   • APCU-1 CONV – OFF (tb-bp)
   • APCU 1 OUTPUT RLY – OPEN (tb-bp)

49 (L12/SSP 1)
   • APCU 1(2) CONV – ON (tb-gray)
   • APCU 2(1) CONV – OFF (tb-gray)
   • √ APCU 1,2 CONV volts STATUS
   All APCU 1,2 OUT VOLTS (four) > 121 and < 127?
   No

50 Powerdown APCU
   (L12/SSP 1)
   • APCU 1(2) CONV – OFF (tb-bp)
   • APCU 1 OUTPUT RLY – OPEN (tb-bp)

51 APCU voltage regulation problem.

52 Continue nominal operations.
COMM

OIU FAIL TO COMMAND
(assy ops/13a/FIN)

1. Requesting PSP Dummy CMDs
   - MCC will uplink PSP Dummy CMDs and verify telemetry.
   - \( ^\text{1} \) PSP Dummy CMD 2(1)
   - \( ^\text{1} \) PSP Config ID 2(1)
   - \( ^\text{1} \) UMB #4(1)
   - \( ^\text{1} \) No SM/PSP load errors
   - \( ^\text{1} \) PSP I/F to OIU OFF/(ON)

2. Power Cycling PSP 1(2)
   - (A1L)
   - S-BD PL CNTL − CMD
   - S-BD PL PWR SYS − OFF
   - S-BD PL CNTL − PNL
   - S-BD PL PWR SYS − 1(2)
   - S-BD PL CNTL − CMD
   - S-BD PL PWR SYS − OFF
   - Expect ‘S62 BCE BYP PSP 1(2)’ message.

3. OIU CMD
   - SM 212 OIU
   - BUS 2 A − ITEM 8 (*)
   - BUS 2 B − ITEM 9 EXEC (*)

4. Transient PSP 1(2) Failure.

5. Determining Current OIU FMT
   - SM 212 OIU
   - FMT (ITEM 1), and log: ______

6. Returning BUS 2 to Nominal Configuration
   - SM 212 OIU
   - BUS 2 A − ITEM 8 EXEC (*)

7. Power Cycling OIU 1(2)
   - On MCC GO
     - (SSP1)
     - OIU PWR − ctr, then
     - OIU PWR − OIU 1(2): ON
     - OIU tb − UP(DN)
   - OIU FMT block 5 = 255?
     - Yes

8. Continue nominal operations.

9. No

10. Yes

Power cycle will place OIU in Format 255. OIU Station TLM will be lost until OIU CMD is recovered. OIU H&S TLM will also be lost if PDI is not configured for OIU FMT 255.
9 Determining Affected DECOM

• DECOM indicating (T), and log: ____

10 OIU CMD

• SM 62 PCMMU/PL COMM

SM 212 OIU

• BUS 2 B – ITEM 9 EXEC (*)

CMD successful?

11 Transient OIU 1(2) Failure.

12 OIU CMD by Attempting to Load Original OIU FMT

SM 212 OIU

• ITEM 1 * X X X EXEC, where X X X is original OIU FMT logged in block 5.

• PDI DCM SYNC for affected Decom

All three “B”, “W”, “F” columns display an “*”? Yes No

13 Returning BUS 2 to Nominal Configuration

SM 212 OIU

• BUS 2 A – ITEM 8 EXEC (*)

14 Continue nominal operations.

15 Transient OIU 1(2) failure.

16 Continue nominal operations.
17 Switching to OIU 2(1)

On MCC GO
(SSP1)
- OIU PWR – OIU 2(1) ON
  /\ OIU tb – DN(UP)
- Switch to PSP 2(1).
  (A1L)
  \ S-BD PL CNTL: CMD
  \ S-BD PL PWR OUTPUT: PL UMB
  S-BD PL PWR SYS: 2(1)
  S-BD PL SEL: PSP
  S-BD PL CNTL: PNL,CMD
- Expect 'S62 BCE BYP PSP 1(2)' message.

SM 62 PCMMU/PL COMM
I/O RESET PSP 2(1) – ITEM 7(6) EXEC (*)
- Config PDI for OIU 1.
  sel DECOM – ITEM 9 +X EXEC
  sel INPUT – ITEM 12 +2(1) EXEC
  LOAD – ITEM 13 EXEC
- OIU FMT block 5 = 255?

18 SM 212 OIU
- BUS 2 B – ITEM 9 EXEC (*)
  CMD successful?

19 PSP 1(2) to OIU 1(2) interface failure.

20 Returning BUS 2 to Nominal Configuration
SM 212 OIU
- BUS 2 A – ITEM 8 EXEC (*)

21 /\ MCC

22 \ MCC
- Continue nominal operations.

23 // OIU CMD by Attempting to Load Original OIU FMT
SM 212 OIU
- ITEM 1 + X X X EXEC, where X X X is original OIU FMT logged in block 5.
- PDI DCM SYNC for affected Decom
  All three "B", "W", "F" columns display an "***"?

24 /\ MCC

25 PSP 1(2) to OIU 1(2) interface failure.

26 \ MCC
- Continue nominal operations.
ASSY OPS

OIU TEMP HIGH MALFUNCTION
(assy ops/13a/fn) 06 dec 06

SM 212 OIU TEMP

OIU message:
OIU TEMP > 212

Nominal Config:
(R1)
- PL CAB
- MNA(MNB)
- PL AUX - ON

(SSP 1)
- OIU PWR – OIU 1(2)
- ON
- tb OIU – UP(DN)

1
SM 212 OIU

- OIU 1(2) TEMP ↑?

Yes No

2
Transrent failure or
OIU 1(2) near temp limit.

- *MCC-H

3

4
OIU 1(2) over temp.

5
- Determine which of these
will occur:
- AOS
- LOS

6
- *MCC

7
Swapping to OIU 2(1)

(SSP 1)
- OIU PWR – OIU 2(1) ON
- (tb-DN (UP))

8
Swapping to PSP 2(1)

(A1L)
- S-BD PL CNTL – CMD
- S-BD PSP CMD
- OUTPUT – PL UMB
- S-BD PWR SYS – 2(1)
- S-BD PWR SEL – PSP
- S-BD PL CNTL – PNL, CMD

- Error message ‘S62 BCE
BYP PSP 1(2)’

- S62 PCMMU/PL COMM
- I/O RESET PSP 2(1)
- ITEM 7(6) EXEC

9
Configuring PDI for
OIU 2(1)

SM62 PCMMU/PL
COMM
- sel DECOM – ITEM 9 +X EXEC
- sel INPUT – ITEM 12
+2(1) EXEC
- LOAD – ITEM 13 EXEC

10
Determining if LOAD
OIU FMT/CONFIG
- *MCC for correct OIU
FMT/CONFIG
- Perform LOAD OIU
FMT/CONFIG (FDF:
ORB OPS FS,
COMM/INST), then:

11
- Continue nominal
operations.
**PL/DPS RECONFIGURATION**  
(ASSY OPS/13A/FIN) Page 1 of 2 pages

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Secure Action</th>
<th>Recovery Action</th>
<th>Info</th>
</tr>
</thead>
<tbody>
<tr>
<td>PL 1(2) MDM I/O ERROR; PL 1(2) MDM OUTPUT (DFD, ORB PKT, DPS)</td>
<td>N/A</td>
<td>N/A</td>
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<tr>
<td>5.3c I/O ERROR PL 1(2); MDM OUTPUT PL 1(2) (DFD, MAL, DPS)</td>
<td>N/A*</td>
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<td>PASS SM GPC FAIL (DFD, ORB PKT, DPS)</td>
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<td>GNC RECOVERY VIA G2FD (DFD, ORB PKT, DPS)</td>
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<td>5.1a CS SPLIT (DFD, MAL, DPS)</td>
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<td>C,D,E **</td>
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<td>5.3g BCE BYP PL1(2) (DFD, MAL, DPS)</td>
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<td>GPC FRP-4 PASS RECOVERY AFTER BFS ENGAGE (ASCENT/ORBIT/ENTRY) (DFD, MAL, DPS)</td>
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<td>GPC FRP-7 DPS RECONFIG FOR LOSS OF AV BAY COOLING (DFD, MAL, DPS)</td>
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<td>DPS SSR-3 GNC REASSIGNMENT (DFD, MAL, DPS)</td>
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<td>ECLSS SSR-10 H2O PUMP OPS VIA GPC (DFD, MAL, ECLSS)</td>
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<td>B</td>
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</table>

*Note: Procedure does not call out PL/DPS RECONFIG, Secure  
**Note: Procedure does not call out PL/DPS RECONFIG, Recovery

**ACTION A**

If ’I/O ERROR PL1’ message

- Loss of ground and orbiter MCDS command interface to ISS via PSP 1/OIU 1.
  - For additional impacts, refer to [ORBITER MDM LOSS IMPACTS](#)
- If failure at IOP XMTR/RCVR at SM GPC
  - If PL2 interface with SM GPC failed
    - √MCC for SM GPC reassignment
    - PF1 interface can be recovered by port moding PL 1/2 buses.

If ’I/O ERROR PL2’ message

- Loss of ground and orbiter MCDS command interface to ISS via PSP 2/OIU 2.
  - For additional impacts, refer to [ORBITER MDM LOSS IMPACTS](#)
- If failure at IOP XMTR/RCVR at SM GPC
  - If PL1 interface with SM GPC failed
    - √MCC for SM GPC reassignment
    - PF2 interface can be recovered by port moding PL 1/2 buses.
**ACTION B**

If SM GPC affected

Note PL/ISS commanding via SM GPC (ground and orbiter MCDS) not possible until SM machine is restored and PL 1(2) MDM I/F is restored.

If GNC GPC affected

Ground commanding not possible until GNC machine is restored.

**ACTION C**

If PSP I/O reset not previously performed

<table>
<thead>
<tr>
<th>SM 62 PCMMU/PL COMM</th>
</tr>
</thead>
<tbody>
<tr>
<td>I/O RESET PSP 1(2) – ITEM 6(7) EXEC</td>
</tr>
</tbody>
</table>

Notify MCC when complete.

**ACTION D**

Reload PDI DECOM FORMAT (FDF, ORB OPS FS, COMM/INST). As required, reenable PDI DECOM FDA. Resume SPEC 62.

**ACTION E**

Reload PCMMU TFLs, load PCMMU FORMAT (FDF, ORB OPS FS, COMM/INST).
1. Checking for PDI DECOM Lock
   SM 62 PCMMU/PL COMM
   PDI DECOM for OIU shows "B", "W", or "F" sync?
   Yes
   No
   Go to (S62 PDI DECOM FAIL), all (SODF: ASSY OPS: MALFUNCTION: COMM).

2. Checking OIU Sync
   OIU AD1 LOCK – YES?
   Yes
   Momentary loss of TLM.
   No
   (S62 PDI DECOM FAIL), block 7 (SODF: ASSY OPS: MALFUNCTION: COMM)

3. Selecting Device
   OIU FMT 007 – SSOR
   OIU FMT 009 – ISS

4. Checking Primary GNC MDM Status Via PCS
   MDM connected status box green?
   Yes
   No
   GNC MDM failure.

5. Reloading OIU Format
   SM 212 OIU
   ITEM 1 + 0 9 EXEC
   AD 1 LOCK – YES?
   Yes
   Loss of SYNC.
   No
   Continue nominal operations.

6. Power Cycling OIU 2(1)
   OIU FMT 009 – ISS
   OIU FMT 007 – SSOR
   OIU 2(1) failure.

7. MCC-H Reports Loss of ISS Data To Ground Via OIU
   Nominal Config:
   (R1)
   PL CAB
   - MNB(MNA)
   PL AUX – ON
   (SSP1)
   OIU PWR
   - OIU 2(1) ON
   tb OIU – DN(UP)
   For ISS:
   One PCS connected to Primary GNC MDM
   SM 212 OIU
   OIU FMT: 009
   For SSOR:
   (R14)
   cb MNA UHF EVA – cl
cb MNC UHF EVA – cl
   (O6)
   EVA STRING: 1(2)
   UHF MODE – EVA
   SM 212 OIU
   OIU FMT – 007

8. MCC-H will likely direct STS or ISS crew to perform
   (3.301 LOSS OF PCS TELEMETRY) (SODF: POC: MALFUNCTION).

9. OIU active device mapping occurs with format load.

10. OIU to PDI problems would annunciate a 'S62 PDI DECOM FAIL' message if FDA enabled.

11. MCC-H will likely direct STS or ISS crew to perform
   (3.301 LOSS OF PCS TELEMETRY) (SODF: POC: MALFUNCTION).

12. Reloading the OIU format forces a resync with the GNC MDM or SSOR.
4 OIU active device mapping occurs with format load.

5 Malfunction restores operational capability; additional troubleshooting to determine BIA failure may be performed later.

6 OIU powerup config on OIU BUS 3 is RT on ch A.

7 Reloading the OIU format forces a resync with the SSOR.

16 Swapping to OIU 1(2)

17 Reconfiguring PSP, PDI, OIU

18 Configuring for Ground Commanding of PL COMM

19 Reloading OIU Format

20 Loss of sync.

21 OIU 1(2) transient failure.

22 Swapping to SSOR String 2(1)

23 SSOR prime (backup) failure.

24 OIU 2(1) failure.

25 Power Cycling OIU 2(1)

26 OIU 2(1) transient failure.

27 OIU 2(1) failure.
28

29 Swapping to OIU 1(2)
(SSP1)
• OIU PWR – OIU 1(2) ON
• Int OIU – UP(DN)

30 Reconfiguring PSP, PDI, OIU
(A1L)
• S-BD PL CNTL – CMD
• S-BD PSP OUTPUT – PL UMB
• S-BD PWR SYS – 1(2)
• S-BD PWR SEL – PSP
• S-BD PL CNTL – PNL, CMD
• Expect error message 'S62 BCE BYP PSP 2(1)'.

31 Configuring for Ground Commanding of PL COMM
• SPEC 62 not loaded
• MCC-H for further actions

SM 62 PCMMU/PL COMM
• I/O RESET PSP 1(2)
  – ITEM 6(7) EXEC
• sel DECOM – ITEM 9 + X EXEC
• sel INPUT – ITEM 12 + 1(2) EXEC
• LOAD – ITEM 13 EXEC

SM 212 OIU
• ITEM 18 + 0 0 7 EXEC
• Continue nominal operations.

No

Yes

OIU powerup config on OIU BUS 3 is RT on ch A.
Nominal Config:
(A1L)
PL DATA INTLVR
PWR – ON
(R1)
PL CAB
– MNA(MNB)
PL AUX – ON
(SSP1)
OIU PWR – OIU 1(2)
ON
_tb-UP(DN)

TCS and SSV not addressed in MAL; FDA not nominally enabled.

S62 PDI DECOM FAIL
(ASY OPS/13A/FIN)

(S212 OIU AD 1 NOLK/LOSS OF ISS or SSOR TELEMETRY), block 1 (SODF: ASSY OPS: MALFUNCTION: COMM) or 2.4g S62 PDI DECOM FAIL (FDF, MAL, COMM)

1. Message accompanied by 'S62 BCE BYP PDI'?
   - No
   - Yes
      • Go to 2.4e S62 BCE BYP PDI (FDF, MAL, COMM).

2. Determining Which DECOM FDA Indicating Fail
   - SM 62 PCMMU/PL COMM
   - PDI DECOM FDA 1(2, 3, 4) indicating fail (↑)?
     - No
     - Yes
        • SM 212 OIU
           • OIU SYNC AD 1 LOCK – YES?
             - No
             - Yes
                • Go to (S212 OIU AD 1 NOLK/LOSS OF ISS OR SSOR TELEMETRY), block 5 (SODF: ASSY OPS: MALFUNCTION: COMM).

3. Reloading DECOM Indicating Fail
   - SM 62 PCMMU/PL COMM
     • sel DECOM – ITEM 9 + X EXEC
     • sel FMT – ITEM 10 + X X X EXEC
     • Load – ITEM 11 EXEC
   - Load – CPLT?
     - No
     - Yes
        • Transient PDI DECOM failure.

4. Transient PDI DECOM failure.
   - No
   - Yes
      • Continue nominal operations.

5. Selecting B/U DECOM Config (if Required)
   - For alt PDI configuration, complete LOAD PDI DECOM FORMAT, all (FDF ORB OPS FS, COMM/INST), then:
     • For alt TFL, perform LOAD PCMMU FORMAT, all (FDF ORB OPS FS, COMM/INST), then:
       • Continue nominal operations.

6. AOS with MCC-H?
   - No
   - Yes
      • Continue nominal operations.

7. B/U DECOM indicating fail (↑)?
   - No
   - Yes
      • Load ALT PDI and PCMMU Configuration

8. Load ALT PDI and PCMMU Configuration
   - For alt PDI configuration, complete LOAD PDI DECOM FORMAT (FDF, ORB OPS FS, COMM/INST), then:
   - For all TFL, perform LOAD PCMMU FORMAT, all (FDF ORB OPS FS, COMM/INST), then:
     • Continue nominal operations.

9. B/U DECOM indicating fail (↑)?
   - No
   - Yes
      • Transient PDI DECOM memory failure.

10. OIU to PDI I/F failure or OIU failure.
For ground commanding of PL COMM system, SPEC 62 must not be loaded.

MCC-H can perform all PL COMM reconfig, except OIU PWR cycle and swap steps.

Alternate (OIU 1) requires PSP 1.
## Table 1. Orbiter Electrical Bus Loss Matrix

<table>
<thead>
<tr>
<th>ORBITER ELECTRICAL BUSES</th>
<th>FC1</th>
<th>FC2</th>
<th>FC3</th>
<th>MNA DA1</th>
<th>MNB DA2</th>
<th>FC3</th>
<th>MNC DA3</th>
<th>MNC FPC3</th>
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</table>

- **X** = Total loss of operational power
- **P** = Loss of primary power source
- **R** = Loss of redundant power source
- **(R)** = Requires action to use redundant source
- **XC** = Total loss of CNTL power
- **XRC** = Loss of redundant CNTL power
- **~** = CNTL bus name identifies power source (ex: CNTL BC1 is powered by MNB & MNC through RPCs and by MNA through cb and fuse)
### Table 2. Orbiter Electrical Bus Loss Matrix (PRLA)

<table>
<thead>
<tr>
<th>ORBITER ELECTRICAL BUS&lt;sup&gt;*&lt;/sup&gt;</th>
<th>MNA DA1</th>
<th>CNTL BUS&lt;sup&gt;*&lt;/sup&gt;</th>
<th>MNB DA2</th>
</tr>
</thead>
<tbody>
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<tr>
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</tr>
<tr>
<td>PL Bay Mech Pwr Sys 2</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

X = Total loss of operational power  
P = Loss of primary power source  
R = Loss of redundant power source  
(R) = Requires action to use redundant source  
XC = Total loss of CNTL power  
XRC = Loss of redundant CNTL power  
* CNTL bus name identifies power source (ex: CNTL BC1 is powered by MNB & MNC through RPCs and by MNA through cb and fuse)

### Table 3. Payload Retention Usage

<table>
<thead>
<tr>
<th>Payload</th>
<th>Latch</th>
<th>PL SEL</th>
<th>Latch Use</th>
<th>Latch Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>S3/S4 Truss</td>
<td>1</td>
<td>1</td>
<td>Latch/Release</td>
<td>Latch 1</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1</td>
<td>Latch/Release</td>
<td>Latch 2</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>1</td>
<td>Latch/Release</td>
<td>Latch 3</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>1</td>
<td>Latch/Release</td>
<td>Latch 4</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>1</td>
<td>Not Used</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>Latch/Release</td>
<td>Keel Latch 1</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>2</td>
<td>Latch/Release</td>
<td>Keel Latch 2</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>2</td>
<td>Not Used</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>2</td>
<td>Not Used</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>2</td>
<td>Not Used</td>
<td></td>
</tr>
</tbody>
</table>
FF1  Uplink through NSP 1 (secondary)

FF3  Uplink through NSP 2 (primary)

PF1  ISS Primary command path (via PSP 1 – UMB 1/OIU 1)
     APCU 1 telemetry
     OIU 1 telemetry (PDI TELEMTRY 1)
     input DIH ODS X2/PMA2 X1 connector mate telemetry – 14
     input DIH ODS X1/PMA2 X2 connector mate telemetry – 15

PF2  ISS Redundant command path (via PSP 2 – UMB 1/OIU 2)
     APCU 2 telemetry
     OIU 2 telemetry (PDI TELEMTRY 2)
     OSVS Interface
     input DIH ODS X1/PMA2 X2 connector mate telemetry – 08
     input DIH ODS X2/PMA2 X1 connector mate telemetry – 09

OF1  PCMMU 1 – mode select telemetry
     PCMMU 1,2 – ON/OFF power telemetry
     PCMMU 1,2 – RPC A telemetry
     PL AUX A – RPC ON/OFF telemetry
     MID MCA 1 OP STATUS 1, 2, 3, 4 telemetry
     MID MCA 3 OP STATUS 1, 2, 3, 4 telemetry
     PL BAY MECH PWR SYS 1, 2 telemetry
     PL RETEN LOGIC PWR SYS 1, 2 telemetry
     PRLA PL SEL 2:
          Latch/System 2B, 3B, 4B, 5B
          R-F-L, LAT, REL telemetry
     PRLA PL SEL 3:
          Latch/System 1B, 2B, 3B, 4B, 5B
          R-F-L, LAT, REL telemetry

OF2  PSP 1,2 – bit and frame sync
     PCMMU 2 – mode select telemetry
     PCMMU 2 RPC B telemetry
     PL AUX B – RPC ON/OFF telemetry
     MID MCA 1 OP STATUS 5, 6 telemetry
     MID MCA 3 OP STATUS 5, 6, 7, 8 telemetry
     PRLA PL SEL 1:
          Latch/System 1B, 2B, 3B, 4B, 5B
          R-F-L, LAT, REL telemetry
     PRLA PL SEL 2:
          Latch/System 1B, 5A
          R-F-L, LAT, REL telemetry
     PRLA PL SEL 3:
          Latch/System 1A, 2A, 3A, 4A, 5A
          R-F-L, LAT, REL telemetry
     PRLA PL SEL 1, 2, 3:
          System A REL and LAT command state telemetry
OF3  Orbiter Comm system telemetry (refer to OI MDM/DSC Failure Impacts)
   PL PRI MNC, MNB, FC3 – ON/OFF telemetry
   PCMMU 1 RPC B telemetry

OF4  Ku-Band – RADAR mode and output power
   S-Band, Ku-Band – PNL/CMD switch position
   PSP, GCIL – ON/OFF telemetry
   ORBITER Comm system telemetry (refer to OI MDM/DSC Failure Impacts)
   CAB PL (MNA, MNB), PL AUX – ON/OFF telemetry
   PRLA PL SEL 2:
      Latch/System 2A, 3A, 4A
      R-F-L, LAT, REL telemetry

OA1  ODS X4/PMA X3 connector mate telemetry
   PMA 2/3 GRP 1 passive hooks (1,3,5,7,9,11) Close telemetry

DSC OA1  ODS X4/PMA X3 connector mate telemetry
   PMA 2/3 GRP 1 passive hooks (1,3,5,7,9,11) Close telemetry

OA2  AFT PL MNB PWR ON telemetry
   AFT PL MNB amps
   ODS X3/PMA X4 connector mate telemetry
   PMA 2/3 GRP 2 passive hooks (2,4,6,8,10,12) Close telemetry

DSC OA2  ODS X3/PMA X4 connector mate telemetry
   PMA 2/3 GRP 2 passive hooks (2,4,6,8,10,12) Close telemetry

OA3  AFT PL MNC PWR ON telemetry
   AFT PL MNC amps
   PRLA PL SEL 1:
      Latch/System 1A, 2A, 3A, 4A, 5A
      R-F-L, LAT, REL telemetry
   PRLA PL SEL 2:
      Latch/System 1A
      R-F-L, LAT, REL telemetry
This display monitors health and status of the two APCUs and is available in SM OPS 2. The APCUs are used to power the joint airlock Launch To Activation (LTA) heaters while the element is in the PLB. The display is generic and has been used on several missions. Figure 1 is a view of this display.

Figure 1.- APCU Status - MCDS Display.

TITLE: APCU STATUS

TYPE: SPEC 200
PARAMETER CHARACTERISTICS

Table 1. Parameter Characteristics

<table>
<thead>
<tr>
<th>CRT NAME</th>
<th>MSID</th>
<th>UNITS</th>
<th>DISPLAY RANGE</th>
<th>STATUS IND [3]</th>
<th>FDA LIMITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>APCU 1 CONV A OUT AMPS</td>
<td>P50C9003V</td>
<td>amps</td>
<td>0 to 12.0</td>
<td>M H L ↑</td>
<td>8.5</td>
</tr>
<tr>
<td>APCU 1 CONV A TEMP</td>
<td>P50T9002V</td>
<td>deg F</td>
<td>0 to 212.0</td>
<td>M H L ↑</td>
<td>20 130</td>
</tr>
<tr>
<td>APCU 1 CONV B OUT AMPS</td>
<td>P50C9004V</td>
<td>amps</td>
<td>0 to 12.0</td>
<td>M H L ↑</td>
<td>8.5</td>
</tr>
<tr>
<td>APCU 1 CONV B TEMP</td>
<td>P50T9005V</td>
<td>deg F</td>
<td>0 to 212.0</td>
<td>M H L ↑</td>
<td>20 130</td>
</tr>
<tr>
<td>APCU 1 OUT VOLTS RES LOW</td>
<td>P50V9001V</td>
<td>volts</td>
<td>0 to 180.0</td>
<td>M H L ↑</td>
<td></td>
</tr>
<tr>
<td>APCU 1 OUT VOLTS RES HIGH</td>
<td>P50V9000V</td>
<td>volts</td>
<td>110 to 160.0</td>
<td>M H L ↑</td>
<td>122 126.5</td>
</tr>
<tr>
<td>APCU 1 TRIP</td>
<td>P50V9006V</td>
<td>volts</td>
<td>-5.00 to 5.00</td>
<td>M H L ↑</td>
<td>-4.40</td>
</tr>
<tr>
<td>APCU 2 CONV A OUT AMPS</td>
<td>P50C9009V</td>
<td>amps</td>
<td>0 to 12.0</td>
<td>M H L ↑</td>
<td>8.5</td>
</tr>
<tr>
<td>APCU 2 CONV A TEMP</td>
<td>P50T9010V</td>
<td>deg F</td>
<td>0 to 212.0</td>
<td>M H L ↑</td>
<td>20 130</td>
</tr>
<tr>
<td>APCU 2 CONV B OUT AMPS</td>
<td>P50C9011V</td>
<td>amps</td>
<td>0 to 12.0</td>
<td>M H L ↑</td>
<td>8.5</td>
</tr>
<tr>
<td>APCU 2 CONV B TEMP</td>
<td>P50T9012V</td>
<td>deg F</td>
<td>0 to 212.0</td>
<td>M H L ↑</td>
<td>20 130</td>
</tr>
<tr>
<td>APCU 2 OUT VOLTS RES LOW</td>
<td>P50V9007V</td>
<td>volts</td>
<td>0 to 180.0</td>
<td>M H L ↑</td>
<td></td>
</tr>
<tr>
<td>APCU 2 OUT VOLTS RES HIGH</td>
<td>P50V9008V</td>
<td>volts</td>
<td>110 to 160.0</td>
<td>M H L ↑</td>
<td>122 126.5</td>
</tr>
<tr>
<td>APCU 2 TRIP</td>
<td>P50V9013V</td>
<td>volts</td>
<td>-5.00 to 5.00</td>
<td>M H L ↑</td>
<td>-4.40</td>
</tr>
</tbody>
</table>
REMARKS

[1] OUT VOLTS LOW displays the measurements from the low-resolution voltage sensor. OUT VOLTS HIGH displays the measurements from the high-resolution voltage sensor.

[2] APCU TRIP indicates the status of the APCU shutdown logic. This status can be interpreted using Table 2.

Table 2

<table>
<thead>
<tr>
<th>TRIP (STATUS VOLTAGE)</th>
<th>TRIP CAUSE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OV</td>
</tr>
<tr>
<td>+4.88</td>
<td>X</td>
</tr>
<tr>
<td>+4.23</td>
<td>X</td>
</tr>
<tr>
<td>+3.59</td>
<td>X</td>
</tr>
<tr>
<td>+2.95</td>
<td>X</td>
</tr>
<tr>
<td>+2.27</td>
<td>X</td>
</tr>
<tr>
<td>+1.62</td>
<td>X</td>
</tr>
<tr>
<td>+0.98</td>
<td>X</td>
</tr>
<tr>
<td>+0.34</td>
<td>X</td>
</tr>
<tr>
<td>-0.30</td>
<td>X</td>
</tr>
<tr>
<td>-0.95</td>
<td>X</td>
</tr>
<tr>
<td>-1.59</td>
<td>X</td>
</tr>
<tr>
<td>-2.23</td>
<td>X</td>
</tr>
<tr>
<td>-2.91</td>
<td></td>
</tr>
<tr>
<td>-3.56</td>
<td></td>
</tr>
<tr>
<td>-4.20</td>
<td></td>
</tr>
<tr>
<td>-4.86 (no trip)</td>
<td></td>
</tr>
</tbody>
</table>

NOTES

OV: Output Overvoltage
OUV: Output Undervoltage
OC: Output Overcurrent
IUV: Input Undervoltage

Tolerance for all reported voltages is 0.20 V.

[3] The parameter status field for all parameters will be blank for normal operation or will display an “M” for missing data. For analog parameters, this field will also display an “H” or “L” for offscale data. Some parameters displayed will be limit-sensed for SM alerts or C&W alarms. For discretes that are limit-sensed, the undesirable state is defined in the FDA low limit field and the FDA high limit field is left blank. Satisfaction of the undesirable state triggers a “↓” indication. For analogs that are limit-sensed, an “↑” or a “↓” will be displayed when the parameter exceeds either an upper or lower limit. The symbols driven in the parameter status field have the following display priority from highest to lowest: ‘M’, “H”, “L”, “↑”, “↓”. All symbols driven in the parameter status column will be displayed four times the normal intensity.
Figure 1.- ISS MCS Moding Display - SPEC 205.
For 12A thru 10A, there is no planned use of this display. For all flights after 10A, the purpose of this display is to allow the orbiter crew to command the ISS at dock and undock and provide the capability to execute the attitude control handover procedures. Specifically, the orbiter crew can command the ISS to free drift upon contact, or to activate attitude control upon separation. The orbiter crew could command at dock and undock from this display starting at 12A, however there is full redundancy in the ISS MCS moding system at that point until the redundancy is removed during Stage 10A. Stage 10A places Node 2 between the Lab and PMA2, and Node 2 does not contain any automatic ACS Moding wiring for undocking and only one string for docking, as opposed to two strings for each prior to Node 2.

For the capability of executing the attitude control handover procedures, the communication link will nominally be through the OIU / GNC Hardline. Therefore, all the commands on Spec 205 have a routing code for the OIU / GNC Hardline. For commanding the ISS at dock and undock, the communication link will nominally be through the SSOR. Since all the Spec 205 commands have a routing code through the OIU / GNC Hardline, the orbiter crew will send a reroute command that reroutes all Hardline commands to the SSOR.

**PARAMETER CHARACTERISTICS**

<table>
<thead>
<tr>
<th>CRT NAME</th>
<th>MSID</th>
<th>UNITS</th>
<th>DISPLAY RANGE</th>
<th>STATUS IND</th>
<th>FDA LIMITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STATUS</td>
<td>[1]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>US GNC MODE</td>
<td>[2]</td>
<td>P79X0845E</td>
<td>text</td>
<td>Refer to remarks</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>P79X0846E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>P79X0847E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RS GNC MODE</td>
<td>[3]</td>
<td>P79X0842E</td>
<td>text</td>
<td>Refer to remarks</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>P79X0843E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>P79X0844E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>US/RS GNC COMM</td>
<td>[4]</td>
<td>P79X0857E</td>
<td>text</td>
<td>0 = ‘GOOD’</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 = overbright ‘FAIL’</td>
<td></td>
</tr>
<tr>
<td>GNC MDM FRAME COUNT</td>
<td>[5]</td>
<td>P79U0856D</td>
<td>Refer to remarks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>US PRI GNC MDM</td>
<td>[6]</td>
<td>P79X0854E</td>
<td>text</td>
<td>0 = ‘GOOD’</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 = overbright ‘FAIL’</td>
<td></td>
</tr>
<tr>
<td>CMG ATT CNTL</td>
<td>[7]</td>
<td>P79X0853E</td>
<td>text</td>
<td>0 = ‘GOOD’</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 = overbright ‘LOST’</td>
<td></td>
</tr>
<tr>
<td>NO OP COMMAND</td>
<td></td>
<td>P79U0855D</td>
<td>Hex</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## SPEC 205 ISS MCS MODING

### CRT NAME | MSID | UNITS | DISPLAY RANGE | STATUS IND | FDA LIMITS
---|---|---|---|---|---
| **INHIBITS** | | | | | |
| MODE XTION | P79X0807E | text | 0 = ‘ENA’ 1 = ‘INH’ | | |
| ATT MNVR | P79X0812E | text | 0 = ‘ENA’ 1 = ‘INH’ | | |
| DESAT REQ | P79X0813E | text | 0 = ‘ENA’ 1 = ‘INH’ | | |
| ATT CNTL SHDN | P79X0806E | text | 0 = ‘ENA’ 1 = ‘INH’ | | |
| **HANOVER CNTL TO ORB** | | | | | |
| US DRIFT AVAIL | P79X0814E | text | 0 = ‘NO’ 1 = ‘YES’ | | |
| **CONTINGENCY DOCKING** | [9] | | | | |
| DOCK SEQUENCE INIT | P79X0858E | text | 0 = blank 1 = “ * ” | | |
| **CONTINGENCY UNDOCKING** | [11] | | | | |
| POST DEP CNTL MODE | P79X0818E | text | Refer to remarks | | |
| UNDOCK SEQUENCE INIT | P79X0859E | text | 0 = blank 1 = “ * ” | | |
| TIME SINCE SEP | P79W0860D | secs | | | |
| **OFF NOMINAL COMMANDS** | [14] | | | | |
| DOCKED IND | P79X0811E | text | 0 = blank 1 = “ * ” | | |
| UNDOCKED IND | P79X0811E | text | 0 = “ * ” 1 = blank | | |
| **HANOVER CONTL TO ISS** | | | | | |
| THRSTR AVAIL FOR DESAT | P79X0805E | text | 0 = ‘NO’ 1 = ‘YES’ | | |
REMARKS

[1] The US (United States) GNC MODE and the RS (Russian Segment) GNC MODE allow the orbiter crew to know how the station is controlling attitude. For nominal ISS attitude control, the US GNC Mode = CMG TA, and the RS GNC Mode = CMG TA. If the RS was controlling, the US GNC Mode = Drift (although depending on the failure scenario, it could be any one of the modes), and the RS GNC Mode = Thruster. If the Orbiter was controlling, the US GNC Mode = Drift (although depending on the failure scenario, it could be any one of the modes), and the RS GNC Mode = CMG TA or Indicatr.

[2] The US GNC MODE allows the orbiter crew to know how the US station is controlling attitude.

Table 2

<table>
<thead>
<tr>
<th>MSID</th>
<th>P79X0845E</th>
<th>P79X0846E</th>
<th>P79X0847E</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0 0 0 0 1 1 1 1</td>
<td>0 0 1 1 0 0 1 1</td>
<td>0 1 0 1 0 1 0 1</td>
</tr>
<tr>
<td>Displayed Text:</td>
<td>DEFAULT</td>
<td>WAIT</td>
<td>RESERVED</td>
</tr>
</tbody>
</table>

[3] The RS GNC MODE allows the orbiter crew to know how the RS station is controlling attitude.

Table 3

<table>
<thead>
<tr>
<th>MSID</th>
<th>P79X0842E</th>
<th>P79X0843E</th>
<th>P79X0844E</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0 0 0 0 1 1 1 1</td>
<td>0 0 1 1 0 0 1 1</td>
<td>0 1 0 1 0 1 0 1</td>
</tr>
<tr>
<td>Displayed Text:</td>
<td>RESERVED</td>
<td>THRUSTER</td>
<td>GY ONLY</td>
</tr>
</tbody>
</table>

[4] The US/RS GNC LOSS COMM: This Caution and Warning (C&W) is used in the handover of attitude control from Orbiter to CMG TA procedure, and if it is in alarm, the handover will not work. This C&W is coded on this Spec as conditional, which utilizes the overbright and flash functionality.

[5] GNC MDM FRAME COUNT: This parameter is used to determine if the entire Spec in general is getting updated data from the ISS. This parameter is normally displayed in decimal form resulting in an increment counter. But due to flight software constraints, this parameter will be displayed in hex form. Hex is sufficient because this parameter just needs to update.
[6] US PRI GNC MDM FAIL: This Caution and Warning (C&W) is used in the handover of attitude control from Orbiter to CMG TA procedure, and if it is in alarm, the handover will not work. This C&W is FDA’d as a Class 3 Alert, which when TMBU enabled, will have an onboard audible alarm, a light indication, an Onboard Fault Summary message, and a down arrow on the Spec parameter status field. This C&W is coded on this Spec as conditional, which utilizes the overbright and flash functionality.

[7] LOSS CMG ATT CNTL: This Caution and Warning (C&W) is used in the handover of attitude control from Orbiter to CMG TA procedure, and if it is in alarm, the handover will not work. This C&W is FDA’d as a Class 3 Alert, which when TMBU enabled, will have an onboard audible alarm, a light indication, an Onboard Fault Summary message, and a down arrow on the Spec parameter status field. This C&W is coded on this Spec as conditional, which utilizes the overbright and flash functionality.

[8] US DRIFT AVAIL: If this parameter, US Drift Available = Yes, then the command Item 9 MODE TO DRIFT will be accepted by the ISS US GNC MDM.

[9] CONTINGENCY DOCKING: These commands do not have any nominally planned use, but if there is a loss of redundancy to mode the ISS to free drift at docking, then MCC may decide to use this section.

[10] DOCK SEQUENCE INIT: This parameter is set high if item 11 was commanded to start the manual ACS Moding software to execute and mode the ISS to free drift.

[11] CONTINGENCY UNDOCKING: These commands do not have any nominally planned use, but if there is a loss of redundancy to mode the ISS to attitude control after undocking, then MCC may decide to use this section.

[12] POST DEP CNTL MODE: The Post Departure Control Mode can be set to CMG TA, CMG Only, or RS CNTL. If this parameter reads RS CNTL, then after undocking, if the ACS Moding software properly executes, the ISS will resume control on Russian thruster control.

Table 4

<table>
<thead>
<tr>
<th>MSID</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>P79X0818E</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>P79X0819E</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Displayed Text: CMG TA, CMG ONLY, RS CNTL

[13] TIME SINCE SEP: When the manual software is initiated or when the automatic software is initiated by the sensors, this time since separation parameter begins to count up from zero to a commanded value (typically 100 seconds) at which time the ISS will resume attitude control using the control method defined by the Post Departure Control Mode parameter.
[14] OFF NOMINAL COMMANDS: These commands do not have any nominally planned use, but may be used in MCC determined contingencies.

[15] THRSTR AVAIL FOR DESAT: telemetry feedback for Item 19 RS PREP FOR CMG DESAT. If that command is successful, then this parameter will show YES, and the RS is prepared to enter CMG TA mode.

ITEM ENTRY CHARACTERISTICS

Item 1: REROUTE TO SSOR: All the commands on this Spec are hardcoded with a routing code = 1, which is for the OIU / GNC Hardline. If the commands are to be sent through the SSOR, then this reroute command will tell the OIU that for any command with a routing code of 1, to change it to 2, which is the routing code for SSOR.

Item 2: ROUTE TO NORMAL HARDLINE: If there was an activity that required commanding from Spec 205 through the SSOR and that commanding activity is complete, then this route to normal command should be sent. All the commands on this Spec are hardcoded with a routing code = 1, which is for the OIU / GNC Hardline. But, for commanding through the SSOR, the OIU can be configured to take all routing codes of 1 and change it to 2, which is SSOR. So, to return the OIU to a nominal configuration, this command will tell the OIU that for all commands with routing code of 1, to assign it a routing code of 1.

Item 3: NO OP COMMAND: The commands to reroute to SSOR and route to normal hardline do not have any telemetry feedback. As a form of feedback, this no op command is sent and the command accept counter telemetry will increment, thus verifying the routing commands success.

Item 4: MODE XTION ENA is used to command the Mode Transition Inhibit to a status of either enabled. The telemetry feedback is ENA.

Item 5: ATT MNVR ENA is used to command the Attitude Maneuver Inhibit to a status of enabled. The telemetry feedback is ENA or INH.

Item 6: DESAT REQ ENA is used to command the Desat Request Inhibit to a status of enabled. The telemetry feedback is ENA or INH.

Item 7: ATT CNTL SHDN ENA is used to command the Attitude Control Shutdown Inhibit to a status of enabled. The telemetry feedback is ENA or INH.

Item 8: MODE XTION INH is used to command the Mode Transition Inhibit to a status of either inhibited. The telemetry feedback is INH.

Item 9: MODE TO DRIFT commands the ISS US GNC Mode to Drift.

Item 10: DOCK SOFTWARE ENA commands the manual dock software within the ACS Moding software to be enabled.
Item 11: DOCK SEQUENCE INIT commands the manual dock software within the ACS Moding software to execute, if the manual dock software is enabled per Item 10. The software that executes is the same software that the automatic ACS Moding software executes if the Capture Long sensors worked.

Item 12: UNDOCK SOFTWARE ENA commands the manual undock software within the ACS Moding software to be enabled.

Item 13: UNDOCK SEQUENCE INIT commands the manual undock software within the ACS Moding software to execute, if the manual undock software is enabled per Item 12. The software that executes is the same software that the automatic ACS Moding software executes if the Interface Sealed sensors and Separation sensors worked.

Item 14: INCORP MASS PROP is a command that incorporates the US GNC mass properties from a buffer location to active use.

Item 15, 16: DOCKED IND and UNDOCKED IND are manual commands that toggle a bit in the Primary C&C MDM automatic ACS Moding software. This bit is used by the Russian Segment to update their mass properties.

Item 17: HOLD CURRENT ATTITUDE is a command to the US GNC MDM that performs a snap and hold at the current attitude, assuming the US GNC Mode is already in CMG TA and controlling attitude.

Item 18: RS TAKE LVLH ATT CNTL is an ISS Tier 1 command that tells the Russian Segment to take attitude control in Thrusters in the LVLH reference frame. This command is an off nominal command without handshake between the US GNC MDM and the RS TBM. The nominal command to have the Russian Segment take control 6-17 is with handshake, which means there is some Tier 2 communication between the US GNC MDM and the RS TBM.

Item 19: RS PREP FOR CMG DESAT is a Tier 1 command that prepares the Russian Segment for CMG TA mode.

Item 20: MODE TO CMG TA is a command that changes the US GNC Mode to CMG TA using CCDB slot number 1, and also will change the RS GNC Mode to CMG TA if it is not already so.
<table>
<thead>
<tr>
<th>FIRE</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRESS</td>
<td>S</td>
</tr>
<tr>
<td>TOX ATM</td>
<td>S</td>
</tr>
<tr>
<td>CAUT</td>
<td>S</td>
</tr>
<tr>
<td>WARN</td>
<td>S</td>
</tr>
</tbody>
</table>

Figure 1.- ISS C&W Display - SPEC 211.
The SM 211 ISS C&W display is available in SM OPS 2 and is used for monitoring pertinent ISS C&W telemetry. Since the PCS does not have the capacity to annunciate alarm tones, the tone status flag from the ISS will be used to trigger the orbiter C&W system.

**PARAMETER CHARACTERISTICS**

<table>
<thead>
<tr>
<th>CRT NAME</th>
<th>MSID</th>
<th>UNITS</th>
<th>DISPLAY RANGE</th>
<th>STATUS IND [1]</th>
<th>FDA LIMITS</th>
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<tbody>
<tr>
<td>FIRE</td>
<td>P79X0803E</td>
<td>M</td>
<td></td>
<td>M</td>
<td>↓ 1</td>
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<tr>
<td>PRESS</td>
<td>P79X0801E</td>
<td>M</td>
<td></td>
<td>M</td>
<td>↓ 1</td>
</tr>
<tr>
<td>TOX ATM</td>
<td>P79X0802E</td>
<td>M</td>
<td></td>
<td>M</td>
<td>↓ 1</td>
</tr>
<tr>
<td>CAUT</td>
<td>P79X0830E</td>
<td>M</td>
<td></td>
<td>M</td>
<td>↓ 1</td>
</tr>
<tr>
<td>WARN</td>
<td>P79X0831E</td>
<td>M</td>
<td></td>
<td>M</td>
<td>↓ 1</td>
</tr>
</tbody>
</table>

**REMARKS**

[1] The parameter status field for all parameters will be blank for normal operation or will display an “M” for missing data. For analog parameters, this field will also display an “H” or “L” for offscale data. Some parameters displayed will be limit-sensed for SM alerts or C&W alarms. For discretes that are limit-sensed, the undesirable state is defined in the FDA low limit field and the FDA high limit field is left blank. Satisfaction of the undesirable state triggers a “↓” indication. For analogs that are limit-sensed, an “↑” or a “↓” will be displayed when the parameter exceeds either an upper or lower limit. The symbols driven in the parameter status field have the following display priority from highest to lowest: “M”, “H”, “L”, “↑”, “↓”. All symbols driven in the parameter status column will be displayed four times normal intensity.

[2] When the tone status flag is set for any FIRE, pressure (PRESS), toxic atmosphere (TOX ATM), caution (CAUT), or warning (WARN) event, a “↓” will be displayed in the appropriate status field. The FIRE, PRESS, and TOX ATM events will initiate a master alarm light and tone, B/U C&W light on panel F7, and a fault message. WARN and CAUT events will initiate an alert light, tone, and fault message. The PCS can be referenced for additional details on the fault condition.
### STATUS

<table>
<thead>
<tr>
<th>ACTIVE DEVICES</th>
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<td>AD  PD  BUS LOCK</td>
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</tr>
<tr>
<td>1 XXXX X XXXXS</td>
<td>1</td>
</tr>
<tr>
<td>2 XXXX X XXXXS</td>
<td>2</td>
</tr>
<tr>
<td>3 XXXX X XXXXS</td>
<td>3</td>
</tr>
<tr>
<td>4 XXXX X XXXXS</td>
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<table>
<thead>
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<th>1 FORMATT XXX</th>
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<tr>
<td>BUS 1 RT 2X</td>
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<td>BC 3X</td>
</tr>
<tr>
<td>A 4X</td>
</tr>
<tr>
<td>B 5X</td>
</tr>
<tr>
<td>BUS 2 RT 6X</td>
</tr>
<tr>
<td>BC 7X</td>
</tr>
<tr>
<td>A 8X</td>
</tr>
<tr>
<td>B 9X</td>
</tr>
<tr>
<td>BUS 3 RT 10X</td>
</tr>
<tr>
<td>BC 11X</td>
</tr>
<tr>
<td>A 12X</td>
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<td>B 13X</td>
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<tr>
<td>BUS 4 RT 14X</td>
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<tr>
<td>BC 15X</td>
</tr>
<tr>
<td>A 16X</td>
</tr>
<tr>
<td>B 17X</td>
</tr>
</tbody>
</table>

**Figure 1.- OIU Display - SPEC 212.**
The SM 212 OIU display is available in SM OPS 2 and is used to configure the OIU for cargo element operations, monitor OIU status, and monitor relevant PDI, PSP, and SSOR statuses.

### PARAMETER CHARACTERISTICS

<table>
<thead>
<tr>
<th>CRT NAME</th>
<th>MSID</th>
<th>UNITS</th>
<th>DISPLAY RANGE</th>
<th>STATUS IND [9]</th>
<th>FDA LIMITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>OIU 1 TEMP [1]</td>
<td>P50T4000V</td>
<td>deg F</td>
<td>-23.4 to +304.3</td>
<td>M H L ↑</td>
<td>212</td>
</tr>
<tr>
<td>OIU 2 TEMP [1]</td>
<td>P50T4001V</td>
<td>deg F</td>
<td>-23.4 to +304.3</td>
<td>M H L ↑</td>
<td>212</td>
</tr>
<tr>
<td>OIU STATUS CTR [2]</td>
<td>P50U4106D</td>
<td>sec</td>
<td>00 to 59</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISS BC TIME [2]</td>
<td>P50U4112D,</td>
<td>time</td>
<td>Refer to remarks</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>P50U4113D,</td>
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<tr>
<td></td>
<td>P50U4111D,</td>
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<tr>
<td></td>
<td>P50U4114D,</td>
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</tr>
<tr>
<td></td>
<td>P50U4115D,</td>
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<td>P50U4116D</td>
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<td>AD 1 PD [3]</td>
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<td>Refer to remarks</td>
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<td>P50X4402E,</td>
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<td></td>
<td>P50X4403E,</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>P50X4404E,</td>
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<td>P50X4405E,</td>
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<td></td>
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<tr>
<td></td>
<td>P50X4406E</td>
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<td></td>
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<tr>
<td>AD 2 PD [3]</td>
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<td>text</td>
<td>Refer to remarks</td>
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<td></td>
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<tr>
<td></td>
<td>P50X4412E,</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>P50X4413E,</td>
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<tr>
<td></td>
<td>P50X4414E,</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>P50X4415E,</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>P50X4416E</td>
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</table>
Continuation of Table 1.

<table>
<thead>
<tr>
<th>CRT NAME</th>
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<th>DISPLAY RANGE</th>
<th>STATUS IND</th>
<th>FDA LIMITS</th>
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<tbody>
<tr>
<td>AD 3 PD</td>
<td>[3]</td>
<td>text</td>
<td>Refer to remarks</td>
<td></td>
<td></td>
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<tr>
<td>AD 4 PD</td>
<td>[3]</td>
<td>text</td>
<td>Refer to remarks</td>
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<tr>
<td>AD 1 BUS</td>
<td>[4]</td>
<td>n/a</td>
<td>0 to 7</td>
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<td></td>
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<tr>
<td>AD 2 BUS</td>
<td>[4]</td>
<td>n/a</td>
<td>0 to 7</td>
<td></td>
<td></td>
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<tr>
<td>AD 3 BUS</td>
<td>[4]</td>
<td>n/a</td>
<td>0 to 7</td>
<td></td>
<td></td>
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<tr>
<td>AD 4 BUS</td>
<td>[4]</td>
<td>n/a</td>
<td>0 to 7</td>
<td></td>
<td></td>
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<tr>
<td>AD 1 LOCK</td>
<td>[5]</td>
<td>text</td>
<td>0,0 = 'NONE'</td>
<td>M</td>
<td>↓ 1,0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0,1 = 'YES'</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
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<td>1,0 = 'NO'</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>1,1 = 'N/A'</td>
<td></td>
<td></td>
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<tr>
<td>AD 2 LOCK</td>
<td>[5]</td>
<td>text</td>
<td>0,0 = 'NONE'</td>
<td>M</td>
<td>↓ 1,0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0,1 = 'YES'</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td>1,0 = 'NO'</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>1,1 = 'N/A'</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD 3 LOCK</td>
<td>[5]</td>
<td>text</td>
<td>0,0 = 'NONE'</td>
<td>M</td>
<td>↓ 1,0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0,1 = 'YES'</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1,0 = 'NO'</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1,1 = 'N/A'</td>
<td></td>
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### Continuation of Table 1.

<table>
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<tr>
<th>CRT NAME</th>
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<th>STATUS IND [9]</th>
<th>FDA LIMITS</th>
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</thead>
<tbody>
<tr>
<td>AD 4 LOCK</td>
<td>[5] P50X4470E, P50X4471E</td>
<td>text</td>
<td>0,0 = 'NONE' 0,1 = 'YES' 1,0 = 'NO' 1,1 = 'N/A'</td>
<td>M</td>
<td>↓</td>
</tr>
<tr>
<td>PDI DCM 1 B,W,F SYNC [13]</td>
<td>V75X6403D, V75X6402D, V75X6401D</td>
<td>text</td>
<td>0 = blank, 1 = ‘<em>’ 0 = blank, 1 = ‘</em>’ 0 = blank, 1 = ‘*’</td>
<td>M</td>
<td>↓</td>
</tr>
<tr>
<td>PDI DCM 2 B,W,F SYNC [13]</td>
<td>V75X6407D, V75X6406D, V75X6405D</td>
<td>text</td>
<td>0 = blank, 1 = ‘<em>’ 0 = blank, 1 = ‘</em>’ 0 = blank, 1 = ‘*’</td>
<td>M</td>
<td>↓</td>
</tr>
<tr>
<td>PDI DCM 3 B,W,F SYNC [13]</td>
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<td>text</td>
<td>0 = blank, 1 = ‘<em>’ 0 = blank, 1 = ‘</em>’ 0 = blank, 1 = ‘*’</td>
<td>M</td>
<td>↓</td>
</tr>
<tr>
<td>PDI DCM 4 B,W,F SYNC [13]</td>
<td>V75X6415D, V75X6414D, V75X6413D</td>
<td>text</td>
<td>0 = blank, 1 = ‘<em>’ 0 = blank, 1 = ‘</em>’ 0 = blank, 1 = ‘*’</td>
<td>M</td>
<td>↓</td>
</tr>
<tr>
<td>OIU CMD CTR</td>
<td>[6] P50U4132A n/a</td>
<td>n/a</td>
<td>0 to 255</td>
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<td>↓</td>
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<tr>
<td>OIU PSP I/F</td>
<td>[7] P50X4283E</td>
<td>text</td>
<td>0 = 'OK', 1 = 'ERR'</td>
<td>M</td>
<td>↓</td>
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<tr>
<td>FLOAT POINT</td>
<td>[8] P50X4288E</td>
<td>text</td>
<td>0 = 'OK', 1 = 'ERR'</td>
<td>M</td>
<td>↓</td>
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<tr>
<td>PSP LAST CMD</td>
<td>[10] V92X1102X, V92X1116X, V92X1129X</td>
<td>text</td>
<td>1,0,1 = ‘REJ’ 0,1,1 = ‘INC’ else = ‘OK’</td>
<td>M</td>
<td>↓</td>
</tr>
<tr>
<td>OIU LAST CMD</td>
<td>[11] P50X4281E, P50X4303E, P50X4287E</td>
<td>text</td>
<td>1,0,0 or 0,1,0 or 1,1,0 0,0,1 or 1,0,1 or 0,1,1 or 1,1,1 = ‘REJ’ else = ‘OK’</td>
<td>M</td>
<td>↓</td>
</tr>
<tr>
<td>SSOR PRI FRM SYNC</td>
<td>[12] V74X2050E</td>
<td>text</td>
<td>0 = 'NO', 1 = 'YES'</td>
<td>M</td>
<td>↓</td>
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<tr>
<td>SSOR PRI STATUS</td>
<td>[12] V74X2051E</td>
<td>text</td>
<td>0 = 'BAD', 1 = 'OK'</td>
<td>M</td>
<td>↓</td>
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</tbody>
</table>
Continuation of Table 1.

<table>
<thead>
<tr>
<th>CRT NAME</th>
<th>MSID</th>
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<th>DISPLAY RANGE</th>
<th>STATUS IND [9]</th>
<th>FDA LIMITS</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>M  H  L ↑ ↓</td>
<td>LO  HI</td>
</tr>
<tr>
<td>SSOR B/U FRM SYNC</td>
<td>V74X2053E</td>
<td>text</td>
<td>0 = ‘NO’, 1 = ‘YES’</td>
<td>M</td>
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<tr>
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<td>text</td>
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<td>P50X4021E</td>
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<td>text</td>
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<td>P50X4041E</td>
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<td>P50X4022E</td>
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<td>BUS 2 BC</td>
<td>P50X4022E</td>
<td>text</td>
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<td>P50X4042E</td>
<td>text</td>
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<td></td>
</tr>
<tr>
<td>BUS 2 B</td>
<td>P50X4042E</td>
<td>text</td>
<td>0 = blank, 1 = ‘*’</td>
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<td></td>
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</tr>
<tr>
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<td>P50X4023E</td>
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</tr>
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<td>P50X4043E</td>
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</tr>
<tr>
<td>BUS 3 B</td>
<td>P50X4043E</td>
<td>text</td>
<td>0 = blank, 1 = ‘*’</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BUS 4 RT</td>
<td>P50X4024E</td>
<td>text</td>
<td>0 = ‘*’, 1 = blank</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BUS 4 BC</td>
<td>P50X4024E</td>
<td>text</td>
<td>0 = blank, 1 = ‘*’</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BUS 4 A</td>
<td>P50X4044E</td>
<td>text</td>
<td>0 = ‘*’, 1 = blank</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BUS 4 B</td>
<td>P50X4044E</td>
<td>text</td>
<td>0 = blank, 1 = ‘*’</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPARE CMD</td>
<td>P93J0101C</td>
<td>n/a</td>
<td>1 to 12</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
REMARKS

[1] The OIU TEMP parameters will read 140° F when the OIU associated with that measurement is OFF. Note that this is the only sure method to determine which OIU is powered up from this display alone. Additional insight is available via the panel L12 OIU PWR tb.

[2] OIU STATUS CTR displays the OIU time parameter for seconds, reading from 00 to 59 and resetting to 00 again. This indicates OIU health by constantly counting from 00 to 59 and recycling when the OIU telemetry is being processed by the PDI. ISS BC TIME follows the format MM-DD-YY/HH:MM:SS and comes from whichever device is BC to the OIU. This parameter will read all zeros at powerup, will show the correct BC time at the time the BC comes up and starts sending telemetry to the OIU, and will remain static at the last good sample when the incoming telemetry from that BC goes away.

[3] ACTIVE DEVICES: The OIU active device (AD) status section provides insight for OIU processing on the external telemetry sources with which the OIU can interface. Status shown for each AD (1 to 4) includes the physical device (PD) assigned to that AD, the BUS being used to acquire that device’s telemetry, and a LOCK status indication. The computation used to drive the PD field is defined in the following table:

<table>
<thead>
<tr>
<th>MSID</th>
<th>Argument 1</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Argument 2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Argument 3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Argument 4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Argument 5</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Argument 6</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Displayed Text:</th>
<th>OIU</th>
<th>GNC1</th>
<th>GNC2</th>
<th>SR-1</th>
<th>SR-2</th>
<th>MP-1</th>
<th>MP-2</th>
<th>N1-1</th>
<th>N1-2</th>
<th>FGB1</th>
<th>FGB2</th>
</tr>
</thead>
</table>

If none of the above conditions are met, the default text displayed is ERR. Note that PD = OIU when no active device is assigned and is also displayed when OIU format supports an OIU error log dump, GNC1 and GNC2 are the ISS Tier 2 Guidance, Navigation and Control MDMs, SR-1 and SR-2 are the Space to Space Orbiter Radios (SSOR), MP-1 and MP-2 are the MPLM MDMs, N1-1 and N1-2 are the Node MDMs, and FGB1 and FGB2 are the ISS FGB MDMs.

[4] BUS: Indicates the OIU bus 1 to 7, 0 indicates OIU bus 8. Note that the OIU hardware currently supports only buses 1 to 4.
LOCK: ‘NONE’ if the current OIU format does not have an AD for this display location.
‘YES’ if the OIU is RT and in sync with the AD (ISS BC or SSOR).
‘YES’ if the AD is OIU in error log dump format (OIU must be in sync with itself).
‘NO’ if the OIU is RT and was in sync with the AD but has lost lock on the AD (ISS BC or SSOR).
N/A if the OIU is BC to the AD, except if the AD is SSOR.
Note that if LOCK goes from ‘YES’ to ‘NO’, the OIU stops attempting to acquire sync with that AD. To force the OIU to attempt to resync with an AD, the OIU format must be reloaded.

OIU CMD CTR will start at 000 at powerup, and will increment by one whenever the OIU receives a valid command from the PSP. The counter reads in decimal, and will count from 000 to 255 and roll over to 000. All commands, whether from the MCC or the MCDS, will cause the counter to increment if received and processed by the OIU.

PSP I/F indicates OK if the OIU is receiving the 16 Khz command carrier from either PSP1 or PSP2. ERR is displayed if no command carrier is being received.

The OIU can convert one ISS floating point parameter value per PDI minor frame (maximum of 100 per major frame) into a shuttle PDI-compatible parameter value. If an ISS floating point value is invalid or results in an invalid floating point value/operation during the conversion process, the OIU annunciates an error. The FLOAT POINT display parameter will read ERR for this condition or ‘OK’ if no floating point error/operation is detected.

The parameter status field for all parameters will be blank for normal operation or will display an “M” for missing data. For analog parameters, this field will also display an “H” or “L” for offscale data. Some parameters displayed will be limit-sensed for SM alerts or C&W alarms. For discretes that are limit-sensed, the undesirable state is defined in the FDA low limit field and the FDA high limit field is left blank. Satisfaction of the undesirable state triggers a “↓” indication. For analogs that are limit-sensed, an “↑” or a “↓” will be displayed when the parameter exceeds either an upper or lower limit. The symbols driven in the parameter status field have the following display priority from highest to lowest: “M”, “H”, “L”, “↑”, “↓”. All symbols driven in the parameter status column will be displayed four times normal intensity.

PSP LAST CMD indicates the command acceptance for crew originated command: ‘OK’ if the PSP has not rejected a crew command, REJ if the PSP rejected the last crew command, or INC of the PSP was not able to complete the transfer of the last crew command. The REJ and INC indications are cleared by the next successfully processed PSP command from either crew or ground.

OIU LAST CMD indicates the command acceptance by the OIU. REJ is displayed if the OIU has detected either a parity error or an incorrect byte count in a command received from the PSP. Otherwise, ‘OK’ is displayed.
For both the primary (PRI) and a backup (B/U) Space to Space Orbiter Radio (SSOR), the FRM SYNC indication gives the status of the frame synchronizer. YES indicates SSOR frame sync with the ISS Space to Space Station Radio (SSSR), 'NO' indicates no SSOR frame sync, or the SSOR is off, or the SSOR is not present. The STATUS indication yields 'OK' if the SSOR is operating normally, or indicates 'BAD' if the SSOR BITE has sensed a failure.

PDI DCM SYNC gives indication of the Bit (B), Word (W), and Frame (F) synchronizer statuses for all four PDI decommutators. For each DCM, the B, W, and F columns will be blank if the decom is not in bit, word, or frame sync, respectively. An asterisk will be displayed in each of the B, W, or F columns if the sync conditions do exist. Note that the decom actually processing OIU telemetry is dependent on orbiter PDI/PCMMU config.

FORMAT: Indicates the currently loaded OIU format.

BUS 1 to 4: The OIU bus processing state [Bus Controller (BC) or Remote Terminal (RT)] and channelization (A or B) is indicated by asterisks for each of buses 1 to 4.

SPARE CMD: Displays the item entry index associated with the last Item 18.

ITEM ENTRY CHARACTERISTICS
Item 1: FORMAT: indexed command item entry used to changing the OIU format (ITEM 1 + XXX EXEC). The valid decimal format numbers for entry via MCDS on STS-117 are 001 to 020, 250, 251, 254, and 255.

Item 2 to 17: BUS 1 to BUS 4: This section allows changing the OIU’s current bus processing state [Bus Controller (BC) or Remote Terminal (RT)] and bus channel (A or B) for any of the currently implemented four OIU buses. For example, if Bus 3 is BC, and using Channel A, there will be an asterisk next to Items 11 and 12. To change Bus 3 to RT, an ITEM 10 EXEC is performed. In the case of the bus channelization (A or B), the displayed telemetry indicates which channel is prime for command and telemetry transactions on that bus if the OIU is BC on that bus. If the OIU is BC on a bus, it will try to send a command for an AD using the prime channel. If the OIU receives no status message from that AD, it tries again on the prime channel, then it tries on the alternate channel. If the AD has not responded, it declares failure and stops trying to send a command to that AD. When the OIU is RT on a bus, it will respond on either channel, depending on which channel received a transaction from the BC; therefore, the channel indication has no meaning when the OIU is RT on a bus.
Item 18: SPARE CMD: an indexed command that allows performing the following internal OIU function mapping:

Item 18 + 1: Change FGB MDM active device to FGB-2 MDM physical device*.
Item 18 + 2: Change FGB MDM active device to FGB-1 MDM physical device*.
Item 18 + 3: Change Node 1 MDM active device to N1-2 MDM physical device*.
Item 18 + 4: Change Node 1 MDM active device to N1-1 MDM physical device*.
Item 18 + 5: Move FGB -2 MDM physical device to OIU Bus 4 *.
Item 18 + 6: Move FGB -2 MDM physical device to OIU Bus 3 *.
Item 18 + 7: Move FGB -1 MDM physical device to OIU Bus 4 *.
Item 18 + 8: Move FGB -1 MDM physical device to OIU Bus 3 *.
Item 18 + 9: Move N1-1 MDM physical device to OIU Bus 4 *.
Item 18 + 10: Move N1-1 MDM physical device to OIU Bus 3 *.
Item 18 + 11: Move N1-2 MDM physical device to OIU Bus 4 *.
Item 18 + 12: Move N1-2 MDM physical device to OIU Bus 3 *.
Item 18 + 13: Change GNC MDM active device to GNC-2 MDM physical device.
Item 18 + 14: Change GNC MDM active device to GNC-1 MDM physical device.
Item 18 + 15: Move GNC-1 MDM physical device to OIU Bus 4 (LB ORB N2-2).
Item 18 + 16: Move GNC-1 MDM physical device to OIU Bus 3 (LB ORB N2-1).
Item 18 + 17: Move GNC-2 MDM physical device to OIU Bus 4 (LB ORB N2-2).
Item 18 + 18: Move GNC-2 MDM physical device to OIU Bus 3 (LB ORB N2-1).

Items accompanied by ‘*’ are not used on STS-117.
Figure 1.- Standard Switch Panel 1.
<table>
<thead>
<tr>
<th>ITEM</th>
<th>DEVICE TYPE</th>
<th>FUNCTION</th>
</tr>
</thead>
</table>
| CB2  | Circuit breaker, 5 amp | closed (in) - Applies orbiter CAB PL1 power to SSP1 S3 and S4, and SSP2 S12.  
open (out) - Removes power from SSP1 S3 and S4, and SSP2 S12. |
| CB1  | Circuit breaker, 5 amp | closed (in) - Applies orbiter CAB PL2 power to the PDIP DC PWR 2 switch outlet and KuBAND RATE switch.  
open (out) - Removes power from PDIP DC PWR 2 outlet and KuBAND RATE switch. |
| PDIP 1 PWR 2/ KuBAND RLY | Circuit breaker, 5 amp | close (in) - Applies orbiter CAB PL2 power to the PDIP DC PWR 2 switch outlet and KuBAND RATE switch.  
open (out) - Removes power from PDIP DC PWR 2 outlet and KuBAND RATE switch. |
| S3   | Toggle switch, two - position (Maintained - Maintained) | ON (up) - Applies power to the APCU 1 converter  
OFF (dn) - Removes power from the APCU 1 converter |
| APCU 1 CONV | Event indicator, two - position | gray - Indicates APCU 1 converter powered  
bp - Indicates APCU 1 converter not powered |
| S4   | Toggle switch, two - position (Maintained - Maintained) | CLOSE (up) - Closes the APCU 1 output relay  
OPEN (dn) - Opens the APCU 1 output relay |
| APCU 1 OUTPUT RLY | Event indicator, two - position | gray - Indicates APCU 1 output relay is closed  
bp - Indicates APCU 1 output relay is open |
| DS4  | Event indicator, two - position | gray - Indicates APCU 1 converter powered  
bp - Indicates APCU 1 converter not powered |
| APCU 2 CONV | Event indicator, two - position | gray - Indicates APCU 2 converter powered  
bp - Indicates APCU 2 converter not powered |
| DS6  | Event indicator, three - position | UP - Indicates that CAB PL3 power is being supplied to OIU 1.  
bp - Indicates power is removed from OIU 1 and OIU 2.  
DN - Indicates that AUX PLB power is being supplied to OIU 2. |
| S15  | Toggle switch, two - position (Maintained - Maintained) | ON (up) - Applies power to TCS.  
OFF (dn) - Removes power from TCS. |
<table>
<thead>
<tr>
<th>ITEM</th>
<th>DEVICE TYPE</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>DS15</td>
<td>Event indicator, two - position</td>
<td>gray - Indicates TCS powered. bp - Indicates TCS not powered.</td>
</tr>
<tr>
<td>CB4</td>
<td>Circuit breaker, 5 amp</td>
<td>closed (in) - Applies orbiter CAB PL3 power to SSP1 S20 and S22. open (out) - Removes power from SSP1 S20 and S22.</td>
</tr>
<tr>
<td>CB3</td>
<td>Circuit breaker, 5 amp</td>
<td>closed (in) - Applies orbiter CAB PL2 power to PDIP DC PWR 1 outlet and redundant power to SSP1 S20 and S22. open (out) - Removes power from PDIP DC PWR 1 outlet and redundant power from SSP1 S20 and S22.</td>
</tr>
<tr>
<td>S20</td>
<td>Toggle switch, two - position</td>
<td>ON (up) - Supplies CAB PL2 and CAB PL3 power for PMA 2 X1 connector mate signal. OFF (dn) - Removes power for PMA 2 X1 connector mate signal.</td>
</tr>
<tr>
<td>S22</td>
<td>Toggle switch, two - position</td>
<td>ON (up) - Supplies CAB PL2 and CAB PL3 power for PMA 2 X2 connector mate signal. OFF (dn) - Removes power for PMA 2 X2 connector mate signal.</td>
</tr>
<tr>
<td>S24</td>
<td>Toggle switch, three - position</td>
<td>OIU 1 ON (up) - Provides CAB PL3 power to OIU 1. OFF (ctr) - Removes power from OIU 1 and OIU 2. OIU 2 ON (dn) - Provides AUX PLB power to OIU 2.</td>
</tr>
</tbody>
</table>
Figure 1.- Standard Switch Panel 2.
<table>
<thead>
<tr>
<th>Item</th>
<th>Device Type</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>CB1</td>
<td>PDIP 2 PWR 2</td>
<td>Circuit breaker, 5 amp closed (in) - Applies orbiter CAB PL2 power to PDIP2 S2 and S3. open (out) - Removes power from PDIP2 S2 and S3.</td>
</tr>
<tr>
<td>S12</td>
<td>C/L CAM PWR</td>
<td>Toggle switch, three-position PRI - Applies CAB PL3 power to PRI C/L CAM. OFF - Removes power from both Cameras SEC - Applies CAB PL 1 power to SEC C/L CAM.</td>
</tr>
<tr>
<td>CB3</td>
<td>PDIP 2 PWR1</td>
<td>Circuit breaker, 5 amp closed (in) - Applies orbiter CAB PL2 power to PDIP2 S1. open (out) - Removes power from PDIP2 S1.</td>
</tr>
<tr>
<td>CB4</td>
<td></td>
<td>Circuit breaker, 5 amp closed (in)</td>
</tr>
</tbody>
</table>
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